

2018

Natural Floodplain Functions Plan



Natural Floodplain Functions Plan

A guide for conserving natural resources within flood zones of Western CT

2018

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WestCOG

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This Plan was developed with financial support from the Nature Conservancy.



Background

A Natural Floodplain Functions Plan is designed to preserve and restore floodplain areas so that they can best provide important functions to humans. This plan includes an inventory of species and habitats (see items 7, 8, and 9 in Appendix), a prioritization of land areas that warrant protection or preservation (see figure 1), and a restoration plan for any species present. The plan provides a list of strategies to restore, preserve, and protect natural resources within the floodplain for each community (see the restoration plan section ahead).

The WestCOG NFP provides an inventory of species in need of protection, the impacts of new development on the habitat, and actions that could be taken to protect the habitat. This plan was designed to address the Natural Floodplain Functions Plan (NFP) action under the Federal Emergency Management Agency (FEMA) Community Rating System (CRS) program. The CRS Program can provide 5% reduction in flood insurance premiums for every 500 credits earned in this program. The NFP can earn up to 100 credits for plans which protect, maintain and provide restoration plans for natural functions and biodiversity within the floodplain (FEMA 2017). The plan must include an inventory of species and habitats, identify areas which warrant protection or preservation, and list strategies to restore, preserve, and protect natural resources within the floodplain. To be considered as a restoration plan, the NFP must list species in need of protection, the impacts of new development on the habitat and actions that could be taken to protect the habitat. These recommendations and restoration goals are listed at the end of the document.

A version of the Marxan¹ Conservation Tool was used to identify which areas warrant the highest priority of protection². The Marxan tool takes a variety of weighted data to create a connected network of parcels of highest priority for preservation, protection, or restoration.

The protection of natural functions of floodplains focuses on the preservation of biodiversity, diverse habitat types and water protection. Floodplains and wetlands are some of the most biologically diverse ecosystems hosting a large variety of flora and fauna and serving as an intersection point for a variety of different habitat types (Anderson 2016). The rich, alluvial soils that develop in the wetland areas promote vegetative growth and provide breeding and feeding grounds along the water's edge for a variety of rare species and waterfowl. Wetlands also have long periods of inundation which house

¹ Marxan is a suite of tools designed to help decision makers find good solutions to conservation planning problems. <http://marxan.org/2-uncategorised.html>.

² In this analysis the Marxan with Zones tool was utilized (Watts 2009).

species unique to these landscapes. Because of this combination of factors, wetland/floodplain ecosystems are vital to the preservation of biodiversity. Wetlands are also integral to the protection of water resources. The ability of floodplain land and wetlands to house long periods of inundation provides natural flood and erosion control for the watercourse. Floodplain lands, especially floodways - the land areas immediately adjacent to a watercourse - are among the most important areas to protect. These areas provide flood water storage and naturally reduce flood velocities and peak flows of rivers and streams. Floodplain soils also help to reduce sedimentation, process organic waste and filter nutrients and impurities from run off.

Data

The Marxan Software is directly influenced by the type and quality of the input, and as such great pains were taken to ensure a robust collection of quality data sets. Parcel, habitat, species diversity, presence of wetland and floodways, critical habitat, and climate resilience data was collected for this analysis. Table 1 includes an inventory of the data, its source and its weighting during the analysis. Each of these data sets is described in more detail below.

Data sources include WestCOG, The Connecticut Department of Energy and Environmental Protection (CT DEEP), The Nature Conservancy (TNC), and the United States Geologic Survey (USGS).

Open Space

Protected areas were identified using the protected area database. The database is an aggregate of data collected by the federal USGS. The data is drawn from DEEP, TNC and the National Conservation Easement Database (2015).

Table 1

Feature	Adjustment	Date	Type	Sources
Biodiversity				
Endangered Species	Weighted Diversity	2013	Raster	USGS GAP
Threatened Species	Weighted Diversity	2013	Raster	
National Diversity Database	Presence of Species	2009	Polygon	CT DEEP
Habitat	Proportion of Habitat	2013	Raster	TNC
Geophysical Characteristics				
Flood Zones	Floodway	2015	Polygon	FEMA
Soils	Alluvial/Poorly Drained	2009	Polygon	CT DEEP
Critical Habitat	Habitat Presence	2009	Polygon	CT DEEP
Climate Resilience	Mean Climate Resilience Score	2013	Raster	TNC

Biodiversity

Biodiversity data includes information on species and within the different regions.

Species Information

Species information focused on “species of concern”, identified using the CT DEEP Endangered Species lists for Fairfield and Litchfield Counties. Distribution data for each of the endangers species within the study area was collected from the USGS GAP analysis website. The GAP analysis data identifies habitat where endangered species are likely to be found, estimating distribution by combining the range of the species with the arrangement of suitable environmental conditions. Factors include hydrological characteristics, land cover, distance from forest edge, distance from open space, elevation and human impact avoidance (USGS GAP 2013).

Habitat Maps

Habitat data was acquired from The Nature Conservancy’s terrestrial habitat database (Ferree 2013).

Assembly of data was done by TNC. The map is based on a conglomeration of data from US State Natural Heritage programs, Atlantic Conservation Data Centre, US Forest Inventory and Analysis, Provincial Forest Inventories (NS, NB, QC, PEI) and Private Forest Inventories (Ferree 2013). There is information on over 140 forest types, wetlands and unique communities. Additionally, the [Terrestrial Habitat Guide](#) is also provided, which outlines potential species and likely plant and animal species within each habitat type.

Geophysical Characteristics

Geophysical characteristics refer to the land and climate. These attributes do not include organic life.

Climate Resilience

A metric representing climate resilience comes from TNC’s Resilient Sites for Terrestrial Conservation project. In the project, geophysical properties, connectivity, and local diversity were used to create a dataset with a single value representing the climate resilience of the landscape (Anderson 2016). In this analysis the assumption is made that parcels with higher scores of climate resilience would face less uncertainty in the face of uncertain future climates and changing ecosystems. The mean resilience score of each parcel is used in the Marxan Analysis to calculate the irreplaceability value for that parcel.

Floodways

Floodways are integral to a regions flood-carrying capacity. A “Regulatory Floodway” represents the channel of the watercourse and all the adjacent land required to discharge the base flood without increasing flood elevation above a certain marker (FEMA 2017). The areas were derived from FEMA

Flood Insurance Rate Maps (FIRM) overlain with WestCOG tax parcels which intersect the flood zones. Because of the importance of these parcels to carrying flood discharge, the parcels were given higher importance in our analysis.

Critical Habitat

Critical Habitat information was taken from the CT DEEP website – Critical Habitat layer (DEEP 2009).

The habitats included in our analysis were

- rich fen
- poor fen
- floodplain forest
- intertidal marsh
- dry circumneutral forest

This was overlaid with parcel information and used to identify which parcels contain some form of critical habitat. As there were only a limited number, all solutions aimed to protect all forms of critical habitat in the solutions.

Methods

The methods for this Natural Floodplain Protection plan is a three-step process.

1. Process input parcel data.
2. Calculate cost values associated with input data
3. Perform Marxan with Zones analysis

The result prioritizes areas which warrant protection or preservation to inform conservation strategies.

The resulting statistic is referred to as an “irreplaceability value.” A value which determines how necessary a given parcel is for ecological connectivity. The larger the value, the more necessary the parcel is for an interconnected preservation of natural resources within the floodplain.

Parcel Data Processing for Marxan Analysis

As a basis for our analysis, only parcels within the FEMA flood zone that fall within the Region were used. There are 26,707 parcels within the Region’s FEMA flood zone, totaling 112,975 acres.

The Marxan Analysis is processing intensive. power to run its multiple iterations data with as many inputs as necessary for this analysis. To reduce the processing load to perform the Marxan Analysis, tax parcels were selectively removed based on a methodology used by the Hudson Valley Conservation group as follows:

- Parcels under five acres were deemed unfeasible for land protection transactions as they generally represent areas which are already heavily fragmented by development (Mudd 2017).
- Parcels which had a perimeter to area ratio of more than two standard deviations above the average were removed. These parcels overly influence the Marxan optimization process and skews results.

After data processing there were 2,973 parcels included in the analysis. Of those parcels, any that overlaid with existing open space were flagged because these parcels would always be included in all the simulations. 368 parcels were flagged as currently protected which reduced the total parcel count in the analysis to 2,605.

Once the protection status was identified, the weighted diversity score, climate resilience score, and presence of endangered species, floodways and wetlands were all spatially joined to the parcels.

ArcMap was used to perform the data processing.

[Calculating Cost Values](#)

The second step of the analysis is determining the “Cost” of conservation for a given parcel. “Cost” in this analysis reflects the difficulty for a given parcel to serve as a useful component within a network of conserved properties dedicated to preserve natural resources within a flood plain. The Cost in this analysis is calculated using parcel area, climate resilience score, and weighted diversity score. These are detailed below:

- **Area:** The area of the parcel. Larger areas reflect a lower cost. This is due to larger protected properties have an increasing benefit to natural functions.
- **Climate Resilience Score:** Higher values reflect a lower cost.
- **Weighted Diversity:** Weighted diversity values were calculated for each parcel for both endangered and threatened species. The lower the diversity the higher the cost. These values were calculated by reviewing the number of overlaying species and the size of their habitat within the parcel. See equation below where:

a = the area of a specific habitat.

A = the total area of the parcel

x = represents the number of threatened or endangered species potentially present in a given habitat. Ranges from 0 to 8.

$$\text{weighted value} = \sum_{i=0}^8 \left(\frac{ai}{A} \right) xi$$

The Marxan Analysis

The prioritization process was performed using “Marxan with Zones” software. Marxan with Zones establishes a best fit network of protected land by running multiple iterations of analysis under various situations. The output being a network of parcels with the highest level of connectivity. Additionally, each parcel is scored for its frequency in being selected during each of the iterations. For example, over a 100 iterations a given parcel may have been selected for conservation either 0 or 100 times.

After one hundred runs, the number of times each parcel was selected as part of the network to be preserved can be counted. This count of instances per parcel serves as a proxy to indicate the importance of the parcel as part of the network needed to protect the natural functions of the floodplain. This statistic is known as the irreplaceability value (Mudd 2017). Parcels selected between 90% - 100% of the time are the most irreplaceable to the maintenance of the floodplain functions and are deemed the most important to protect.

The Marxan with Zones Analysis includes rules on how to select parcels during the multiple iterations involved with the analysis. The rules involved in the Marxan analysis were as follows:

- In all endangered and threatened species habitat the target was to maintain at least 50% of the parcels which have valid habitat for each species of concern.
- Higher weights were given for wetlands and critical habitat, aimed to maintain over 60% and 80% of the floodways.

Results

The results of the Marxan with Zones analysis are depicted in units of irreplaceability and depicted in Figure 1. In the map protected land is marked in green and the 1st and 2nd standard deviations of irreplaceability are presented in a yellow to red color ramp. The values range from 0 to 100 and are equal to the % of instances the parcel was selected for the network. Red represents values of the most irreplaceability, those which occurred in nearly all simulations. The following statistics were drawn from the analysis.

- 2,973 parcels in the analysis (84,080 acres)
- 368 parcels are protected (17,953 acres, 21% of study area)

- Weighted Irreplaceability Stats: 62.2 mean, 21.6 std, 37 min, 100 max
- 14,337 acres (17.1%) of the area has an irreplaceability value greater than 84 or 1 std.
- 51,469 acres (61.2 %) of the area have an irreplaceability between 40 and 84.

The parcels with values above the 84% irreplaceability often fell within the floodway and generally had high biodiversity and diverse habitat. The resulting map is a conservation scenario where areas would 50% of the habitat required for each species of concern is protected. This conservation scenario can help inform flood zone protection policies, POCD development, stormwater management plans, and conservation strategies.

Irreplaceability of Flood Zone Parcels

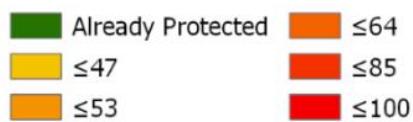
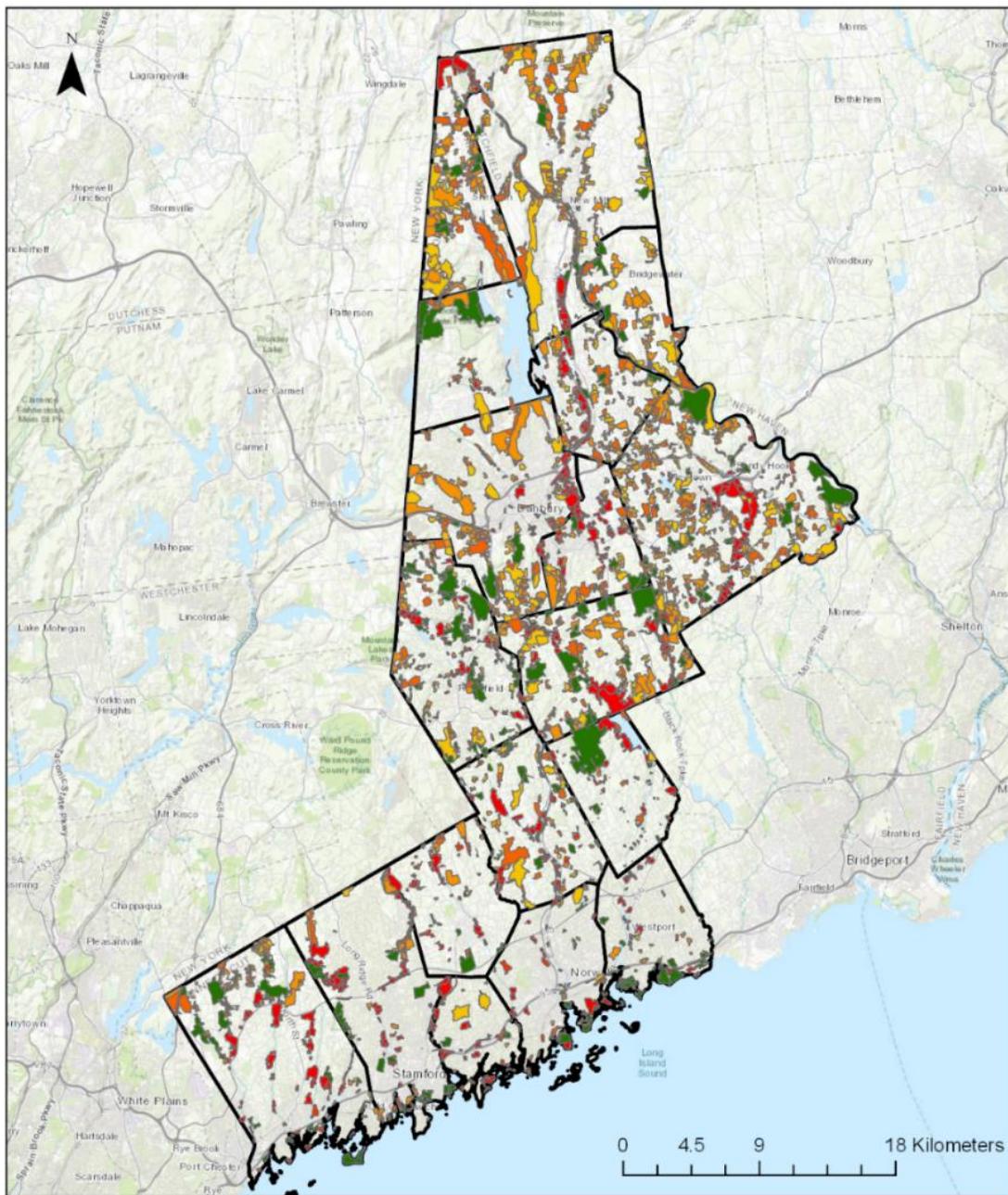


Figure 1: The irreplaceability map shows the tax parcels used in our analysis of highest importance conservation properties. These are tax parcels above 5 acres and the colors represent how often they were selected in our analysis, using this as a proxy for the importance of the parcel to a connected network of protected land.

Restoration Plan

Recommendations at the regional, municipal, and species level are provided as part of a Restoration Plan to serve as a guide to protect the natural resources within flood zones within the Region. Regional recommendations were derived from reviewing existing POCDs among communities and creating language reflecting regional patterns for protection and restoration of flood plain natural resources. Municipal recommendations are pulled directly from community POCDs and reflect existing community activities. The species recommendations provided in table 2 highlight the inventory of species in need of protection, the impacts of new development on the habitat, and actions that could be taken to protect the habitat. Overall these recommendations aim to restore, preserve, and protect natural resources within the floodplain for each community and across the Region.

The protection of natural resources is required in Connecticut, where a state regulation requires any developments which are planned within the range of species found within the Natural Diversity Data Base (NDDB) to submit a request for development along with a natural resources inventory. This is detailed in section 26-310 (a) of the Connecticut General Statutes states:

each state agency, in consultation with the DEEP commissioner, shall conserve endangered and threatened species and their essential habitats, and shall ensure that any activity authorized, funded or performed by such agency does not threaten the continued existence of any endangered or threatened species or result in the destruction or adverse modification of habitat designated as essential to such species.

The NDDB database also provides spatial information on where threatened or endangered species but does not publicly share this sensitive information and for this reason species location information is not included in this NFP. As an alternative, this NFP utilized an inventory of species distribution data, which depicts where species could exist.

Regional Recommendations

The plan provides a list of strategies to restore, preserve, and protect natural resources within the floodplain for each community.

1. Protect priority property

Recommendation: Focus on purchasing properties or conservation easements based on irreplaceability values within the flood zone.

Responsible Entity: Planning and Zoning, Local Land Trusts, Hudson to Housatonic

Potential Funding: CTDEEP, US Endowment Healthy Watersheds Consortium Grant Program, CT DEEP OSWA program, FEMA Hazard Mitigation Funds

Time line: Strategizing land conservation efforts focused high priority properties can occur immediately following the adoption of the plan by the community. The acquisition of property and establishment of easements will occur on a rolling basis as funding becomes available.

2. Inventory Natural Resources

Recommendation: Coordinate and update the comprehensive inventory and assessment of natural resources and publish this document for public and private agencies to utilize when making land-use decisions.

Responsible Entity: CT DEEP, Land trusts, WestCOG, Town Department

Potential Funding: OPM RPIP, more funding sources to be researched.

Time line: CT DEEP updates their inventory of threatened species every 5 years, and this inventory is scheduled to update in line with that process every 5 years as well. The updated, analysis would be attached as part of the appendix. The new analysis will utilize the most available data and software.

3. Manage runoff

Recommendation: To reduce and manage runoff, establish regulations to limit impervious lot coverage and reduce site hydrology for all new construction on residential properties

Responsible Entity: Building department, Planning and Zoning

Potential Funding: CTDEEP (researching additional funding sources)

Time line: Strategizing

Municipal Recommendations

An inventory of policies and actions is provided for WestCOG communities active in the CRS program. These actions and policies were pulled from each communities POCD. Upon adoption of this plan, these recommendations would be updated to include requirements needed for CRS credit (identifying responsible parties, potential funding sources, and expected time of completion.)

Darien

Goal: Protect Other Important Natural Resources.

Policies

1. Continue to protect and enhance wetlands and watercourses. *IWC Leader, PZC Partner*

2. Establish and maintain vegetated buffers adjacent to wet- lands and watercourses. *IWC Leader, PZC Partner*
3. Continue to protect other important natural resources such as steep slopes, sensitive habitats and other natural diversity areas. *IWC Leader, PZC Partner*
4. Discourage the introduction of invasive species and seek to remove invasive species. *CC Leader, PZC Partner*

Actions

1. Ensure that local application procedures require investigation of Natural Diversity Database (NDDB) sites. *PZC Leader, Partner IWC*

Greenwich

Actions

- 1.34 Coordinate and update the comprehensive inventory and assessment of natural resources and publish this document for public and private agencies to utilize when making land-use decisions.
- 1.35 Encourage the use of native plant species in compliance with State law.
- 1.36 Provide for continued habitat and wildlife management on Town-owned properties.

New Milford

Overall Goals for natural Resource Protection

1. Encourage future development to locate away from sensitive natural resources.
2. When development does occur in conservation areas, minimize potential Impacts.
3. When reviewing proposed developments, refer to natural resource inventories to help determine areas that should be protected.

Preserve open space and greenways:

1. Continue efforts to create an accurate database (le, GIS inventory) of permanently protected open space and make the inventory available to boards, commissions, town departments and non-profit entities that work to preserve open space.
2. Continue efforts to acquire Open Space and create Greenways.
 - a. Create a current open space plan that outlines a vision for an Open Space System and includes criteria to help prioritize future open space acquisition
 - b. Move forward with planned trails and greenways and identify additional opportunities.
 - c. Continue efforts including seeking funding sources, encouraging private donations, working with developers to set aside open space, etc.
 - d. Establish administrative procedures to track when fee-in-leu of payments are due.
 - e. Continue and expand partnerships between the Town, conservation organizations, the State, Federal funders and private landowners
3. For existing protected Open Space:
 - a. Manage and maintain existing public open space areas

- b. Seek additional public access where feasible on public open space
- c. For privately owned open space, encourage the provision of public access in cases where the donor intended such access

Protect water quality and address drainage:

1. Explore the need for and feasibility of a septic management ordinance.
2. Reduce storm water flows:
 - a. Adopt a town drainage policy and standards to ensure consistency.
 - b. Consider adopting Low Impact Development (LID) standards into zoning and subdivision regulations.
 - c. Encourage town practices to employ measures to reduce storm water flow (LID).
 - d. Educate residents and property owners on ways that they can reduce storm water runoff and possibly adopt regulatory incentives over the longer term.
 - e. Continue to require storm water review in the Candlewood Lake District.
 - f. Collaboratively determine which types of construction projects might have potential to create significant off-site drainage impacts and require drainage review to reduce impacts to neighboring properties.
 - g. Continue to require erosion and sediment control review and consider reducing the threshold for triggering review.
 - h. During site plan review, continue to encourage that minimal land is cleared during construction.
3. Continue to enforce existing water quality protection measures.

Newtown

Issue #2: Increase public awareness of the need for open space to preserve the character of Newtown and to meet the state guidelines.

Goal: Actively pursue ways to increase open space to preserve the character of Newtown and to meet the State goal of 21%.

Strategies from the Conservation Commission: Newtown Plan of Conservation and Development 2014

1. Develop comprehensive guidelines to identify specific natural resource areas, features and trails for protection as open space.
2. Create and implement a Master Plan for Open Space acquisition.
3. Legislative Council: Allocate capital funds for acquisition of open space parcels or conservation easements based on the Master Plan for Open Space Acquisition.
4. Support legislation that would increase State funds available for open space acquisition and improvements to existing open space.

Norwalk

C2.1 Preserve open space for natural resource management and to preserve neighborhood character

C2.1.1 Evaluate and protect coastal and other fragile natural resources

C2.1.3 Encourage the preservation of undeveloped lands within the 100-year flood zone with the use of Open Space purchase, donation or conservation easement.

C2.1.5 Encourage the preservation of already-protected open space, and encourage the protection of existing “transitory” open space (land that functions as open space but is not formally protected from development) within the environmentally sensitive areas

C2.1.8 Encourage private landowners to establish conservation easements for protecting wetlands and open space (e.g., Dolce Norwalk Center)

Stamford

7L.2 Land protection methods. Assemble tools available to communities to protect and acquire open space. They include acquisition, conservation easements, land use regulation and tax incentives.

7L.2-a: Acquisition. Outright fee-simple acquisition is the surest method to protect an open space property. Fee-simple ownership gives the purchaser rights to the land and full legal title.

7L.2-b: Conservation Easements and Purchase of Development Rights. With a conservation easement, the purchaser acquires a less-than-fee interest in the land but not necessarily the land itself. The easement or right purchased is recorded on the deed and runs with the land in perpetuity

7L.2-c: Land Use Regulation. Stamford permits open space subdivisions in its zoning regulations. Under this approach, the subdivider dedicates a portion of the property as open space in perpetuity. The intent of these regulations is to preserve any unique natural characteristics on a site while also allowing for development. The Planning Board may require such a dedication or a developer may be able to obtain a density bonus or reduced setback requirements for a dedication

Policy 7M: Protect Watersheds. Protect land areas that may be of critical interest for Stamford’s watersheds. The City has three primary watershed areas to be monitored. Activity on land in these areas affects the water table level, and water quality for all of Stamford.

7O.4: Establish partnerships to monitor natural areas. These may be done in partnership with area nonprofit organizations. Typical management concerns may address erosion on steep slopes and

heavy foot or bicycle traffic areas. Management practices may also encourage use of native species for plantings and removal of invasive species, and may include restriction of uses in floodplain areas

Westport

Priority 1

1. Acquire additional open space and improve existing open space parcels.
Responsible Party LAC, PRC, BOS, RTM.
2. Continue to require open space provision as part of every residential subdivision development (land set-aside or fee-in-lieu of land).
Responsible Party PZC
3. Make all passive and active recreation areas welcoming and available with adequate signage, parking areas, vegetation and appropriate facilities for their designated uses.
Responsible Party PRC
4. Provide adequate funds to take care of and enhance town parks and open space.
Responsible Party PRC, BOS, BOF

Priority 2

1. Include land trusts and other similar non-profit agencies in discussion of required subdivision open space.
Responsible Party PZC
2. Update local land use regulations to enhance open space preservation requirements (require provision by multi-family developments, allow off-site dedication, lot area flexibility, etc.).
Responsible Party PZC
3. Zone additional parcels of land as park zones, some for passive use and others for active use.
Responsible Party PRC, PZC

Species and Habitat Recommendations:

An inventory of habitats recommended for species preservation for all species identified in existing recommendations for all animal species noted in available data

- Included in the table 2, there is a list of recommendations for individual species based on the species distribution data from the GAP analysis (GAP 2013). Our analysis aims to preserve at least half of the habitat which can support each species.
- Outlined in the table 2 are the primary habitats to conserve for each species and which human activities are most threatening.

Primary threats are wetland protection and conservation, human activity is the primary threat to threatened and endangered reptiles and climate change, specifically sea level rise, which is a major

threat to the birds who nest on the boundaries of rivers and streams. These align with our recommendations of protecting priority properties which heavily weight these factors in the analysis.

Table 2: Human Activity Risks and Habitat Conservation Recommendation Tables for Threatened and Endangered Species within the WestCOG Region

The following tables depict endangered and threatened species within the floodplains of the WestCOG planning region. Human Activities that impact the species and necessary habitats for species survival are noted for each of these species. Recommendations for species survival include limiting the listed human activities and protecting or restoring the habitats for a given species. Each of the human activities and habitats are noted with letter codes provided below.

Table Notes

HA = Human activity, including poaching, hunting and harvest for trade

UD = Habitat loss through urban development

D = Disturbances, Birds often abandon nests when loud disturbances such as construction occur near nests

CC = Climate change including, but not limited to, sea level rise and flooding

W = Primary conservation would be the protection of wetlands

MF = Mature forest habitat

F = Farmland habitat

OG = open grassland or early successional habitat

**Amphibian categories are different.*

HF = Habitat fragmentation and loss of landscape connectivity

ABP = Aquatic breeding pools and vernal pools are most important for endangered species

Endangered Bird Species

Species	Scientific Name	Human Activity				Habitat Conservation			
		HA	UD	D	CC	W	MF	F	OG
American Bittern	<i>Botaurus lentiginosus</i>					X			
Barn Owl	<i>Tyto alba</i>							X	
Common Moorhen	<i>Gallinula chloropus</i>					X			
Grasshopper Sparrow	<i>Ammodramus savannarum</i>							X	
King Rail	<i>Rallus elegans</i>			X		X			
Long-eared Owl	<i>Asio otus</i>							X	
Northern Harrier	<i>Circus cyaneus*</i>					X			
Red-headed Woodpecker*	<i>Melanerpes erythrocephalus</i>								
Pied-billed Grebe	<i>Podilymbus podiceps</i>					X			
Roseate Tern	<i>Sterna dougallii</i>			X					
Saltmarsh Sharp-tailed Sparrow	<i>Ammodramus caudacutus</i>	X		X	X				
Sharp-Shinned Hawk	<i>Accipiter striatus</i>	X					X		
Sedge Wren	<i>Cistothorus platensis</i>			X		X			
Upland Sandpiper	<i>Bartramia longicauda</i>							X	
Vesper Sparrow	<i>Pooecetes gramineus</i>							X	
Yellow Breasted Chat	<i>Icteria virens</i>						X	X	

Threatened Bird Species

Species	Scientific Name	Human Activity				Habitat Conservation			
		HA	UD	D	CC	W	MF	F	OG
American Oystercatcher	<i>Haematopus palliatus</i>				X				
American Kestrel*	<i>Falco sparverius</i>							X	
Bald Eagle	<i>Haliaeetus leucocephalus</i>			X					
Great Egret	<i>Ardea alba</i>					X			
Least Bittern	<i>Ixobrychus exilis</i>								
Least Tern	<i>Sternula antillarum</i>								
Northern Goshawk*	<i>Accipiter gentilis</i>							X	
Peregrine Falcon*	<i>Falco peregrinus</i>			X					
Piping Plover	<i>Charadrius melanotos</i>	X		X					
Seaside Sparrow*	<i>Ammodramus maritimus</i>					X			
Short-Eared Owl	<i>Asio flammeus</i>								X
Snowy Egret	<i>Egretta thula</i>					X			

Endangered Reptile Species		Human Activity				Habitat Conservation			
Species	Scientific Name	HA	UD	D	CC	W	MF	F	OG
Timber Rattlesnake	<i>Crotalus horridus</i>	X							
Kemp's Ridley Sea Turtle	<i>Lepidochelys kempii</i>	X							
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	X	X						
Bog Turtle	<i>Glyptemys muhlenbergii</i>		X	X		X			

Threatened Reptile Species		Human Activity				Habitat Conservation			
Species	Scientific Name	HA	UD	D	CC	W	MF	F	OG
Five-lined Skink	<i>Plestiodon fasciatus</i>	X							
Green Sea Turtle	<i>Chelonia mydas</i>	X			X	X			
Loggerhead Sea Turtle	<i>Caretta caretta</i>	X							

Endangered Amphibian Species*		Human Activity				Habitat Conservation			
Species	Scientific Name	HA	UD	HF	CC	W	MF	ABP	OG
Blue-Spotted Salamander	<i>Ambystoma laterale</i>	X	X	X				X	

Threatened Amphibian Species*		Human Activity				Habitat Conservation			
Species	Scientific Name	HA	UD	HF	CC	W	MF	ABP	OG
Northern Slimy Salamander	<i>Plethodon glutinosus</i>	X					X	X	
Northern Spring Salamander	<i>Gyrinophilus porphyriticus</i>	X			X	X		X	

References

- Anderson, M.G., Barnett, A., Clark, M., Prince, J., Olivero Sheldon, A. and Vickery B. 2016. Resilient and Connected Landscapes for Terrestrial Conservation. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA.
- FEMA. 2017. National Flood Insurance Program Community Rating System Coordinator's Manual.
- Ferree, C and M. G. Anderson. 2013. A Map of Terrestrial Habitats of the Northeastern United States: Methods and Approach. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA.
- Mudd, J.P, Spector, S., & Tabak, N.M. (2017) The Hudson Valley Conservation Strategy: Conservation in a Changing Climate. Poughkeepsie, NY: Scenic Hudson, Inc.
- Smardon, R., Fellemen, J. 1996. Protecting Floodplain Resources.
<https://www.fema.gov/media-library-data/20130726-1440-20490-5918/fema268.pdf>
- State of Connecticut, Department of Environmental Protection. 2009. Connecticut Critical Habitats.
- State of Connecticut, Department of Environmental Protection. 2009. Connecticut National Diversity Database.
- U.S. Geological Survey Gap Analysis Program. 2013. U.S. Geological Survey Gap Analysis Program Species Distribution. <http://gapanalysis.usgs.gov/species/data/download/>
- Watts, M.E, I.R. Ball, R.R. Stewart, C.J. Klein, K. Wilson, C. Steinback, R. Lourival, L. Kircher, and H.P. Possingham. 2009. Marxan with Zones: software for optimal conservation based land- and sea-use zoning, Environmental Modelling & Software (2009), doi:10.1016/j.envsoft.2009.06.005