APPENDIX 2a: CONNECTICUT'S HABITATS AND CORRESPONDING VEGETATIVE COMMUNITIES

This appendix comprises the best available information and expert opinion on the location and relative ecological condition of each of the ten key habitat types and associated vegetation communities or sub-habitats, as well as the status of inventory and mapping data for each. Representative sites and some priority areas within the habitats also have been identified. Primary sources of information used in developing this list of habitats were Metzler and Barrett (2006) and Metzler and Wagner (1998).

Upland Forest: Oak Forests

Definition: Forests dominated (greater than 50 percent total stocking) by oaks (*Quercus spp.*) with various mixtures of other hardwoods or pine. Species of oak present depend on soils that range from excessively well drained to somewhat poorly drained.

Condition: Dry Oak Forests are found on sand, gravel, or shallow soil over bedrock and are dominated by oaks, such as scarlet and chestnut oak, with mixtures of pine and understory shrubs, such as huckleberry or lowbush blueberry. The condition of oak forests varies.

Extent/Location: Dry Oak Forests are scattered throughout Connecticut in low-lying valleys with sands and gravels and on bedrock summits with shallow soils. Most are remnants or in poor condition. Information is needed on size and juxtapositions of these Dry Oak Forests. Canaan Mountain Natural Area Preserve (Canaan), Pachaug (Voluntown, Griswold, Plainfield) and Meshomasic State Forests (Hebron, Glastonbury, Portland, East Hampton), and Hurd State Park (East Hampton). Historical occurrences in Glastonbury and Windsor have been diminished by development. Information is needed on size and juxtapositions of these Dry Oak Forests.

Mapping/Notes/References: State Lands Management GIS Database. Northeastern Terrestrial Habitat Classification System (*NETHCS*).

Representative Sites: A few examples in good condition can be seen at the Canaan Mountain Natural Area Preserve (Canaan) and Pachaug State Forest (Voluntown, Griswold, Plainfield) and Meshomasic State Forests (Hebron, Glastonbury, Portland, East Hampton).

Relative Condition Rating: Fair to good. Condition of forests varies widely across the state depending upon location, forest /community type, localized threats and scale.

Upland Forest: Calcareous Forests

Definition: Forests found on pH-neutral soils often associated with limestone bedrock. They are characterized by sugar maple, red oak, and red cedar, with white ash and tulip poplar being found at the base of slopes.

Condition: The condition of Calcareous Forests is generally fair. Most areas that have reverted after agricultural abandonment, or have been subject to excessive deer browse, are in poor to fair condition because they are dominated by invasive species.

Extent/Location: Restricted to western Connecticut in areas of pH-neutral soils

Mapping/Notes/References: Not well captured, but could be easily identified using soils overlay with USFS maple-beech-birch.

Representative Sites: Examples of Calcareous Forests in good condition can be found in Mt. Riga State Park (Salisbury), Robbins Swamp Wildlife Management Area (WMA) (Canaan), Upper Paugussett State Forest (Newtown), and at the Bulls Bridge area in Kent to Redding.

Priority Areas: Western marble valleys

Relative Condition Rating: Fair. Condition of forests varies widely across the state depending upon location, forest /community type, localized threats and scale.

Upland Forest: Coniferous Forests

Definition: Forests dominated (greater than 50 percent total stocking) by White pine (*Pinus strobus*) or Eastern hemlock (*Tsuga canadensis*). Plantations of older Red pine (*Pinus resinosa*), spruce (*Picea spp.*), and other conifers are included due to the similar structure and habitat they provide.

Condition: Overall condition for these habitats statewide is fair. Eastern hemlock is most prevalent, but has recently declined, especially in the southern portion of the state due to infestation by the hemlock wooly adelgid. White pine occurs with its greatest abundance in the northern and eastern portions of the state. Most state forests have examples of eastern hemlock forests in various stages of hemlock woolly adelgid infestation and hemlock scale infestation.

Extent/Location: Coniferous Forests are found throughout the state on a variety of soil types, either as pure or mixed stands. White pine occurs with its greatest abundance in the northern and eastern portions of the state. Coniferous plantations are scattered throughout the state; many are dying or being harvested.

Mapping/Notes/References: UConn Clear Landcover data, State Lands Management GIS Database.

Representative Sites: Examples of white pine forests in good to excellent condition can be found in Peoples State Forest (Barkhamsted), Nipmuck State Forest (Union, Stafford, Ashford, Willington, and Woodstock).Relatively healthy Coniferous Forests are found at Tunxis (Hartland. Barkhamsted. Granby), Housatonic State Forests (Sharon, Canaan, Cornwall, North Canaan), Nepaug State Forest (New Hartford), and other public lands in northwestern Connecticut. The decline of hemlocks caused by woolly adelgid infestation and hemlock scale is evident in other coniferous forests.

Priority Areas: Throughout, but especially in the northern and eastern part of the state.

Relative Condition Rating: Fair. Condition of forests varies widely across the state depending upon location, forest /community type, localized threats and scale.

Upland Forest: Old Growth Forests

Definition: Late successional forests that are not manipulated from their natural state of growth; this type includes both coniferous and deciduous forests. Late successional forests are often characterized by large mature trees.

Condition: Old Growth Forests include both coniferous and deciduous forests that have not been disturbed by manipulation. A few examples of Old Growth Forests remain and they are small in areal extent. The condition of these forests is poor.

Extent/Location: Some small remnants can be found in Connecticut, mostly in the northwest.

Mapping/Notes/References: Critical Habitats layer available at http://www.cteco.uconn.edu/guides/Critical_Habitat.htm, State Lands Management GIS Database

Representative Sites: The Nature Conservancy (TNC) property in Cornwall, Catlin Woods at the White Memorial Foundation (Litchfield), Tobey Bog (Norfolk), Sages Ravine (Salisbury) on the Housatonic River, Gold's Pines Natural Area Preserve (Cornwall), and Ballyhack Preserve (Cornwall).

Priority Areas: Mostly those in northwest Connecticut except one along the coast.

Relative Condition Rating: Poor. There are few examples, and they are small.

Upland Forest: Northern Hardwood Forests

Definition: Forests dominated (greater than 50 percent total stocking) by northern hardwoods such as Sugar maple (*Acer saccharum*), Yellow birch (*Betula alleghaniensis*), and American beech (*Fagus grandifolia*), occasionally mixed or co-dominated by Eastern hemlock (*Tsuga canadensis*).

Condition: Beech-dominated areas are in poor condition with no understory or herbaceous layer other that beech. Sugar maple dominated areas are in good to fair condition because of the decline of white ash.

Extent/Location: Throughout the state, primarily in the northeast and northwest. Absent from the Connecticut River Valley. Presence of northern hardwood forests is dependent upon soils and aspect. Rich soils support barberry, poor soils have no understory. Soil moisture and past land use dictate their location.

Mapping/Notes/References: State Lands Management GIS Database. Connecticut Highlands Project in the northwest corner: (note the Conservation Focal Areas map) http://na.fs.fed.us/highlands/media-kit/

Representative Sites: Great Mountain Forest (Norfolk), Tunxis State Forest (Hartland, Barkhamsted, Granby), Peoples State Forest (Barkhamsted), Algonquin State Forest (Colebrook, Winchester), and all of the Metropolitan District Commission land (Barkhamsted, Hartland, Colebrook) into Massachusetts.

Relative Condition Rating: Fair. Condition of forests varies widely across the state depending upon location, forest /community type, localized threats, and scale.

Upland Forest: Mixed Hardwood Forests

Definition: Mixed Hardwood Forests are 60 percent or more hardwoods that are not dominated by oak or northern hardwoods. Species include ash, maple, basswood, tulip, and/or white, red, black, scarlet, and chestnut oaks, hickory, and a small percentage of birch, beech, and maple. Understory contains witch hazel and viburnums.

Condition: Fair

Extent/Location: Interspersed throughout the state.

Mapping/Notes/References: State Lands Management GIS Database (cover type #520 - mixed upland hardwoods)

Representative Sites: Interspersed within Peoples State Forest (Barkhamsted), Tunxis State Forest (Hartland, Barkhamsted, Granby), Cockaponset State Forest (Haddam, Chester, Deep River, Killingworth, Durham, Guilford, Madison, Clinton, Westbrook, Middletown, Middlefield), and some Wildlife Management Areas.

Relative Condition Rating: Fair

Upland Forest: Young Forests

Definition: Young Forests are characterized by seedling sapling trees smaller than 4.9 inches diameter at breast height (DBH), usually composed of late seral state species (oak, hickory, maple, beech, ash), but may include "pioneer" type species including cherry, aspen, and birch. Young Forests may be either coniferous, deciduous, or both, having trees less 0-20 years in age. Usually characterized by high stem density and often interspersed with patches of herbaceous plants and briars growing up shortly after disturbance.

Condition: Young forests are a successional stage that is typically on the landscape for about 20 years post-disturbance. The structure is good for wildlife, but the composition of species is not ideal from a forestry management perspective. Young forests are scarce in the Connecticut landscape, making up only approximately 5 percent of the land cover. They are created and maintained through active management. Most of the natural processes (e.g., fire) that once created this age class have been controlled. Silvicultural operations such as regeneration/clear cuts that create this type of habitat are conducted on a limited basis on state lands. Fewer regeneration cuts are carried out on private land, with more timber stand improvements or high grading taking place, which does not usually produce young forest habitat conditions.

Extent/Location: The extent of young forests is limited in Connecticut except where active forestry is occurring and/or another type of land disturbance has occurred and the land is left to grow back (e.g., former gravel pits). Numerous sites have been created across the state on Wildlife Management Areas and in some State Forests to provide habitat for the New England cottontail and many other species of greatest conservation need.

Mapping/Notes/References: State Lands Management GIS Database captures young forests by size or age class, not by cover type. "Estimation of Early Successional Habitat in Connecticut" (Chad Rittenhouse, 2014)

Representative Sites: Robbins Swamp (Canaan), Housatonic River WMA (Cornwall, Kent), Goshen WMA (Goshen), Simsbury WMA (Simsbury), Bartlett Brook WMA (Lebanon), Bear Hill WMA (Bozrah), Camp Columbia State Park/State Forest (Morris), Pachaug State Forest (Voluntown, Griswold, Plainfield), Roraback WMA (Harwinton), Sessions Woods WMA (Burlington), and others.

Relative Condition Rating: Poor to limited

Upland Forest: Maritime Forests

Definition: Dry to moist coastal forests mostly showing the effects of salt spray with low-statured, gnarled trees and numerous lianas (climbing vines). Characteristic canopy trees include black oak (*Quercus velutina*), serviceberry (*Amelanchier canadensis*), sassafras (*Sassafras albidum*), scarlet oak (*Quercus coccinea*), white oak (*Quercus alba*), and blackgum (*Nyssa sylvatica*). Maritime forests often occur as a strand community, occupying a narrow band between other maritime and upland communities. These forests can also grade into maritime shrublands.

Condition: The remaining areas of maritime forest are generally in poor condition. These areas are limited in distribution and have been impacted by invasive species and recreational overuse.

Extent/Location: Associated with Long Island Sound and the mouths of major rivers entering the Sound.

Mapping/Notes/References: Critical Habitat Layer (maritime shrublands and maritime forest currently lumped) Northeastern Terrestrial Habitat Classification System (NETHCS) Northern Atlantic Coastal Maritime Forest CES203.302
http://www.cteco.uconn.edu/guides/Critical_Habitat.htm

Representative Sites: Barn Island WMA (Stonington)

Relative Condition Rating: Poor

Upland Woodland and Shrub: Red Cedar Glades

Definition: Red Cedar Glades are found on exposed summits, ledges, and outcrops and include red cedar (*Juniperus virginiana*), low shrubs, and medium-tall grasses/herbs, such as little bluestem (*Schizachyrium scoparium*). In the western Marble Valleys, red cedar is mixed with hop hornbeam (*Ostrya virginiana*) and hickories (*Carya spp.*), with a diverse herbaceous understory that is a unique mixture of plants characteristic of dry sites and those limited to calcareous soils.

Condition: Red Cedar Glades are found on exposed summits, ledges, and outcrops and include red cedar, low shrubs, and medium-tall grasses/herbs, such as little bluestem. In the western Marble Valleys, red cedar is mixed with hop hornbeam and hickories, with a diverse

herbaceous understory that is a unique mixture of plants characteristic of dry sites and those limited to calcareous soils. The upland calcareous Red Cedar Glades have been heavily impacted by limestone quarry activities. Calcareous uplands are included as one of the thirteen most imperiled ecosystems in Connecticut (Metzler and Wagner 1998). There are few areas remaining that have representative native vegetation. Red cedar glades are being crowded by hardwoods overtopping them. Red cedar is diminishing and is not being sustained because of increases in juniper, hardwoods and ash.

Extent/Location: Occurrences include areas in the towns of Salisbury, Canaan, Sharon, Kent, Southington and Meriden. Other Red Cedar Glades on basalt (trap rock) outcrops are in relatively good condition, such as those found at West Rock Ridge State Park (Hamden), Sleeping Giant State Park (Hamden), and Penwood State Park (Bloomfield).

Mapping/Notes/References: Crosswalked with NETHCS Central Appalachian Alkaline Glade and Woodland (202.602), and sometimes associated with Circumneutral Rocky Summit Outcrop in Critical Habitat

Representative Sites: West Rock Ridge (Hamden).

Relative Condition Rating: Poor to imperiled (Metzler & Wagner, 1998)

Upland Woodland and Shrub: Pitch Pine - Scrub Oak Woodlands

Definition: Dry woodlands found on sand and gravel or bedrock, typically including pitch pine, bear oak, and lowbush blueberry.

Condition: An estimated 95 percent of Pitch Pine/Scrub Oak Woodlands have been degraded and consequently, are the most impacted terrestrial habitat in Connecticut (Metzler and Wagner 1998). Small remnants are in poor condition due to lack of fire.

Extent/Location: Woodlands found primarily in eastern and central Connecticut on sandy soils or acidic, dry rocky summits.

Representative Sites: Examples include Hopeville Pond Natural Area Preserve (Griswold), Pachaug State Forest (Voluntown, Griswold, Plainfield), and Meshomasic State Forest (Glastonbury, Hebron, Portland, East Hampton). Other examples can be found at Lantern Hill (Ledyard- Mashantucket Pequot Tribal lands) and Wharton Brook State Park (Wallingford) as well as areas in Groton. Historically, they were found at the North Haven-Wallingford sandplains, Mansfield Hollow State Park (Mansfield), and Windsor Locks sandplains.

Relative Condition Rating: Poor

Upland Woodland and Shrub: Maritime Shrublands

Definition: Shrubland community occurring on seaside bluffs and open headlands exposed to winds and salt spray. Characteristic species include bayberry (*Morella pensylvanica*), Shining sumac (*Rhus copallinum*), black huckleberry (*Gaylussacia baccata*), and beach plum (*Prunus maritima*). These shrublands may also include dense growth of catbrier (*Smilax rotundifolia*) or areas of dwarf shrubs (heathland) Maritime shrublands may grade into other communities, including ‘maritime forest’ and ‘coastal beaches and dunes.’

Condition: The remaining areas of maritime shrubland are generally in poor condition. These areas are limited in distribution and have been impacted by invasive species and recreational overuse.

Extent/Location: Maritime Shrublands are associated with Long Island Sound and the entrance of major rivers into the Sound.

Mapping/Notes/References: Critical Habitats layer http://www.cteco.uconn.edu/guides/Critical_Habitat.htm (maritime shrublands and maritime forest currently lumped), NETHCS (*Morella pensylvanica – Prunus maritima* association listed under Northern Atlantic Coastal Maritime Forest CES203.302 and Northern Atlantic Coastal Plain Dune and Swale CES203.264)

Representative Sites: Bluff Point State Park and Coastal Reserve (Groton)

Relative Condition Rating: Poor

Upland Woodland and Shrub: Reverting Field and Early Successional Shrubland

Definition: Reverting fields are formerly cleared lands composed of a mix of grasses and herbaceous growth with not more than 75 percent woody vegetation in the form of shrubs, saplings, and pole size trees. Reverting fields are characterized by red cedar, spirea, cherry, birch, and scattered brush and/or shrub species. Early Successional Shrublands are formerly cleared land growing back to greater than 50 percent shrub cover and less than 30 percent tree cover. Native shrublands are characterized by dogwoods, viburnums, blueberry, and alder. Non-native shrublands are often dominated by autumn and Russian olive, multiflora rose, and honey suckle.

Condition: Most reverting fields contain heavy infestations of non-native invasive species that may limit their value to some species of wildlife, especially insects, but provide good habitat for other species. Most shrublands contain moderate to heavy infestations of non-native, invasive species. Examples of native shrublands are uncommon, especially examples of any significant size. Shrublands dominated by non-native species are more common, but also tend to be limited in size. While they may offer similar structure to native shrublands and provide habitat for some wildlife, non-native invasive shrubs typically do not host the diversity of native insects, so are of more limited wildlife value in general. The limited shrublands remaining across the state are still being developed for residential and commercial use, turned back into farmland at some sites, or naturally succeeding into forestland.

Extent/Location: Reverting fields and early successional shrublands are found statewide but are limited in size and quality. Reverting fields and shrublands occur mainly on old agricultural sites, and can be found near former or currently active agricultural lands, edges of wetlands, and riparian zones. These habitat types generally occur on moist soils. Probably the best examples occur in northwestern, northeastern, and southeastern Connecticut.

Mapping/Notes/References: Mapped to some extent on Wildlife Management Areas as powerlines and right-of-ways (ROWs). ROWs are also captured in UConn Clear Landcover data. “Estimation of Early Successional Habitat in Connecticut” (Rittenhouse, 2014)

Representative Sites: Cromwell Meadows (Cromwell), Nathan Hale SF (Andover, Coventry), Simsbury WMA (Simsbury), Robbins Swamp (Canaan), Bartlett Brook (Lebanon),Bear Hill WMA (Bozrah), Zemko Pond (Salem), Flaherty WMA (East Windsor), Goshen WMA

(Goshen), Barn Island WMA (Stonington), Mansfield Hollow Flood Control Area (Mansfield), Quinebaug WMA (Canterbury, Plainfield), Naugatuck SF.(Naugatuck), Roraback WMA (Harwinton), Skiff Mountain Cooperative WMA (Kent), and others.

Relative Condition Rating: Fair

Upland Herbaceous: Coastal Beaches and Dunes

Definition: Windswept and wave-washed sandy beaches and their associated dunes along Long Island Sound. Coastal dune vegetation typically includes species such as beach grass (*Ammophila breviligulata*), switchgrass (*Panicum virgatum*), and seaside goldenrod (*Solidago sempervirens*).

Condition: Connecticut's beaches and remaining coastal dunes are generally small and in good to fair condition. These areas are used by several GCN bird species, notably the piping plover (state and federally threatened) and least tern (state threatened). Most of the sandy beaches with Coastal Dunes are under private ownership.

Extent/Location: Scattered across the coast, with adjacent low energy beaches on Long Island Sound.

Mapping/Notes/References: Critical Habitat Layer http://www.cteco.uconn.edu/guides/Critical_Habitat.htm (beachshore)

Representative Sites: Meig's Point and Hammonasset State Park Natural Area Preserve (Clinton), Bluff Point State Park and Coastal Reserve (Groton), TNC's Griswold Point, (Old Lyme), and Milford Point Unit of the Stewart B. McKinney National Wildlife Refuge(Milford).

Relative Condition Rating: Good to Fair

Upland Herbaceous: Grassy Glades and Balds

Definition: Grassy Glades and Balds are found on dry exposed summits, ledges, and outcrops, including acidic (gneiss, schist, granite), subacidic (basalt, diabase, calcareous schists), and pH neutral (marble, dolerite) soil types. Grassy Glade and Bald vegetation is typically low shrubs, grasses, and herbs, including bearberry, lowbush blueberry, sand cherry, poverty grass, and little bluestem.

Condition: Grassy Glades and Balds associated with ridge tops are conserved through either state or non-profit ownership. However, recreational use has had a major impact on this habitat (e.g., trampling by hikers, dirt bikes). In some areas, a long history of mining for coarse aggregate or the recent increase in residential development have had impacts. Additionally, the open character of some sites has been reduced or lost through natural succession.

Extent/Location: Grassy Glades and Balds are found in Central Connecticut (Hartford, Middlesex, New Haven Counties) and in western Connecticut and the Pomperaug River Valley (Litchfield and New Haven Counties).

Mapping/Notes/References: Critical Habitats Layer http://www.cteco.uconn.edu/guides/Critical_Habitat.htm (Acidic- and Circumneutral Rocky Summit Outcrop)

Representative Sites: Examples may be found at Canaan Mountain (Canaan), Pond Mountain Natural Area(Pond Mountain Trust, Kent), Talcott Mountain State Park (Simsbury), Onion Mountain (Simsbury), West Rock Ridge State Park (Hamden), Higby Mountain (Meriden), and Sleeping Giant State Park (Hamden).

Relative Condition Rating: Fair to poor

Upland Herbaceous: Sand Barrens and Sparsely Vegetated Sand and Gravel

Definition: Sand Barrens are sparsely vegetated, unconsolidated stable or actively moving sands and/or gravels, including eroding sandy bluffs and escarpments, active inland dunes, and other open sandy sites. These areas are typically maintained by fire, erosion, or anthropogenic disturbance. Plants are slow to establish, though annuals such as orange grass (*Hypericum gentianoides*) and forked bluecurls (*Trichostema dichotomum*) are typically the first to colonize these areas. Sand barrens often transition into little bluestem (*Schizachyrium scoparium*)–poverty grass (*Danthonia spicata*) medium-tall grasslands, and may occur among bear oak (*Quercus ilicifolia*) shrublands."

Condition: The condition of sand barrens is fair to poor. Development, natural succession, and invasion by exotic species such as autumn olive (*Elaeagnus umbellata*) has eliminated or changed the character of many sites. Sites require continued maintenance to remain viable.

Extent/Location: On areas of glacial outwash, primarily in coastal counties and the Connecticut River Valley.

Mapping/Notes/References: Critical Habitat Layer http://www.cteco.uconn.edu/guides/Critical_Habitat.htm (sand barren)

Representative Sites: Examples of sand barrens can be found at Matianuck Natural Area Preserve (Windsor), Shaker Pines (Enfield), and in the vicinity of Wharton Brook State Park(North Haven/Wallingford) where expansive barren and sandplain vegetation once occurred.

Relative Condition Rating: Fair to poor

Upland Herbaceous: Warm Season Grasslands

Definition: Warm Season Grasslands are dominated by native grasses such as little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), and Indiangrass (*Sorghastrum nutans*), which grow best in the summer heat. These grasslands typically occur on dry glaciofluvial deposits or on shallow soils and ledges of hilltops.

Condition: Warm Season Grasslands are among the most impacted terrestrial habitats in Connecticut, second only to Pitch Pine/Scrub Oak barrens (Metzler and Wagner 1998). The overall condition of natural Warm Season Grasslands is poor. Some managed grasslands are in acceptable condition but require continued management (controlled burns and a mowing regime) to remain viable.

Extent/Location: Warm Season Grasslands are found on fine deposits from glacial outwash, distributed in the coastal counties as well as in the Connecticut River Valley.

Mapping/Notes/References: UConn Clear Landcover data: grasslands overlaid with glaciofluvial deposits.

Representative Sites: Suffield WMA (Suffield), Rentschler Field (East Hartford), Bradley Airport (Windsor Locks), and other airfields around the state.

Relative Condition Rating: Poor

Upland Herbaceous: Cool Season Grasslands

Definition: Hayfields and other managed grasslands consisting primarily of naturalized European species.

Condition: Cool Season Grasslands include hayfields and other managed grasslands consisting primarily of naturalized European species, such as timothy, red clover, and red fescue, as well as other herbaceous or broad-leaved plants and flowers. These habitats are routinely mowed or burned prior to or after the conclusion of the avian breeding season. Cool Season Grasslands require active management to remain in an open, grassy state. They can be found statewide in areas of active agriculture.

Extent/Location: This type of habitat tends to be most common in Litchfield, Windham, and northern Hartford, and Tolland Counties.

Mapping/Notes/References: The Connecticut Wildlife Diversity Program has point data of areas that are suitable cool season grasslands. They were identified by inference as places where bobolinks have consistently been documented.

Representative Sites: Two examples of Cool Season Grassland habitat include Topsmead State Forest (Litchfield) and the northern fields of Goshen WMA (Goshen).

Relative Condition Rating: Good

Forested Inland Wetland: Atlantic White Cedar Swamps

Definition: Atlantic White Cedar Swamps are seasonally flooded forests dominated by Atlantic white cedar (*Chamaecyparis thyoides*), and include highbush blueberry (*Vaccinium corymbosum*), rosebay rhododendron (*Rhododendron maximum*), swamp azalea (*Rhododendron viscosum*), red maple (*Acer rubrum*), and yellow birch (*Betula alleghaniensis*). The shrub and herbaceous layer are variable, ranging from poorly- to well-developed, depending upon canopy light penetration.

Condition: Atlantic White Cedar Swamps are considered one of the thirteen most imperiled ecosystems in Connecticut (Metzler and Wagner 1998). Most are in poor condition. Atlantic White Cedar is shade intolerant and requires sunlight for regeneration. Cedar reproduction is poor in these wetland habitats, except in streamside and lakeside flooded habitats without extreme water level fluctuations. These habitats are showing little regeneration and are being succeeded by hemlock and hardwoods such as red maple.

Extent/Location: Occurrences of Atlantic White Cedar Swamps are concentrated in the eastern third of Connecticut, with additional scattered occurrences in Middlesex, New Haven, New London, and Windham counties.

Mapping/Notes/References: Critical Habitats layer http://www.cteco.uconn.edu/guides/Critical_Habitat.htm, State land Management GIS layer (cover type #606)

Representative Sites: Other examples of Atlantic White Cedar Swamps in various conditions are found at Pachaug Great Meadow Natural Area Preserve (Voluntown), Rhododendron Sanctuary Natural Area Preserve (Voluntown), and Chester Cedar Swamp National Natural Landmark (Chester). Other areas include Joshua's Trust Atlantic White Cedar Bog (Windham), as well as Windham and Bolton Lakes.

Relative Condition Rating: Poor

Forested Inland Wetland: Red/Black Spruce Swamps

Definition: Red/Black Spruce Swamps are saturated bog forests dominated by red spruce (*Picea rubens*) or black spruce (*Picea mariana*). Tree cover is often dense, but can be variable due to blow-downs from storms. Shrub and herbaceous cover is patchy and typically includes mountain holly (*Ilex mucronata*), sheep laurel (*Kalmia angustifolia*), and highbush blueberry (*Vaccinium corymbosum*).

Condition: The condition of these habitats is relatively unknown.

Extent/Location: Red/Black Spruce Swamps of relatively good condition are limited to Northwestern Connecticut. They are sporadic in northeast, Connecticut.

Mapping/Notes/References: State Lands Management GIS Database (cover type #123 - red spruce, and #125 - black spruce.

Representative Sites: Examples of Red Spruce Swamps may be found at TNC's Holleran Swamp (Colebrook) and in areas of Wyantenock State Forest (Warren, Kent, Cornwall), and Nipmuck State Forest (Union, Stafford, Ashford, Willington, and Woodstock). The only occurrence of a Black Spruce Swamp is found at Mohawk Mountain Black Spruce Bog Natural Preserve (Cornwall).

Priority Areas: Shade Swamp (Farmington)

Relative Condition Rating: Good

Forested Inland Wetland: Northern White Cedar Swamps

Definition: Northern White Cedar Swamps are seasonally flooded forests in which northern white cedar (*Thuja occidentalis*) occurs in nearly pure stands or is mixed with other trees including red maple (*Acer rubrum*), eastern hemlock (*Tsuga canadensis*), eastern white pine (*Pinus strobus*), yellow birch (*Betula alleghaniensis*), black ash (*Fraxinus nigra*), and occasionally larch (*Larix laricina*).

Condition: The few examples of Northern White Cedar Swamps that occur in the state are in poor condition.

Extent/Location: There is not much historical information on the extent of Northern White Cedar Swamps in Connecticut. Presently, they are rare in the state and occur on poorly-drained, seasonally flooded, calcium-rich soils. Examples of Northern White Cedar Swamp occur at Robbins Swamp Natural Area Preserve (Canaan) though this site is in poor condition, and in the towns of Salisbury and Union.

Mapping/Notes/References: State Lands Management GIS Database (cover type # 127) Critical Habitats Layer http://www.cteco.uconn.edu/guides/Critical_Habitat.htm (Circumneutral Northern White Cedar Swamp)

Representative Sites: Robbins Swamp Natural Area Preserve (Canaan).

Relative Condition Rating: Poor

Forested Inland Wetland: Floodplain Forests

Definition: Floodplain Forests include mesic forests and associated alluvial wetlands that occur on flood-deposited sandy or nutrient-rich silty soils adjacent to rivers or streams. These temporarily flooded, deciduous forests may include silver maple (*Acer saccharinum*), sycamore (*Platanus occidentalis*), eastern cottonwood (*Populus deltoides*), American elm (*Ulmus americana*), pin oak (*Quercus palustris*), green ash (*Fraxinus pennsylvanica*), and box elder (*Acer negundo*). The diversity and cover of shrubs and herbaceous species may vary, though common components include silky dogwood (*Cornus amomum*), spicebush (*Lindera benzoin*), sensitive fern (*Onoclea sensibilis*), and white snakeroot (*Ageratina altissima*).

Condition: The few examples of Floodplain Forests that remain are fragmented by a history of agricultural activity because they are typically found on prime soils.

Extent/Location: Low Floodplain Forests are still found along the Connecticut River. Best examples include Wangunk Meadows WMA (Portland), Folly Brook Natural Area (Wethersfield), and Great Meadows Land Trust (Wethersfield). Few examples of high Floodplain Forests remain (e.g., Fisher's Meadow Park in Avon). Alluvial Floodplain Forests, along small and mid- gradient rivers, are found at Quinnipiac River State Park (North Haven and Wallingford), Nepaug State Forest (New Hartford), and Satan's Kingdom State Recreation Area (New Hartford).

Mapping/Notes/References: State Lands Management GIS Database (cover type #701-709 -elm- ash-red maple group) Also captured in Palustrine Forested categories in Critical Habitats Layer http://www.cteco.uconn.edu/guides/Critical_Habitat.htm

Representative Sites: Wangunk Meadows WMA (Portland), Folly Brook Natural Area (Wethersfield), Great Meadows Land Trust (Wethersfield), Fisher's Meadow Park (Avon), Quinnipiac River State Park (North Haven and Wallingford), Nepaug State Forest (New Hartford), and Satan's Kingdom State Recreation Area (New Hartford).

Relative Condition Rating: Fair to good

Forested Inland Wetland: Red Maple Swamps

Definition: Seasonally flooded forests dominated by Red maple (*Acer rubrum*) and with a variable understory of herbs and shrubs. Includes Red maple/ Skunk cabbage (*Acer rubrum/Symplocarpus foetidus*) seasonally flooded forests, Red maple/Highbush blueberry (*Acer rubrum/Vaccinum corymbosum*) seasonally flooded forests, and Red maple/ Pin oak (*Acer rubrum/Quercus palustris*) seasonally flooded forests.

Condition: Red Maple swamps are common throughout the state and in relatively good condition.

Extent/Location: Common throughout the state.

Mapping/Notes/References: State Lands Management GIS layer (cover type #708 -red maple lowlands)

Representative Sites: Pachaug State Forest (Voluntown, Griswold, Plainfield), and Meshomasic State Forest (Glastonbury, Hebron, Portland, East Hampton)

Relative Condition Rating: Good

Shrub Inland Wetland: Bogs and Fens

Definition: Bogs and fens are natural peatlands that occur in topographic basins influenced by groundwater. Spring fens, which are characterized by groundwater discharge and minimal peat accumulation, are addressed separately. The topography of bogs and fens is generally hummocky, with shrubs and an herbaceous layer that includes wetland plants, grasses, sedges, ferns, and mosses. Typical vegetation may include bog birch, hoary willow, silky dogwood, leatherleaf, highbush blueberry, black huckleberry, sweet gale, bog cinquefoil, sedges, white beak sedge, beaked spikerush, cattails, rushes, bog moss, sundew, marsh St. Johnswort, and cinnamon fern.

Condition: Bogs and fens are considered among Connecticut's thirteen most imperiled communities (Metzler and Wagner, 1998) and provide habitat for several imperiled plants, invertebrates, amphibians, and the southern bog lemming. Although most of Connecticut's bogs have escaped serious degradation, nutrient input from surrounding development and beaver impoundments threatens some occurrences. Fens are less widespread than bogs, with some in good condition and others threatened by development. Rich fens are small and plagued by invasive species; the condition of acidic fens is unknown.

Extent/Location: Bogs and fens are vegetatively diverse and found throughout Connecticut; however, they are not abundant. Bogs are found primarily in Litchfield County, with a few scattered occurrences in New Haven and Hartford counties. There are also scattered examples of non-calcareous fens in eastern Connecticut.

Mapping/Notes/References: Critical Habitats Layer (rich, medium, and poor fens) http://www.cteco.uconn.edu/guides/Critical_Habitat.htm

Representative Sites: Examples of bogs in fair to good condition are mostly closed to the public. Few bogs, such as Mohawk Mountain Black Spruce Bog (Cornwall), have public access. Examples of fens are found at Pachaug State Forest (Voluntown, Griswold, Plainfield),

Hampton Reservoir (Hampton), Morey Pond (Ashford), Cromwell Meadows WMA (Cromwell), and Babcock Pond WMA (Colchester). A rare "sea-level fen" is found at Barn Island Wildlife Management Area (Stonington).

Relative Condition Rating: Not well known

Shrub Inland Wetland: Shrub Swamps

Definition: Seasonally or semipermanently flooded areas where shrubs greater than 0.5 meter tall form more than 25 percent canopy coverage. Includes Black willow (*Salix nigra*) temporarily flooded shrublands, Speckled alder (*Alnus incana ssp. rugosa*) temporarily flooded shrublands, Highbush blueberry (*Vaccinium corymbosum*) seasonally flooded shrublands, Common buttonbush (*Cephalanthus occidentalis*) semipermanently flooded shrublands, and Swamp loosestrife (*Decodon verticillatus*) semipermanently flooded shrublands.

Condition: The overall status of shrub swamps is not well known at this time.

Extent/Location: Statewide

Relative Condition Rating: Unknown

Herbaceous Inland Wetland: Calcareous Spring Fens

Definition: Calcareous Spring Fens are naturally open wetlands occupying groundwater discharge sites. In the Marble Valleys, the vegetation is influenced by base- rich organic soils with minimal peat accumulation. Typical vegetation includes inland sedge, bristlestalked sedge, and other kinds of sedges, with scattered shrubs, such as bush cinquefoil and gray dogwood.

Condition: Historically, these wetlands were impacted by damming, draining, and nutrient input. Although many are now under the protection of The Nature Conservancy, open Calcareous Spring Fens are presently threatened by invasive species (e.g., phragmites, purple loosestrife, reed canary grass) and natural succession. Nutrient input from non-point sources and poor agricultural practices also remain threats.

Extent/Location: Calcareous Spring Fens are rare and limited to western Connecticut, including the western Marble Valleys in Fairfield and Litchfield counties.

Mapping/Notes/References: Captured in Critical Habitats layer http://www.cteco.uconn.edu/guides/Critical_Habitat.htm

Representative Sites: Examples of Calcareous Spring Fens are found at Beeslick Pond (Salisbury), Benton Hill Fen (Sharon), and Bauer Woods (Salisbury). All three locations are under TNC protection.

Relative Condition Rating: Varies. Some under protection, others threatened

Herbaceous Inland Wetland: Freshwater Marshes

Definition: Freshwater Marshes are typically adjacent to rivers and streams, and periodically flooded and influenced by runoff from adjacent upland areas. Basin Freshwater Marshes also are found in glacial kettles. Typical plants include cattail, buttonbush, highbush blueberry, water willow, and swamp loosestrife.

Condition: Estimates of wetland loss since colonial times vary widely. Metzler and Tiner (1992) contend that Connecticut has lost between one-third and one-half of its original wetlands based on existing data and personal observation of land development across the state. Passage of the Inland Wetlands and Watercourses Act in 1972 greatly slowed the loss of wetlands in the state. Freshwater Marshes have been and continue to be degraded from a variety of sources, including direct discharges, sedimentation, and contaminated stormwater or groundwater. Ongoing and pending stormwater permit programs will help reduce the effects of stormwater on fresh wetlands. Some emergent wetland areas are man-made. These man-made Freshwater Marshes are well distributed throughout Connecticut. A typical example is found at Charter Marsh WMA (Tolland).

Extent/Location: Freshwater Marshes are typically adjacent to rivers and streams, and periodically flooded and influenced by runoff from adjacent upland areas. Basin Freshwater Marshes also are found in glacial kettles. Some emergent wetland areas are man-made. These man-made Freshwater Marshes are well distributed throughout Connecticut.

Mapping/Notes/References: DEEP GIS Data – Hydrography http://www.ct.gov/deep/cwp/view.asp?a=2698&q=322898

Representative Sites: Cromwell Meadows WMA (Cromwell)

Herbaceous Inland Wetland: Wet Meadows

Definition: Wet meadows are seasonally saturated wetlands dominated by graminoids and forbs. Encroachment by woody vegetation is typically slowed by periodic flooding or fire. In Connecticut, most wet meadows are primarily maintained through cutting or grazing.

Condition: Wet meadow habitat is created in grass-dominated areas where water seasonally pools or floods, or where the water table is close to the surface. Many of these areas have limited agricultural value, but provide excellent wildlife habitat. The location and condition of wet meadow habitat varies statewide. As agricultural pressure has increased, many sites have been altered through channelization of water, ditching, or creation of berms.

Extent/Location: The location and condition of wet meadow habitat varies statewide.

Representative Sites: Three good examples of wet meadow habitat are Durham Meadows WMA (Durham and Middlefield), the southern fields of Goshen WMA (Goshen), and the Route 7 fields of Robbins Swamp WMA (Canaan).

Relative Condition Rating: Varies throughout the state.

Tidal Wetland: Salt and Brackish Marshes

Definition: Intertidal Marshes - regularly and irregularly flooded marshes includes salt and brackish tidal marshes. Salt Marsh - includes Marsh elder (*Iva frutescens*) tidally-flooded shrublands, Saltmarsh cordgrass (*Spartina alterniflora*) tidally- flooded grasslands, Saltmeadow cordgrass (*Spartina patens*) tidally-flooded grasslands, and Glasswort (*Salicornia europaea*) tidally-flooded forb vegetation. Community examples: killifish (*Fundulus spp.*), silversides (*Menidia spp.*), and horseshoe crab (*Limulus polyphemus*). Brackish Marsh - includes Saltmarsh cordgrass (*Spartina alterniflora*) tidally-flooded grasslands, Three-square bulrush (*Scirpus pungens*) tidally-flooded grasslands, Narrowleaf cattail (*Typha angustifolia*) tidally-flooded grasslands, and Saltmeadow cordgrass tidally-flooded grasslands. Community examples: killifish (*Fundulus spp.*), sticklebacks (*Gasterostiedae*), and blue crab (*Callinectes sapidus*).

Condition: Tidal Wetlands include salt and brackish marshes. The overall condition of these habitats is considered good. Tidal Wetlands have been impacted by structures and practices that alter normal tidal flow, such as tide gates, undersized culverts, and mosquito ditches. Restoration efforts have successfully reversed over 2,000 acres of damage caused by these activities. Stormwater runoff from developed lands often carries contaminants and sediments to Tidal Wetlands, interferes with the natural freshwater and saltwater balance, and exacerbates the spread of the invasive reed grass, *Phragmites australis*. Ongoing and pending stormwater permit programs help regulate and reduce the effects of stormwater on Tidal Wetlands. The greatest threat to Tidal Wetlands is sea level rise accelerated by climate warming, which drowns the wetland when it exceeds accretion rates.

Extent/Location: Remaining wetland areas are found adjacent to Long Island Sound and reaching upstream on all of the major rivers and streams under tidal influence.

Mapping/Notes/References: USFWS National Wetlands Inventory

Representative Sites: Charles E. Wheeler WMA (Milford) is an example of an outstanding Tidal Wetland. Seven focus areas have been identified for regional conservation priority by the Atlantic Coast Joint Venture Plan (2004).

Tidal Wetland: Intertidal Beaches, Flats and Rocky Shores

Definition: Intertidal beaches and shores - includes saltwater and brackish intertidal beaches and rocky shores; those areas along the Connecticut shoreline inundated by normal daily tides. Saltwater Intertidal Beaches and Shores -Vegetative community examples include Sea rocket (*Cecile edentula*) tidally-flooded forb vegetation, Pigweed (*Chenopodium album*). Key finfish species include killifish (*Fundulus spp.*), silversides (*Menidia spp.*), and young-of year (newly hatched) GCN species. Brackish Intertidal Beaches and Shores - includes Three-square bulrush (*Scirpus pungens*)-Arrowhead spp. (*Sagittaria spp.*) tidally flooded grasslands and Water hemp (*Amaranthus cannabinus*) tidally-flooded forb vegetation. Young-of-year GCN finfish species are common.

Condition: The intertidal flats are regularly or irregularly exposed mud or sand areas with sparse to dense vegetation. Intertidal beaches and shores are buffer zones between open water and upland habitats. These thin zones are physically extremely variable habitats viable only to

those plants and animals highly adapted to conditions of periodic inundation and exposure to storm surge and/or wave erosion. Historically they have been subjected to bulkheading and other forms of shoreline armoring. These alterations have destroyed their 'living shoreline' function of providing feeding and nesting areas for numerous shorebird species, marine invertebrates, and young-of-year finfish. Many Intertidal Beaches and Shores are under private ownership and therefore susceptible to undocumented pesticide runoff, alteration or removal of vegetation, and/or grade changes. State regulations passed in 2012 were designed to facilitate conversion of privately owned armored shorelines to vegetated sand berms and low, hard-bottom slopes so these habitats would regain their ability to filter runoff, absorb storm surge, and provide shelter and food to wildlife.

Extent/Location: Approximately 26 percent of the Connecticut shoreline is comprised of intertidal sandy beaches (16 percent) and sedimentary shores (10 percent). Because of the greater tidal prism in the western Sound (2.3 m) compared to the eastern (0.8 m), the extent of intertidal areas is greatest west of the Housatonic River and between the Quinnipiac River and Connecticut River.

Representative Sites: Most sandy beaches in Connecticut are under private ownership. Notable public beaches include Sherwood Island State Park (Westport), Hammonasset State Park (Clinton, Madison, and Rocky Neck State Park (East Lyme). Notable intertidal habitats are also found at Greenwich Point ,Calf Pasture Beach (Norwalk), Penfield Point (Fairfield),Milford Point, Indian and Joshua Coves (Guilford), and Bluff Point State Park and Coastal Reserve (Groton)

Priority Areas: Priority needs to be given to those intertidal areas with demonstrated GCN species, which are vulnerable to human alterations and/or loss due to sea level rise. Examples include Long Beach (Stratford), Sandy Point Bird Sanctuary (West Haven), and Ocean Beach Park (New London).

Relative Condition Rating: Unknown to Good

Freshwater Aquatic: Large Rivers and their Associated Riparian Zones

Definition: Deep rivers that often support a diverse assemblage of fishes, including species that are resident, diadromous, or marine visitors. Large rivers provide adult fish holding areas, migration staging areas, and foraging and spawning areas for many fishes. Indicator communities in inland reaches are fishes such as shortnose sturgeon, largemouth bass, smallmouth bass, redbreast sunfish, white and channel catfish, American eel, and spottail shiner. Seasonal diadromous indicator fish include Atlantic sturgeon, American shad, blueback herring, alewives, and sea lamprey. Indicator communities in the lower estuaries include marine and estuarine fishes such as striped bass, winter flounder, mummichog, tomcod, and hogchoker. Riverbank Communities - flood scoured rocky or gravelly riverbanks with annual or perennial vegetation and includes riverbank beach/shore communities, riverside seeps, and riverside outcrops. Riverbank Beach/Shore Community includes black willow (*Salix nigra*); temporarily flooded shrublands with speckled alder (*Alnus rugosa*); big bluestem (*Andropogon gerardii*); and temporarily flooded grasslands with twisted sedge (*Carex torta*). Community examples: Black willow - Fall panic grass (*Panicum dichotomiflorum*) –found at Great Meadow Land Trust's Folly Brook Natural Area (Wethersfield); Speckled alder - Willow spp. Community example: White Memorial Foundation's Little Pond (Litchfield) and includes: big bluestem - bluebell bellflower

(*Campanula rotundifolia*)-Narrow goldenrod (*Solidago simplex*) community; Riverside Seep - includes Inland sedge (*Carex interior*)-Bristle-stalked sedge (*Carex leptalea*)-Sedge (*Carex flava*) saturated grasslands. Community examples: Sedge (*Carex sterilis*)/Bush cinquefoil (Potentilla fruticosa) community, Sedge (*Carex sterilis*)/Gray dogwood (*Cornus racemosa*) community.

Condition: The Large Rivers and Streams and their Associated Riparian Zones support a diverse assemblage of fishes, including resident and diadromous species and marine visitors. These deep freshwater habitats provide adult fish holding areas, migration staging areas, and foraging and spawning areas for many fish. The associated riparian zone includes flood-scoured rocky and gravelly riverbanks, riverside seeps, and riverside outcrops. Indicator communities in inland reaches are fish, such as largemouth bass, smallmouth bass, redbreast sunfish, white and channel catfish, American eel, and spottail shiner. Seasonal diadromous indicator fish include American shad, blueback herring, alewives, and sea lamprey. Indicator communities in the lower estuaries include marine and estuarine fishes, such as striped bass, winter flounder, mummichog, tomcod, and hogchoker. Connecticut contains a few large rivers, most notably the Connecticut, Housatonic, and Thames Rivers (and their major tributaries). Most of these habitats have been altered due to dam construction, navigational dredging, and consumptive water use. Development of upstream and downstream fish passage on many rivers has been initiated, leading toward restoration of riverine migratory corridors. Dam removal efforts that have recently been, undertaken also restore habitat connectivity. Progress should continue on all fronts to restore riverine habitat conditions for the benefit of fish and wildlife resources. The Connecticut River is our best example of a Large River. It includes large areas of open water and deep water, as well as associated floodplain forests, erosional banks, sand bars, and alluvial marshes. Numerous rare taxa have been found in and along the Connecticut River during the last decade as a result of improving water quality over the last 30 years. Portions of the Shetucket and Farmington Rivers also provide examples of viable Large River habitats. Large Rivers and Streams and their Associated Riparian Zones are considered one of the thirteen most imperiled habitats in Connecticut (Metzler and Wagner 1998). Riverside development, water diversion, and discharges are the major threats to this ecosystem. The overall condition of the habitat and living resources in our major rivers is generally best in the Connecticut River due to less industrial development and fewer dams. Other large rivers are impacted to a greater degree by dams (Housatonic, Shetucket, Farmington), pollution (PCBs in the Housatonic), and highly developed shorelines (Thames).

Extent/Location: Connecticut contains several large rivers, most notably the Connecticut, Housatonic, and Quinnipiac Rivers. Also includes major tributaries of the Thames River.

Mapping/Notes/References: Oliver et al. TNC listed as large rivers (17 miles) and large tidal rivers (99 miles)

Representative Sites: The Connecticut River is our best example of a Large River. Portions of the Shetucket and Farmington Rivers also provide examples of viable Large River habitats.

Priority Areas: Connecticut River

Relative Condition Rating: Fair

Freshwater Aquatic: Unrestricted, Free-Flowing Streams

Definition: Free-flowing waters that support many of the indigenous fishes of Connecticut. Unrestricted free-flowing streams are essential for many fishes to complete their life cycles. Indicator communities include fishes such as white sucker, brown trout, fallfish, creek chub, cutlips minnow, smallmouth bass, redbreast sunfish, American eel, and grass pickerel. These communities are impacted by any activity or event that restricts free movement of fish.

Condition: Unrestricted, Free-flowing Streams include riffles, rapids, and other mesohabitats that are unrestricted by dams, culverts or other manmade barriers. Many support runs of anadromous fish. These habitats also support many of the indigenous fish of Connecticut because they depend on the habitats to complete their life cycle. Indicator communities include fishes such as white sucker, brown trout, fallfish, creek chub, cutlips minnow, smallmouth bass, redbreast sunfish, American eel, and grass pickerel. There are no large undammed rivers in Connecticut. Damming changes sedimentation patterns and seasonal water flow, which is critical to the welfare of many freshwater mussels and certain life cycle stages of mayflies and dragonflies. Seasonal and daily flow changes also impact spawning of anadromous and resident fishes and can influence water temperatures, thus affecting survival of salmonids. Floodplain vegetation and sediment deposition also are impacted by regulated water flow and discharges. Unrestricted, Free-flowing Streams are included as one of the thirteen most imperiled ecosystems in Connecticut (Metzler and Wagner 1998). Nearly all of the state's streams have been influenced by damming and the regulation of discharges and diversions. The overall condition of the longer free-flowing stream segments in Connecticut is only fair due to the influence of upstream impoundments, water, diversions, and development in the watersheds, all of which affect seasonal flows and water temperatures. Smaller free-flowing streams are still common and many are in relatively good condition. These waters need to be protected in order to conserve fluvial dependent biota.

Extent/Location: These communities are scattered across Connecticut on any stream or river without dams or other obstructions to movement (e.g., perched culverts).

Mapping/Notes/References: It would be possible to map these habitats using the current state stream, falls, fishways, and dam coverages. Culvert data are only available for a 36 towns in Eastern Connecticut, so these barriers would not be completely represented.

Representative Sites: There are no large undammed rivers in Connecticut. Segments of the Hollenbeck River (South Canaan to Cornwall), Moore Brook (Salisbury), Eight-Mile River (East Haddam, Salem, Lyme), Moodus River (East Haddam), and Natchaug River (Eastford, Chaplin, Mansfield, Windham) provide examples of Unrestricted, Free-flowing Stream habitat.

Priority Areas: Priority areas would be any locations where removal or by-passing of stream obstructions would allow free passage of stream communities.

Relative Condition Rating: Fair/limited

Freshwater Aquatic: Cold Water Streams

Definition: Cold streams, ponds, and wetlands include surface springs, seeps, and thermal refuges. These easily degraded areas provide habitat for many of our cold water-dependent fishes such as slimy sculpin, American brook lamprey, brook trout, smelt, and burbot. Other community indicator members are white sucker, common shiner, blacknose dace, longnose dace and tessellated darter.

Condition: Cold Water Streams are rapidly flowing clear waters with gravelly or cobbly substrate. They include the smaller (< 30 ft. wide) perennial streams located at the headwaters of drainage systems, surface springs, seeps, and thermal refuges. These habitats support many of Connecticut's most sensitive fish, including the slimy sculpin and brook trout. These habitats have permanently flooded vegetation and riverweed is often the only vascular plant present, forming a low algal-like crust on submerged rocks. Some of the community indicator members are brook trout, slimy sculpin, white sucker, common shiner, blacknose dace, longnose dace, and tessellated darter. Cold Water Streams are very sensitive areas that are often overlooked by local land use commissions. The overall health of a watershed depends on the conditions of its headwater streams. Future suburban sprawl into outlying areas represents a long-term threat to these aquatic habitats. Localized riparian mismanagement and other anthropogenic actions (e.g., general development, road maintenance) represent threats to these habitats elsewhere. Fragmentation of these habitats by culverts and dams results in isolated populations and in some cases threatens the genetic stability of brook trout populations. The distribution of typical riverweed vegetation is currently unknown due to its inconspicuous growth. It would serve, however, as a good indicator of the health of this easily perturbed habitat because of its response to poor water quality. Riverweed generally has little competition from other plants, although in some streams a variety of submerged bryophytes occur. The overall condition of cold water streams in Connecticut is poor due to the cumulative warming effects on many streams by impoundments, water diversions, and development of wetland areas. However, many exceptions do occur, and these waters support healthy populations of cold water dependent fauna (Hagstrom et al. 1996, see Class 1 and Class 2 Wild Trout Management Areas in Connecticut Angler's Guide). Remaining cold water streams need to be protected in order to conserve cold water dependent biota.

Extent/Location: Cold Water Streams in Connecticut are typically associated with undeveloped forested areas, where shade from the forest canopy and inflow from groundwater and undisturbed wetlands maintain stable and suitable water temperatures, especially during summer. Cold Water Streams and undisturbed wetlands are most prevalent in rural areas. These habitats are largely non-existent in urban areas and are diminishing in suburban areas.

Mapping/Notes/References: Cold water streams are mapped in the TNC stream classification.

Representative Sites: Mott Hill Brook (Glastonbury), Sage Ravine (Salisbury), and Joe Clark Brook (Preston).

Relative Condition Rating: Fair/threatened

Freshwater Aquatic: Head-of-Tide and Coastal Streams

Definition: The upstream limit of waters affected by the tide. These are staging areas critical to successful spawning migrations of many diadromous, fishes. Indicator communities include diadromous species such as American shad, blueback herring and sea lamprey as well as resident, fishes such as shortnose sturgeon (Connecticut River), hogchoker and mummichog. In addition there is a continuum of fish species communities that straddle the head-of-tide from the fresh to the saltwater side. These include indicator species such as several stickleback species and sheepshead minnow. These areas are critical winter spawning habitat for tomcod, as well as summer feeding areas for sea-run brown trout and summer spawning habitat for blue crabs.

Condition: Head-of-Tide habitat includes the upstream limit of waters affected by the tide. These staging areas are critical to the successful spawning migration of many diadromous fish. Indicator communities include diadromous species, such as American shad, blueback herring, Tomcod, smelt, and sea lamprey, as well as resident fishes such as, shortnose sturgeon (Connecticut River), hogchoker, and mummichog, The relative condition of Head-of-Tide areas varies widely across the state. Many Head-of-Tide habitats coincide with heavily developed urban, areas, offering little opportunity for functional restoration. Most other Head-of-Tide habitats have been subject to moderate degrees of alteration. Only a few of these areas remain truly pristine. Efforts should be directed at studying and protecting these unique habitats, which serve as a linkage between upland and tidal areas and play important life history roles for various species of fish and wildlife.

Extent/Location: Coast wide on all rivers and streams

Mapping/Notes/References: Unknown. The coastal boundary coverage at Magic UConn may identify these habitats.

Representative Sites: West River (New Haven), Norwich Harbor (Norwich)

Relative Condition Rating: Fair

Freshwater Aquatic: Lakes and their Shorelines

Definition: Nearshore lake habitats, including areas of emergent and submerged plants and shoreline terrestrial vegetation. This is critical spawning and nursery habitat for many fishes. Indicator communities include largemouth bass, smallmouth bass, chain pickerel, bluegill, pumpkinseed, golden shiner, bullheads, and American eel. Shorelines unimpaired by residential development are rare in most public Connecticut lakes.

Condition: Lakes and their Shorelines include an open water zone, a shallow littoral zone (where light penetrates to the bottom), and the adjacent terrestrial shoreline. Lakes vary in depth and productivity. Some deep lakes with greater than average transparency are low to moderately productive, maintaining dissolved oxygen levels at or above 3 ppm during summer. Other less deep lakes are very productive, with low transparency and abundant aquatic plants, but may experience a drop in dissolved oxygen during summer because of the heavy accumulation of organic matter. Submerged and emergent vegetation is found in the littoral zone including three-way sedge, bog loosestrife, arrow arum, and pickerelweed. Adjacent shoreline terrestrial vegetation includes black willow, fall panic grass, speckled alder, reed canary

grass, bluejoint reedgrass, bog white violet, and upright sedge. Inshore indicator communities include largemouth bass, smallmouth bass, chain pickerel, bluegill, pumpkinseed, golden shiner, and bullheads. Offshore pelagic indicator communities include brown trout, rainbow trout, kokanee, walleye, smelt, alewives, yellow perch, and white perch. The status of Lakes and their Shorelines is well documented in Connecticut (Frink and Norvell 1984, CT DEP 1982, CT DEP 1991, Canavan and Siver 1995, Jacobs and O'Donnell 1996, Jacobs and O'Donnell 2002). The overall condition of Lakes and their Shorelines in Connecticut is generally fair to poor. Lake shorelines unimpaired by residential development are rare in most public lakes in Connecticut and are under increasing threat due to an increased demand for waterfront property. Aside from water supply reservoirs and public lakes with state-owned shorelines, the land adjacent to most Connecticut lakes is privately owned and zoned for residential development. As such, these areas are being developed at a relatively rapid pace, leaving little opportunity for maintaining natural conditions. New lakefront property owners often convert naturally vegetated shorelines into a landscaped monoculture of turf causing increased nutrient loading when these areas are fertilized. Landscaping often continues to the shoreline where seawalls and other hard armoring is constructed and into shallow waters where natural aquatic vegetation is often removed indiscriminately. Shoreline alterations often lead to future demands for winter drawdowns, furthering the stress on the lake biota. Watershed development and land use practices have greatly reduced the volume of oxygenated water entering lakes due to inputs of sediments and nutrients from watershed runoff. When sufficient nutrient levels have become established in these stratified lakes they can be released each summer through internal loading, thereby fueling algae growth and leading to further declines in water quality. The resulting loss of cold water habitat directly reduces or eliminates suitable pelagic habitat for cold water fishes, including salmonids in many waters (Thorpe 1942, Wilde 1959, Schluntz and Bender 1993, Jacobs and O'Donnell 2002). Nutrient loading also can increase the density of aquatic vegetation. Both noxious algae blooms and nuisance levels of aquatic vegetation can impair the recreational and aesthetic values of these waters. The trophic status of naturally eutrophic lakes also has been accelerated through watershed development and unwise land use practices, resulting in increased incidence of algae blooms and aquatic vegetation. The adverse consequences for lentic fishes and aquatic vegetation can include reduced species diversity, increased incidence of winterkills, stunting, dense monocultures of invading aquatic species, and reduction in overall species diversity among plants, fish, and invertebrates. About 2,300 lake-acres are considered impaired by exotic species and nuisance aquatic plants and many more are considered threatened. This problem is largely attributable to the transport of vegetation from one lake to another when plant fragments attach to boats and boat trailers. Connecticut has an aggressive plant transport prevention program, and the state works with communities to control existing problems through the Connecticut Lakes Grant Management Program. Excessive algal growth is identified as an impairing cause of about 3,300 lake-acres in Connecticut. Most of these waters are impoundments of rivers, which drain large watersheds and carry runoff and treated effluents from numerous point sources. For the 2004 assessment cycle, 1,900 acres comprising Lake Lillinonah were added to the total of impaired acres due to nuisance algae and aquatic plant growth, as well as floating debris. Recreational water quality in 84 percent of assessed lake-acres is considered suitable for primary contact (e.g., swimming). More than half of the affected acres are considered impaired due to extensive algal or aquatic weed growth rather than indicator bacteria. Impairments to use by aquatic life can generally be attributed to eutrophication processes associated with human activities. Connecticut DEEP has contracted with consultants to develop total maximum daily load (TMDL) assessments for four lakes identified with eutrophication issues. A significant portion of the lake-acres (3,150 of the 4,000) impaired for fish consumption can be attributed to PCB contamination of sediments in the large impoundments of

the Housatonic River including Lakes Zoar and Lillinonah. Lake McDonough (Barkhamsted), Silver Lake (Berlin), Wyassup Lake (North Stonington) and Dodge Pond (East Lyme) carry advisories for mercury. Two urban ponds, Union Pond (Manchester) and Brewster Pond (Stratford), are affected by chlordane, a pesticide. As with rivers, a mercury related statewide consumption advisory for freshwater fish results in all Connecticut lakes being technically classified as impaired for fish consumption by humans. Despite the environmental impacts to Lakes and their Shorelines, many of Connecticut's lake and pond fish populations have proven very resilient. Introduced species, such as largemouth bass and bluegill, and native species, such as yellow perch, often thrive despite major alterations to lake environments. Populations of other species, such as brook trout, lake trout, bridle shiner, chain pickerel, and creek chubsucker, have been reduced or eliminated in many lakes. The condition of fish populations in these waters is monitored as part of Connecticut's Lakes and Ponds Survey Program (CT DEP 2004).

Extent/Location: Throughout the state.

Mapping/Notes/References: Olivera at TNC is working on a classification and mapping but it is still in development.

Representative Sites: Lake McDonough (Barkhamsted), Silver Lake (Berlin), Wyassup Lake (North Stonington), and Dodge Pond (East Lyme).

Relative Condition Rating: Fair

Freshwater Aquatic: Coastal Plain Ponds

Definition: Ponds associated with coastal-plain sandy substrate areas. Waters are neutral to acidic, often tannic colored. Coastal ponded or slow moving waters support several sensitive fishes such as banded sunfish and swamp darters. Other indicator community members are warm water lake fishes such as largemouth bass, pumpkinseed, golden shiner, bullheads, and American eel.

Condition: Coastal-Plain Ponds are associated with sandy substrate areas. They typically have low nutrient sandy soils and seasonally exposed sandy, gravelly, or muddy sediments. Typical submerged and emergent vegetation includes arrow arum, fringed sedge, pickerelweed, meadow beauty, golden hedge- hyssop, beaked-rush, witchgrass species, pipewort, and Dortmann's cardinal flower. Coastal ponded or slow-moving waters support several sensitive fishes, such as banded sunfish and swamp darters. Other indicator community members are warm water lake fishes, such as largemouth bass, pumpkinseed, golden shiner, bullheads, and American eel. Connecticut does not technically support a coastal plain habitat and thus should not technically include Coastal Plain Ponds. However, the bodies of water found in this freshwater aquatic habitat are associated with coastal sandy substrate areas, so for the purposes of this project, these bodies of water are referred to as such because the term "coastal plain pond" is widely used and understood. Coastal Plain Ponds are one of the state's thirteen most imperiled ecosystems (Metzler and Wagner 1998). Most of the Coastal Plain Ponds have been impacted by waterfront development, recreational beach development, and water level manipulation. Particularly impacted are the sandy shorelines. For example, the shores of Beach Pond (Voluntown) are no longer suitable for many of its former coastal plain residents. Dams, consumptive water diversions, and other anthropogenic perturbations have altered some natural Coastal Plain Ponds. The overall condition of Coastal Plain Pond habitat and associated biota in Connecticut is largely unknown. There are data on larger water bodies; however, little or no data have been collected from

most of the smaller ponds. Given the suite of threats (invasive species, development, drawdowns, etc.) and the limited amount and distribution of Coastal Plain habitat, it is appropriate to consider this habitat imperiled.

Extent/Location: They are geographically restricted and are found within a band extending down the eastern side of the Quinebaug River valley to the shore and then west as far as Wallingford.

Mapping/Notes/References: Critical Habitats GIS Layer (Freshwater Aquatic- subtype "Coastal Plain Pond") http://www.cteco.uconn.edu/guides/Critical_Habitat.htm

Representative Sites: Wyassup Lake (North Stonington)

Relative Condition Rating: Poor

Estuarine Aquatic: Coastal Rivers, Coves and Embayments

Definition: Those subtidal areas with salinities ranging from 0.5 ppt to full strength saltwater (salinities of 30 to 35 ppt) yet contained within semi-enclosed areas with water depths less than 30 feet. Key finfish species using this habitat as nursery and feeding grounds are winter flounder (*Pseudopleuronectes americanus*) and tautog (*Tautoga onitis*).

Condition: Coastal Rivers, Coves, and Embayments are those subtidal, semi-enclosed water bodies with salinities ranging from full strength seawater (30-35 ppt) to slightly brackish (0.5 ppt) and water depths less than 30 feet. The Connecticut shoreline is composed of approximately fifty distinct bays, coves, and embayments, many more than Long Island's north shore. The majority of these habitats have been negatively impacted by shoreline construction, sewage, agricultural runoff, and armoring. Highly urbanized river mouths are most heavily impacted, followed by those areas surrounded by residential beach communities.

Extent/Location: The state's coastline is divided more or less equally by four major coastal river mouths (Housatonic, Quinnipiac, Connecticut, and Thames Rivers). All together, the coastline is composed of approximately fifty cove/harbor complexes, encompassing more than 80 sq. km.

Mapping/Notes/References: DEEP GIS Data - Hydrography, http://www.ct.gov/deep/cwp/view.asp?a=2698&q=322898

Representative Sites: Lower Thames River, Mystic River/Beebe Cove, Niantic River and Bay, Lower Connecticut River, Hammonasset River/Clinton Harbor, Guilford Harbor/East and West Rivers, Branford River and Harbor, Lower Quinnipiac River/New Haven Harbor, Lower Housatonic River, Pequonnock River/Bridgeport Harbor/Lewis Gut, Saugatuck River, Norwalk River and Harbor, Holly Pond, Stamford Harbor, Greenwich Cove, and Cos Cob Harbor

Priority Areas: Lower Connecticut River, Lower Quinnipiac River/New Haven Harbor, and Norwalk River & Harbor

Estuarine Aquatic: Vegetation Beds

Definition: Those subtidal areas with significant cover of aquatic plants, both vascular and non-vascular. Vegetation Beds are highly productive communities that provide critical habitat for a diversity of GCN species at various life stages. These beds form critical nursery habitat for many species of finfish, shellfish, and benthic invertebrates. Submerged aquatic beds enhance sediment stability with their grass-like leaves and extensive root and rhizome systems.

Condition: Vegetation Beds include submerged aquatic beds on various substrates and in various salinities, such as eel grass, horned pondweed, and widgeon grass. The condition of Vegetation Beds varies markedly throughout the state, although mapping studies have shown that their total acreage is greatly reduced from historical abundances in many locations throughout Connecticut. These submerged rooted aquatic beds change dominant species with changing salinities. In brackish water along the lower Connecticut River monospecific beds of horned pondweed are found in coves and creeks with silt bottoms. As the salinity increases to ranges between 16.5 to 31 ppt, monospecific beds of widgeon grass form. These are host to epiphytic algae and other marine organisms, such as young bay scallops. Eelgrass is highly sensitive to pollution. Historically, eelgrass was common along Connecticut's coast in bays and in the lower reaches of tidal rivers and creeks. In the 1930's, eelgrass wasting disease caused a massive die-off of most beds. Recovery since then has been very slow and is compounded by poor water quality. Algae beds can provide three-dimensional cover for benthic invertebrates and young-of-year finfish. However, some beds (e.g., sea lettuce) most common near sewage outfalls can become so dense as a result of nutrient loading that they smother the underlying benthic communities.

Extent/Location: The current extent of eel grass beds in Connecticut was mapped in 2012. A total of 240 beds, covering 9.12 sq km (2,061 acres), extending from Little Narragansett Bay (off Stonington) to Duck Island (Westbrook), Fishers Island and Plum Island, NY, and the eastern north shore of Long Island, NY were documented. Additionally, remnant patches of various sizes persist in Hotchkiss Grove (Branford), Clinton Harbor, and the lower Connecticut River. This coverage is an increase of 1.15 sq km (260 acres) over the total area mapped in 2002. The 2012 mapping also recorded 80 mixed vegetated beds (eel grass and algal beds) totaling 2.6 sq km (584 acres), representing a gain of 0.4 sq km (83 acres) since 2002. Additional kelp beds are scattered in hard bottom areas in the eastern Sound.

Mapping/Notes/References: USFWS National Wetlands Inventory, DEEP GIS DATA - Eelgrass Beds available at http://www.ct.gov/deep/cwp/view.asp?a=2698&q=322898

Representative Sites: A good example of eelgrass beds are in Quiambog Cove (Stonington) and Mystic Harbor (Groton). Large algal beds are common in Norwalk Harbor, New Haven harbor and eastern Little Narragansett Bay. Large kelp beds occur off Kelsey Point (Clinton) and Millstone Point (Niantic)

Priority Areas: Niantic Bay (Niantic), Quiambaug Cove (Stonington), Little Narragansett Bay (Stonington), Norwalk Harbor (Norwalk), and Mystic Harbor (Groton)

Estuarine Aquatic: Hard Bottoms

Definition: Hard Bottoms are submerged marine bedrock outcroppings in substrates ranging from cobble to boulders. Most have significant relief and provide a protective substrate for epifauna and infauna. Despite comprising a small percentage of available habitat, Hard Bottoms are likely to be disproportionately important in the production and recruitment of fishes and important commercial invertebrates such as lobster and rock crab.

Condition: The conditions of these habitats are generally thought to be good, except for those areas degraded by sedimentation and poor water quality. A few locations have been altered to accommodate energy cables and pipelines, which inhibit migration of benthic species and expose sensitive areas to potential toxic spills.

Extent/Location: The extent of many of these habitats is mapped as navigational hazards in Long Island Sound.

Mapping/Notes/References: TNC LISEA

Representative Sites: Stratford Shoals (midway between Connecticut and New York, Townshend Ledge (off East Haven), and Kimberly Reef (near Falkner Island off Guilford).

Estuarine Aquatic: Sponge Beds

Definition: Sponge Beds are submerged marine communities exhibiting significant three-dimensional relief, often in high energy areas with significant productivity. They include well-developed communities of sponge, such as *Cliona spp.*

Condition: The condition and location of Sponge Beds is generally unknown. Sponge Beds are associated with a high diversity of vertebrates and invertebrates, many unique to this habitat, including sea urchins, coral, and reef fish.

Extent/Location: Unknown.

Representative Sites: Sponge Beds can be found surrounding Falkner Island and Kimberly Reef (off Guilford), and Lewis Gut (Stratford).

Estuarine Aquatic: Shellfish Reefs/Beds

Definition: Open water areas with concentrations of shellfish and shell hash (loose shell accumulations) forming reefs and extended beds. Common species are Eastern oyster (*Crassostrea virginica*), mussels (*Mytilus edulis, Geukensia demissa and Modiolus modiolus*), and gem clam (*Gemma gemma*).

Condition: Connecticut contains both natural and artificial beds; artificial cultured beds are leased from state or municipal governments and are well maintained for continual harvest. Beds are prevalent west of New Haven and east of the Thames River, although maintained beds are found throughout the Sound. The condition and location of natural beds are less well known and mapped, although well known natural beds exist in the eastern end of the Sound and in the lower Housatonic River.

Extent/Location: Natural shell reefs (exclusive of aquaculture operations) occur in the western Sound and large river mouths west of New Haven. These structures are very dynamic and ephemeral and no total area has been determined.

Representative Sites: Artificial beds off the Norwalk Islands and off the mouth of the Thames River. Natural beds in the eastern end of the Sound and in the lower Housatonic River.

Priority Areas: Natural beds in the eastern end of the Sound and in the lower Housatonic River.

Estuarine Aquatic: Sedimentary Bottoms

Definition: Open water areas with sedimentary bottoms with grain sizes ranging from silt/clays to coarse sands. Three major subdivisions exist (Sand, Transition, and Mud): Sand bottom - The underwater area having sediment type characterized by Reid et al. (1979) as having less than 5 percent silt/clay. Transition Bottom - The underwater area having sediment type characterized by Reid et al. (1979) as having 5 to 50 percent silt/clay. Mud Bottom - The underwater area having sediment type characterized by Reid et al. (1979) as having greater than 50 percent silt/clay. All of these sedimentary bottoms are influenced by environmental factors, such as currents, and the sediment characterization will have a major influence on benthic community composition.

Condition: Sedimentary bottoms are influenced by environmental factors such as currents and winds. Many of the nearshore Sedimentary Bottoms (particularly within harbors) have been severely impacted by human activity, but many of the offshore areas are in relatively good condition. A general decline in quality is evident from east to west within the Sound

Extent/Location: Mud bottoms comprise about 50 percent of the total bottom in Long Island Sound. The largest area is in the central basin of the Sound, between the mouth of the Connecticut and Housatonic Rivers. Transition bottom types comprise approximately 30 percent and are dispersed in patches where topography and/or currents result in mixed sediments. Sand bottoms comprise about 20 percent of the sedimentary bottoms in Long Island Sound and are most common southwest of the Connecticut River mouth (e.g., Long Sand Shoal off Old Saybrook).

Mapping/Notes/References: Reid et al 1979; USGS 2000

Representative Sites: Central basin of the Sound off Madison to Milford is representative of mud bottom; sand shoals and waves are found in the eastern portion of LIS and along the north shore of Long Island; a significant transitional area exists between them including areas around Falkner Island (off Guilford) and the Mattituck Sill (west of the mouth of the Connecticut River)

Priority Areas: All of Long Island Sound functions as one ecological unit and is highest priority, especially critical habitat areas for GCN species.

Estuarine Aquatic: Open Water

Definition: Open Water includes all the deep water areas (> 9 m) of the Long Island Sound estuary. Some of this habitat is directly connected to and influenced by the open Atlantic Ocean water through Block Island Sound or New York Harbor. Open Water provides critical habitat for large migratory marine fish, resident pelagic species, and GCN mollusks and crustacean species.

Condition: As with benthic habitats, the quality of Open Water pelagic habitat tends to improve on a gradient from west to east where it is influenced by the Atlantic Ocean. Large urbanized areas along the western coast have caused hypoxia and associated water quality problems. However, considerable tidal flushing has mitigated impacts to sediment and water quality. Locations of dredge spoil deposition and cable or pipeline spills are areas of concern.

Extent/Location: Deep water areas of the Long Island Sound estuary extend for 1,528 sq km, or approximately half of the total area of the Sound, including the middle waters from the Race to the deeper trenches in the Narrows. More open deep water occurs in the New York portion of the Sound than the Connecticut portion.

Representative Sites: The Race, deep water south of Faulkner Island (Guilford), the central basin of the Sound south of New Haven, especially in New York waters, and mid-Sound south of Norwalk.

Priority Areas: All of Long Island Sound functions as one ecological unit and is highest priority, especially critical habitat areas for GCN species.

Relative Condition Rating: Good to Excellent

Estuarine Aquatic: Algal Beds

Definition: Algal Beds include those subtidal areas with significant cover of submerged non-vascular marine plants, including attached and drift kelp (*Laminaria saccharina*), Irish moss (*Chrondrus crispus*) and sea lettuce (*Ulva spp*.). Algal canopy provides predator refuge and enhanced benthic prey critical for a diversity of GCN species at vulnerable larval and juvenile stages. Submerged aquatic beds enhance sediment stability with their grass-like leaves and extensive root and rhizome systems.

Condition: Algal beds are most abundant in low energy shallow locations, especially those areas enriched with nitrogen discharges from sewage treatment facilities. Most historically large beds that had negative effects on biodiversity have been reduced in size due to aggressive programs that have improved nearshore water quality. Algal beds are ephemeral in space and time, showing considerable variability annually and seasonally with changes in rainfall, flushing rate, storms, and grazing effects.

Extent/Location: Due to their high variability, the extent of algal beds is unknown. Common locations include, but are not limited to, sea lettuce beds surrounding large municipal sewage facilities (e.g., Norwalk, New Haven); kelp beds are associated with rocky reefs.

Mapping/Notes/References: None

Representative Sites: New Haven Harbor, Thimble Islands (Branford), Kimberly Reef (near Falkner Island off Guilfrod), and Two Tree Reef (off Waterford).

Priority Areas: Thimble Islands (Branford) and Kimberly Reef (near Falkner Island off Guilford)

Unique; Natural or Man-Made: Traprock Ridges

Definition: Traprock Ridges include a variety of habitats ranging from dense forest to open rocky summits, cliff faces, consolidated rock, boulders, gravel, talus, or unconsolidated materials. Plants can be scattered or absent, covering less than 26 percent of the substrate if present. Of most significance are large contiguous areas of forest, rich, moist lower slopes, and the rocky summit-cliff-talus complex. Traprock ridges contain many of the habitats of conservation significance that are described in this Plan, but the extensive, uninterrupted, and undeveloped nature of these ridges, and the abundance of GCN species that occur there, warrants consideration of these areas as a separate subhabitat.

Condition: Traprock ridges are generally in good condition.

Extent/Location: Connecticut River Valley and areas in Woodbury and Southbury

Mapping/Notes/References: Bedrock Geology (basalts and dolerites with associated areas of red silty shales) Geoscience datasets available for download at http://www.ct.gov/deep/cwp/view.asp?a=2698&q=322898

Representative Sites: West Rock Ridge State Park (Hamden), Sleeping Giant State Park (Hamden), and Penwood State Park (Bloomfield)

Relative Condition Rating: Good

Unique; Natural or Man-Made: Offshore Islands

Definition: Offshore islands host a variety of coastal, estuarine, and upland habitats discussed previously, but their relative isolation from the mainland makes them particularly important landscape features. Offshore islands provide an important refuge for colonial-nesting herons and ground-nesting shore birds from predators that feed on nestlings and eggs (e.g., raccoons, foxes, and domestic cats). Falkner Island hosts common tern and roseate tern colonies of national significance. They are one of the thirteen most imperiled communities in Connecticut (Metzler and Wagner 1998) as they are being subjected to development pressures and the potentially damaging effects of heavy recreational use. Offshore Islands are critically important for the breeding success of many shorebirds and provide valuable haul-out sites for marine mammals and important stopover sites for migratory species.

Condition: Offshore Islands are limited geographically and are potentially vulnerable to rising sea levels, storm damage, and other geological phenomena. The larger islands are included in the EPA Long Island Sound Stewardship Program in order to improve nesting conditions for many GCN bird species which are threatened by invasive plants and animals, storm erosion, and careless human intervention. They are being subjected to development, pressures and potentially damaging effects of heavy recreational use.

Extent/Location: There are 603 islands in Long Island Sound and adjacent river mouths, totaling 6.9 sq km (4.3 sq miles). Islands are equally distributed across the full length of the Connecticut shoreline from the Narrows through the Race and Fishers Island Sound.

Representative Sites: Mason Island (Mystic), Menunkatesuck Island (Westbrook), Charles Island (Milford), Falkner Island (Guilford), the Thimble Islands (Branford), Cockenoe Island (Westport), the Norwalk Islands (Sheffield and Chimon Islands), and Great Captain's Island (Greenwich)

Priority Areas: Falkner Island (Guilford), Charles Island (Milford), and the Norwalk Islands

Unique; Natural or Man-Made: Coastal Bluffs and Headlands

Definition: Coastal Bluffs and Headlands include cliffs and escarpments that border Long Island Sound. They can be composed of either consolidated rock (headlands) or unconsolidated sediments such as glacial till (bluffs and escarpments), with the slope and rate of erosion dependent on the substrate and exposure to wave action.

Condition: Although many bluffs and headlands have been altered by human disturbance, some natural areas exist. The vegetation can be variable, including coastal woodlands of oak and pitch pine; shrublands of bayberry, huckleberry, arrowwood, and red cedar; or grasslands maintained by mowing.

Extent/Location: Bordering Long Island Sound.

Mapping/Notes/References: Critical Habitats Layer (Coastal Bluffs and Headlands), http://www.cteco.uconn.edu/guides/Critical_Habitat.htm

Representative Sites: Rocky Neck State Park (East Lyme) and Farm River State Park (East Haven)

Relative Condition Rating: Unknown

Unique; Natural or Man-Made: Caves and Other Subterranean Habitats

Definition: Caves and other Subterranean Habitats are found throughout Connecticut. They include natural limestone caves found in the western marble valley and man-made habitats, such as aqueducts, abandoned mines, and transportation tunnels. Caves, whether natural or manmade, can have more than one entrance type and many different microhabitat zones. Water movement into and through these subterranean habitats has a major influence on the microhabitat of caves. Chambers, domes, or tunnel branches can influence cave temperatures. Crevices, ceiling pockets, fault lines, blast holes, and woody or rocky debris introduce important habitat variables that influence temperature and humidity conditions.

Condition: The condition of many natural limestone caves has been degraded to various extents by human activity. Their quality is directly linked to human access. In contrast, a number of man-made "caves" occur in protected areas with restricted access or gated entryways. They serve as relatively high-quality cave environments.

Extent/Location: Cave habitat is limited in Connecticut. Naturally occurring caves occur in calcareous areas in western Connecticut

Mapping/Notes/References: Locations of many subterranean habitats are documented on topographic maps e.g., mines, aqueducts and train tunnels. Many sites are protected or on private property and their exact locations are not open to the public. A centralized statewide coverage has not been developed.

Representative Sites: Roxbury Iron Mine Land Trust Property.

Relative Condition Rating: Varies site by site depending upon access restrictions

Unique; Natural or Man-Made: Urban and Man-made Features

Definition: Urban and Man-made features are characterized by high population density and a high degree of impervious surfaces. City parks and greenways are included in this habitat. Building complexes and transportation infrastructure are also included because various species of wildlife have adapted to use these man-made features.

Condition: The quality of urban habitat for some species has declined. The redesign of building roof-tops and the replacement of gravel with alternative roofing materials has decreased nesting habitat for common nighthawks. Likewise, the capping and lining of chimneys has decreased roosting and nesting habitat for chimney swifts. The present and future condition of urban habitats is directly related to awareness of, and information about, wildlife and their use of urban habitats and man-made features. Urban and suburban habitat could be improved through: 1) the adoption of architectural elements designed to provide habitat or reduce mortality; 2) the management of urban green spaces to enhance their ecological value; 3) the landscaping of urban and suburban properties with non-invasive, preferably native, plant species; and 4) the adoption of low-impact and cluster development elements with the goal of maximizing areas of contiguous open space and minimizing their perimeters.

Extent/Location: Statewide

Representative Sites: City of Hartford, City of Bridgeport

Relative Condition Rating: Poor

Unique; Natural or Man-Made: Cliffs and Talus Slopes

Definition: Cliffs with steep rock faces or slopes formed by masses of fallen rock (talus) at their base. Cliffs may be naturally occurring or may result from human activities such as quarrying. Plants are usually scattered, covering less than 25 percent of the substrate, and often

occurring as small tufts lodged in cracks or crevices. The area may be open or shaded by adjacent overhanging trees. At some locations, vegetation may be completely absent depending upon moisture availability and shading. Pioneer species, such as mosses and lichens, may have moderate coverage on cliffs. Herbaceous vegetation is generally perennial and xerophytic, often with adaptations to the movement and weathering of the substrate. Typical vegetation includes mountain spleenwort, wallrue spleenwort, maidenhair spleenwort, purple cliffbrake, bluebell bellflower, red columbine, mosses, narrowleaf pinweed, rusty woodsia, little bluestem, churchmouse threeawn, rock harlequin, poverty grass, and early saxifrage.

Condition: The condition of cliffs and talus slopes is generally good. Although the thin soils are subject to erosion, and some invasive species are able to take hold, species occurring in these areas are generally well adapted.

Extent/Location: Scattered statewide. In Connecticut talus slopes are typically associated with traprock ridges in the Connecticut River Valley.

Mapping/Notes/References: Quaternary geology GIS data http://www.cteco.uconn.edu/guides/Quaternary_Geology.htm (Talus). Also Surficial Materials Layer. Cliffs are not among the geoscience data layers but could be derived using the surficial materials data layer and the Contours data or, Lidar data to identify extreme slopes

Relative Condition Rating: Good

Unique; Natural or Man-Made: Surface Springs and Seeps

Definition: Seeps and surface springs are characterized by saturated wetland soils that receive groundwater discharge throughout the year.

Condition: Surface Springs are one of Connecticut's thirteen most imperiled communities and are found statewide (Metzler and Wagner 1998). It is likely that more than 95 percent of them have been modified. Historically, these springs were used by early colonists for a water supply. Associated wildlife of conservation concern includes invertebrates and the state threatened northern spring salamander. Native brook trout also are associated with the cold water streams fed by these springs.

Extent/Location: Surface Springs are distributed throughout Connecticut and are often associated with seeps or cold headwater streams. It is rare to find a Surface Spring with year round runs of more than 50 feet.

Representative Sites: An example of a Surface Spring is found at Dismal Swamp (Milford).

Unique; Natural or Man-Made: Vernal Pools

Definition: Vernal pools are landscape depressions that periodically fill with water and lack a permanent above ground outlet. These basins fill with the rising water table or with the meltwater and runoff of snow and rain. Vernal pools hold water for a few months in the spring and early summer and are usually dry by late summer. Because of the ephemeral nature of vernal pools, they generally do not support fish. In the absence of fish, many wildlife species, especially amphibians, can thrive in these habitats, using them as breeding and feeding sites. Vernal

pools can be found in a variety of habitats in low areas of a forest, in the floodplain of a river or stream, within a vegetated wetland, in an open field, between coastal dunes, in abandoned quarries or natural rock formations, and other areas where water pools.

Condition: The condition of vernal pools varies widely and is not well documented.

Extent/Location: Vernal pools can be found scattered across Connecticut in a variety of habitats in low areas of a forest, in the floodplain of a river or stream, within a vegetated wetland, in an open field, between coastal dunes, in abandoned quarries or natural rock formations, and other areas where water pools.

Mapping/Notes/References: The location of vernal pools is documented in a variety of decentralized resources including forest management plans, local wetland, maps, and land trust maps. A state wide GIS layer pulling from all the possible sources of information has not yet been developed.

Representative Sites: Vernal pool on the Beaver Marsh Trail at Sessions Woods Wildlife Management Area (Burlington).

Relative Condition Rating: Varies widely, mostly unknown.

Unique; Natural or Man-Made: Agricultural Lands

Definition: Agricultural lands include areas with low impervious cover that are managed for the production of agricultural crops and livestock. This includes cultivated fields, orchards, Christmas tree farms, pastures, and hayfields, among others. It should be noted that pastures or hayfields may also be categorized as Wet Meadow and Warm or Cool-Season Grassland habitat described previously.

Condition: According to the 2012 USDA Census of Agriculture, over 5,700 acres of cropland and pastureland were taken out of production in Connecticut during the previous five-year period. Although this decrease does not necessarily indicate conversion, open fallow fields may be more susceptible to commercial and residential development.

Extent/Location: Statewide

Mapping/Notes/References: UConn Clear Land cover data: http://clear.uconn.edu/projects/landscapelis/landcover.htm

Representative Sites: Wethersfield Meadows (Wethersfield)

Relative Condition Rating: Good

Unique; Natural or Man-Made: Navigational channels, Breakwaters, Jetties and Piers

Definition: Channelized areas of coastal rivers, coves, and embayments where tidal effects of current and salinity are augmented by depth and geometry. Few are naturally occurring corridors created and maintained by river flow; most are augmented natural corridors that have been widened, lengthened, or altered to meet navigational needs; some are carved out of tidal marshes or mud flats with no contributing

natural tidal flow. Most of these channel areas are frequently disturbed by maintenance dredging, which keeps the benthic and infaunal communities in simplified, early successional status. Many serve as connecting corridors of deeper and more saline habitats used by spawning and foraging marine species. GCN species served by this man-made habitat include shortnose and Atlantic sturgeon, winter flounder, summer flounder, bluefish, and American lobster. Altered shoreline geometry creating breakwaters, jetties and piers where tidal effects of current, salinity, and sedimentation are affected by three-dimensional man-made structures. Often these structures provide habitat for benthic organisms favoring hard substrates and slow current, which promote sediment accumulation. GCN species served by this man-made habitat include blue crab, blue mussel, reef fish such as tautog, and forage fish such as three-and four-spine sticklebacks and sheepshead minnow.

Condition: Most channelized areas are in perpetual flux, temporarily deepened and/or widened by dredging and boat wake scour, followed by sediment settling and recolonization by benthic infauna and their predators. Storm surge, which may become more severe with climate change, quickens this cycle of scour and recolonization. Warming trends may make these deeper waters critical corridors of tolerable water temperature and salinity. Communities associated with shoreline groins and piers are more stable, but can inhibit natural riparian connectivity and magnify storm surge scour. Discharges from boating and industrial activities adjacent to these structures can degrade water quality.

Extent/Location: Every harbor, river mouth, and most marinas maintain navigational corridors, breakwaters, jetties and/or piers, which alter the natural sedimentation patterns of the coastline and riparian zone. Most of these navigational channels and structures have been maintained for decades or up to a century or more. Current regulations and increasing expense have curtailed some construction and dredging projects in scope and frequency in smaller embayments. In contrast, commercial harbors (e.g., Bridgeport, New Haven, and New London/Groton) have increased the extent of riparian structures and dredged channels to accommodate increasingly large shipping vessels and recreational access. The expectation of more frequent and severe storm activity with future climate warming may exacerbate the effects of these large projects.

Mapping/Notes/References: NOAA navigational charts; horseshoe crab shoreline GIS layer: manmade structure

Representative Sites: Thames River channel (Groton/New London), Connecticut River channel and breakwaters, New Haven Harbor channel and breakwaters, Long Wharf Pier (New Haven), Milford Point Jetty (Milford), Bridgeport Harbor channel and piers, and Norwalk River channel and piers.

Priority Areas: Connecticut River channel, New Haven Harbor channel and breakwaters.

Unique; Natural or Man-Made: Public Utility Transmission Corridors

Definition: In Connecticut, public utility transmission corridors often contain a variety of early successional habitats that are maintained through periodic vegetation management. Although such management is intended to protect overhead wires or subterranean pipelines, the resulting shrublands, grasslands, and sparsely vegetated areas provide suitable habitat for many GCN species. In some cases, the habitat within transmission corridors has allowed early successional species to persist in areas that would have otherwise reverted to closed canopy forests. Transmission corridors are also unique in that they form networks of linear habitat, which can facilitate species movement across the landscape.

Condition: The condition of habitats within transmission corridors varies widely. Some upland and wetland areas have been heavily degraded by invasive species while others remain exemplary occurrences of native plant communities. In addition, areas that are continuously trafficked by unauthorized vehicles may serve as sinks for GCN species that require exposed soil, but are intolerant of disturbance during one or more life stages.

Extent/Location: Statewide

Mapping/Notes/References: Layers exist but are not publicly available (likely due to homeland security concerns). UConn Clear Land cover data also has a classification for "Utility Rights-of-way (Forest)". This includes utility rights-of- way that were manually digitized on-screen from rights-of-way visible in the Landsat satellite imagery. The class was digitized within the deciduous and coniferous categories only. http://clear.uconn.edu/projects/landscape/project.htm

Priority Areas: Transmission corridors through areas of circumneutral, calcareous, or sandy soils. Corridors through New England Cottontail Focal Areas.

Relative Condition Rating: Poor to Good. Condition of habitat within transmission corridors varies widely.

APPENDIX 2b: CROSSWALK OF CONNECTICUT'S HABITATS

This appendix links Connecticut's Key Habitats to the National Land Cover Class Definitions (NLCD) described in the National Land Cover Characterization (USGS 2001; http://landcover.usgs.gov/natllandcover.html) and to the National Vegetation Classification System (NVC) described in NatureServe Explorer: An Online Encyclopedia of Life (2005; http://www.natureserve.org/explorer). AFWA guidance recommended that linkage be made between states' key habitats and regional and national classification systems. This appendix addresses Element 2.

Information in Columns 2-5 is from The Vegetation of Connecticut (Metzler and Barrett 2006). In the last column (NVC), "NA" notes where there is no NVC correlate to Metzler and Barrett.

CT SWAP Habitat	CT SWAP Sub-Habitats or Vegetative Community	NETHCS Ecological Systems	ES_CODE
1) Upland Forest	a) Oak Forests	Central Appalachian Dry Oak-Pine Forest	202.591
		North Atlantic Coastal Plain Hardwood Forest	203.475
		Northeastern Interior Dry-Mesic Oak Forest: moist-cool	202.592
		Northeastern Interior Dry-Mesic Oak Forest: typic	202.592
	b) Calcareous Forests	Central Appalachian Alkaline Glade and Woodland	202.602
	c) Coniferous Forests	Appalachian (Hemlock)-Northern Hardwood Forest: drier	202.593
		Appalachian (Hemlock)-Northern Hardwood Forest: moist-cool	202.593
		Appalachian (Hemlock)-Northern Hardwood Forest: typic	202.593
		Laurentian-Acadian Pine-Hemlock-Hardwood Forest: moist-cool	201.563
		Laurentian-Acadian Pine-Hemlock-Hardwood Forest: typic	201.563
		Northeastern Coastal and Interior Pine-Oak Forest	203.999
	d) Old Growth Forests	N/A (habitat structural character within other systems)	N/A
	e) Northern Hardwood Forests	Appalachian (Hemlock)-Northern Hardwood Forest: drier	202.593
		Appalachian (Hemlock)-Northern Hardwood Forest: moist-cool	202.593
		Appalachian (Hemlock)-Northern Hardwood Forest: typic	202.593
		Laurentian-Acadian Northern Hardwood Forest: typic	201.564
		Laurentian-Acadian Northern Hardwoods Forest: moist-cool	201.564
	f) Mixed Hardwood Forests	N/A (may represent transition between forest types or may result from previous land management practices)	
	g) Young Forests	N/A (habitat structural character within other systems)	N/A
	h) Maritime Forests	North Atlantic Coastal Plain Maritime Forest	203.302
2) Upland Woodland	a) Red Cedar Glades	Central Appalachian Alkaline Glade and Woodland	202.602
	b) Pitch Pine and Scrub Oak Woodlands	Northeastern Interior Pine Barrens	202.590

CT SWAP Habitat	CT SWAP Sub-Habitats or Vegetative Community	NETHCS Ecological Systems	ES_CODE
and Shrub	c) Maritime Shrublands	North Atlantic Coastal Plain Heathland and Grassland	203.895
	d) Reverting Field and Early Successional Shrubland	NLCD 52/71: shrublands/grasslands	5271
3) Upland Herbaceous	a) Coastal Dunes	Northern Atlantic Coastal Plain Dune and Swale/Sandy Beach	203.264/203.301
	b) Grassy Glades and Balds	Northern Appalachian-Acadian Rocky Heath Outcrop	201.571
	c) Sand Barrens and Sparsely Vegetated Sand and Gravel	N/A	N/A
	d) Warm Season Grasslands	North Atlantic Coastal Plain Heathland and Grassland	203.895
		NLCD agricultural classes 81-82	80
	e) Cool Season Grasslands	NLCD agricultural classes 81-82	80
4) Forested Inland Wetland	a) Atlantic White Cedar Swamps	North Atlantic Coastal Plain Basin Peat Swamp	203.522
	b) Red/Black Spruce Swamps	North-Central Appalachian Acidic Swamp	202.604
		Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	201.574
	c) Northern White Cedar Swamps	Laurentian-Acadian Alkaline Conifer-Hardwood Swamp	201.575
	d) Floodplain Forests	Central Appalachian River Floodplain	202.608
		Central Appalachian Small Stream Riparian	202.609
		North-Central Interior Wet Flatwoods	202.700
	e) Red Maple Swamps	North-Central Interior and Appalachian Rich Swamp	202.605
5) Shrub Inland Wetland	a) Bogs and Fens	North-Central Interior and Appalachian Acidic Peatland	202.606
	b) Shrub Swamps	Laurentian-Acadian Wet Meadow-Shrub Swamp	201.582
6) Herbaceous Inland Wetland	a) Calcareous Spring Fens	North-Central Appalachian Seepage Fen	202.607
	b) Freshwater Marshes	Laurentian-Acadian Freshwater Marsh	201.594
	c) Wet Meadows	NLCD agricultural classes 81-82	80
7) Tidal Wetland	a) Salt and Brackish Marshes	North Atlantic Coastal Plain Tidal Salt Marsh: salt/brackish/oligohaline	203.519
	b) Intertidal Beaches, Flats, and Shores	Northern Atlantic Coastal Plain Dune and Swale/Sandy Beach	203.264/203.301
8) Freshwater Aquatic	a) Large Rivers and Streams and their Associated Riparian Zones	N/A (not a system type)	N/A
	b) Unrestricted, Free-flowing Streams	N/A (not a system type)	N/A
	c) Cold Water Streams	N/A (not a system type)	N/A
	d) Head-of-Tide	N/A (not a system type)	N/A
	e) Lakes and their Shorelines	N/A (not a system type)	N/A
	f) Coastal Plain Ponds	N/A (not a system type)	N/A
	a) Coastal Rivers, Coves, and Embayments	N/A (not a system type)	N/A

CT SWAP Habitat	CT SWAP Sub-Habitats or Vegetative Community	NETHCS Ecological Systems	ES_CODE
	a) Coastal Rivers, Coves, and Embayments	N/A (not a system type)	N/A
9) Estuarine Aquatic	b) Vegetated Beds	N/A (not a system type)	N/A
	d) Sponge Beds	N/A (not a system type)	N/A
	e) Shellfish Reefs/Beds	N/A (not a system type)	N/A
	f) Sedimentary Bottoms	N/A (not a system type)	N/A
	g) Open Water	N/A (not a system type)	N/A
10) Unique; Natural or Man-made	a) Traprock Ridges	Not a system type, but highly associated with the following systems:	N/A
		Central Appalachian Pine-Oak Rocky Woodland	202.600
		North-Central Appalachian Acidic Cliff and Talus	202.601
	b) Offshore Islands	N/A (not a system type)	N/A
	c) Coastal Bluffs and Headlands	Acadian-North Atlantic Rocky Coast	201.573
	d) Caves and other Subterranean Habitats	N/A (small-scale habitat element within other systems)	N/A
	e) Urban and Man-made Features	NLCD developed classes 21-24 & 31	20
		Laurentian-Acadian Acidic Cliff and Talus	201.569
		North-Central Appalachian Circumneutral Cliff and Talus	202.603
	g) Surface Seeps and Springs	N/A (small-scale habitat element within other systems)	N/A
	h) Vernal Pools	N/A (small-scale habitat element within other systems)	N/A
	i) Agricultural Lands	NLCD agricultural classes 81-82	80
	j) Navigational Channels, Breakwaters, Jetties, and Piers	N/A (not a system type)	N/A
	k) Public Utility Transmission Corridors	N/A (not a system type)	N/A