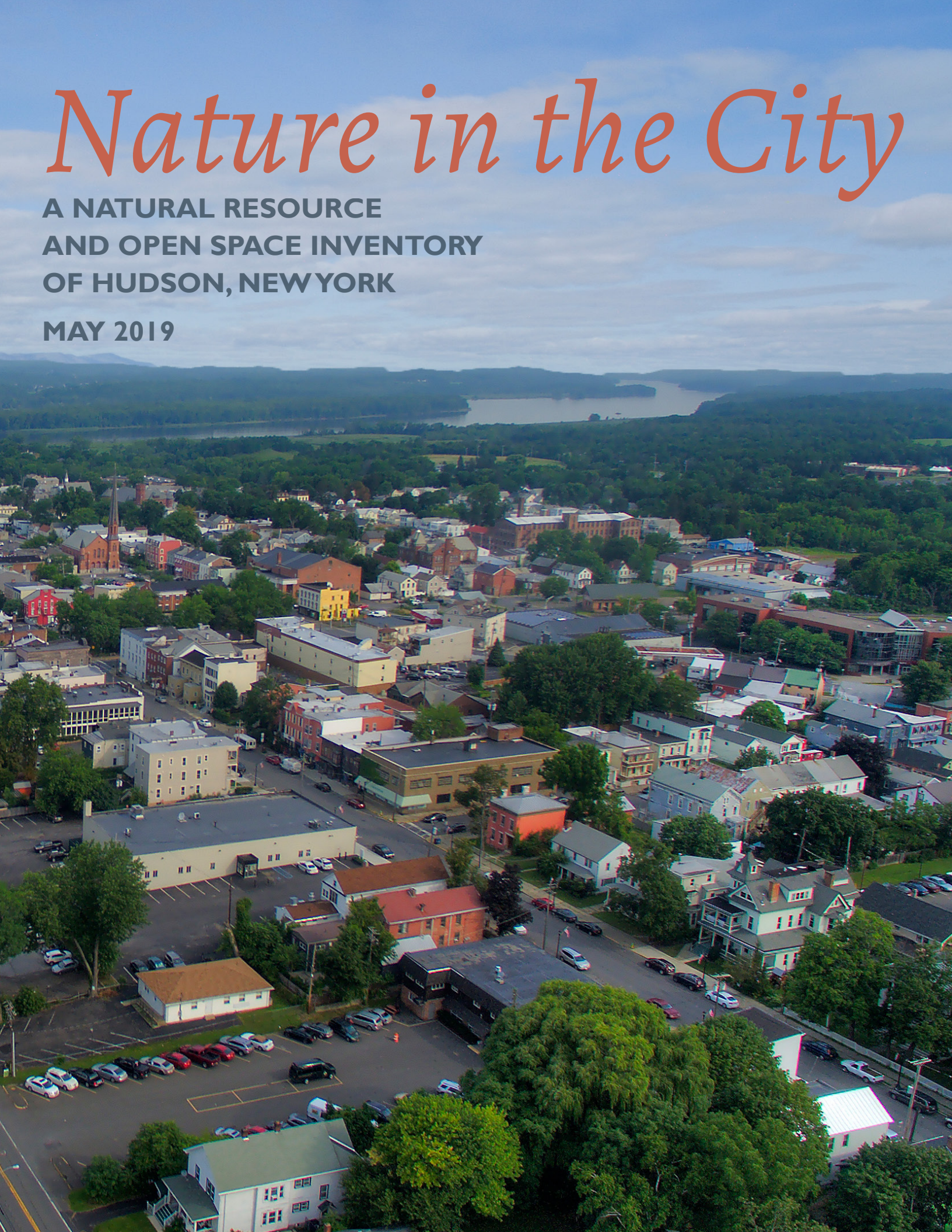
Nature in the City

A NATURAL RESOURCE AND OPEN SPACE INVENTORY OF HUDSON, NEW YORK

MAY 2019



WHY HAVE WE CONDUCTED THIS INVENTORY?

Hudson's Conservation Advisory Council (CAC) conducted this Natural Resources and Open Space Inventory to compile information about the City's open spaces and natural features in one place. The inventory is not an exhaustive description of all the natural resource information available for Hudson. Rather, it is a broad overview of readily available information important to health and well-being and relevant to planning and decision-making. The maps and analysis presented here are as accurate as possible given the currently available data on which they are based, and the CAC's limited resources. Natural and urban conditions are always evolving, so this information should be taken as a snapshot in time. The CAC intends that it be updated periodically.

The inventory will help citizens and community leaders understand the kinds of natural resources in the City, the benefits they provide, and where to go to find more information. Specifically, it can be used to:

- educate the public about the resources in our midst;
- identify issues and resources that require further study, and where additional information can be found;
- highlight issues and questions for planning and development projects; and
- inform the management and enhancement of parks and open spaces.

Other uses for the inventory were identified during initial community conversations. Members of the public suggested the information collected could be used to:

- improve and support recreational opportunities, including trails and water access, park planning and management, and waterfront management plans;
- review development proposals, informing state-required environmental review;
- identify gaps in and weaknesses of the street tree canopy;
- support tourism and small businesses by highlighting the City's natural assets as an attraction;
- inform waterfront redevelopment and remediation;
- understand and improve the storm water system and green infrastructure opportunities;
- prioritize areas appropriate for infill to meet housing needs, particularly affordable housing.

This inventory is a high-level summary and cannot be used in place of on-the-ground assessments. It should not be the only source used to:

- answer all questions about natural resources in Hudson;
- identify all resources or issues on a specific site;
- initiate any enforcement action;
- dictate engineering analysis or design; or
- understand what state or federal permits might be needed for an action.

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View from Promenade Hill.
Photo by Peter Jung.

Henry Ary, *View of Mount Merino from Promenade Hill,* 1854

The City of Hudson faces environmental challenges posed by development pressures, antiquated infrastructure, a post-industrial legacy, and climate change. Hudson is both small and densely urbanized (Map 1). The 2002 Comprehensive Plan for Hudson included minimal description of natural resources and related issues. Budget constraints have led to a lack of investment in public space. Hudson's increasing popularity as a tourism destination and a place to live and work creates development pressure. Most of the limited available opportunities for new development are situated at the flood-prone margins between the urbanized area and tidal wetlands, while infill development is obstructed by outdated development rules. With its location on the Hudson River Estuary, the City is exposed to rising sea level and storm surges. Healthy and accessible open spaces and natural resources can ensure a livable, sustainable future for Hudson, but information about these resources has not previously been compiled in a comprehensive way.

NATURAL RESOURCES IN HUDSON'S HISTORY

Open spaces and natural resources are not the first thing that comes to mind when thinking of the City. However, since the beginning of human settlement, natural resources played an important role in the history and economy of the place we now call Hudson.

A tribe of Mahicans lived in the area when Europeans first arrived. The river they called Mahicannituck provided food and transportation, and nearby rocky outcrops provided materials for tools as well as shelter. In 1662, Dutch settlers purchased the land from the Mahicans, started farming in the area, and set up a trading post at the river. The North and South Bays were deep enough to accommodate ocean-going vessels; in 1783 whalers and merchants whose ships were being attacked by the British established a safe inland port and laid out Hudson's distinctive urban grid. The settlement thrived, and in 1805, Hudson became the Columbia County seat, providing services for the surrounding area. Today, government offices and healthcare, education, and prison services are an important part of the City economy.

INTRODUCTION

By 1851, when the Hudson River Railroad was built and cut off the bays from the river, the whaling industry had declined. Hudson became a factory town, producing bricks, textiles, cement and other goods. It reached its peak population of 12,337 in 1930. The wealth built in the community during periods of prosperity resulted in a rich stock of historic buildings in a range of architectural styles. More than 700 historically significant buildings have been federally recognized and are part of the appeal of the City for new residents and visitors.

After World War II, Hudson experienced divestment and population loss, like many urban centers. By 2010, it was home to only 6,713 people. Because it is only 2.32 square miles, Hudson is as dense as larger urban areas, with about 3,000 people per square mile.[1] That density makes the City stand out in rural Columbia County, which has an overall population density of only 99 people per square mile.

Despite continued population decline, Hudson has attracted new economic drivers and residents over the past 30 years. In the 1980s, antiques dealers began occupying empty commercial spaces here. The new shops along with the historic architecture and the convenient train to New York attracted visitors. Artists, writers, and other creatives came next. People started buying second homes, and retirees moved in. These new residents, entrepreneurs, and visitors are stimulating reinvestment in the City.

Top: W.G. Wall, View of Hudson South Bay, 1822.
Middle and Bottom: Industry on Hudson waterfront, 19th century. Courtesy of Hudson Area Library, History Room

People care about Hudson's Open Spaces and Natural Resources

The Hudson CAC conducted a survey of 222 residents and visitors and found that nearly 80% of respondents thought conserving natural areas was very important. When asked about specific resources, they responded even more positively: 89% of respondents said parks and public spaces were very important and 88% said lakes, streams, and shorelines were very important. And they want to do more to take care of Hudson's green spaces: 85% reported they want to know more about cleaning up and preserving natural areas and open spaces.

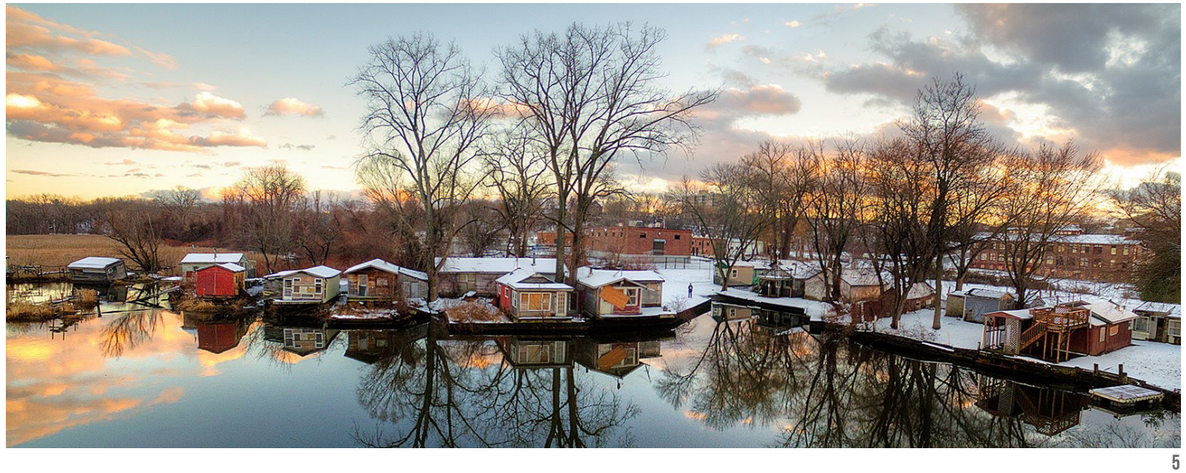
WHY PROTECT OPEN SPACE AND NATURAL RESOURCES?

More than half of the world's population now lives in cities, and urban open spaces and natural resources provide tremendous benefits for people. Parks and natural areas give urban residents places to encounter plants and animals and experience solitude.[2] Well maintained landscaping is linked to lower crime and violence[3] and can even instill civic pride.[4]

Healthy natural areas provide services to the community that mitigate the impacts of dense development. For example, forests can absorb polluted runoff, and large wetlands like North and South Bays can reduce flooding damage to developed areas.[5]

In the urban core, vegetation in pocket parks, street trees, and gardens, can positively affect human health and well-being. Spending time looking at vegetation can improve mental health. Even looking at a picture of a tree for a few minutes can reduce blood pressure and tension.[6] More trees and songbirds in neighborhoods are associated with less depression, anxiety, and stress.[7] Nature can make people physically healthier too. Living near well-maintained green space can encourage people to walk more.[8] Urban vegetation may reduce air temperature on very hot days, and reduce air pollution.[9] In areas with lower air quality, more trees and greenery can reduce air pollution and emergency asthma attacks.[10]

Below: The Furgary, Hudson North Bay
Photo by Andy Milford.



“When we see land as a community to which we belong, we may begin to use it with love and respect.”

ALDO LEOPOLD

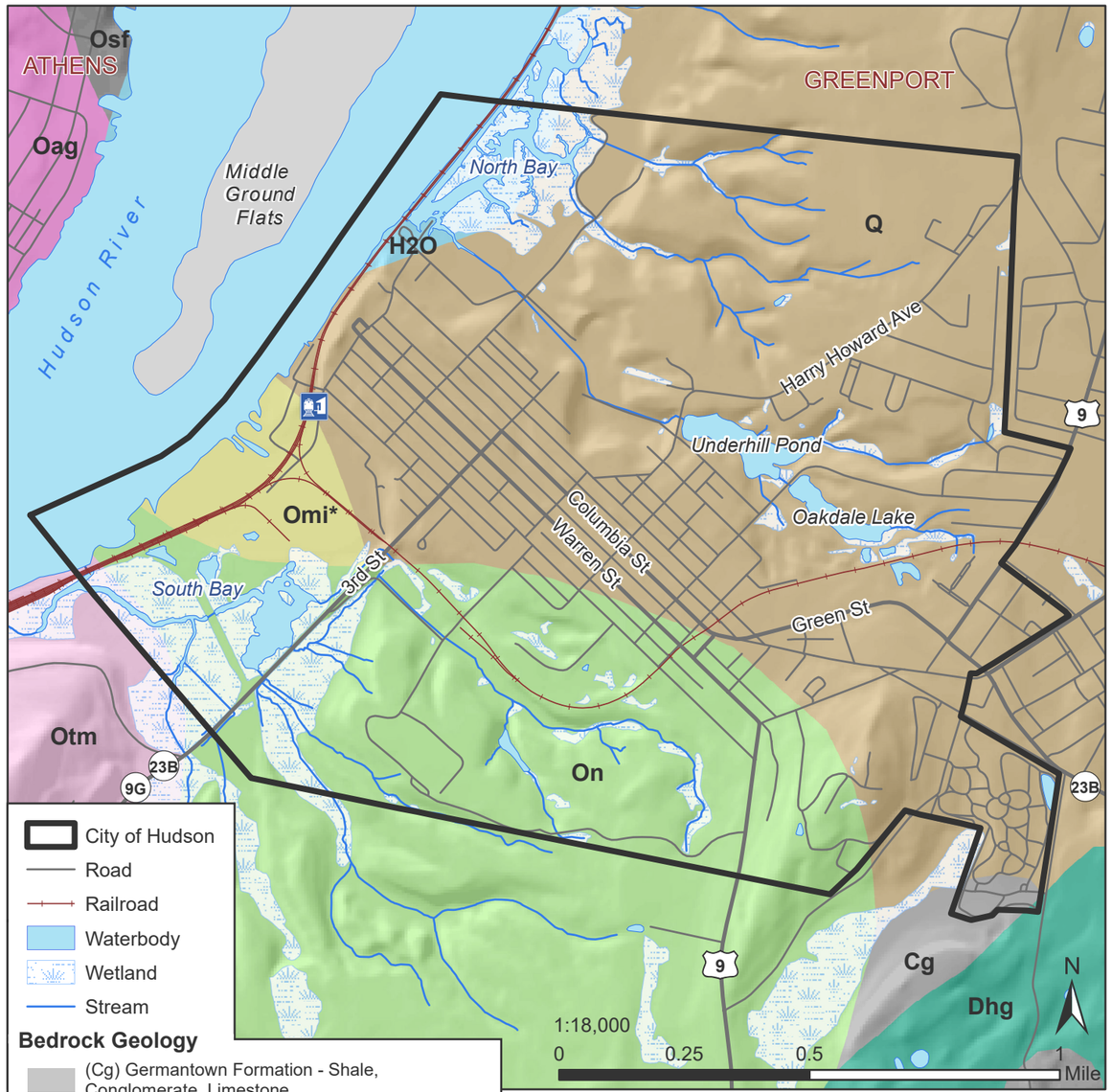
Middle Ground Flats and the Hudson waterfront, looking north.
Photo by Andy Milford.

LAND FORM AND LAND USE

Hudson’s physical setting and landforms determined the City’s historical development pattern. People were first attracted to its landforms—a rocky promontory surrounded on three sides by the Hudson River and two large bays. This section describes Hudson’s landforms and how they have influenced land use in the past and may affect it in the future.

The geology and topography of Hudson and the surrounding region were significantly affected by glacial action. Nearly all of New York State was covered by a mile-thick layer of ice 20,000 years ago. As the massive ice sheet melted a large lake formed. The lake existed for 7,000 years — long enough for meltwater streams to carry in large quantities of sediment.[11] That left a thick layer of clay beneath Hudson, which can be seen today in the clay bluffs on the edges of the urban core.

MAP 1: CITY OF HUDSON BEDROCK GEOLOGY



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*Lowland areas in South Bay are predominantly manmade fill.

Note: This map was produced for the City of Hudson Open Space and Natural Resources Inventory and is intended for general planning and information purposes. It relies upon public data sources that may contain errors or omissions and is not a substitute for site-level surveys. Map by Shannon Doyle, 2018.

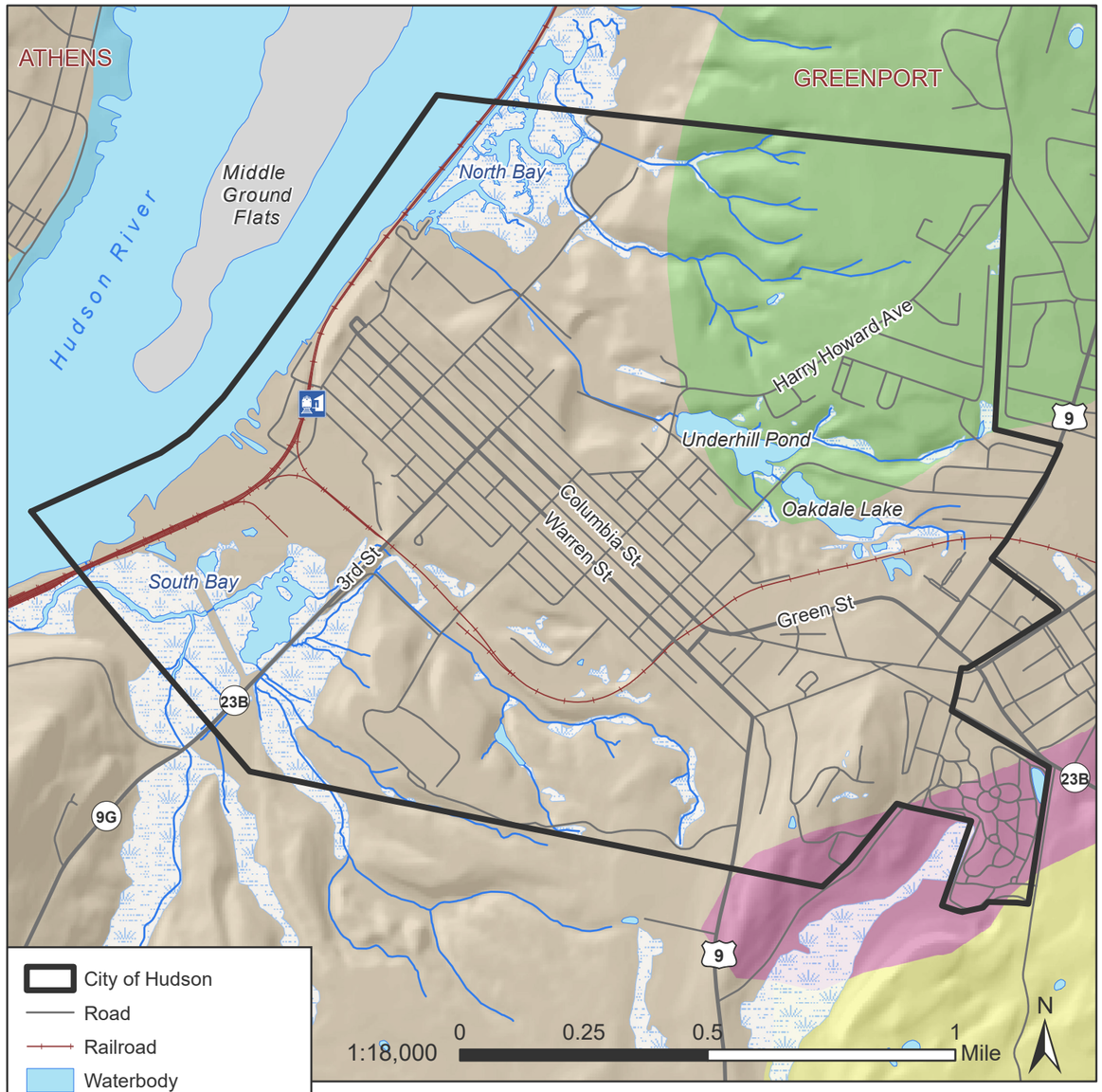
BEDROCK GEOLOGY

Map 1, Bedrock Geology, shows the types of rock that underlie the soil in Hudson. Most of the City is mapped as unconsolidated sediments (shown in brown in Map 2) because the very thick layer of clay that was deposited after the glaciers melted left few rocky outcrops for geologists to use in identifying the underlying bedrock. The southern half of the City is primarily underlain by shale, and there are some limestone bedrock areas to the southwest.

Shale and limestone bedrock are an important economic resource. Becraft Mountain, just east of and partially owned by the City of Hudson, has long been a major source of high-quality limestone. Its stone was used by the Mahicans for toolmaking, and overhanging ledges were used by them for shelter. Becraft Mountain has been mined for building material since at least 1675, and its marble and limestone can be found in the foundations of Hudson's historic buildings.[12] For most of the past 100 years, the limestone was used in the cement industry. Today, it is mined for crushed stone aggregate destined for construction and maintenance of roads.[13]

Promenade Hill, bedrock was exposed when the railroad was built. Recently to prevent rocks falling onto the tracks, the exposed bedrock was coated with shotcrete, textured and colored to give the appearance of natural bedrock. Photo courtesy of Gossips of Rivertown.

MAP 2: CITY OF HUDSON SURFICIAL GEOLOGY



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SURFICIAL GEOLOGY

SURFICIAL GEOLOGY
Surficial geology refers to the loose geologic material that lies on top of bedrock, including sand, gravel, clay, silt, and glacial till.[14] Because nearly all of Hudson's surficial geology was deposited while Hudson was at the bottom of the glacial lake,[15] it is technically described as lacustrine.

Map 2 shows that most of the City is covered by lacustrine silt and clay, with smaller deposits of sand and till (mixed sediments) throughout the City. Historically, clay-mining and brick-making were an important industry along Hudson's North Bay in the 19th and early 20th centuries.

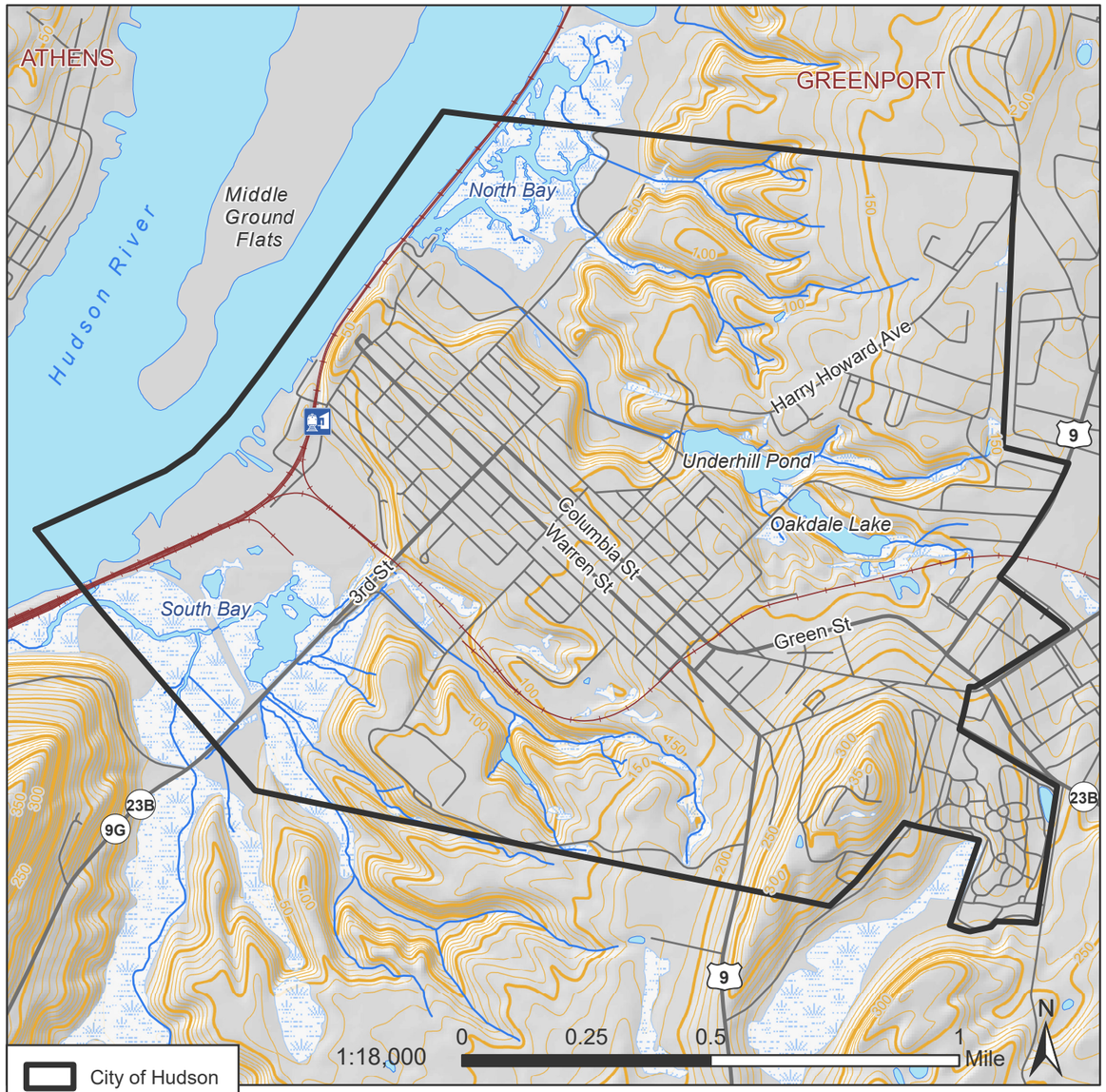
The draft Local Waterfront Revitalization Plan (LWRP) for Hudson describes the challenges of clay for building:[16]

> *"... brownish to grayish lacustrine clay is exposed on the surface in the plateaus east of North and South Bays and is beneath the urbanized center of the City. These clays can pose a significant landslide hazard in areas having slopes greater than 12% and relief (change in elevation) greater than 40 feet because they become soft and plastic with increasing wetness and depth. Disturbance and development of the plateau and escarpment areas would necessitate special engineering designs and environmental analysis."*

Although the low-lying areas in in the Hudson River floodplain and the bays show as lacustrine silt and clay in Map 2, they are covered by alluvial soils, which are deposited on the land when the Hudson floods. Those soils have been supplemented with dredged material from the river and man-made fill.

Remnants of a blue clay quarry in North Bay; the clay was used historically for brick-making.
Photo courtesy of the Columbia Land Conservancy.

MAP 3: CITY OF HUDSON TOPOGRAPHY



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KEY FINDINGS

- ***Hudson has natural and land use constraints that create challenges for future growth and development.***
- ***Large waterfront wetlands and floodplains that are vulnerable to sea level rise and steep and unstable clay slopes make risky places to build.***
- ***Large institutional landholdings on the edge of the urban core and significant historic buildings limit directions in which the City can expand.***

SUGGESTED ACTION

- ***Inventory vacant and City-owned properties to develop a more accurate land use map.***

TOPOGRAPHY

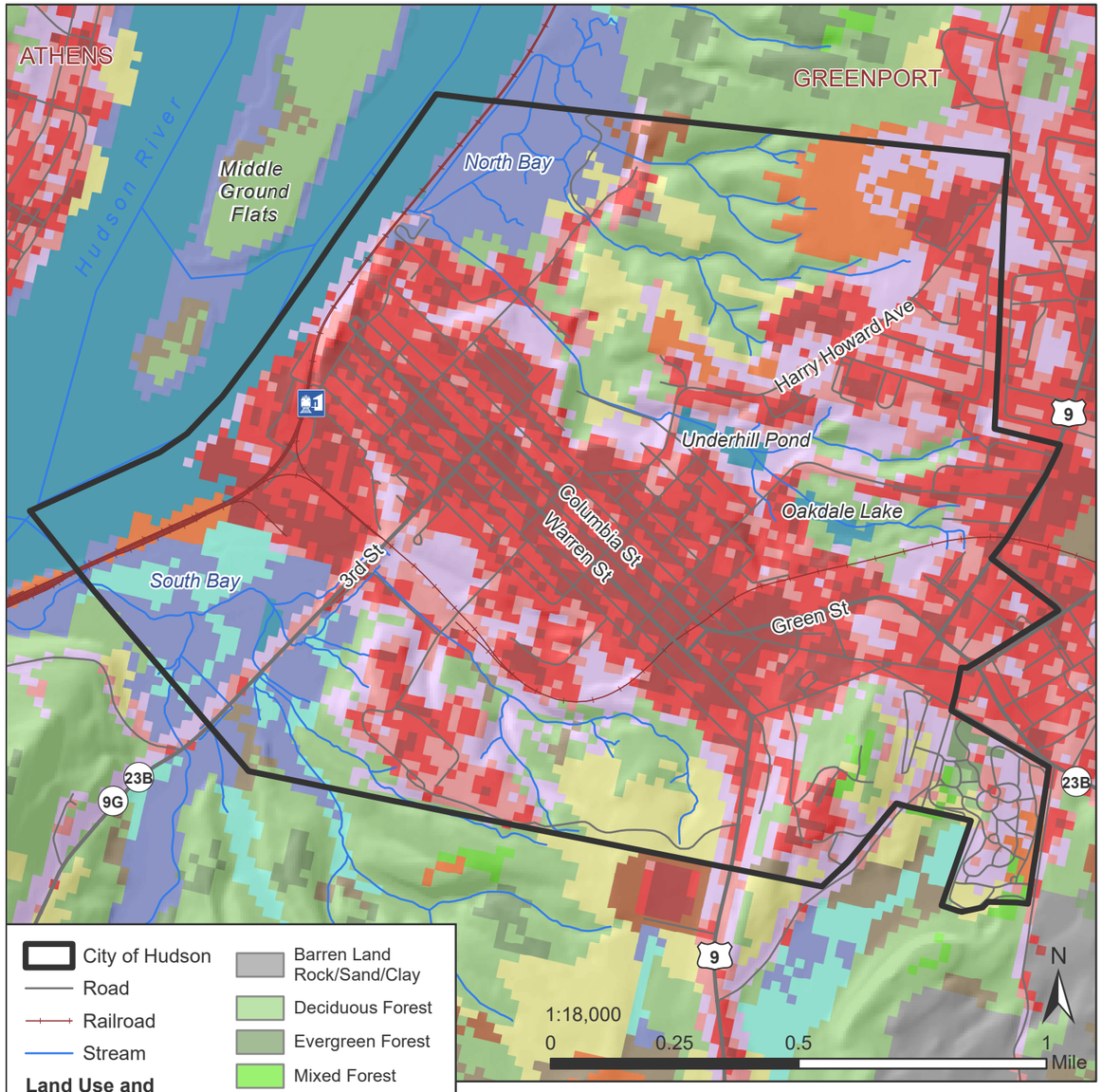
Map 3 shows the topography, or hills and ravines, of the City of Hudson. The center of the City sits on a low plateau about 100 feet above the Hudson River. There are steep drops down to the river. (Steep areas are indicated on the map by lines that are close together). Clay bluffs on the fringes of the urban core are cleaved by small and intermittent streams that flow to North and South Bays. The lowest elevation is the Hudson River, at sea level, and the highest elevation is Academy Hill, which is at 371 feet above sea-level.

Hudson's draft LWRP describes how topography affected the City's historical land uses:

> *"The topography has strongly influenced the pattern of development in the City. The low-lying areas near the bays were ideally suited to the development of industry. The [flat] plateau areas [at higher elevations] were better suited for non-industrial uses because the escarpments [steep slopes] created a distinct barrier from the industrial uses. The escarpments limit access between the plateaus and the bays to just a few locations."*

This view from Promenade Hill, circa 1880, shows how Hudson's topography allowed industry to be separated, at the waterfront, from the rest of the growing city. Photo courtesy of Hudson Area Library History Room.

MAP 4: CITY OF HUDSON LAND USE AND LAND COVER



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Municipal Boundary: NYS GIS Program Office, 2017 | Road: NYS GIS Program Office, 2018 | Railroad: NYS Department of Transportation, 2009 | Stream: Hudsonia Ltd, 2018 and National Hydrography Dataset, US Geological Survey and NYSDEC, 2011 | Land Use and Land Cover: National Land Cover Database 2011, Multi-Resolution Land Characteristics Consortium, 2015

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Hudson is as densely populated as larger urban areas, with about 3,000 people per square mile.

LAND USE AND LAND COVER

Although the shape of Hudson was primarily formed by geological and glacial action, humans caused significant change. North and South Bays used to be part of the river, with the City jutting out into the Hudson between them. When the rail line was finished in 1851, the tidal flow of water to the bays was severely constricted and North and South Bays become wetlands rather than extensions of the river. That action caused silt to collect in the wetlands, which were also artificially filled in places to create more developable land near the river, especially in South Bay.

Map 4 is a 2011 Land Use and Land Cover map that gives a generalized view of the land that is relatively natural or developed in Hudson. The data are derived from a satellite that captures images in 1000-square-foot blocks, which gives the map its boxy quality. Nationally, when the remotely sensed land cover data were compared to aerial photography, it was correct 83% of the time.[17] Therefore, people should not expect these data to be accurate at any specific locations in the City.

The City's dense urban core pops out in red, with higher density development in darker shades. Lower density development, forest, and meadows show in greens, yellows, and light purple surrounding the City center. The bays and the waterfront area are primarily wetland, with some developed areas, in reds, close to the urban core; the less densely developed waterfront shows up in blues and light and dark purple. The map shows at a glance how much of the City is developed and helps to highlight where there may be opportunities for new growth.

If you compare Maps 3 and 4, you can see how topography influences the current land uses. The dense urban core is on the central plateau. The steeper and unstable slopes that are more difficult to develop are primarily on institutional lands of the Hudson Correctional Facility, Hudson School District and the Fireman's Association of the State of New York. The sea-level waterfront is still where industrial uses are concentrated, though today those are limited to some light manufacturing and gravel shipment at the port.

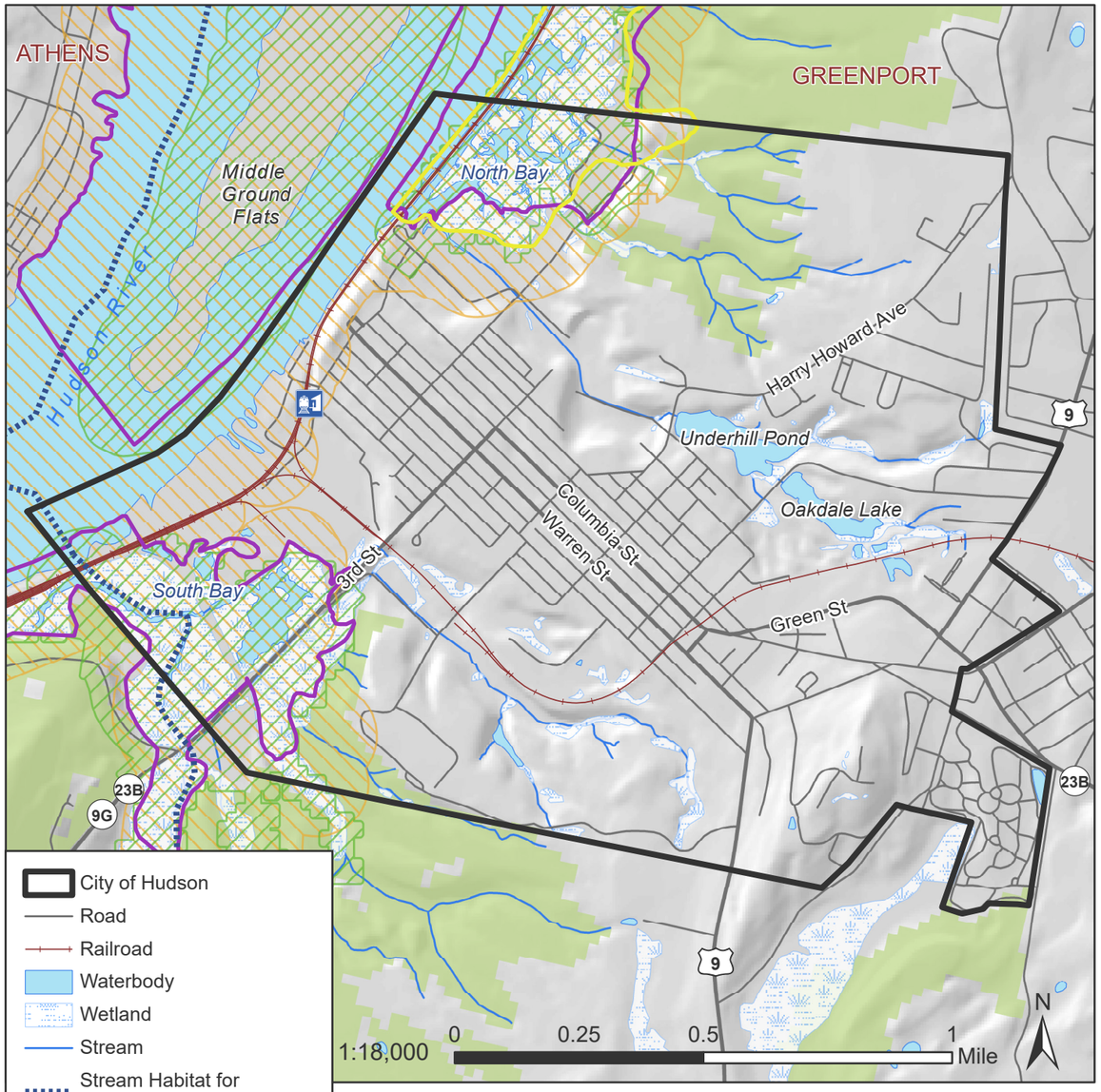
Natural and developed areas are immediately adjacent to each other in Hudson. (The large brick industrial building depicted at the left side of the image, belonging to Kite's Nest, burned recently.) Photo courtesy of the Columbia Land Conservancy.

NATURAL HABITATS

The Upper Hudson River Estuary is a globally rare freshwater tidal ecosystem.

Most of the documented natural habitat in the City is located outside of the urban core. Map 5, Major Ecological Features, shows resources of regional significance, including New York State (NYS) designated coastal habitat, an important bird area, migratory fish habitat, and forests larger than 200 acres. Areas important for the health of rare plants and animals known to the New York Natural Heritage Program (NYNHP) are shown in green and yellow hatching, and include records of nesting wading birds, two freshwater mussel species, an endangered fish species, and a rare plant. North and South Bays stand out as the areas with the most significant natural habitat in the City. A complete list of rare species documented in Hudson can be accessed from the CAC's web page at CityofHudson.org.

MAP 5: CITY OF HUDSON MAJOR ECOLOGICAL FEATURES



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Note: This map was produced for the City of Hudson Open Space and Natural Resources Inventory and is intended for general planning and information purposes. It relies upon public data sources that may contain errors or omissions and is not a substitute for site-level surveys. Map by Shannon Doyle, 2018.

New York Natural Heritage Program

The New York Natural Heritage Program (NYNHP) has the most complete and up-to-date database of rare plants, rare animals, and significant ecosystems in New York State. This information is used for environmental review of development sites and can also be used for local planning. Using their databases and the best available science about species' habitat requirements, the Program identified areas of importance for sustaining populations of rare plants, rare animals, and significant natural communities, which are shown in Maps 6 and 7. Although the NYNHP is the best single source for information about rare species, many areas haven't been surveyed for them. In Hudson, for example, additional rare species were found by local ecological studies in North and South Bays. Find more on their website www.nynhp.org.

THE HUDSON RIVER, NORTH AND SOUTH BAYS

Like so much else in the City, the natural habitat is dominated by its namesake tidal river. The City has 1.75 miles of shoreline and the western boundary of the City of Hudson extends well into the river (Map 5). Though only 12% of the City's area, the Hudson River and tidal habitats contain a concentration of natural resources with statewide significance.

The Hudson River is connected to the ocean, so it rises and falls with the tides. The Upper Hudson River Estuary is identified as a "significant biodiversity area" by the New York State Department of Environmental Conservation (NYSDEC) Hudson River Estuary Program. It is a globally rare freshwater tidal ecosystem that supports many rare species as well as regionally important fisheries.[18] Near Hudson, the river is also habitat for the federally-endangered shortnose sturgeon. In the main channel of the river off of North and South Bays, there are patches of submerged aquatic vegetation, or SAV, which is plant life that grows underwater (Maps 6 and 7). The underwater plants help keep water clean by trapping soil that runs off from the land and adding oxygen to the water. Even if SAV is not present, these areas need protection from disturbance, so the plants can regrow when conditions are right.

Watery habitats connected to the Hudson are also affected by tides. Tidal wetlands, creeks, and subtidal shallows of the Hudson River Estuary, like those in the North and South Bays, provide essential habitat for rare plants, rare birds, and young fish. Waterfront communities also benefit because tidal wetlands remove some pollutants from water entering the river and protect shorelines from waves and strong storms.

Hudson North Bay comprises the southern end of the Stockport Creek and Flats Significant Coastal Fish and Wildlife Habitat designated by New York State, and the Stockport Flats Important Bird Area designated by Audubon New York (Map 5). Both significant areas extend north through the Towns of Greenport, Stockport, and Stuyvesant. Mudflats and shallows provide refuge and feeding grounds for several species of migratory fish, including striped bass, American shad, alewife, and blueback herring, as well as resident species like smallmouth bass. The wetlands are also valuable bird habitat for nesting and migrating birds. North Bay supports nesting Least Bittern, a NYS Threatened Species, and Marsh Wren which is regionally rare in the Hudson Valley.[19] Other birds of conservation concern that have been observed in North Bay include migrating Pied-billed Grebe (NYS Threatened), resident Bald Eagle (NYS Threatened), and migrating Northern Harrier (NYS Threatened). The Stockport Creek wetlands also

support large concentrations of waterfowl including American Black Ducks, Mallards, and Common Merganser, which creates excellent hunting opportunities. North Bay is connected to the Hudson by a single culvert under the railroad embankment, which limits tidal flushing and habitat quality.

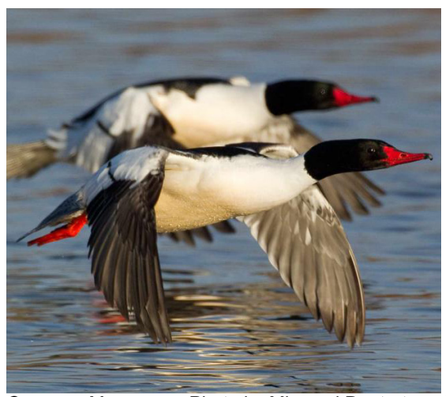
North Bay and the surrounding uplands are described in detail in an ecological report[20] developed for 123 acres owned by the City and County. The report notes that despite significant (ecological) challenges of contamination, a capped landfill, dumping, legacy industrial pollution, thick stands of trees and shrubs, and heavy deer browse, North Bay remains a unique area within the Hudson River corridor with a rare assemblage of natural habitats worthy of protection and restoration.

Hudson South Bay is a 120-acre tidal wetland complex that is designated by NYS as South Bay Creek and Marsh Significant Coastal Fish and Wildlife Habitat. The tidal creek is habitat for migrating fishes including blueback herring and American Eel. Resident fishes include white suckers and fathead minnow. Two species of rare freshwater mussels have been documented in the bay, along with marsh birds, and numerous state-listed rare plants (A list of rare and endangered species present in Hudson can be accessed from the CAC's page on the City website). The bay is connected to the Hudson River by a single culvert under the railroad embankment. Tidal water movement across the bay is further restricted by the culverts under the "haul road" causeway running to the deepwater port and under Route 23/9G. Like North Bay, South Bay has been extensively altered by human activity. The southern part of the Bay that has more tidal flushing has higher quality habitat. The South Bay habitat is described in more detail in an ecological report of South Bay and adjacent uplands.[21]

Because the Major Ecological Features Map is based on data of statewide importance, it had significant gaps. In 2018 the Hudson CAC reached out to Hudsonia, a science-based non-profit organization that works for better conservation and management of the environment in the Hudson Valley. With funding from the Hudson River Estuary Program, and help from Hudson CAC members, Hudsonia completed a habitat assessment for the City (Maps 6 and 7).[22] The resulting maps add valuable information about the City's habitats, especially for areas that hadn't been studied before. (To show more detail, these maps are at a larger scale than the others, and oriented with the river at the top.) Although these are the most accurate available habitat maps of Hudson, all habitats and boundaries should be confirmed on the ground before being considered in land use or management decisions.

Least Bittern. Photo by Greg Lavaty - All About Birds.

American Black Duck. Photo by Evan Lipton - Macaulay Library



Common Merganser. Photo by Missouri Deptartment of Conservation.

Habitat	Percentage of Hudson	Total acreage
Hudson River and tidal habitats	11%	172 acres
Forested upland habitats	19%	272 acres
Open upland habitats	19%	272 acres
Non-tidal wetland habitats	3%	47 acres
Ponds and open water	1%	20 acres
Total Habitat	**53%**	**783 acres**
Developed areas (not mapped)	47%	687 acres
Total Acres of Hudson	**100%**	**1470 acres**

Table 1:
Total acreage of habitats shown on maps 6 and 7

Spotted Salamander.
Photo courtesy of the Columbia Land Conservancy.

Just over half of the City's 1470 acres was mapped as habitat. Table 1 summarizes the broad habitat types described in this section. In addition to the habitats listed in Table 1, Hudsonia has identified 324 acres of clay bluff and ravines, areas with clay soils "characterized by steep-sided ravines cut by small streams, steep bluffs fronting the river, and more gradual slopes extending away from the river."[23] It primarily co-occurs with forest, and also swamps, meadows, and cultural areas.

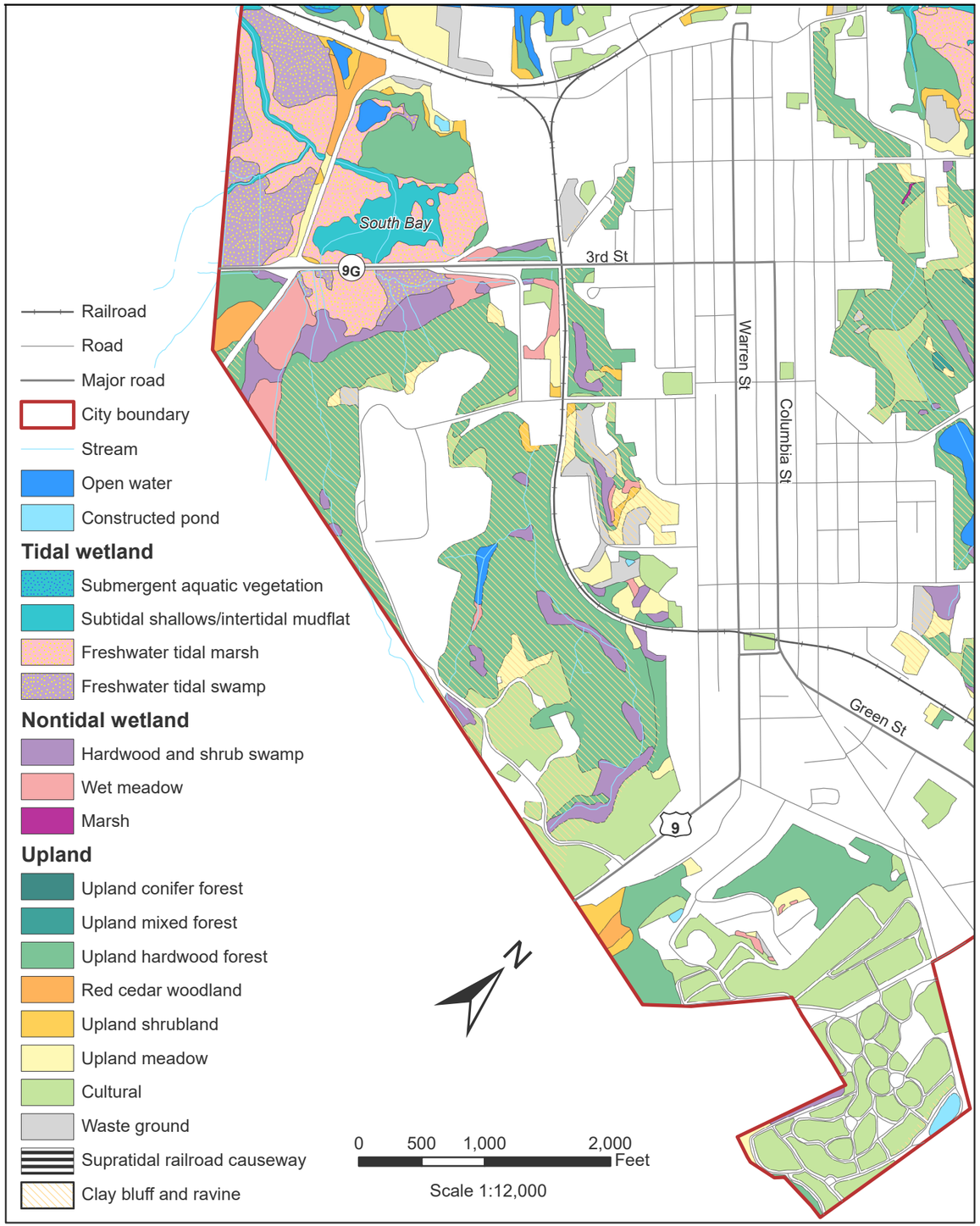
FORESTS

Forest makes up most of the natural habitat in Hudson, covering about 19% of the City. This includes upland conifer forest, upland mixed forest, upland hardwood forest, and red cedar woodland shown on Maps 6 and 7, but does not include street trees, which are discussed in the Cultural Resources section of this inventory. (Street trees and smaller forest patches are shown on Map 14.) The majority of Hudson's forests, both large and small, are found in settings with steep clay bluffs and ravines, which is not surprising because remnant natural areas in cities are often found in places that are difficult or impossible to develop.

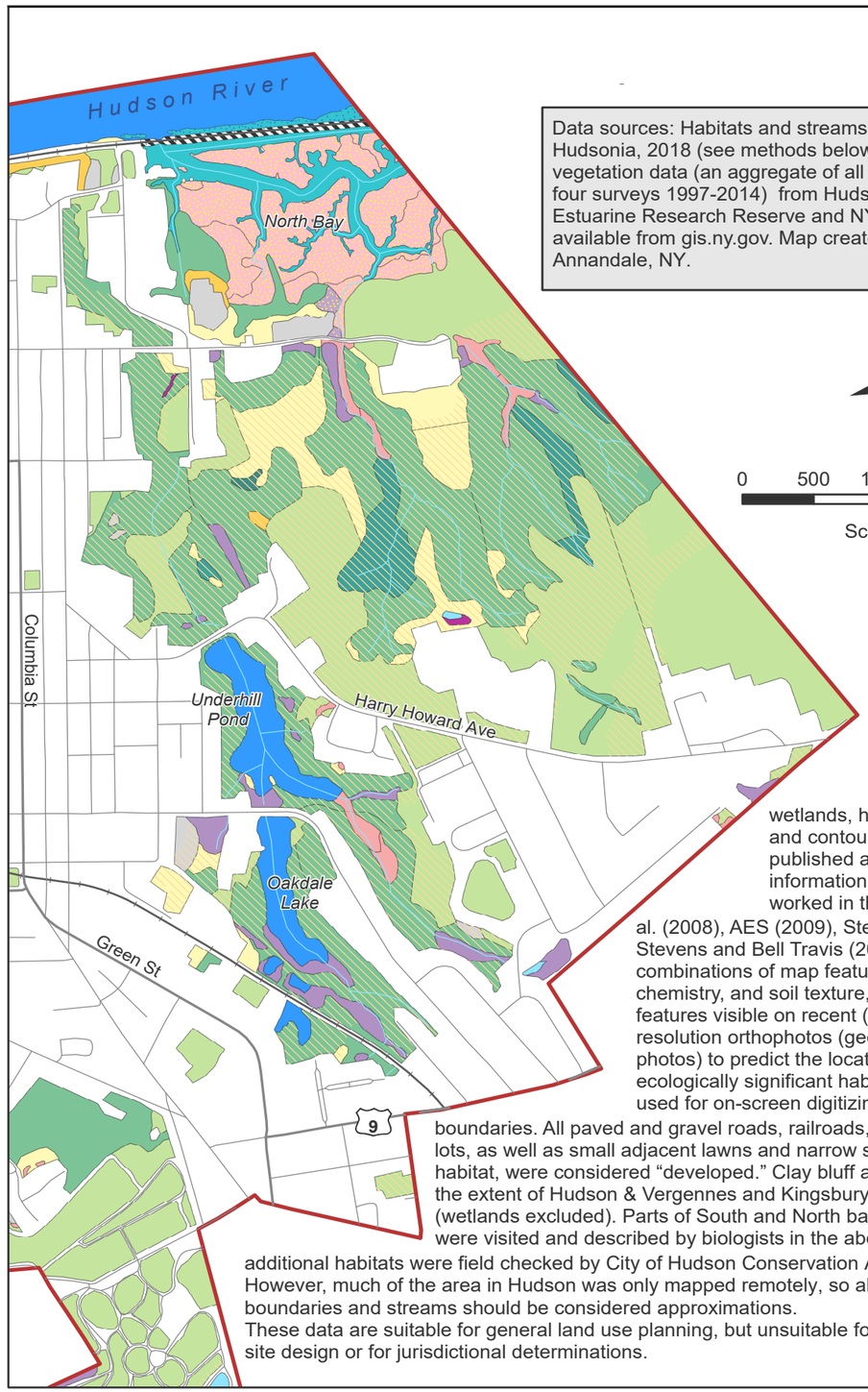
Map 5 shows two forest blocks larger than 200 acres in Hudson, both of which are shared with the neighboring Town of Greenport. The largest forest block in Hudson is about 1,100 acres and adjacent to North Bay. Within the City, that forest is primarily located on the Hudson High School and Fireman's Home properties; it extends into the Greenport Conservation Area. A local biological assessment mapped parts of this forest and found them to be the highest quality forest on the North Bay study site.[24] The forests along stream edges included an oak-dominated forest and a maple-elm forest on the south facing slopes, and a mixed hardwood forest on the north-facing slopes. Several animals found there also indicate higher quality forest habitat, including red-backed and spotted salamanders, and Pileated Woodpecker and Eastern Wood-Peewee.

The other large forest patch is a 750-acre upland hardwood forest patch that is adjacent to South Bay and extends south into the Town of Greenport. In the City, this patch is mostly on Hudson Correctional Facility land. Map 6 shows that this patch is mostly upland mixed forest, and a local biological assessment that included parts of this forest patch showed that it is comprised of maple, oak, hickory, cottonwood, and elm trees.[25] Animals found in the area that indicate higher quality forest habitat included Jefferson's salamander, which is a species of special concern, as

MAP 6: CITY OF HUDSON HABITATS - SOUTH



MAP 7: CITY OF HUDSON HABITATS - NORTH



Data sources: Habitats and streams mapped remotely by Hudsonia, 2018 (see methods below). Submergent aquatic vegetation data (an aggregate of all areas with SAV from four surveys 1997-2014) from Hudson River National Estuarine Research Reserve and NYSDEC, 2016, available from gis.ny.gov. Map created by Hudsonia Ltd., Annandale, NY.

Methods:
Hudsonia mapped ecologically significant habitats and surface waters. Data sources referred to included topographic maps, bedrock and surficial geology, soils, wetlands, hydrography, flood zones, and contours, as well as existing published and unpublished information from biologists who have worked in the area, including Bell et al. (2008), AES (2009), Stevens et al. (2015), and Stevens and Bell Travis (2018). They used combinations of map features (e.g., slopes, bedrock chemistry, and soil texture, depth, and drainage) and features visible on recent (2010-2017), high-resolution orthophotos (georeferenced digital aerial photos) to predict the location and extent of ecologically significant habitats. Orthophotos were used for on-screen digitizing of streams and habitat boundaries. All paved and gravel roads, railroads, buildings, and parking lots, as well as small adjacent lawns and narrow strips of intervening habitat, were considered "developed." Clay bluff and ravine overlay follows the extent of Hudson & Vergennes and Kingsbury & Rhinebeck soil series (wetlands excluded). Parts of South and North bays and adjoining uplands were visited and described by biologists in the above sources, and a few additional habitats were field checked by City of Hudson Conservation Advisory Council. However, much of the area in Hudson was only mapped remotely, so all mapped habitat boundaries and streams should be considered approximations.
These data are suitable for general land use planning, but unsuitable for detailed planning and site design or for jurisdictional determinations.

well as the forest songbirds Eastern Wood-Pewee, Ovenbird, Wood Thrush and Scarlet Tanager.

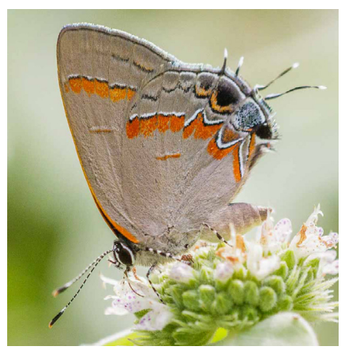
Though small compared to forest patches in other parts of the county, the presence of forest resident species indicate Hudson's large forest patches may provide connections for animal movement and plant dispersal from uplands to the river. These forests also serve a critical ecological function as buffers to the City's tidal wetlands and help prevent erosion in the small creeks that flow to those wetlands.[26]

OPEN AREAS

Another 19% of the City is in the open upland category (Table 1). In Maps 6 and 7, open areas are in shown in light green (cultural), yellow (upland meadow), and dark yellow (shrubland). Nearly all of that is what Hudsonia calls "cultural" habitat (202 acres), which means areas that are intensively mowed or otherwise managed as lawns, playing fields, cemetery, schools, or parks. Although they are not high-quality habitat, some of these areas are important recreation areas for City residents and may buffer adjacent natural habitats from disturbance.[27]

There are also 55 acres of natural open uplands, including some areas of high-quality habitat. Upland meadows in the City are found in and around cultural habitats and hardwood forest. Their significant species include birds that specialize in open habitats, like Bobolink and Eastern Meadowlark, as well as coral hairstreak butterflies, and spreadwing damselflies.[28]

Eastern Meadowlark. Photo Courtesy of National Audubon Soiciety.



Haristreak Butterfly. Photo courtesy of Mary Anne Borge, the Natural Web.

Typical Forest habitats in Hudson. Photos Courtesy of the Columbia Land Conservancy.

KEY FINDINGS

- *North and South Bays are the highest quality habitat in Hudson, with resources of statewide significance, globally rare freshwater tidal wetlands and state-listed bird and plant species.*
- *A new habitat assessment by Hudsonia found that forests are the most abundant natural habitat in Hudson, covering 19% of the City. Open uplands were also 19% of the City, most of which are intensively managed spaces like lawns and playing fields.*

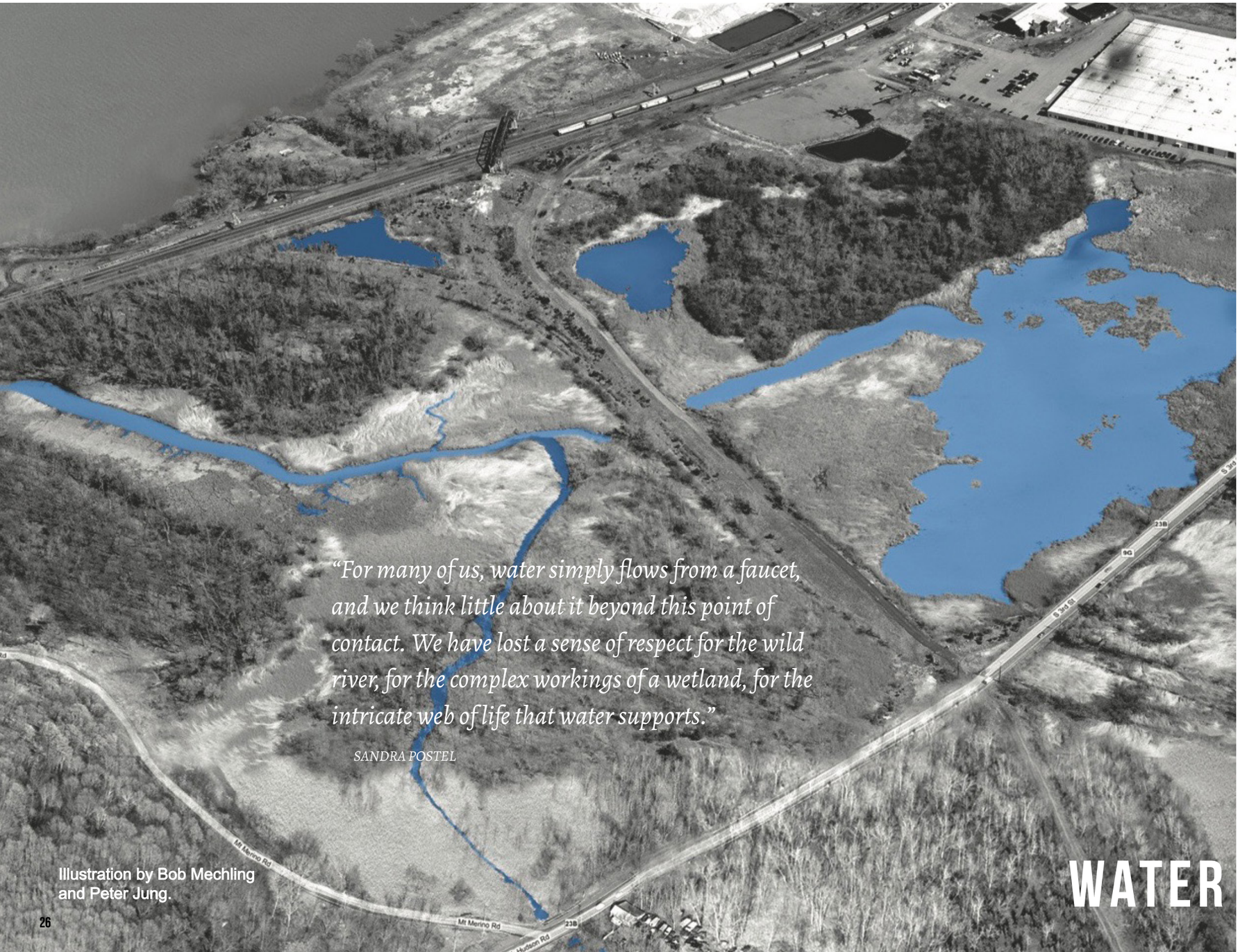
SUGGESTED ACTIONS

- *Raise awareness about the natural habitats in the City and what can be done to protect them.*
- *Verify the Hudsonia habitat maps with direct field observation, to make them suitable for land use management or decision-making.*

NON-TIDAL WETLANDS

A wetland is a vegetated area with soils that are wet during the growing season. Wetlands can benefit people as well as wildlife by absorbing flood water and filtering sediment and pollutants from water that flows through them. Non-tidal wetlands are only 3% of the City of Hudson (Table 1), found mostly along streams and ponds. There are three kinds of wetlands in Hudson: hardwood swamps, wet meadows, and marshes. Hardwood swamps are wetlands dominated by trees; wet meadows in Hudson are dominated by common reed; and marshes have areas of open water surrounded by grasses and non-woody plants. Hudsonia only mapped two small non-tidal marshes in Hudson, but additional marsh areas may occur at the margins of ponds or wet meadows.[29] Spotted turtle, spotted salamander, blue-spotted and Jefferson's salamander are species of conservation concern that live in Hudson's wetlands.[30]

Non-tidal wetland near Hudson, NY. Photo by Emily Crimmins.



"For many of us, water simply flows from a faucet, and we think little about it beyond this point of contact. We have lost a sense of respect for the wild river, for the complex workings of a wetland, for the intricate web of life that water supports."

SANDRA POSTEL

Illustration by Bob Mechling and Peter Jung.

WATER RESOURCES

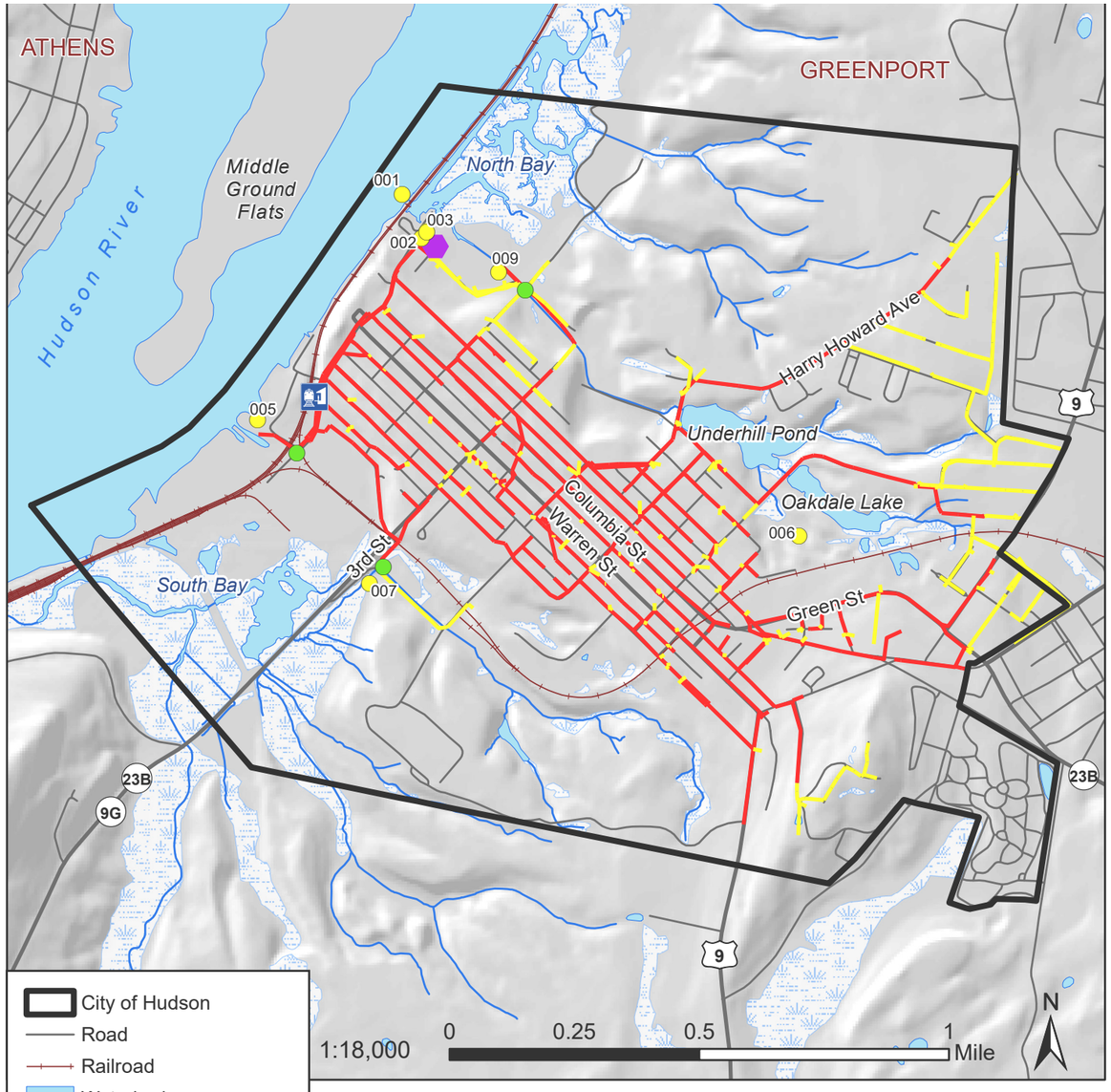
Clean water is vital for human health and well-being. This section describes where Hudson's water comes from and where it goes, its quality and threats.

WATERSHEDS AND STORMWATER SYSTEMS

All of rain that falls on the City of Hudson ultimately drains to the Hudson River, either through the City's stormwater system or small streams. In less developed areas, water is absorbed through the ground, and excess generally flows downhill into the nearest stream or waterbody. Where pavement and buildings have replaced natural vegetation, an underground piped sewerage system is typically used to remove stormwater. Nearly one third of Hudson's area is covered by roads, roofs, and pavement, and is impervious to water.[31]

Map 8 shows the sewer system in the City of Hudson. Like many other older urban areas, the City of Hudson has combined sewers, where stormwater runoff from rain and snowmelt is collected in the same pipes as wastewater from homes and businesses. All of this water goes to the wastewater treatment plant where it is cleaned before being discharged into waterbodies. When there is a lot of rain or snow melt, there can be too much water for the plant to process, so the system is designed to overflow into open waterbodies. When it does, a mix of stormwater and untreated sewage is released. In 2017, there were at least 72 overflows into the Hudson River, North Bay, and an intermittent stream that feeds into Underhill Pond.[32] Because this is not good for the health of the waterbodies, the City is working with the NYSDEC to solve this problem through a Long-Term Control Plan.[33]

MAP 8: CITY OF HUDSON SEWER SYSTEM



Data sources:
Municipal Boundary: NYS GIS Program Office, 2017 | Road: NYS GIS Program Office, 2018 | Railroad: NYS Department of Transportation, 2009 | Stream/Waterbody: Hudsonia Ltd, 2018 and National Hydrography Dataset, US Geological Survey and NYSDEC, 2011 | Wetland: Hudsonia Ltd, 2018 and National Wetland Inventory, US Fish and Wildlife Service, 2011 | Combined/ Sanitary Sewer Line, Pump Station: City of Hudson DPW, 2016 | Combined Sewer Overflow: NYSDEC, 2013

Note: This map was produced for the City of Hudson Open Space and Natural Resources Inventory and is intended for general planning and information purposes. It relies upon public data sources that may contain errors or omissions and is not a substitute for site-level surveys. Map by Shannon Doyle, 2018.

One approach to reduce sewer overflows is to separate the stormwater system from the sanitary sewers so excess stormwater no longer flows to the treatment plant. The yellow lines on Map 8 show places where sewers are already separated. These are mostly the parts of Hudson that have been developed since the early 20th century. Separating the older combined sewers is a slow and expensive process, so the City makes piecemeal progress as grant funding becomes available.

Another approach is to use nature-based solutions, called green infrastructure, to absorb or trap water and reduce the volume of stormwater before it enters the combined sewer system. In 2018 and 2019, with state funding, stormwater retention tanks that also serve as street tree planters were installed along upper Union Street to absorb rainwater and reduce runoff. Other green infrastructure technologies and solutions include permeable pavement, rain gardens, and green roofs.

Tidal creek in Hudson North Bay. Photo courtesy of the Columbia Land Conservancy.

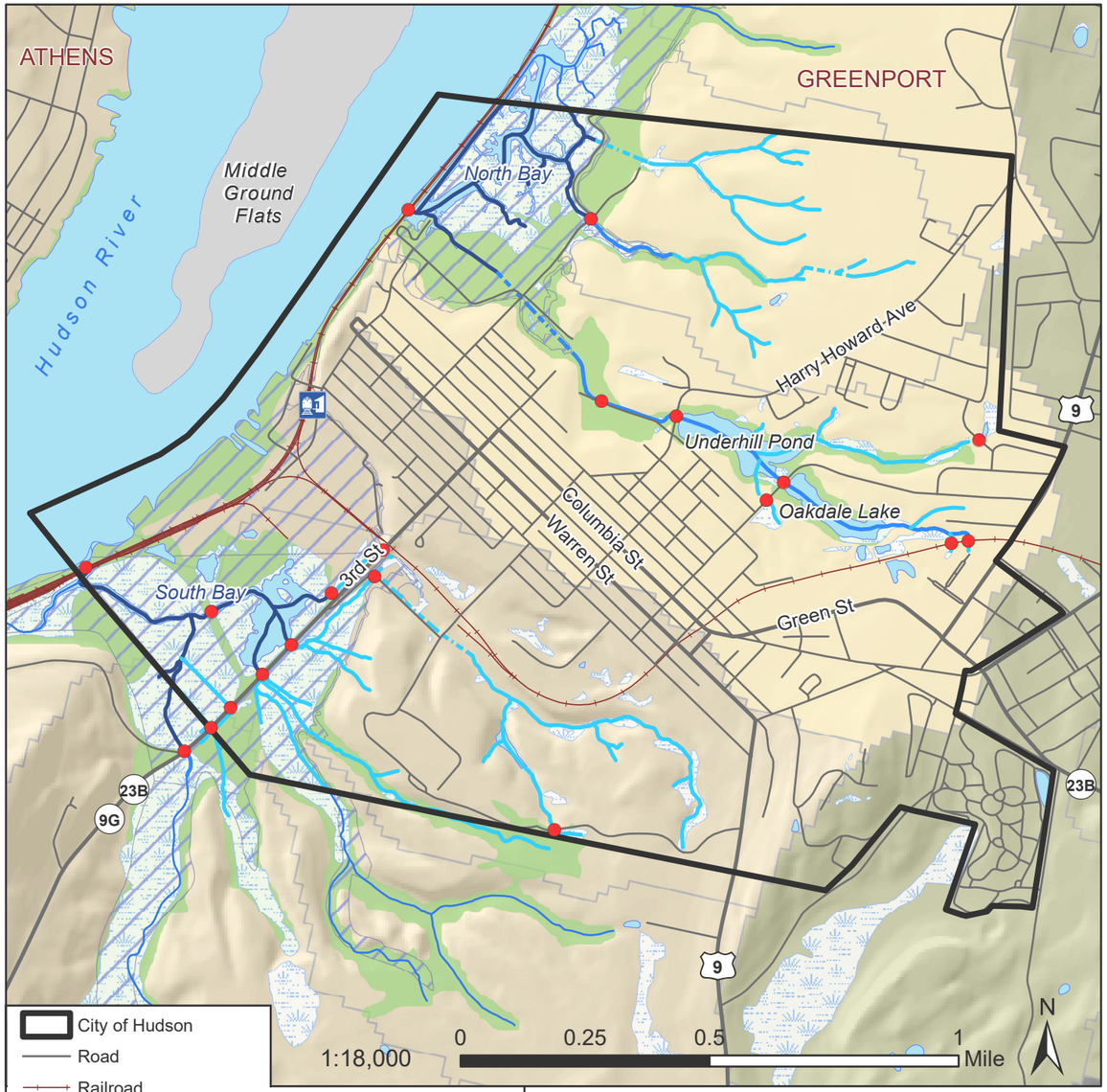
STREAMS AND WATERSHEDS

Map 9 shows streams that were mapped by the CAC. The water that is not captured by sewer infrastructure collects in small streams that become tidal creeks before they empty in the Hudson River (shown in dark blue). The streams that flow to South Bay in Hudson are largely intermittent (shown in light blue on Map 9), flowing only when there are heavy rainstorms or snow melt. Portions of these streams are buried. The only stream that flows year-round (shown in medium blue on Map 9) is not recognized by most people as a single stream, nor is it named. This tributary emerges at the end of Spring Street, feeds Oakdale Lake and Underhill Pond, and continues to the Hudson; a long stretch of this stream is buried in a culvert as it approaches North Bay.

Map 9 also shows Hudson's subwatersheds, areas which, due to topography, drain in different directions. Southwest of Warren Street, water flows to South Bay, while northeast of Warren Street, water flows to North Bay. East of Academy Hill, in the southeastern corner of the City where the cemeteries are, water flows into the Claverack Creek watershed (darkest tan on Map 9). Claverack Creek becomes Stockport Creek when it merges with Kinderhook Creek about 6 miles north of the City, before flowing into the river.

The red dots on Map 9 are the places where streams and other waterbodies cross under roads via culverts and bridges. Culverts are

MAP 9: CITY OF HUDSON STREAMS AND WATERSHEDS



Data Sources:
Road: NYS GIS Program Office, 2018 | Railroad: NYS Department of Transportation, 2009 | Municipal Boundary: NYS GIS Program Office, 2017 | Streams/Waterbody: Hudsonia Ltd, 2018 and National Hydrography Dataset, US Geological Survey and NYSDEC, 2011 | Mapped Wetland: Hudsonia Ltd, 2018 and National Wetland Inventory, US Fish and Wildlife Service, 2011 | FEMA Special Flood Hazard Area : Federal Emergency Management Administration, 1996 | Subwatershed and Riparian Buffer: NYNHP, 2018 | Culvert/Bridge: Hudsonia Ltd, 2018

Note: This map was produced for the City of Hudson Open Space and Natural Resources Inventory and is intended for general planning and information purposes. It relies upon public data sources that may contain errors or omissions and is not a substitute for site-level surveys. Map by Shannon Doyle, 2018.

KEY FINDINGS

- ***Primary water supply is clean and expected to be for the near future.***
- ***There are uncertainties about the backup supply.***
- ***Three temporary streams run through the City, all unnamed, and mostly unknown by City residents.***

SUGGESTED ACTIONS

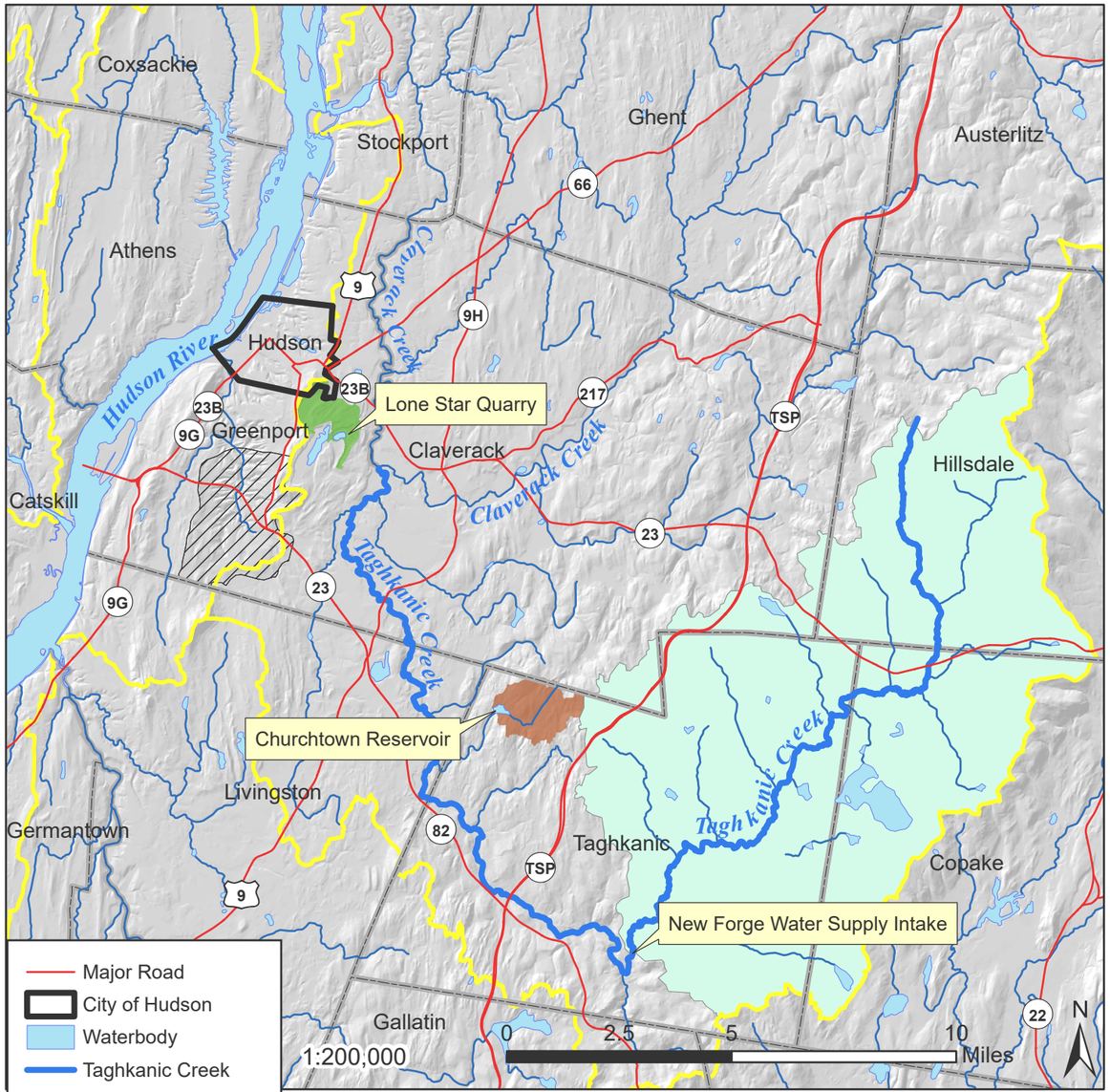
- ***Raise awareness about where Hudson's water comes from, where it goes, and how clean it is.***
- ***Consider protective initiatives for the drinking water supply (e.g., how are rules and regulations enforced)***
- ***Determine the source and encourage periodic quality monitoring of backup drinking water supply***
- ***Study and promote the use of green infrastructure tactics to reduce stormwater pressure on combined sewer system***

typically used to maintain the flow of water; however, if undersized, they can act as barriers that can have serious effects on local flooding and water quality. During periods of heavy rain or snowmelt, streams that flow into undersized or clogged culverts can back-up and flood upstream areas. They can even overtake and wash out a road during extreme events. Dams and culverts in streams can also restrict movement of fish and other organisms that use stream corridors.

The green areas along streams on Map 9 are known as riparian areas. These areas are important for stream health because they intercept stormwater runoff, trap sediment and nutrients, and help reduce flooding. Forested riparian buffers provide organic matter that supports the in-stream food web and shade that helps maintain cool water temperatures. They also support unique and diverse habitats and serve as wildlife travel corridors.[34] The riparian areas were mapped using computer models based on elevation, mapped wetlands, and the 50-year flood zone.[35] This information should be verified on the ground before use in specific projects. Their representation on Map 9 can, however, provide a starting point to inform land use strategies and stream protection efforts. Riparian areas overlap with the Special Flood Hazard Area shown in blue hatched lines.

Taghkanic Creek.

MAP 10: CITY OF HUDSON DRINKING WATER SUPPLY



Data sources:
Municipal Boundary: NYS GIS Program Office, 2017 | Major Road: NYS GIS Program Office, 2012 | HUC10 Watershed Boundary: USGS and DEC, 2016 | Stream/Waterbody: Medium-Resolution National Hydrography Dataset, US Geological Survey and EPA, 2012 | New Forge/Churchtown/Lone Star Basin: delineated using USGS StreamStats, 2018 | Greenport CEA: NYSDEC, 2014

Note: This map was produced for the City of Hudson Open Space and Natural Resources Inventory and is intended for general planning and information purposes. It relies upon public data sources that may contain errors or omissions and is not a substitute for site-level surveys. Map by Shannon Doyle and Ingrid Haeckel, 2018.

Safeguarding the Supply

Although both Hudson's primary and secondary water supplies are located in municipalities where the City cannot regulate land use, Hudson has protective rules and regulations under NYS Public Health Law.[36] The rules allow Hudson to limit some land uses near current or potential public water supply sources to reduce the risk of contamination, and allow Hudson's Department of Public Works to inspect those watersheds to ensure the rules are followed. The rules presently apply to Taghkanic Creek, the Churchtown Reservoir, the Lone Star Quarry Reservoir and their watersheds in the Towns of Taghkanic, Greenport, Claverack, Hillsdale and Copake, which are shown on Map 10. The Churchtown Reservoir and the Taghkanic Creek also require NYSDEC permits for alterations to their beds or banks.

Map 10 shows the Critical Environmental Area (CEA) designated by the Town of Greenport to protect its own water supply. Hudson cannot designate a CEA in the other municipalities, though the City could work with the other Towns to designate them. Designating a CEA does not establish permit requirements or specific standards for water quality, but it does create awareness of the resource, which can inform environmental reviews.

HUDSON'S DRINKING WATER SUPPLY

Map 10 shows the source of Hudson's drinking water. The intake for Hudson's water supply is on the Taghkanic Creek in the Town of Taghkanic. Water from that intake is conveyed by pipe to the City-owned Churchtown Reservoir. From there, water is piped and pumped up to a Department of Public Works facility on Academy Hill where it is treated. It then flows by gravity through water mains to supply homes and businesses. Recent water quality reports show Hudson's water meets or exceeds state standards. The watersheds of both the intake and the reservoir have high forest cover and very little impervious surface; thus, they are likely to continue to produce clean water.

According to the most recent New York State Department of Health (DOH) Source Water Assessment, Churchtown Reservoir has medium-to-high susceptibility to microbial contamination and phosphorus. Potential sources of bacteria or phosphorus include low-intensity residential development, row crops, and pasture land uses. The reservoir has a low susceptibility to organics, industrial solvents, nitrates, and other industrial contaminants because there are no permitted discharges within the watershed. The DOH noted a potential source of sediment and turbidity contamination from one mine in the watershed.[37]

Hudson has an emergency water supply at the former Lone Star Quarry in Greenport, which stores over 1 million gallons. The quarry is located on a 14-acre parcel within a 395-acre tract that the City acquired in the 1960s, which is currently under a lease-purchase contract with a mining company. The company will take ownership of the larger tract in 2042, with the 14-acre quarry parcel remaining City property. The company is obligated to maintain the quality of the water, even after that time. If the DOH determines that the backup water supply is no longer drinkable, or is for any reason unavailable, the mining company must provide a substitute backup water supply that is equal or superior in quality or quantity to the existing backup reservoir. It is, however, unclear what that alternative backup supply might be.

"The road we have long been traveling is deceptively easy, a smooth superhighway on which we progress with great speed, but at its end lies disaster. The other fork of the road - the one less traveled by - offers our last, our only chance to reach a destination that assures the preservation of the earth."

RACHEL CARSON / Silent Spring

Photo by Andi State

CLIMATE RISKS

Scientists have observed that the earth's temperature has been rising over the past 100-plus years and agree that the increase is caused by the burning of fuels for transportation, heat, and electricity. An increase in global temperature also affects the water cycle, leading to more extreme rain and snow fall, short-term drought, and severe storms.[38] In Hudson, there are three primary climate risks: heat waves, short-term droughts, and flooding from extreme storms, storm surge, and sea-level rise. This section of the inventory describes natural resource-related risks that Hudson could consider in future planning and development; these are primarily flood-related. For a fuller description of climate risks and opportunities, see the Climate Summary prepared by the Hudson River Estuary Program [39], which can be found on the CAC's web page at CityofHudson.org

PUBLIC VIEWS ON CLIMATE CHANGE

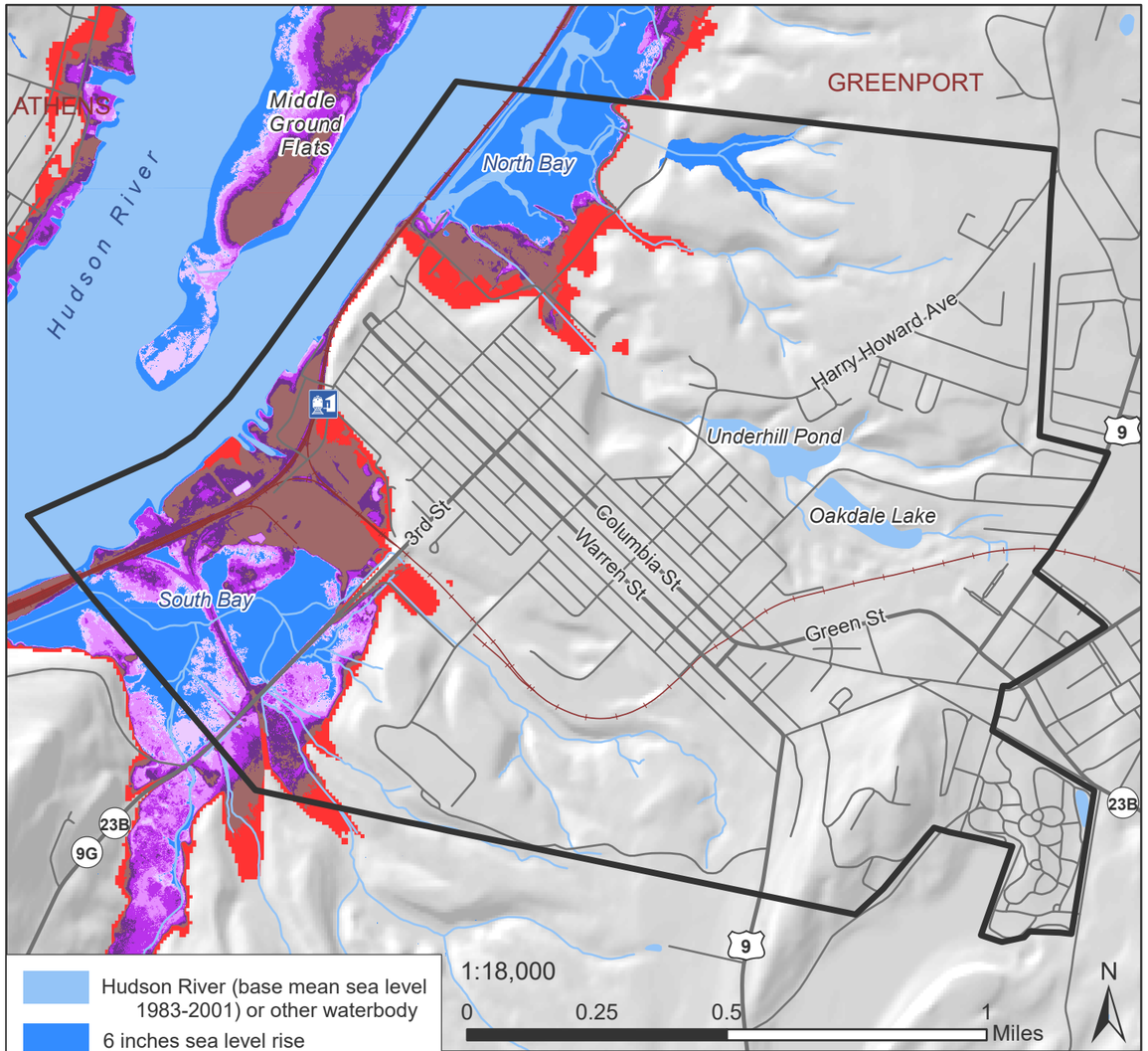
The public opinion survey conducted by the Hudson CAC indicated that residents and visitors to Hudson are aware of how climate change and sea-level rise might affect Hudson (Yes 53%, Somewhat 32%, and No 14%). A majority (71%) wanted to know more about risks from climate change and flooding. Open responses included ideas for managing climate change impacts and highlighted the need for more awareness about the implications for Hudson in the short term (emergency management during flood events) and long term (adaptation for sea-level rise). In answer to the question, "What should we do to prepare Hudson for more frequent storms and flooding that are forecast to be coming due to climate change?," respondents suggested:

- Thoughtfully consider waterfront planning (12%)
- Raise awareness of climate risks (12%)
- Make sure residents know what to do in a flood emergency (10%)
- Manage or improve the stormwater and sewer system (10%)

Specific ideas suggested for development on the waterfront, given the risk of flooding, storm surge, and sea level rise included:

- Protect existing assets by raising them or creating barriers (8%)
- Use nature-based solutions like avoiding construction in floodplains, protecting wetlands, or using green infrastructure to manage stormwater (5%)
- Require buildings to be floodproofed (3%)

MAP 11: CITY OF HUDSON SEA LEVEL RISE SCENARIOS



Data Sources:
Municipal Boundary: NYS GIS Program Office, 2017 | Road: NYS GIS Program Office, 2018 | Railroad: NYS Department of Transportation, 2009 | Stream/ Waterbody: Hudsonia Ltd, 2018 and National Hydrography Dataset, US Geological Survey and NYSDEC, 2011 | Baseline mean sea level (1983-2001): National Oceanic and Atmospheric Administration | Modeled sea level rise elevations and flood zones: Orton, P., MacManus, K., Fico, A., Mills, J., F. Conticello, F. Cioffi, T. Hall, N. Georgas, U. Lall, A. Blumberg. 2018. Hudson River and Western Long Island Sound Flood Elevations from Tides, Storm Surge and Rainfall. New York. Interactive mapper and report available at http://www.ciesin.columbia.edu/hudson-river-floodmap/

Note: This map was produced for the City of Hudson Open Space and Natural Resources Inventory and is intended for general planning and information purposes. It relies upon public data sources that may contain errors or omissions and is not a substitute for site-level surveys. Map by Ingrid Haeckel, NYSDEC/Cornell, 2018.

No one can predict with certainty the exact degree of sea level rise at any specific time in the future. But we concluded that it's essential to consider worst-case scenarios, and not minimize potential risk.

Time Interval	Range of Projected Sea-level rise
2020s	1 - 9 inches
2050s	5 - 27 inches
2080s	10 - 54 inches
2100	15 - 71 inches

Table 2.
Sea-level Rise Projections for the Mid-Hudson Region.[42]

SEA LEVEL RISE

Because the Hudson River is connected to the ocean, its water level will rise as the sea level rises. Global warming has already caused the Hudson River to rise an estimated 5.8 ± 0.44 inches since 1900[40], and it is predicted to rise significantly during the rest of this century. NYSDEC has adopted official projections of sea-level rise (Table 2) as part of a 2014 state law called the Community Risk and Resiliency Act (CRRA).[41] We recognize that it is not possible to predict with certainty the exact degree of sea level rise at any specific time in the future. But we believe that for Hudson to be best prepared, it is essential to consider worst-case scenarios and not minimize potential risk. Most climate scientists agree that the "high" projections are more likely, given recent observations of increasingly rapid ice melt and other factors contributing to global warming, so these are the projections used for Maps 11 and 12.

Map 11 shows how Hudson's shoreline will change under a range of sea-level rise scenarios. If scientists are correct about the high projections, nearly all of the current floodplain will be inundated by 2100. The map also shows that the future floodplain will reach much further inland. Because this will happen over time, Hudson can take time to prepare a strategy to adapt to these changing conditions.

CURRENT AND FUTURE FLOOD RISK

The Special Flood Hazard Areas shown in Map 9, were developed for the National Flood Insurance Program by the Federal Emergency Management Agency (FEMA). The Program uses its maps to determine flood insurance rates and requires local floodplain management regulations to reduce risk of flood damage. The majority of Hudson's Special Flood Hazard Areas are adjacent to the Hudson River and tidal portions of streams (blue hatched area in Map 9). The Special Flood Hazard Areas probably underestimate Hudson's flood-prone areas

because smaller streams are not typically mapped as part of the federal program, and it doesn't include flooding of the built stormwater system. The FEMA maps are also 30 years old and based on historic data, so they don't reflect physical changes in floodplains, new data, and better computer models, nor do they consider more recent trends in precipitation, tidal dynamics, sea-level rise and storm surge.[43] Given the high probability of frequent flooding on Hudson's waterfront in the near future, the City should carefully consider waterfront development.

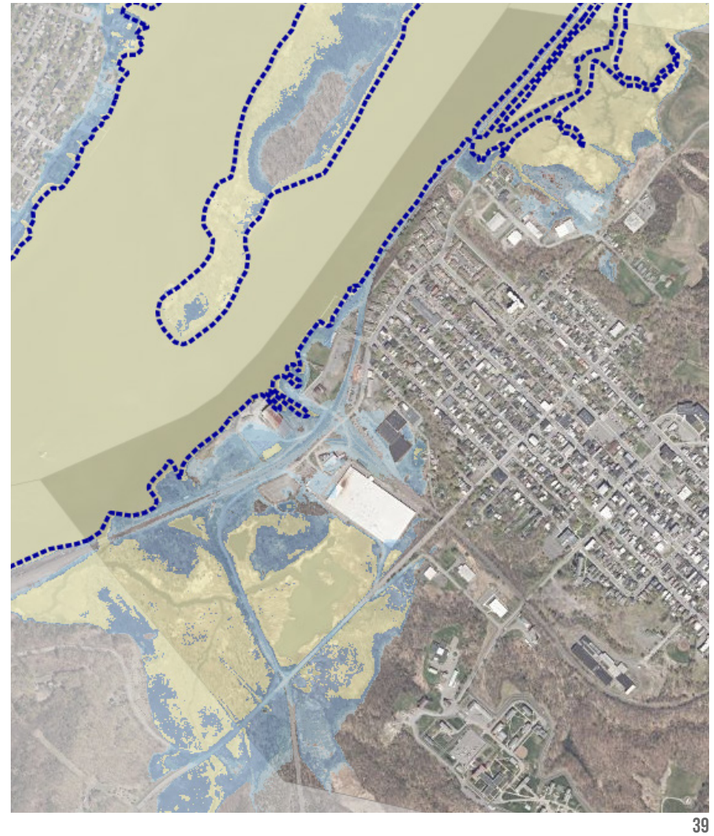
As of 2017, only seven policies were held under the National Flood Insurance Program in the City of Hudson, with a total of $1.7 million in coverage.[44] These relatively low numbers may reflect the fact that Hudson is not extensively developed in the floodplain. One of the most vulnerable buildings is Hudson's wastewater treatment facility, which is located within the FEMA Special Flood Hazard Area. The City has been making upgrades to the facility's pumps and other mechanical components, to mitigate the current flood risk.[45] However; 16% of its footprint would be inundated by six feet of sea level rise, so it is still at risk.

Flooding on Hudson's waterfront during Hurricane Irene, August 2011. Photos by Sarah Sterling

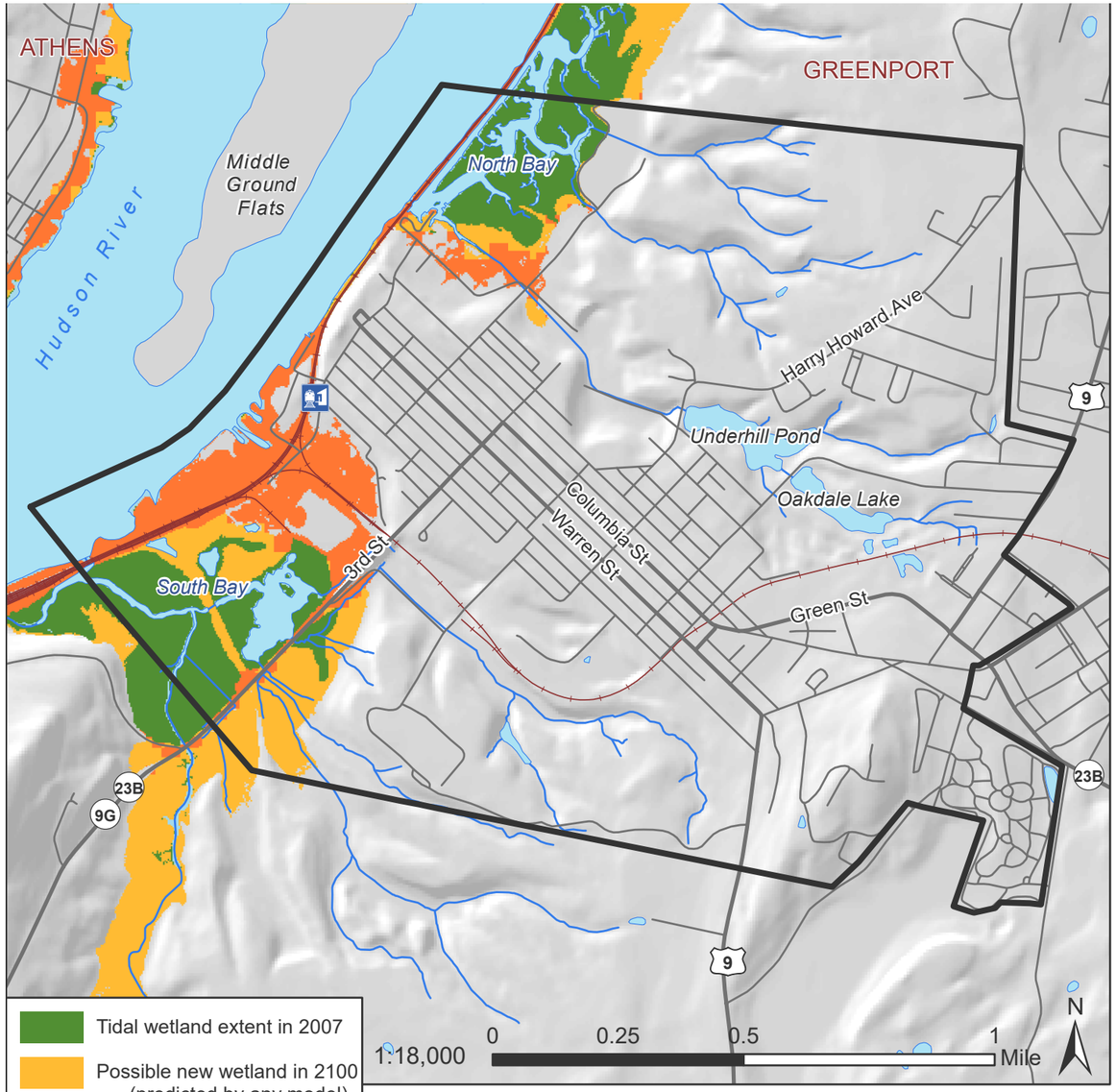
Nearly one-third of Hudson's area is impervious surfaces, such as pavements and roofs, which cannot absorb rainwater, and thus can overwhelm the stormwater system.

What will flood?

The Hudson River Flood Impact Decision Support System is an interactive mapping tool that can be used to explore how flood zones along the Hudson would change due to sea level rise. Unlike FEMA's Special Flood Hazard Areas shown in Map 9, the model also considers increasing precipitation trends, tidal dynamics, and sea-level rise. This screenshot represents flooding on Hudson's waterfront when there has been 24 inches of sea level rise (which is within the range of projections for 2050) and a 5-year storm (which has a probability of occurring once every five years). The lightest blue indicates flooding up to one foot in depth; the medium blue indicates flooding of one to two feet in depth; the darker blue indicates flooding of two to four feet in depth. (The dark dotted line represents the shoreline as determined in 2004.) Under this scenario, a 5-year storm would flood much of the waterfront during high tide. Among places at risk of flooding are the train tracks, the South Bay causeway, S. 3rd Street/9G, the KAZ warehouse site, the Basilica and Kite's Nest, and the Furgary.



MAP 12: CITY OF HUDSON TIDAL WETLAND MIGRATION



Data sources:
Municipal Boundary: NYS GIS Program Office, 2017 | Road: NYS GIS Program Office, 2018 | Railroad: NYS Department of Transportation, 2009 | Stream/Waterbody: Hudsonia Ltd, 2018 and National Hydrography Dataset, US Geological Survey and NYSDEC, 2011 | Wetland migration data: Sea Level Affecting Marshes Model (SLAMM), Scenic Hudson, 2015, "Wetland_resilience_composite," "time0," and "SLAMM_WetlandPathway_ScenicHudson_2015" files. SLAMM was used to compare projections of tidal wetlands in the Hudson River estuary across two sea level rise rate scenarios and three accretion models (Tabak et al. 2016); Hudson River estuary depth: NYSDEC Hudson River Estuary Program, 2009

Note: This map was produced for the City of Hudson Open Space and Natural Resources Inventory and is intended for general planning and information purposes. It relies upon public data sources that may contain errors or omissions and is not a substitute for site-level surveys. Map by Hudsonia Ltd., Annandale, NY 2018

KEY FINDINGS

- *Public survey results show that most people know about climate risks in Hudson and want to learn more.*
- *Most of North and South Bays are currently vulnerable to flooding.*
- *The low-lying areas will flood more frequently and become even more vulnerable with projected sea level rise.*

SUGGESTED ACTIONS

- *Raise awareness of likely impacts of climate change for Hudson and of the options for adapting to them.*
- *Conduct a coastal vulnerability assessment to help the City identify current and future flood hazards and prioritize assets at risk.*

A limited number of culverts under the railroad track constrict what was originally a natural tidal flow to the North and South Bays. Photo courtesy of the Columbia Land Conservancy.

TIDAL AND WETLAND MIGRATION

As the Hudson's water level rises over the next century, tidal wetlands will disappear unless they can gain sediment or move to higher ground. Wetlands cannot move to higher ground where the shoreline is too steep, or roads and houses are in the way. Without tidal wetlands, the Hudson River will have less fish nursery habitat and waterfowl feeding area. The protection from flooding and storm surge that tidal wetlands provide the City, by absorbing and temporarily holding high water, will also diminish as wetlands shrink.

Map 12 shows the pathways where tidal wetlands are likely to move as the sea level rises. The areas in green are tidal wetlands that existed in 2007 and areas in yellow are those predicted to become new wetlands by 2100. The orange areas would become wetland, but existing development is in the way.

A recent report predicts Hudson's South Bay is one of the few areas in the Hudson River Estuary where steep slopes are not a barrier to migration.[46] However, roads such as South 3rd St/Rt 9G and the South Bay causeway may block inland movement, especially where culverts underneath these roads impede the river's tidal flows. Enhancing the flow between the river, bays, and upland wetlands by installing additional culverts or elevating roads and causeways may allow the wetlands to migrate and may mitigate flooding in developed parts of the waterfront by absorbing high tides and surges.

Conserving natural shorelines along North and South Bays will also potentially allow Hudson's tidal wetlands to migrate inland and persist as sea level rises. The Hudson River Sustainable Shorelines Project[47] provides information and tools on how to enhance the ecology of engineered shoreline protection, including bulkheads and rip-rap revetments, as well as how to conserve natural shorelines.

Photo by Rachel Brennecke.

CULTURAL AND CIVIC RESOURCES

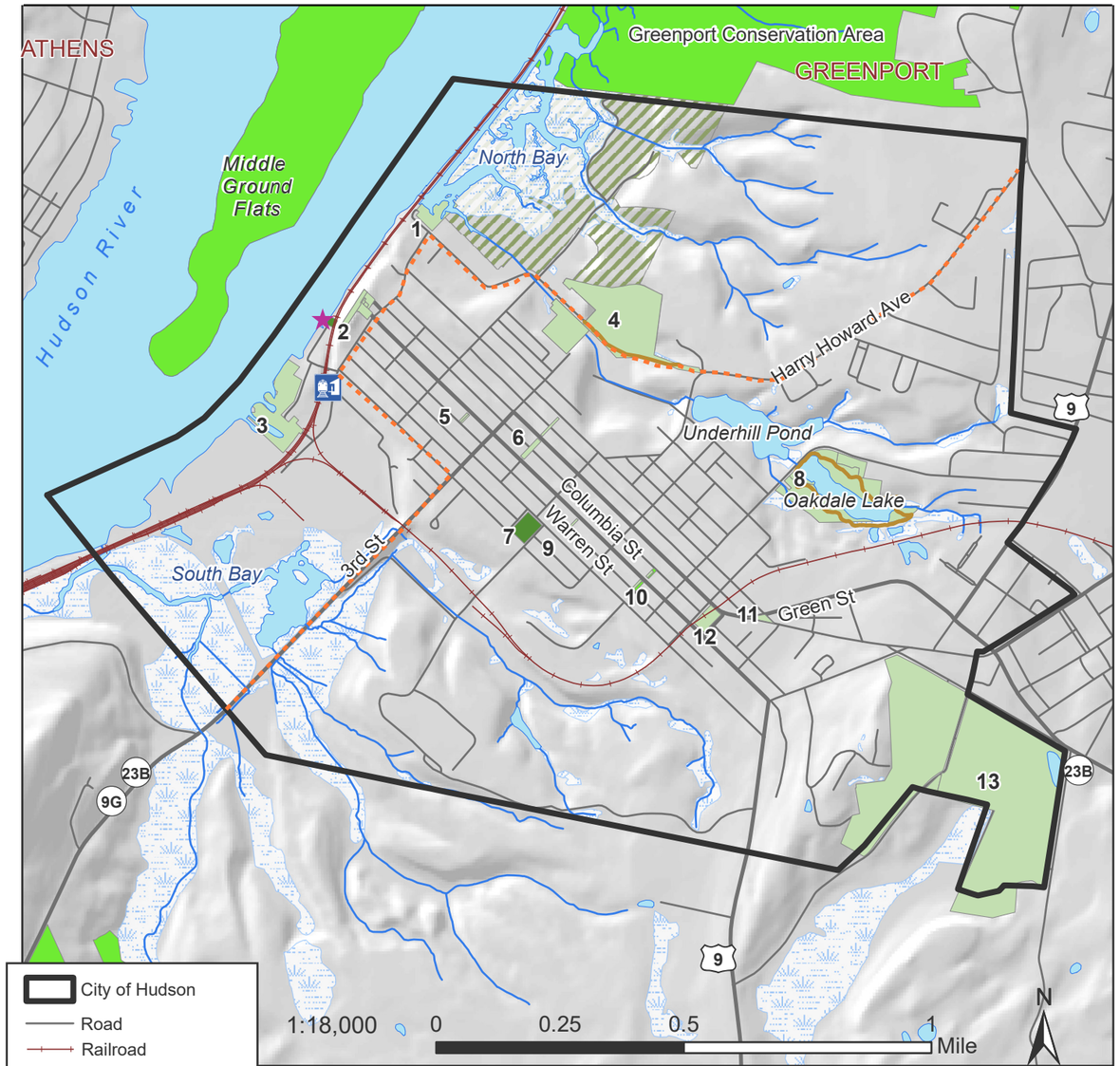
PARKS

Parks and green spaces provide places for physical activity, social interaction, and quiet contemplation. There are 13 public parks and open spaces shown on Map 13 and listed in Table 3. Hudson City and Cedar Park Cemeteries are included as parks because they are publicly accessible open spaces for walking and reflection.

Recent analyses found that 83% of Hudson residents and 87% of Hudson youth live within a 10-minute walk, or a half mile, of a park.[48] However, the CAC’s survey revealed that the park maintenance and amenities are insufficient. Concerns about the parks included lack of maintenance and lack of facilities and programming. The most common suggestions for improving parks were: clean up or maintain parks (44), improve landscaping/street trees (27), add amenities, including trails, seating, and things for kids to do (29). This is consistent with research findings that people are more likely to use parks for physical activity if they are perceived to be aesthetically pleasing,[49] safe,[50] and have organized activities.[51] Results from the survey revealed that City residents most often use Waterfront Park and Promenade Hill. Many respondents complained that there’s nothing to do in the parks, a condition especially noticeable at the pocket parks and Parc Foundation Park on Warren Street.

Map 13 shows the trail encircling Oakdale Lake, and the proposed route through Hudson of the Empire State Trail. The latter overlays the Dugway, a paved path which goes from Harry Howard Avenue to Charles Williams Park. Currently, the Dugway and the trail at Oakdale are the only formally established and maintained trails in the City. However, there are a number of other informal trails that City residents commonly use.

MAP 13: CITY OF HUDSON PARKS AND TRAILS



City of Hudson Parks:
1. The Furgary | 2. Promenade Hill | 3. Henry Hudson Riverfront Park | 4. Charles Williams Park
5. Thurston Park | 6. Parc Park | 7. Washington Park at the County Courthouse | 8. Oakdale Park
9. 400 Block Pocket Park | 10. 500 Block Pocket Park | 11. Rogers Park | 12. 7th Street Park/Public Square
13. Cedar Park Cemetery

Data Sources:
Municipal Boundary: NYS GIS Program Office, 2017 | Road: NYS GIS Program Office, 2018 | Railroad: NYS Department of Transportation, 2009 | Stream/Waterbody: Hudsonia Ltd, 2018 and National Hydrography Dataset, US Geological Survey and NYSDEC, 2011 | Wetland: Hudsonia Ltd, 2018 and National Wetland Inventory, US Fish and Wildlife Service, 2011 | City Parks: identified by Dale Schafer, using Columbia County 2017 tax parcels | Other Parks and Conservation Lands: Columbia County GIS Resource, 2017 | Public Trails and Empire State Trail: digitized by Beth Feingold and Nick Zachos

Note: This map was produced for the City of Hudson Open Space and Natural Resources Inventory and is intended for general planning and information purposes. It relies upon public data sources that may contain errors or omissions and is not a substitute for site-level surveys. Map by Shannon Doyle, 2018.

1. The Furgary	Waterfront historic fishing village, currently provides kayak access and fishing; under consideration for development for historic interpretation and recreation
2. Promenade Hill	Views of Hudson River and Catskills, playground
3. Henry Hudson Riverfront Park	Boat launch and limited dock space, pavilion, picnic areas, event space and restrooms
4. Charles Williams Park	pavilion, playground, sports fields
5.Thurston Pocket Park	Playground, seating
6. Parc Foundation Park	Seating, planting
7. Washington Park	Seating, pavilion, memorials
8. Oakdale Park	Lake with swimming beach, trails, playground, pavilion, picnic areas, basketball court, skate park; home to Hudson Youth Department summer program; currently under consideration for renovation
9. 400 Block Pocket Park	Seating
10. 500 Block Pocket Park	Seating
11. Rogers Park	Olympic torch, currently a traffic island
12. 7th Street Park/Public Square	Seating, strolling. In the public survey it had the most mentions of any park
13. Hudson City Cemetery and Cedar Park Cemetery	City-owned cemeteries with walking paths; former wading pool area, not used as cemetery, could be reimagined for recreation

Table 3.
Parks in the City of Hudson.

PARK AND TRAIL OPPORTUNITIES

Hudson has opportunities for several new park spaces and long-distance regional trail connections.

North Bay Recreation Area and Trail
The City has been working with Columbia County and the Columbia Land Conservancy (CLC) to transform 123 acres of underused City- and county-owned land into a community asset (the proposed park is shown on Map 13). The North Bay Recreation and Natural Area Concept Master Plan[52] lays out recreation and management options for the site. The plan was developed by the CLC, the local land trust that owns public conservation areas around the county and assists communities with natural resource planning. In addition to the new park, the partners envision a trail network that would link the City's Charles Williams Park north through the land trust's Greenport Conservation Area, to Harrier Hill Park in Stottville. As of this writing, the project is in the design phase, but funding has yet to be secured for construction.

Oliver Bronson House and Grounds
The Oliver Bronson House is a historic home listed as a National Historic Landmark that is located on the Hudson Correctional Facility lands. Historic Hudson, a nonprofit dedicated to preservation, has a lease agreement for the house and one acre. Because the Correctional Facility uses only 40 of the 162 acres of its land, there is a proposal to create a 90-acre park around the historic house, which could be connected to the Hudson street grid by a footpath, possibly incorporating a bridge across the ravine to the south of Union Street. Such a park could be a valuable community asset and tourist attraction.

Empire State Trail
New York State is investing more than $100 million in the Empire State Trail which will go from New York City to Canada and Buffalo. As part of this effort, the Hudson River Valley Greenway is developing the Albany-Hudson Electric Trail, which will follow a historic electric trolley line from the City of Rensselaer to the City of Hudson.The route of this proposed trail through Hudson is indicated on Map 13.

Boston and Albany Rail Trail
At the time of this publication, a proposal was under development to build a trail of approximately 20 miles on an old rail corridor, connecting Hudson's Oakdale Park to the Harlem Valley Rail Trail which runs north and south near the eastern border of Columbia County.

CHALLENGES TO PEDESTRIAN CONNECTIVITY

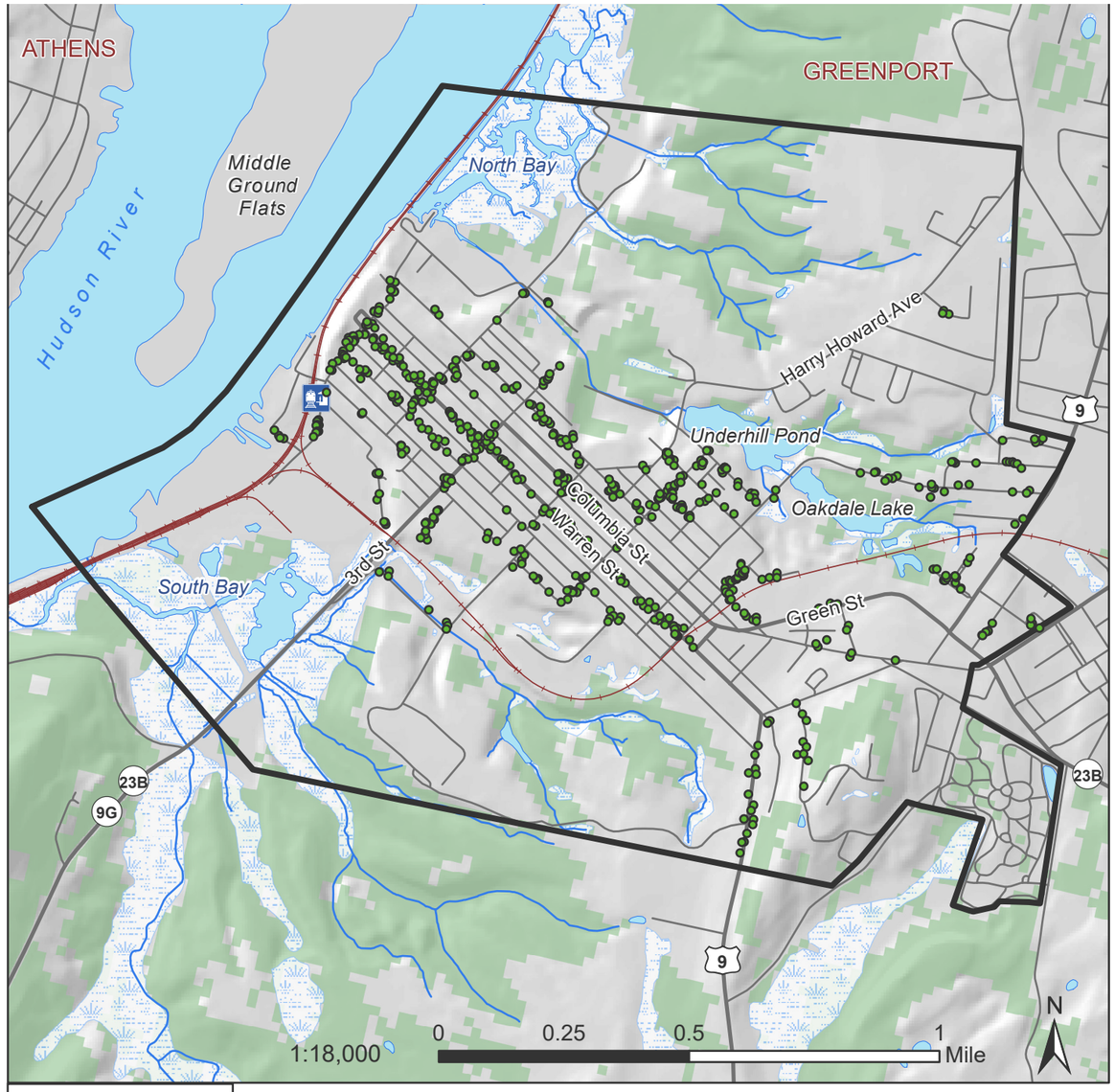
Hudson is generally walkable place and there are sidewalks throughout most of the City, however, there are significant challenges for people who aren't in cars. Steep hills make navigating the City difficult and reduce access to some parks. For example, the main access from Charles Williams Park to nearby residential neighborhoods is a very steep block of North 2nd Street without a sidewalk or steps. Sidewalks are also inconsistently maintained, which creates a safety hazard. This may be due to the City requirement that homeowners maintain their own sidewalks. Other pedestrian challenges include few cross-block connections between the long City blocks in the historic urban grid; lack of sidewalks in the newer residential parts of the City; lack of defined crosswalks; at grade train crossings; and truck routes through the City. There are also no formal or marked bike routes in Hudson.

The principal connection between Charles Williams Park and Hudson's residential neighborhoods is up a steep hill lacking sidewalk or steps. Photo by Jonathan Lerner.

Cyclists enjoying a completed section of the Empire State Trail elsewhere in New York. Photo courtesy of New York Empire State Trail.

If the Oliver Bronson House were to become a park, it could be linked to Hudson's street grid by a footbridge across a ravine; this one used to serve that purpose. Photo courtesay of Hudson Area Library History Room.

MAP 14: CITY OF HUDSON STREET TREES AND FOREST



Data sources:
Municipal Boundary: NYS GIS Program Office, 2017 | Road: NYS GIS Program Office, 2018 | Railroad: NYS Department of Transportation, 2009 | Stream/Waterbody: Hudsonia Ltd, 2018 and National Hydrography Dataset, US Geological Survey and NYSDEC, 2011 | Wetland: Hudsonia Ltd, 2018 and National Wetland Inventory, US Fish and Wildlife Service, 2011 | Street Tree: City of Hudson CAC, 2018 | Forest: C-CAP 2010 Land Cover, NOAA Office for Coastal Management, 2013

Note: This map was produced for the City of Hudson Open Space and Natural Resources Inventory and is intended for general planning and information purposes. It relies upon public data sources that may contain errors or omissions and is not a substitute for site-level surveys. Map by Shannon Doyle, 2018.

STREET TREES

Street trees not only make the City more beautiful, they also make sidewalks more inviting for pedestrians and safer by establishing a sense of separation from auto traffic; absorb stormwater runoff; lower winter heating and summer cooling costs; absorb air pollution; dampen noise; and absorb storm water. As noted above in the introduction, research shows that well-maintained urban greenery has numerous beneficial health and quality-of-life effects.

The Hudson Conservation Advisory Council conducted a partial street tree inventory in 2017; the previous one was done in 2007. Street trees are a resource that changes continually, as new ones are planted and old ones die. Even the 2017 inventory is already out of date; since then, about 80 new trees have been planted and other trees have been removed. The inventory was limited, by definition, to trees planted in the sidewalks or unpaved right-of-way alongside Hudson's streets, and so did not include trees on other City-owned property such as parking lots. Nonetheless, the 2017 inventory provides valuable information about the location and condition of trees in the City. The inventory was conducted by four CAC members and 18 additional volunteers. They uploaded the data collected to iTree, an online database that will allow the CAC to view trends, create maps, and periodically update the records with relative ease.

Map 14 shows the results of the 2017 inventory, with each green dot identifying an individual street tree. We found that there are many parts of the City that have few or no street trees. There are large gaps in in the newer parts of Hudson, on streets east of Harry Howard Avenue and north and east of Oakdale Lake, where there are few or no sidewalks. But even in the dense urban grid, many existing street trees are in poor condition, and many blocks have few street trees or none at all. In some places, unfortunately, sidewalks are too narrow for street trees. In addition, many existing trees need pruning and other maintenance. Some trees are heaving adjacent sidewalks. The inventory revealed that street tree and sidewalk conditions are intimately connected, because both are the legal responsibility of adjacent property owners.

The CAC and the City are working to improve Hudson's street tree canopy. To encourage planting of appropriate street trees, the CAC devised, and the City adopted, an application and permit process for planting street trees, with an accompanying guide to appropriate urban species choices and proper planting and maintenance practices. The CAC is also working with the Galvan Foundation to plant additional street trees.

KEY FINDINGS

- *A Public survey showed people want more maintenance and amenities in Hudson's parks.*
- *A street tree inventory conducted for this report showed that there are many parts of the City with few or no street trees, many street trees in need of maintenance, and the need for a comprehensive, citywide approach to promoting a healthy street tree population.*

SUGGESTED ACTIONS

- *Encourage a comprehensive plan to enhance facilities and programming in parks.*
- *Complete and publish the 2017 tree inventory and apply for funding to create a citywide plan to improve the street tree canopy.*
- *Encourage efforts to resolve the connected problems of responsibility for and condition of sidewalks and street trees.*
- *Develop a pedestrian and bicycle circulation plan for the City.*

Many Hudson blocks have few or no trees, and many Hudson street trees are in poor condition. Photos by Jonathan Lerner.

In some towns, lush street tree plantings create inviting and healthful streetscapes. In Hudson, even on Warren Street, which has the most consistent tree presence, there are still big gaps. Top photo by the Stockbridge Chamber of Commerce; Bottom photo by Teri Tynes.

NEXT STEPS

FROM HERE

This Natural Resources and Open Space Inventory is presented to the City of Hudson and its citizens to encourage holistic, conservation-based planning. Through this project the Conservation Advisory Council gathered a large amount of existing information, and collected new information on public opinion, street trees, habitats, and streams. As our natural and urban environment is constantly changing, however, it is our intention that this inventory be revisited and updated periodically. It should be kept as accurate and useful as possible, so that the community can take sensible action to protect and enhance the benefits of these resources for all the people who live, work or visit in Hudson.

In conducting this inventory, we have identified as priorities the following challenges for the City and the CAC:

- Develop conservation planning guidelines, based on the findings of this inventory, to be adopted as City policy.
- Update and complete the street tree inventory.
- Develop a comprehensive, citywide street tree and sidewalk plan, incorporating green infrastructure to address stormwater issues wherever possible.
- Confront the expectation of higher tides and inundation in the low-lying parts of the City, by proposing robust design requirements for any new construction or adaptive reuse of buildings in the flood plain; and urging realistic decisions about how much, and what, should be invested there.
- Identify poor condition and lack of amenities and programming in City parks.

Initially, the CAC plans to use this inventory to educate the community and inform planning. The information in it can help illuminate both the problems and the opportunities inherent in our natural areas and civic spaces. The inventory can also be used to support grant applications, and to identify information gaps and topics that need further study. The CAC is committed to helping residents, community leaders and City officials use it to the fullest.

Links to background and information sources on the topics discussed in this inventory can be found on the CAC's page at CityofHudson.org.

ACKNOWLEDGEMENTS

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Maps (except where noted) by Shannon Doyle

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Contributions to this project large and small were made by former CAC members Andrea Girolamo•Lauren Lafleur
Dianne O'Neal•Carol Smillie•Nick Zachos
and by these members of the community
Ryan Alcazar•Peter Bujanow•Wren Bytheway
Joe Connelly•John Craig•Keith Crowe
Rodney De Jongh•Merry DePhillips•Carol Friedman
Brent Johnson•Tamarah Jones•Peter Jung
John Kane•George Kroenert•Bradley Kurtz
Ginna Moore•Timothy O'Connor•Carole Osterink
Robert Perry•James Prendergast•Phillip Schwartz
Nicole Smith•Damara Stolfo•Katharine Umsted•Adam Weinert
and the staff of the Columbia Land Conservancy

This inventory project was funded by a grant to the City of Hudson from the New York State Environmental Protection Fund, through the Hudson River Estuary Program of the New York State Department of Environmental Conservation.
Additional funding was provided by a grant from the Hudson River Valley Greenway.
Special thanks to Ingrid Haeckel
and the staff of the Hudson River Estuary Program.

NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation | Hudson River Estuary Program

NEW YORK STATE OF OPPORTUNITY. Hudson River Valley Greenway

strong OUTCOMES

END NOTES

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