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Open Space Planning; Utilizing Green Infrastructure to Preserve Community

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Open Space Planning;
utilizing green infrastructure to preserve community

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Open Space Planning;
utilizing green infrastructure to preserve community

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TABLE OF CONTENTS

ABSTRACT

Current sprawl development patterns typical of contemporary development in the United States are unsustainable. The uniform development guidelines prevent context sensitive community design, degrading our communities and consuming large amounts of natural and cultural resources. Significant progress has been made in reorganizing community planning towards sustainable development practices. However, these alternatives still work under the misconception that there is a disconnect between planning open space networks and planning development. Through a comprehensive land use planning approach, this project explores combining concepts of landscape ecology, green infrastructure planning and conservation subdivision patterns to design an integrative open space/community network.

INTRODUCTION:

Subdividing Communities

My concern about continued sprawled subdivision development patterns stems from comparison between my hometown and that of my parents. I grew up in Plainfield, a small New Hampshire town along the Connecticut River. Two village centers hold much of the population (about 2,400 residents) with clustered housing, churches, libraries, and an office or two. There are as many dirt roads as there are paved, main street is the center of activity, and homes are scattered among forest, field and marsh. My parents tell me that their hometown of Southington, CT was much the same as Plainfield 40-some-odd years ago. They told me about it during a summer visit to the Southington area. I sat in the back seat and listened to my parents as they pointed to the unrelenting march of subdivisions and told me about what used to be there; these houses used to be the farm of a friend, this subdivision was a woodland that kids would cut through en-route to school... my father mused that it was likely just that Plainfield would develop similar patterns. I sat in amazement, trying to imagine the transformation of Southington occurring in Plainfield; my picturesque hometown covered in a blanket of development. It was then, in that car on a hot summer day, that I realized the importance of conserving beautiful places and creating a landscape for living.

CHAPTER 1: PRESENTING THE ISSUES

Land Development in the U.S.A.

----Post WWII Development Practices----

Transportation improvements and population growth experienced in the United States after WWII engendered and enabled mass-produced subdivisions as the typical development practice across the country. (Van der Ryn & Calthorpe, 1986; Nelson & Duncan, 1995) Highway construction and paving rural roadways made lands surrounding cities available for development. This coincided with social forces of urban emigration, creating a market for subdividing rural lands around cities into residential housing plots. The subdivisions provided 'miniaturized estates' to a growing middle class that was chasing the 'American Dream' through a plot of land to call their own. (Van der Ryn & Calthorpe, 1986) Social pressure was augmented by the Federal housing Acts of the 1940's and 50's which used financial incentives and suggested development layouts to promote suburban development (Nelson & Duncan, 1995; Nelson, 2006). An example of the typical suburban development pattern is Levittown, NY (shown in Figure 1.1), one of the first of these subdivision developments to be constructed. (Dunham-Jones & Williamson, 2009) The speed with which subdivisions were designed and constructed resulted in the deterioration of community design from integrated site-appropriate design, to a mono-culture of mass produced boxes. Building plots were

Figure 1.1) Levittown, NY
(image from NYTimes.com)

arranged for maximum unit yield, and land bulldozed to fit the engineering layout. Consideration of the impacts on existing natural and cultural systems was virtually unheard of, resulting in the loss and degradation of many of the natural and cultural features which had attracted development. This is not to say that all developments before this era are idyllic, nor that all those built afterwards are prosaic. It is however accurate to state that pre-WWII developments were more likely to be designed to create a place, whereas post-WWII developments were designed to be constructed quickly.

Contemporary sprawl development patterns result from the continued adherence to guidelines provided by the FHA in its 1938 bulletin for 'Planning Profitable Neighborhoods' as well as standardized subdivision design practices presented in 1954 (Nelson, 2006). The 1938 bulletin discussed street network, promoting disconnected street networks in part to limit through-traffic in urban residential areas. The 1954 design recommendations were intended for the subdivision of rural lands. The disconnected street network was maintained, though the focus of these recommendations were on land use segregation, automobile access and accommodating nuclear families. (Nelson, 2006) An example of a typical New England residential subdivision is seen in Figure 1.2. Note the disconnected street network and isolated housing units which create 'miniature estates'.

Figure 1.2) Rural MA Sprawl (image from umass.edu)

----*Standard Development Practices in Contemporary Rural America*-----

Land use decisions continue to follow the FHA guidelines through the use of planning and zoning regulations. (Van der Ryn & Calthorpe, 1986) The use of planning and zoning established itself in American development decision-making in 1916 when New York city became the first municipality to adopt zoning regulations. (Porter, 2008) Presently, towns have zoning maps that indicate lands available for residential subdivision, and subdivision regulations dictate minimum lot size, structural square-footage allowances and street design requirements etc. (examples can be found in most towns, like East Lyme and Mansfield, Connecticut).

The consequence of following the standardized subdivision guidelines for decades has been the conversion of vast amounts of rural land into scattered residential developments. During the 1990's alone, rural land was developed at a rate of 1 million acres per year. Most of this land developed was farms or forests located on the outskirts of cities and near highway interchanges. (Benedict & McMahon, 2006)

> "Land use decisions are normally made independent of social, ecological or human behavior concerns. . . . The larger values of society and those of the ecosystem in question have been ignored by such activities." (Rodiek, 2010)

Without plans in place to coordinate the location of subdivisions, town planning was de facto the responsibility of land owners and developers. As a result, there was little recourse for environmentalists to protect natural and cultural features as low-density subdivisions and retail strips were built atop farmlands, sensitive habitats, and historically significant sites with thirty to forty percent of the land dedicated to automotive infrastructure. (Porter, 2008; Van der Ryn & Calthorpe, 1986)

Land Conservation in the U.S.A.

------Environmentalism Challenges Unchecked Suburban Growth------

The most effective way to prevent environmental and cultural degradation due to subdivision development is to stop developing. This is however an untenable solution. Beyond the reality that population growth continues to create demand for single-family homes, landowners value their right to locate development where and how they chose. (Duany et al., 2010; Nelson, 2006) In order to guide development without impeding landowner rights, planning and zoning regulations were promoted through financial incentives such as loans and mortgages provided for subdivision developments which follow FHA recommendations. (Rodiek, 2010; Nelson & Duncan, 1995) However, these regulations did nothing to protect communities from cookie-cutter developments sprawling across the landscape. During the 1970's legislation coupled with state and regional agencies were established to stem the undiscriminating development of natural and cultural resources. (Mason, 2008; Porter, 2008) Hoping to ameliorate the inadequacies of local agencies in effectively managing growth, state and regional agencies focused on coordinating and mandating planning and growth management activities. By encouraging and facilitating strategic land use planning, controlling agencies worked to prevent the loss of the environmental and natural features which had attracted new development in the first place. (Nelson & Duncan, 1995)

An important aspect of growth management was state mandated documentation of town resources and future development plans. Generally this document is in the form of a town Plan of Conservation and Development (hereto after POCD). (Porter, 2008; Mason,

2008) Town POCD's provide information and summaries of town policy and intent regarding issues such as economic development and land use goals. (CT general statutes, 2010) A typical section of a POCD is an Open Space plan. The Open Space plans identify lands throughout the town which should remain as naturalized/undeveloped lands. These lands could be any lands from woodlands or habitat protection areas to historically significant sites. However, when attempting to find a definition of open space in POCD documentation, little success was made. One definition was found in Coventry, CT POCD:

> "...land that is preserved, protected and may have use restrictions for any of the following purposes:
> 1. Maintains or enhances the conservation of natural, scenic, cultural and historic resource.
> 2. Protects wetlands/watercourses and other bodies of water.
> 3. Protects water supply sources.
> 4. Promotes the conservation of soils and prime farmland
> 5. Enhances the public value of abutting or neighboring parks, forests, wildlife preserves, natural reservations and sanctuaries, and/or other open space.
> 6. Enhances public recreation opportunities.
> 7. Preserves historic and/or culturally significant sites.
> 8. Assists in the promotion of orderly growth and development."
>
> (Coventry POCD, 2010)

Many towns provide an Open Space plan without defining the term. Lands are identified as open space based on areas inappropriate for development, and by default appropriate for conservation. The theory is that by implementing the open space plan, natural and cultural resources can be protected from continued sprawl development. (Mason, 2008; Porter, 2008; Nelson & Duncan, 1995)

-----Identifying Critical Areas for Conservation Via Open Space Plans-----

In order to maximize effectiveness of Open Space plans, towns must prioritize lands by identifying target areas for conservation (Bryan et al., 2010). Also known as 'place-based environmentalism' or 'critical area protection', land prioritization is organized based on a variety of criteria unique to the locale. Depending on what natural/cultural features are present in a town, and how the community values those features, planners may attempt to protect the habitat of a target species, a particular eco-region, or a site with historical significance. (Mason, 2008)

Determining what areas of a town are critical for conservation can be based on environmental and/or social variables. By utilizing local residents as community experts, planners are able to identify regionally-critical areas for conservation as well as locally valued places. For instance, biodiversity initiatives look for habitats of endangered species to identify as critical conservation areas. Residents of a town may not be aware of the endangered-species-habitat, but are aware of a hilltop view or stand of trees as culturally significant. These are two different, but valid, attitudes towards critical area identification. (Bryan et al., 2010) Planners have the opportunity to bring in broader ecological issues of landscape ecology and biodiversity protection while using local residents to help identify place-specific priorities.

If open space plans are designed based on individual critical area protection, the planning may fail as a resource protection technique in terms of the health and functionality of the local systems impacted by conservation efforts. By focusing conservation efforts at specific sites as patches, planners inadvertently create fragmented remnants of nature degraded by isolation. (Benedict & McMahon, 2006; Forman, 1995) An

'adjoining land strategy' is a method used in locating critical areas for conservation which helps to mitigate ecosystem degradation by encroaching development and isolation. In brief, undeveloped lands adjacent to existing tracts of conserved lands should be prioritized for conservation. Protecting lands adjacent to undeveloped parcel follows landscape ecology principles which promote contiguous open space area to mitigate adverse effects of development on core habitat areas. (Arendt, 2004; Forman, 1995; Miller, 2009) The importance of using the adjoining lands strategy is seen in the review of CLEAR's Forest Fragmentation study and landscape ecology principles. CLEAR used national research of development impact on forests to determine a forest edge width to be 300 feet. This means that the effect of development on the forest systems fades at 300 feet, here the edge forest transitions into core forest. From a landscape ecology standpoint habitat edge conditions may be anywhere between 50 and 100 feet depending on species and vegetation. These areas may be impacted by proximity to non-forested areas, but is still inhabitable by wildlife. (CLEAR, 2008; Forman, 1995)

-----*Implementing Conservation Via Open Space Plans*-----

Contemporary methods for implementing open space plans utilize legislation, land acquisition, and/or development planning frameworks. A legislative model of 'command-and-control' can be a highly effective method for preserving a valued resource. In such instances, a central government establishes specific, legally binding requirements which apply to the lands within that jurisdiction. (Mason, 2008) A common example of this is wetlands protection. The ecological, water purification and flood-control functions of wetlands were deemed to be a priority conservation area by both

environmental experts and communities. This methods is easily applied over large areas as it does not require a parcel-by-parcel inventory to locate all occurrences.

Land acquisition is a time intensive and costly method for natural resource protection is land acquisition. However, it is a widely accepted method. Purchase and dedication of lands for open space generally takes place through public or private agencies. Public agencies will identify areas for purchase or easement using a ballot vote to approve funding. Non-profit land trusts also seek to purchase land for protection. These are locally active private organizations, and therefore do not need consensus on investment decisions. Limited local funding for resource protection can be an obstacle to successful open space plans because it is often not feasible for towns to secure lands for dedicated open space. (Bryan et. al., 2010; Miller et. al., 2009) Land can be expensive and there is little to no profit in deeding land as open space, this is often an unreliable method in land use planning. Despite this, town open space plans generally depend upon its use. (Mason, 2008)

Sustainable development planning frameworks are a method of protecting cultural and natural resources by limiting green field development. A broad but fitting definition for sustainable development is that it "..is economically sound, environmentally friendly, and supportive of healthy communities." (Van der Ryn & Calthorpe, 1986) As a conservation technique, these models utilize dense development patterns to create healthy communities, simultaneously limiting consumption of town land/resources. Development models such as Smart Growth and New Urbanism, can be promoted in a municipality to limit sprawl development patterns. (Nelson & Duncan,1995; Porter, 2008)

----*Integrating Conservation Planning and Sustainable Development*-----

Green Infrastructure planning is a more recent method for open space/natural resource protection planning which integrates conservation and development planning. Green Infrastructure is defined as an "...interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife. (Benedict & McMahon, 2006)" The 'green infrastructure' open space planning technique identifies critical areas and then evaluates the connections between those areas and the community. This has cultural benefits such as longer walking trails and more accessible natural areas. There are also environmental benefits such as limiting habitat fragmentation and patch isolation. By designing a green infrastructure method as part of the open space plan, towns can enhance the quality of naturalized areas, and help prioritize critical areas. (Benedict & McMahon, 2006)

The use of conservation subdivisions is promoted by Randall Arendt as a method of integrating greenways and development planning into cohesive networks. He defines greenways as "community-wide and regional systems of interconnected open space that will ultimately coalesce to produce a network of linked landscapes." (Arendt, 2004) Figure Conservation subdivision is well suited to a pairing with Green Infrastructure; conservation subdivision approaches the issue with a focus on development whereas the Green Infrastructure focus is on resource conservation. By using both approaches in designing an open space network, town planning could eliminate the perception of development and conservation as being mutually exclusive. In his article, *Linked Landscapes,* Randall Arendt discusses the potential for pre-identification of conservation

areas within subdivisions in such a way that each development situates its open space to enhance the community-wide conservation network. 1.3 is an example of how conservation subdivisions and green infrastructure could be utilized to protect natural and cultural resources. By using conservation subdivisions, Arendt argues that conserved lands could account for forty to seventy percent of the buildable lands within a subdivided parcel. (Arendt, 2004)

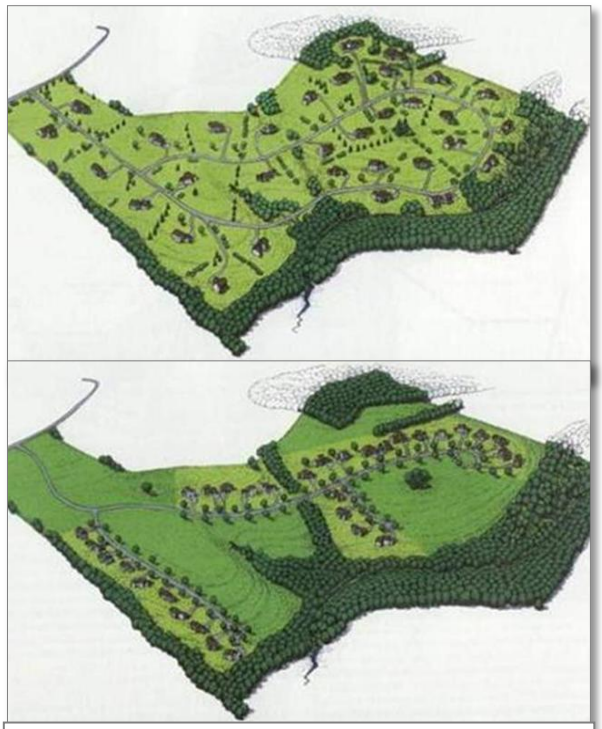


Figure 1.3) Standard Subdivision (top) and Conservation Subdivision (bottom) by Randall Arendt

Difficulties in implementing cluster subdivisions include a gap in rhetoric and implementation. Entrenched zoning regulations and social opinion of suburbs as desirable landscapes combine to make use of cluster subdivisions rare. Market demands and consumer preference are more influential with developers than are theories of sustainability produced by planners, even if those theories are supported by local government agencies. (Grant, 2009) Of those cluster subdivisions which are constructed, the import of the community as a sustainable development is at times lost to the home-owners. (Austin, 2004) This indicates that while conservation subdivisions are appealing housing options due to aesthetics and social values (Arendt, 2004), many overlook their potential as a method of environmental conservation.

CHAPTER 2: PROJECT FRAMEWORK

Comprehensive Land Use Planning Research Project

------Lands of Unique Value Study-----

The *Lands of Unique Value Study* (hereto after *LUV Study*), is a comprehensive town-wide land use exploration involving an inclusive inventory of the town's natural and cultural systems for the purpose of facilitating sensible development policies. It includes extensive resource documentation and community coordination to compile recommendations for future land uses and policy associated with land under municipal regulatory jurisdiction.

The LUV Study has been developed to address the gap in communication between developers, town officials, and citizens and provide a foundation for informed land use decision-making. The study was designed by Associate Professor Peter Miniutti of the Landscape Architecture program at the University of Connecticut (hereto after UConn), in accordance with EPA Smart Growth principles as seen through the EPA websites as well as the *Smart Growth Online* resource. The study facilitates discussion on development location, form and function, and prioritizing natural and cultural resources. These queries guide the town POCD modifications with a clear understanding of community values and priorities. Zoning regulations can then be updated accordingly; allowing town officials to streamline the types of development that the community finds appropriate, and discourage unwanted patterns. In this way, the study strives to promote a "pro-sensible development" approach to town growth; balancing conservation, preservation, and sustainable development.

The document presented to the town at the end of the study is representative of community values and the expertise of LUV Study researchers from UConn's Community Research and Design Collaborative (hereto after CRDC). It provides a foundation of information in the form of inventory mapping and a set of recommendations (as seen in Figure 2.1) for enhancing community character, locating future development, transportation and an open space system. As such, it is meant as a resource for town officials, perspective developers and environmental conservationists alike. It is not intended to dictate what should or should not be done, but rather to highlight community concerns/values and suggest methods for addressing those issues. The CRDC team considers the document to be flexible. It is the hope that it will be adapted to suit the changing social and environmental dynamics, always working towards a healthy, sustainable future.

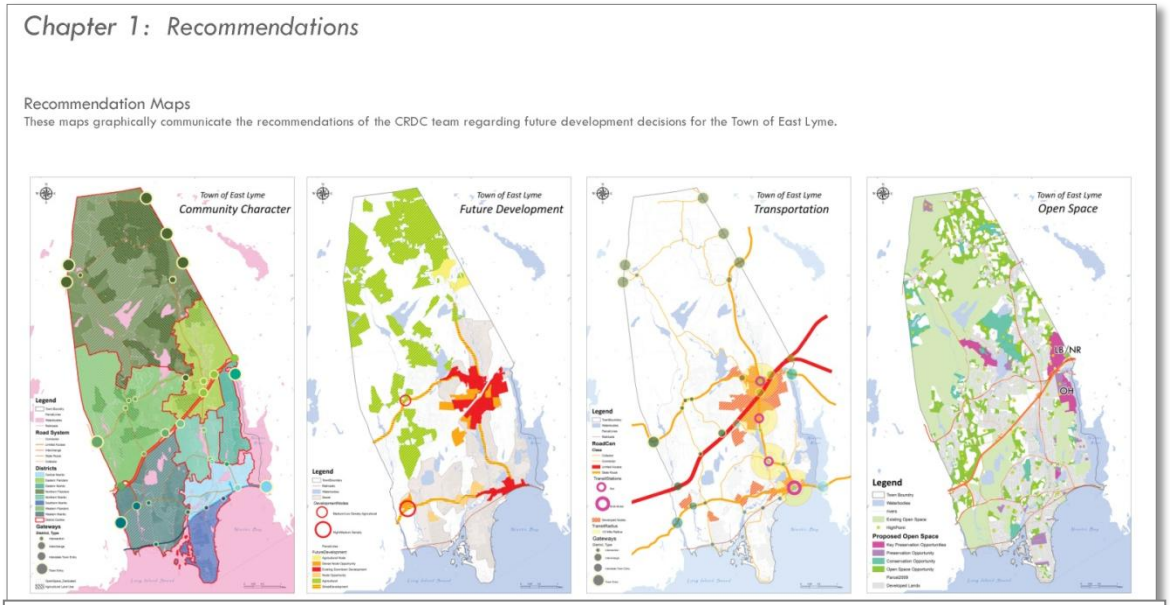


Figure 2.1) LUV Study Recommendation Maps

----Case Study Research Focus: LUV Study for East Lyme Connecticut----

Connecticut statutes require that every town produce a POCD and that the document be updated every ten years. (CT General Statutes, 2010) When the Town of East Lyme, CT, contacted Peter Miniutti about conducting a LUV Study during spring of 2008, there was just over a year until their POCD update was due (December 2009). Town officials hoped to use the work from the LUV Study research and mapping to inform the POCD updates, which would be occurring simultaneously. UConn's CRDC research team was introduced to the project in 2008 through a graduate of the UConn landscape architecture program who initiated negotiations between Peter Miniutti and East Lyme's town planner.

The town is located on Long Island Sound. For the most part it is a bedroom community; most residents commute to work at the Pfizer facility (pharmaceutical company), Millstone Nuclear Plant, and Casinos. Demographically, the town is much like most of Connecticut, with a growing population of retiree's, and a slight decline in young families. Being a beach town however, East Lyme also has a large volume of seasonal residents, and an influx of tourism each summer. The dynamic but stable community was reflected in the political situation found by CRDC team when the LUV Study process began. The town had (and has) a well-liked and respected First Selectman, a seasoned Zoning Official, a new Town Planner, and actively involved residents.

East Lyme is bisected by I-95, a condition which enhances the local perception of two towns within East Lyme; Flanders and Niantic. Flanders has a rural agricultural character, which is enhanced by its hilly terrain and challenged by encroaching sprawl

development along I-95. In Niantic the terrain is relatively level and development comprised of dense beach communities. However, more recent development transitions to sprawl as one moves North towards I-95. Both areas have a strong sense of independence from one another, though residents in Niantic value Flanders' scenic roads, and Flanders residents value Niantic's village center. Figure 2.2 shows the relationship between Flanders and Niantic.

The existing dedicated open space in East Lyme is seen in Figure 2.3. Conservation efforts in East Lyme have long focused on Oswegatchie Hills; a ridgeline along the Niantic River which is highly prized by East Lyme's citizens for its passive recreation and ecological functionality.

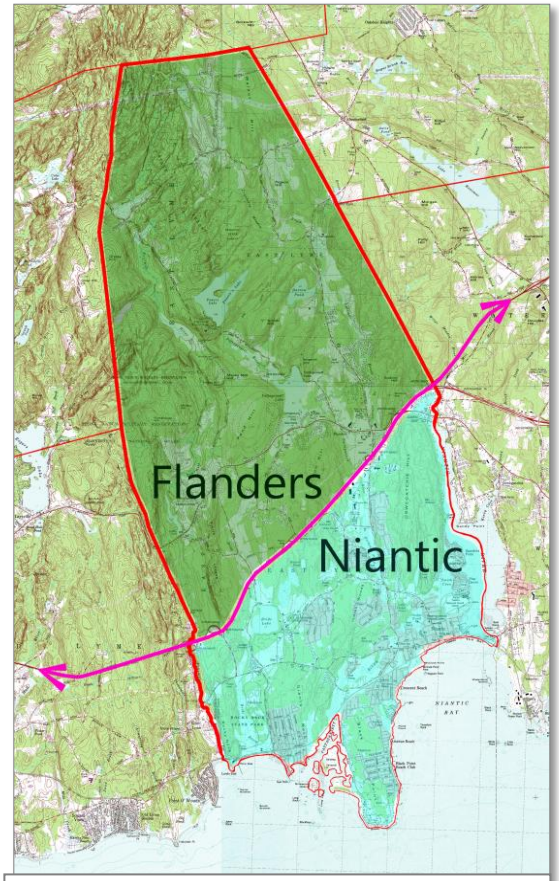


Figure 2.2) USGS map: East Lyme Villages

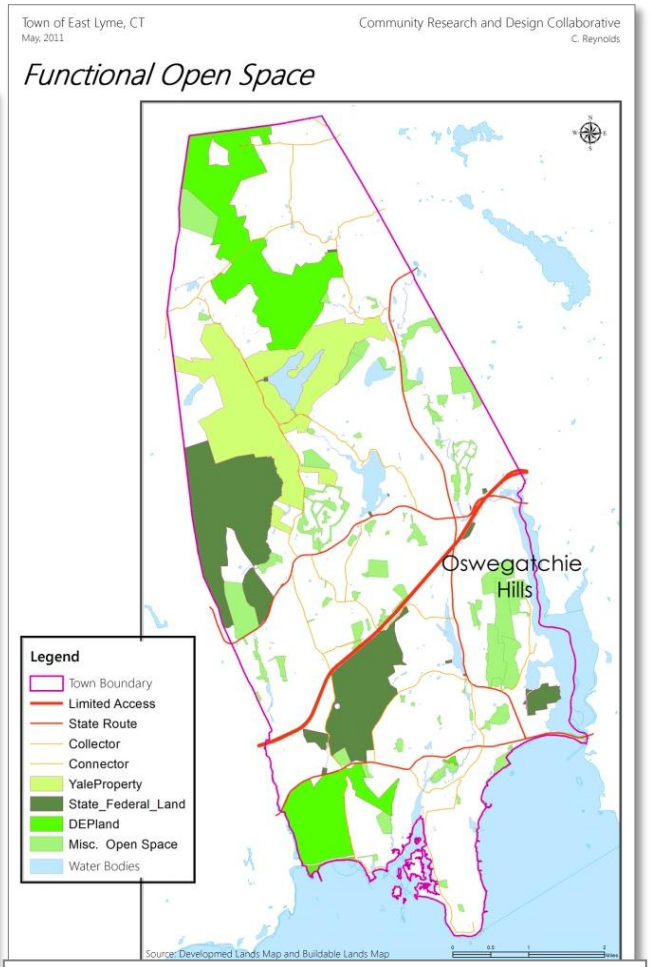


Figure 2.3) Existing Open Space in East Lyme

Other significant impacts on East Lyme conservation efforts are the large tracts of land owned by the State DEP; the Nehantic State Forest in Flanders, and Rocky Neck State Park in Niantic. Yale University also owns a large tract of forested land in Flanders which is used for forestry-research. These lands account for roughly one third of the town. These lands have maintained ownership and use for decades, with no known plans for changing in the future. As stable tracts of wooded lands with non-invasive land uses, they provide an excellent opportunity for connecting open space networks.

Current development-related conservation efforts entail cluster-development specifications in the subdivision regulations (such developments are only permitted in rural-residential districts which constitute about half of the Flanders land area). These regulations ensure that a cluster subdivision includes between fifty and seventy-five percent open space as defined in zoning ordinance 1.43 as:

> "Space on a lot or parcel that is: (A) Unoccupied by principal or accessory buildings above the finished grade; (B) Unobstructed to the sky; (C) Not devoted to service driveways, service areas, off street parking at finished grade or loading areas; (D) Devoted to landscaping, active or passive recreation and other like uses; (E) Made available in the same proportion to all occupants of the building or buildings on the lot or parcel."

Furthermore, East Lyme subdivision regulation 7-2-3 states that no more than fifty percent of said declared open space may be comprised of wetlands or water bodies. As for non-rural-residential zones, cluster subdivisions are not permitted. Throughout town the default zoning is for the standard subdivision pattern of sprawled units and remnant open space.

A recent example of such a subdivision was constructed in East Lyme. Most of the units had been finished when the CRDC team began the LUV Study, and citizens were still upset over the project. The development is called 'The Orchards' (Figure 2.4), a verbal monument to the apple orchards which had been cultivated there before development. East Lyme residents were vocal in their disappointment that planning & zoning permitted the development. In addition to the lost agriculture, *The Orchards* is located on a highpoint which used to provide a view over Niantic and out over the Niantic Bay/Long Island Sound. With typical subdivision guidelines, the development spread housing lots across the entire hill top, leaving thin strips of undeveloped land to meet open space requirements set by the town (about ten percent of the buildable land). This development is an example of what will happen to the rest of the undeveloped lands in East Lyme if steps are not taken to comprehensively plan future development and conservation efforts.

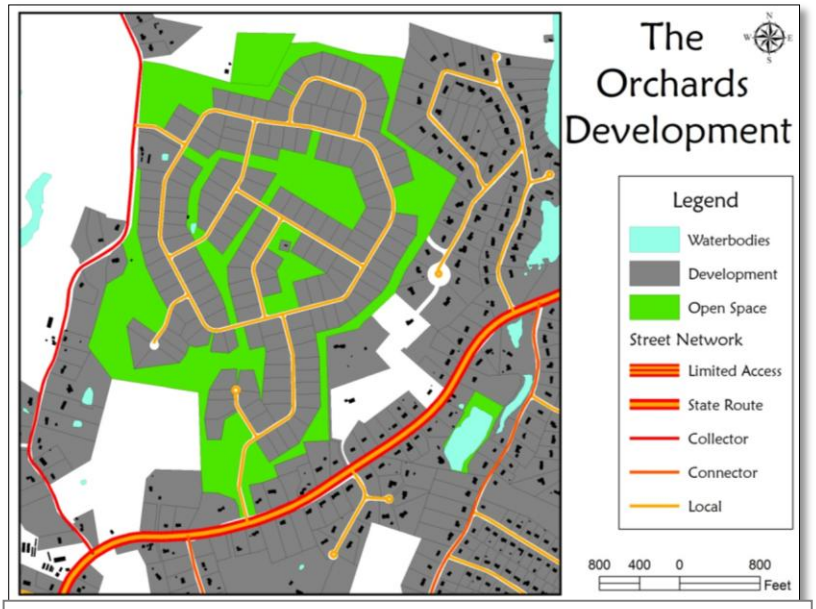


Figure 2.4) Fragmented Open Space of a recent subdivision in East

Lands of Unique Value Study in East Lyme

-----Case Study Research LUV Study for East Lyme Connecticut-----

The East Lyme LUV Study was a collaborative research project comprised of professors, students, public officials and East Lyme residents. The CRDC team members participating on this project included two graduates from UConn's Landscape Architecture program, led by Associate Professor Peter Miniutti. The team began research with a steering-committee formed by the Planning Commission. The steering committee was comprised eight citizens with some familiarity; town Planning Director, First Selectman, Zoning Official, two members of the zoning commission, a member of the planning commission, the Chair of the Planning Commission, a member from the East Lyme Historical Society, a member of the Commission for the Conservation of Natural Resources, and a member of the Water and Sewer Commission.

The Steering Committee members were chosen by the Planning Director and First Selectman for their knowledge of East Lyme and their experience serving on various land use-related commissions. The Steering Committee were community leaders, representing the East Lyme residents throughout the LUV Study process and helping to encourage fellow citizens in participating in public meetings and workshops organized by the CRDC team. In order to maximize attendance of the various committee members, monthly meetings were scheduled, with additional meetings arranged as needed to supplement.

----East Lyme LUV Study : Forum for Thesis Research------

The LUV Study is a comprehensive town-wide document which framed my open space design project. The East Lyme LUV study provided a forum for exploration of an integrated land use management approach which works to preserve the unique natural and cultural features of a growing town through the integration of conservation subdivision development patterns and a planned green infrastructure network. This would ensure full yield potential for any future subdivisions while freeing forty to seventy percent of the site to be incorporated into the town-wide open space network of green infrastructure. In this study, Future Development Recommendations were provided which focused on issues of zoning and identifying nodes to promote dense development around existing commercial land uses. The open space plan was used to design the green infrastructure network with the assumption that residential zoning regulations would be modified in accordance with the LUV recommendations to follow Smart Growth Principles. Designing the green infrastructure network before developers layout subdivisions, enables proactive conservation of valued natural and cultural resources, as opposed to waiting for a developer to instigate concern for a resource located on the site of a proposed subdivision.

CHAPTER 3: PROCESS AND METHODS

-------- Process for open Space Planning------

The design of the East Lyme open space plan was performed as part of the LUV Study. Though a non-linear process, the design of this open space plan generally followed these steps:

1.) Inventory natural and cultural features throughout town
2.) Determine lands vulnerable to future development
3.) Establish critical areas for inclusion in the open space network
4.) Design the Green Infrastructure network to balance development and conservation
5.) Evaluate the final East Lyme Open Space Plan

Identifying Natural and Cultural Resources

---Step 1: Inventory---

The CRDC utilized ArcMap 10 Geographic Information System (hereto after GISystems) to compile mapping of town resources. The first LUV Study (compiled by Peter Miniutti and Mathew Bishop for Mansfield, Connecticut) provided guidelines for initial resource inventory. Data was acquired from both the town and state databases, as well as interviews with local residents and analysis of aerial imagery with field verification. The data layers were sorted into six categories; Geology, Hydrology, Ecosystems, Cultural Artifacts, Cultural Controls, and Development. An inventory summary sheet was compiled for each category, providing a brief description of the data, a list of important facts, a chart representing a unique aspect of the category, and photographs. Each mapping exercise had its own set of challenges and required research into the resources being mapped as well, review for data accuracy and often data correction/creation. The inventory maps are found in Appendix B.

Landform

UConn's *Center for Land use Education And Research* (hereto after CLEAR) has compiled raster data layers of Connecticut terrain from LiDAR satellite imagery. The LiDAR imagery was made available for download by town as Digital Elevation Models (DEMs) through the CLEAR website. Using the *contour* tool from the ArcToolbox Surface tool set converted the DEM into a topography map.

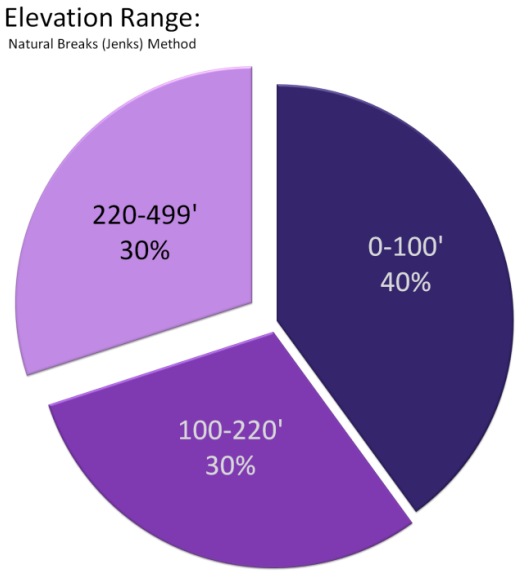


Figure 3.1) Pie Chart of Elevation variation

Figure 3.1 shows the range in elevation of East Lyme; a third at roughly sea level, and a third far above it.

Geology

The geology was inventoried two GISystem datalayers; one from the town database and a second from the state DEP database. The town geodatabase *soil* datalayer identifies farm and wetland soils throughout town. The quaternary geology datalayer shows glacial deposits; *beach and sand, sand/gravel, end moraines and rocks*. Figure 3.2 demonstrates the type and relative quantities of various geologic elements.

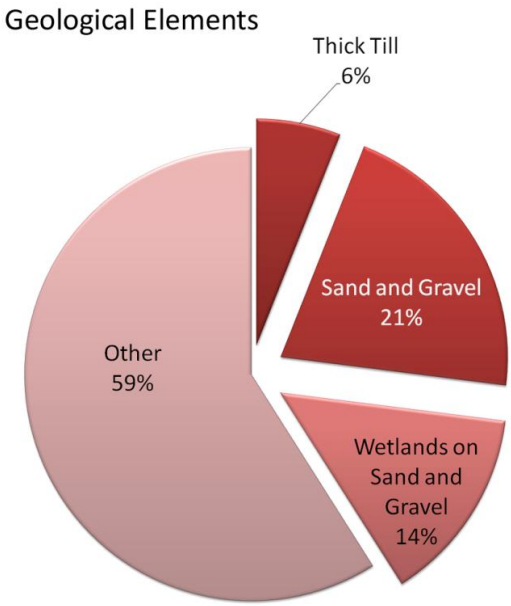


Figure 3.2) Pie Chart of local geology

Hydrology

The hydrology map locates surface water flow, watersheds, wetlands, marshes and aquifers. At the time of the LUV Study the river systems in East Lyme had not been digitized into a datalayer. In order to delineate them, an aerial imagery analysis was conducted in conjunction with water body and wetland mapping.

The accuracy of the wetlands mapping was questioned by a resident of East Lyme who worked on the wetlands commission. This prompted an additional step to creating the hydrology map; determining the accuracy of the wetlands datalayer. The wetlands datalayer from the town GISystems database was evaluated by comparing surveyed wetlands with the GISystems wetlands datalayer. This was done by digitizing 45 parcel surveys acquired through the town planner's office; specifically mapping the wetlands on those parcels, using the town parcel polygon datalayer for spatial reference. The town wetlands datalayer was then overlaid and the two datalayers were compared. By visual analysis of the 'wetland test' layer as compared with the town's wetland mapping. It was determined that the provided wetlands mapping was of sufficient accuracy.

Figure 3.3 demonstrates the types of wetlands identified in the wetlands mapping provided by the town, as well as the town's soils datalayer.

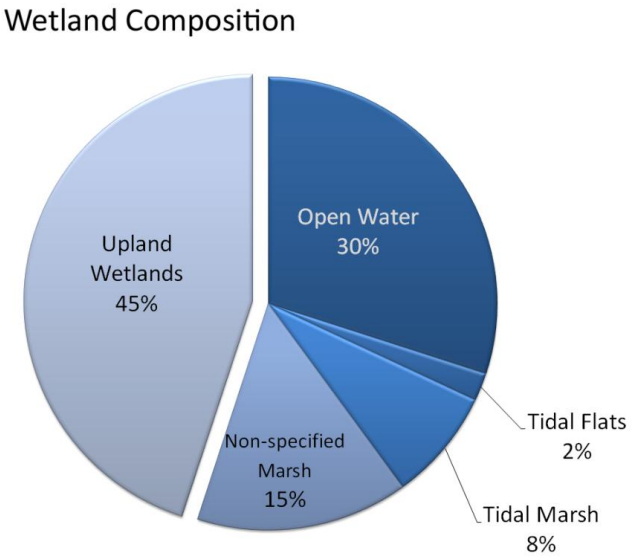


Figure 3.3) Pie Chart of relative wetland types

Ecosystems

A review of East Lyme ecosystems was conducted by locating environs throughout town that are indicative of natural wildlife; in East Lyme these are forest and wetlands. This is supplemented by the state Natural of Diversity Database datalayer. This datalayer is based on animal sightings reported to the DEP. The Natural Diversity Database datalayer was taken directly from the DEP website. The forest datalayer was created by the CRDC team using aerial imagery analysis with reference to a CLEAR land cover datalayer.

Further analysis of East Lyme forests involved determining acres of contiguous tracts of forest. Application of landscape ecology principles as well as the CLEAR forest fragmentation research, informs us that the larger tracts of contiguous forest presents greater habitat area and biodiversity opportunities. Figure 3.4 shows how the East Lyme forest can be broken down in terms of relative size. We can see that most of the forests are over 100 acres in size.

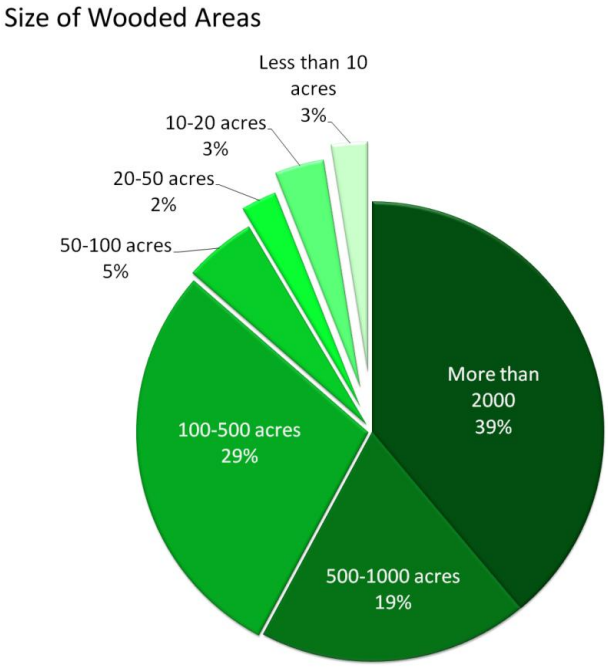


Figure 3.4) Pie Chart of relative woodland sizes

Cultural Artifacts

Documenting the historic and culturally significant sites around town involved compiling information from the town geodatabase, reviewing the town visitors map, and interviewing members of the East Lyme Historical Society. The information on archeological sites, historic and antique buildings, and stone walls was taken from the town geodatabase. Recreation areas were identified through the town parks and recreation department by meeting with the parks and recreation director with a map of the town. The locations acquired through that meeting were digitized to align with the town's parcel polygon layer, then field verified by visiting the identified sites.

Railroad and street intersections were mapped by reviewing town GISystem datalayers of the street centerlines and the railroad right-of-way. Major street intersections were mapped by reviewing street centerlines based on classification. Intersecting state streets constituted major intersections as they are the roadways with the highest volume of vehicular traffic.

Cemeteries were mapped by contacting a member of the East Lyme Historical Society who helps with the maintenance of the many historic cemeteries throughout town. The local expert and a CRDC team member drove to each of the cemeteries with a camera and map of the town. The accuracy of the data is reliable, however most of the older cemeteries are located on private property; six to ten gravestones behind a stone wall. The approximate location was marked with a point in a GISystems datalayer.

Cultural Controls

The CRDC team identified lands throughout East Lyme as lands outside of typical zoning regulations. The parcel polygon datalayer from the East Lyme geodatabase provided the first look at land ownership. State and Federal lands were identified as controlled; meaning that the town has limited control over how those lands are developed. Similarly, Yale University lands were identified as controlled due to the political power of Yale University influencing town regulations on land use. Figure 3.5 shows the proportions of controlled lands versus those ('other') which are directly under the purview of the town.

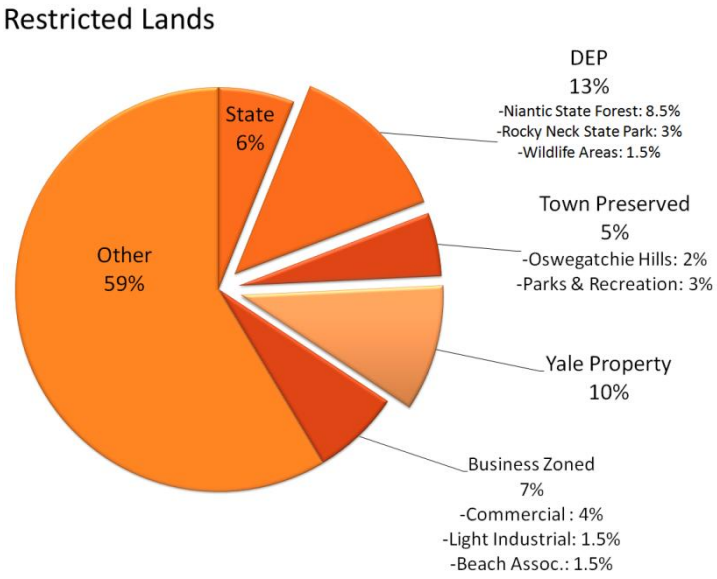


Figure 3.5) Pie Chart of proportions of land use zones

Development

East Lyme subdivision regulations mandate that a parcel must be at least ten acres in order to be subdivided. The team therefore concluded that any parcel with an area of less than ten acres and an existing dwelling structure, would be considered developed.

Parcels larger than ten acres with a unit can be developed further through subdivision, meaning that the resources remaining on the parcel are still vulnerable to

development. These parcels were considered 'partially developed' and were evaluated in the open space planning process as 'undeveloped' to determine where future construction would be appropriate on that site.

In addition to 'developed' and 'undeveloped', the team also considered 'controlled lands'. These were identified early in the LUV study process during the inventory mapping phase. Most of the controlled lands are comprised of public and private dedicated open space and low-impact recreation/education activities. Speaking with town officials, the team concluded that the best approach would be to treat those lands as having stable land uses, with the expectation that no development would be occurring on those parcels. The development was measured in acres, and converted to percentages for comparison.

Figure 3.6 and Figure 3.7 show general proportions of land development conditions and land use distribution. Figure 3.6 clearly shows a large portion of East Lyme as being undeveloped, and therefore vulnerable to future development. Figure 3.7 looks at development from a different perspective; how the land is being used.

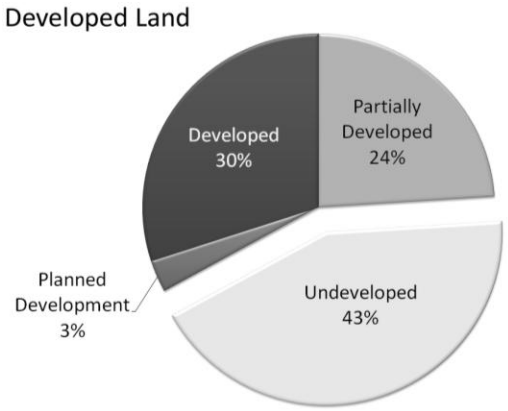


Figure 3.6) Pie Chart of development

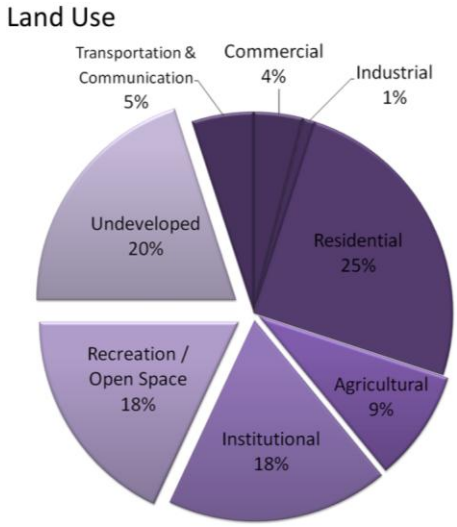


Figure 3.7) Pie Chart of land uses

---Step 2: Buildable Lands---

The first step in determining how many acres of resources can be protected through the open space plan is to find the resources on buildable lands. Some resources coincide with unbuildable lands such as wetlands and water bodies. Including resources that overlap unbuildable lands when calculating the proportion of resources that could be developed would be inaccurate. In order to obtain an accurate assessment of what resources would actually be developed, the first step was to remove unbuildable lands from the calculations.

Unbuildable lands were those lands which cannot be developed. Water bodies, tidal marsh and wetlands are the most obvious of these lands. Road and railroad right-of-way were also considered unbuildable due to their nature as important transportation corridors. Buildable Land can therefore be calculated as (*(Total Area) - ((Water Bodies) + (Wetlands) + (Right of Way)))*. Using GISystems mapping, the town boundary was overlaid with the unbuildable features, then the 'erase' tool was used to remove the unbuildable lands from the total acreage. The resources coinciding with the unbuildable lands are intrinsically protected and therefore subtracted from the calculations of resource vulnerability. Figure 3.8 shows how the unbuildable lands are distributed throughout town.

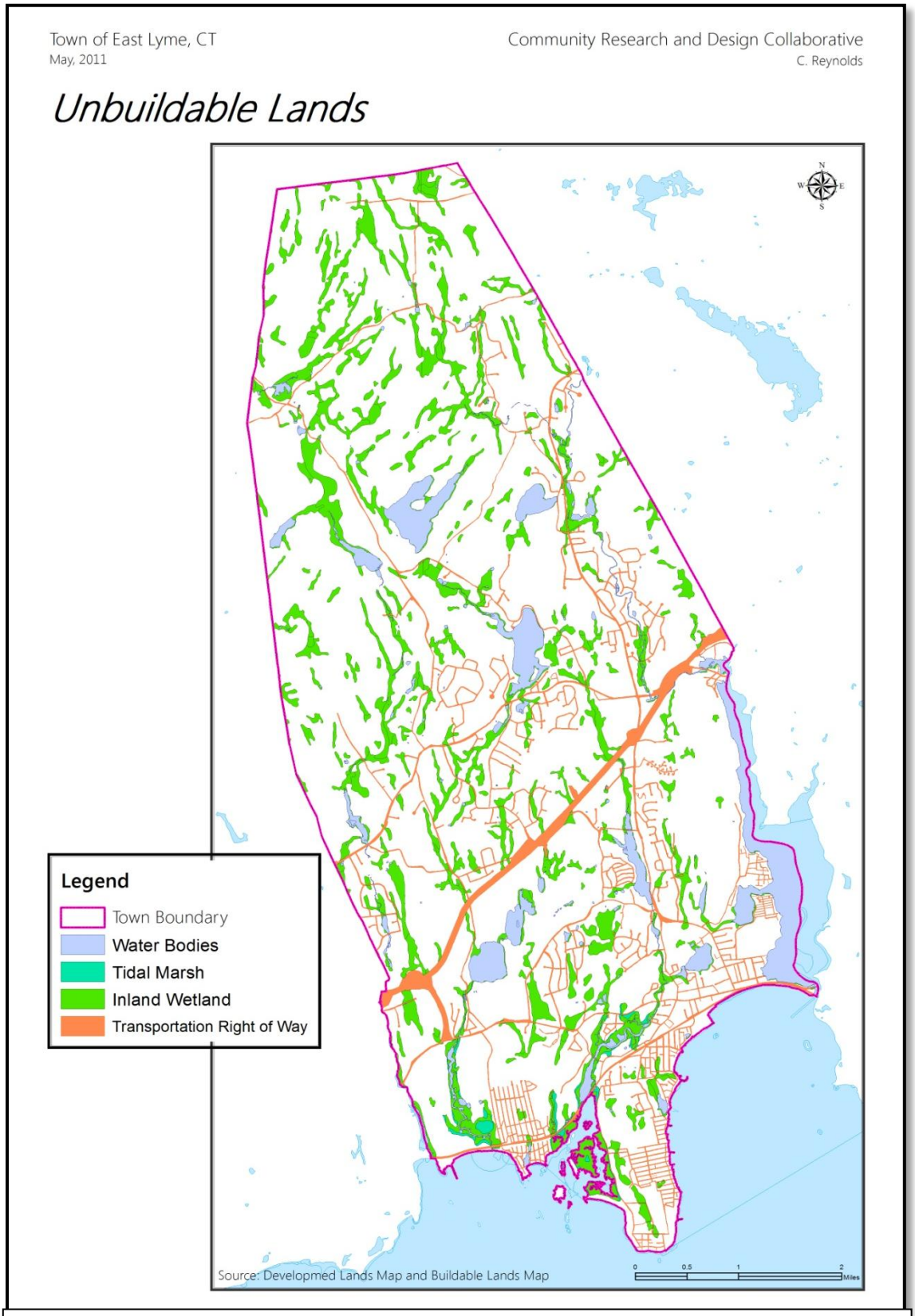


Figure 3.8) Residential Zones

When calculating the unbuildable lands, overlap of features would have created an inaccurate count. Overlap of right-of-way with water bodies, wetlands, or tidal marsh was resolved by erasing right of way from water bodies, wetlands, and tidal marsh layers. Overlap of water bodies with wetlands and tidal marsh layers was resolved by erasing water bodies from the wetlands and tidal marsh layers. Overlap between the wetland and tidal marsh layers was resolved by erasing the tidal marsh layer from the wetland layer. Figure 3.9 shows the unbuildable lands throughout town and how these lands relate to the existing and potential development areas. Table 3.1 summarizes the acreage of buildable and unbuildable lands.

	Acres	Percent of Town
Town of East Lyme	22618.14	100
Total Unbuildable Land	5302.87	23.4
Water Bodies	1209.87	5.4
Wetlands	2823.43	12.5
Tidal Marsh	61.25	0.03
Right of Way	1208.32	5.3
Total Buildable Land	17315.32	76.6
Already Developed	5986.73	34.6 (of Buildable)
Not Yet Developed	**5379.59**	**31.1 (of Buildable)**
Controlled Open Space	5979.00	34.5 (of Buildable)

Table 3.1) Undeveloped, buildable lands

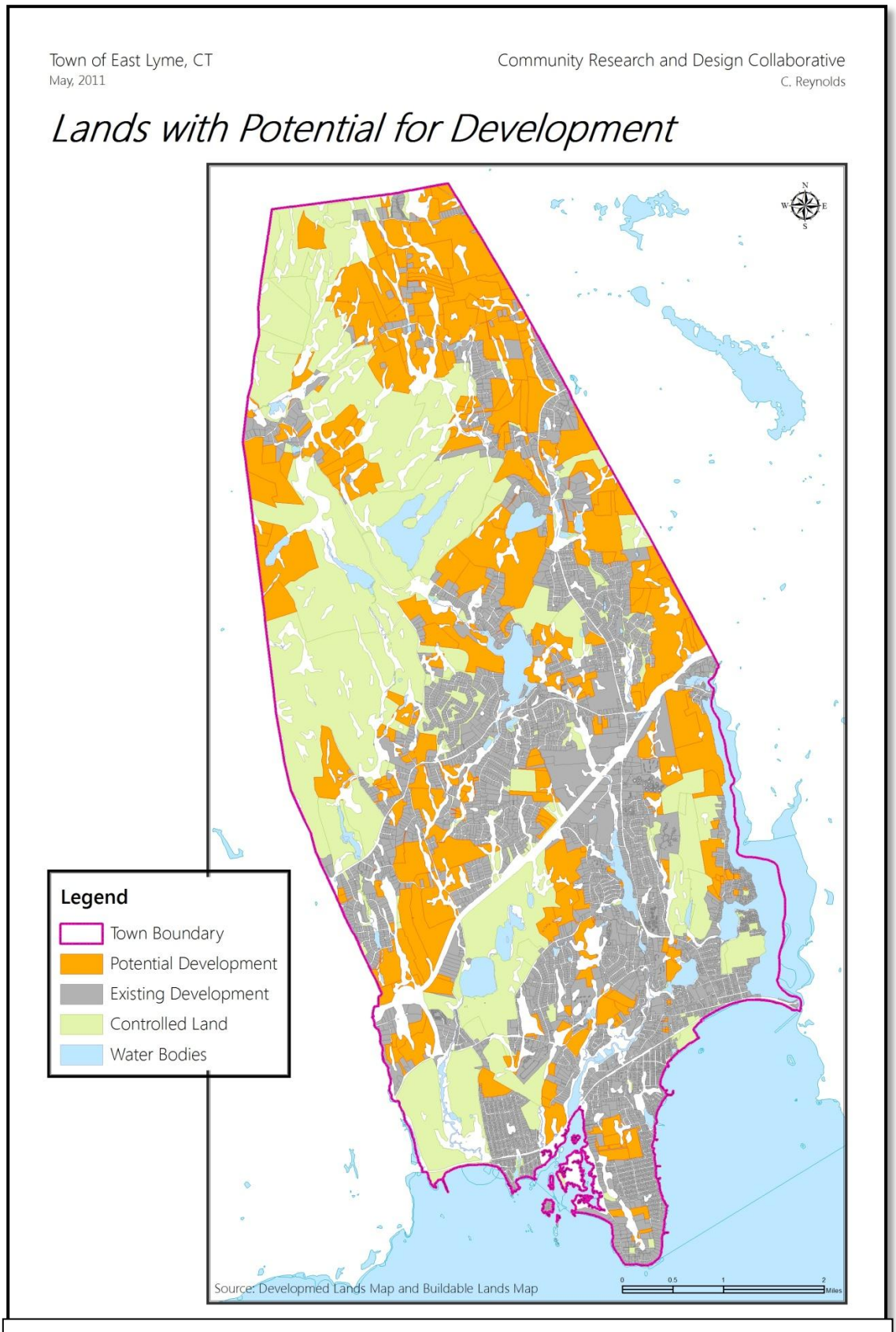


Figure 3.9) Residential Zones with unbuildable lands erased

Discrepancies in data layers resulted in the *buildable* layer containing 2.6 acres of remnant areas marked as water bodies. These did not align with the water body, wetland, tidal marsh or right of way layers. This indicates that they are the result of the parcel delineation of the water bodies having discrepancies with the water bodies datalayer. The issue was resolved by placing these fragments into the category of town-owned Dedicated open space. Their relatively small size (2.6 acres being the sum of six remnants paralleling water bodies) makes this a negligible discrepancy in data analysis.

When considering what lands would be considered buildable, a decision was made to exclude existing development; the rationale being that the resources on those lands have already been lost, or are not going to be developed. The commercial and industrial land in town has already been developed, almost to capacity, but adaptive reuse and infill can be utilized to improve or increase those land use needs. Residential land is seen as stable as it is highly uncommon for a housing unit to be torn down and rebuilt somewhere else on the site. Ninety of East Lyme is zoned as residential use, and the remaining commercial lands are already developed, it was therefore determined that the LUV Study open space plan would focus on the residential zones as seen in Figure 3.10 (zones: AHD, BPBA, RU-10, RU-12, RU-20/40, RU-40, RU-80, RU-120, SU, SU-E), as these are the most vulnerable to future sprawl subdivision development. Buildable lands information was also overlaid with town zoning data to determine how many acres of 'buildable land' was located on undeveloped, residentially-zoned lands.

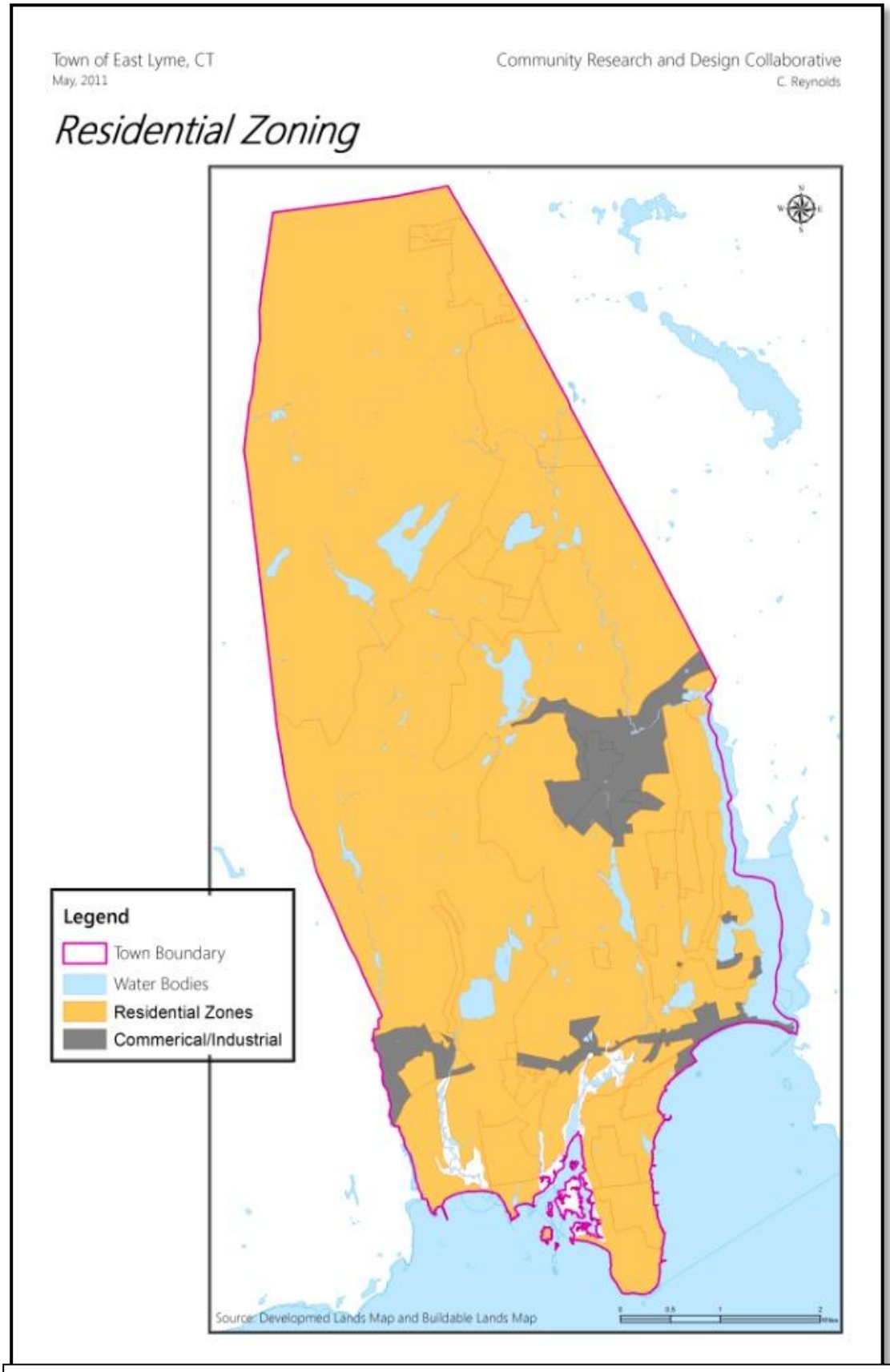


Figure 3.10) Residential Zones

---Step 3: Establishing Critical Areas---

Community Prioritization

A large part of this study involves facilitating public workshops to give the citizens a chance to share their opinions of town regarding what they find valuable, what they do or do not like about the town, and how they want it to grow through future development and preservation. This is an important aspect of the study, aimed at engaging citizens in making decisions about their town's future.

> "Many times we discover the end product does not achieve its purpose as viewed by the user groups or the general public. A primary reason for this oversight is found when the promoters of the land use fail to see the relationship the plan has with the associated values people have for the resources impacted by the land use." (Rodiek, 2010)

During collection and compilation of resources, the CRDC team used these workshops to help verify accuracy and alter the content as necessary. For the resource mapping, this was a matter of putting the summary sheets on the wall for attendees to review, answering questions and making notes of any inaccuracies or omissions that were pointed out. To review Joseph's district study, an exercise was developed to engage to locals.

One of the workshops conducted in the LUV Study process included a *Views and Vistas* exercise. The participants were divided into groups, and given a large printout (24"x36") of the town aerial image. They were also given twelve arrows; three long red, three long green, three short red, and three short green. The red were to represent negative views in town; the long arrows being more offensive than the short. The green represented positive views in the town, the long arrows being best, short arrows being

secondary. The team observed that all of the negative elements were of culturally controlled elements, while of the positive views, only twenty percent of the short arrows pointed to cultural elements. This reinforces what the citizens were expressing verbally; they don't like how the town is developing and they highly value the remaining natural resources. Figure 3.11 summarizes the results of the views and vistas exercise.

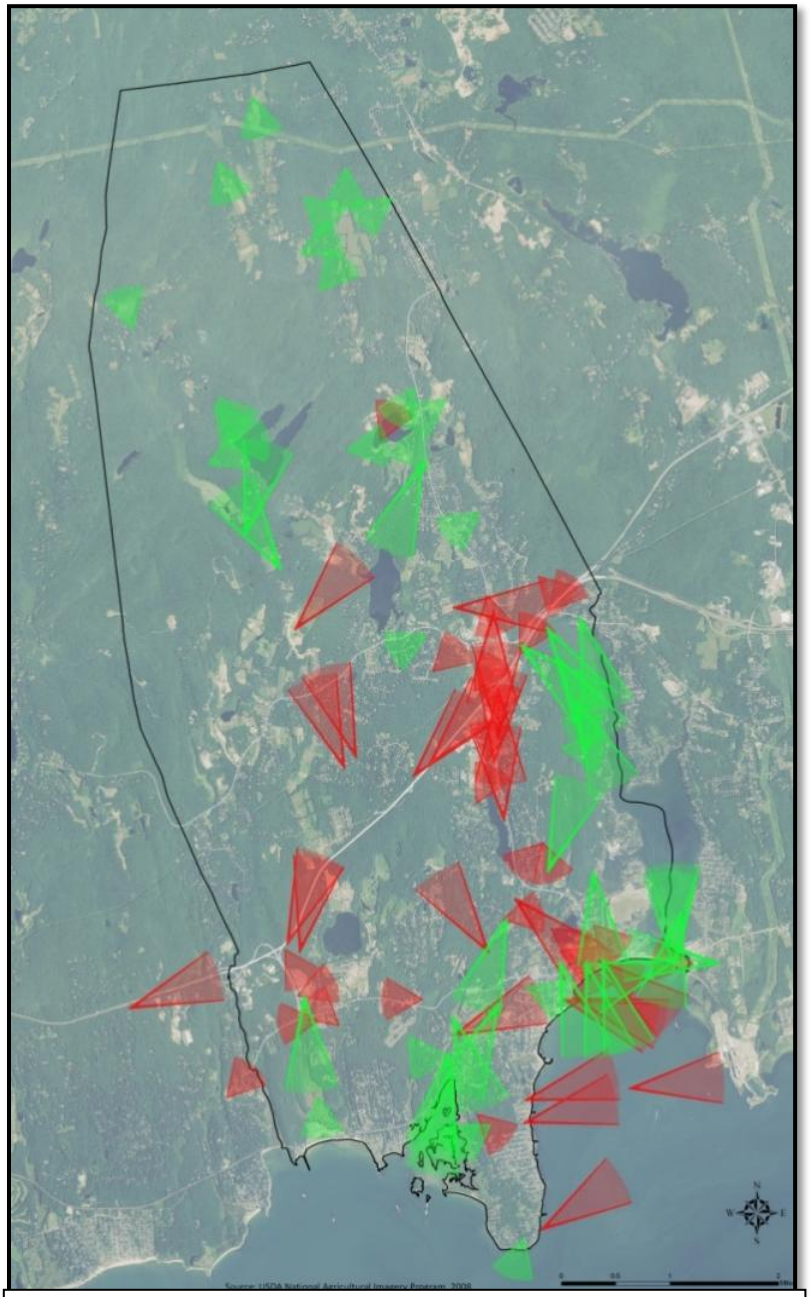


Figure 3.11) Views and Vistas workshop summary.

The Views & Vistas aspect is to help give clarify what the citizens like and don't like about their town. A large aerial image of the town was set before each group, along with a set of arrows used to indicate good and bad views throughout town. After the workshop, the indicated views were placed on a single aerial to see what if any consistencies appear. While most of the negative views were oriented towards development, the good views were consistently oriented to the Long Island Sound, Niantic Bay, and the hay fields of Flanders. Views of undeveloped lands were identified as important resources, however the citizens expressed as much concern with environmental health and water quality. With this in mind, the views became relatively less important than resources such as aquifer recharge areas and natural diversity database zones.

Discussion with citizens at the workshops and meetings illuminated an overarching concern with potable water supply. As a coastal town with a healthy economy, East Lyme has a large influx of summer residents, placing strain on the water supply during the hottest part of the summer (June-August). Aquifers are not visible features, however in a coastal town with a high summer population, it is one of the most important natural processes in the town. Without aquifer recharge, water will quickly run out. Currently, water is plentiful through fall, winter and spring, with drastic shortages in the summer months. This combined with the awareness that groundwater runs almost directly into the Long Island Sound, makes the water quality almost as important as quantity. Citizens were in agreement that keeping development off of the remaining aquifer was a high priority.

At the first workshop in East Lyme for instance, I happened across a couple who were very active in the town's agricultural community and had been doing some extensive research on their own into the history and current operations of the local farmers. This was most fortuitous as we have been struggling to determine exactly what parcels are being used for farming of some sort, without much luck. We were able to arrange a face to face meeting in order to sit down with a parcel map and start working out what was being farmed and where.

One of the identifying characteristics that citizens identify with Flanders is the strong presence of agricultural activities. As important as agriculture is to the citizens, the CRDC research team could find little information about what types of agriculture are found in town, and where the activities are located. The town offices did have a list of properties which are classified as PA 490; a classification which applies to farm land, forested tracts, and open space. The purpose of PA 490 identification is to ensure taxation on the current use of land rather than taxation on fair market value (i.e. value of land if sold to a developer. (See CT government website for more information.) With this as a starting point, the CRDC team then endeavored to compile a map of the town's agricultural activities. In order to improve the accuracy of the map, eliminate PA 490 parcels which were inaccurately labeled, and gain a better understanding of the farming community in East Lyme, the team began a series of meetings with a pair of local farmers with comprehensive knowledge of the community. Mrs. Nancy Kalal and Mr. Mark Christiansen are two residents of East Lyme who agreed to meet with CRDC team

member Cynthia Reynolds to review a parcel map of the town and attempt to locate the agricultural activities as they understood them.

To this group, agriculture referred to activities where persons tend animals or plants for economic purposes. Thus, when they sat down and poured over a parcel map of the town, the two locals attempted to locate known forestry activities, plant nurseries, apiculturists, orchards, barnyards, and fields utilized for crops or livestock. Figure 3.12 is a map of agricultural activities produced at the first meeting. The information was input to GISystems, and then the group met again to review the data.

For the purposes of the LUV Study, a preliminary map of the agricultural activities in East Lyme was sufficient. To produce a more detailed analysis of these activities would have been beyond the scope of this document, however it is highly recommended that a more detailed and more

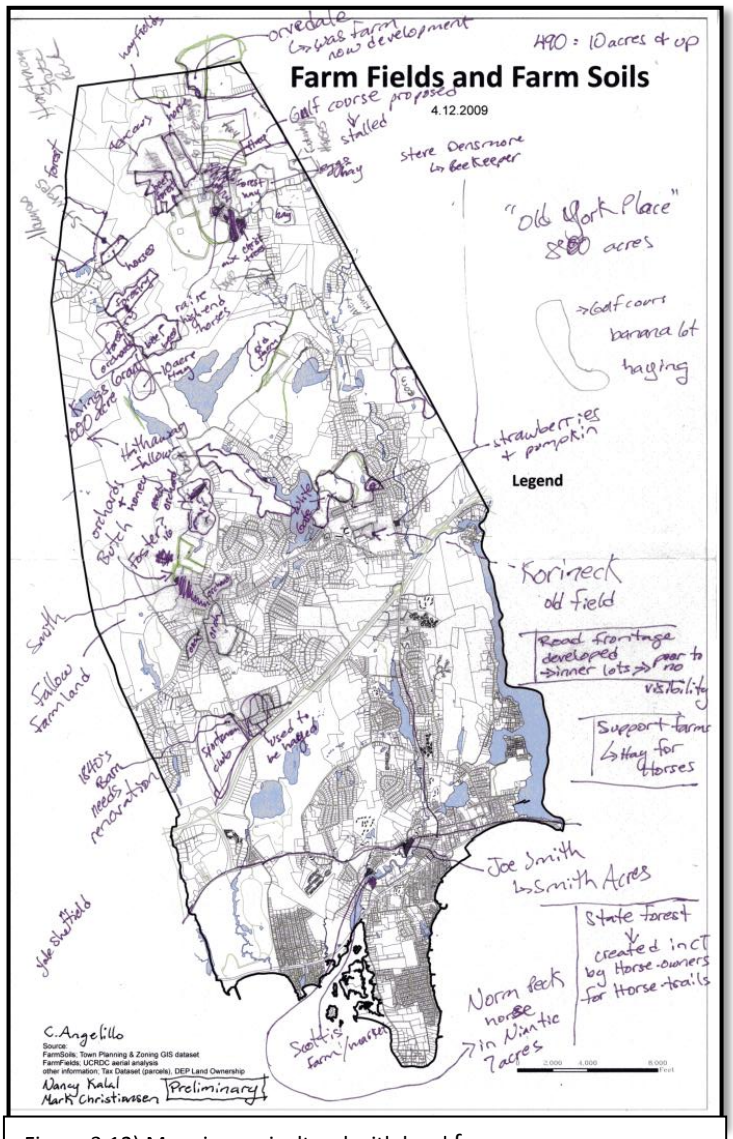


Figure 3.12) Mapping agricultural with local farmers

thoroughly researched and field verified report be performed. The work done to date for the LUV Study form a solid foundation from which such a project could be launched. Regardless of its incomplete status, the compiled data is the most accurate available at this time. In order to determine how many acres of land are utilized for agriculture, the CRDC team identified parcels of land which contain agricultural activities and calculated the total acreage of all such parcels. Figure 3.13 show the preliminary conclusions found through meetings with the local farmers.

The East Lyme residents were very supportive of maintaining the agricultural and rural character of the Northern portion of town, Flanders. This support came about despite the fact that most of the citizens reside in the Southern portion of town, in the coastal village of Niantic. While those that lived in Flanders valued the agriculture and rural characteristics for their livelihood and 'middle-of-nowhere' atmosphere, citizens in Niantic valued it from their cars. This lead to the understanding that most of the citizens are interested in having continuous tracks of undeveloped land to enjoy for its visual appeal, while those living on the land appreciated it as a lifestyle choice. These values, combined with the community desire for resource protection and environmental health, made the undeveloped lands in Flanders to be of particular importance.

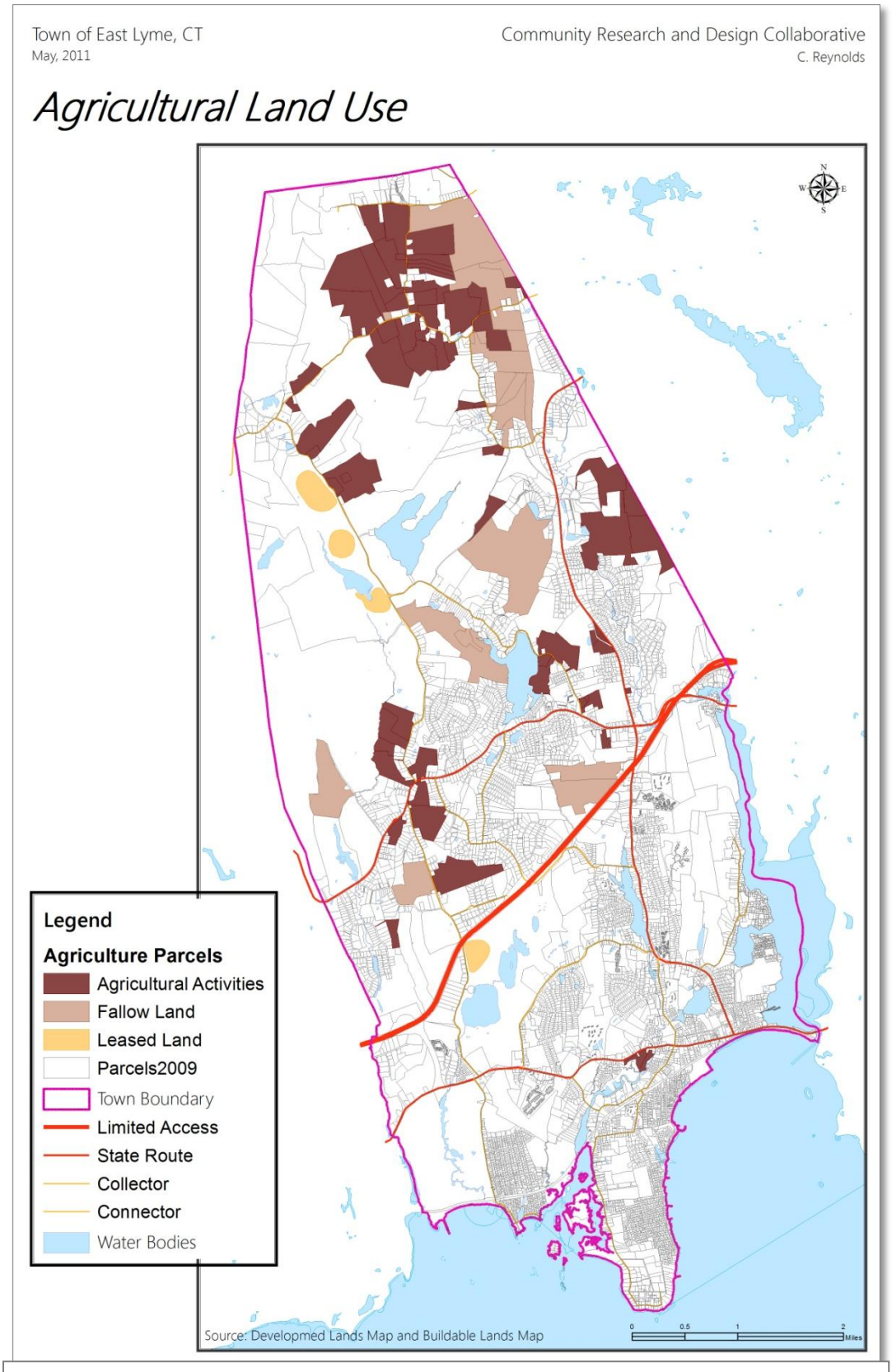


Figure 3.13) Preliminary mapping of agricultural land use in East Lyme

Environmental Prioritization

East Lyme's highest environmental priority is to limit surface and ground water contamination. In addition to importance for continued potable water supply, surface and ground water of East Lyme drains into sensitive aquatic habitats; wetlands, marshes, rivers, lakes, Niantic Bay and the Long Island Sound. It is therefore important to maintain surface permeability and limit non-point source pollution commonly produced by the paving associated with standard developments. (WERF, 2010) Resources which directly impact water quality include vegetative cover and geology. Forested areas retain rainwater in the canopy, creating a gradual saturation of the surface; optimizing infiltration and minimizing runoff. Beyond vegetation, geology is critical to storm water infiltration. Soils which absorb water quickly are good for limited surface runoff, but are not as useful for filtering pollution out of the water. Development that is located on these soils must therefore be designed with minimal impervious surface and specific attention to treatment of storm water runoff.

Identified Resource Prioritized

Evaluation of citizen concerns and environmental systems determined which existing resources contribute to town health, character, and sustainability. Aquifers, farm soils, and high points were identified by the community as being priority protection areas. In addition to those resources, the LUV Study process identified nine other resources to be of importance to the Town of East Lyme which are at present not protected as dedicated open space. These were chosen due to their importance to the local natural and cultural systems. The final list of resources to consider in the open space planning process included thirteen physical features:

Agricultural Land Use
Aquifer Protection Area
Aquifer Recharge
Coastal Boundary
Critical Habitat
End Moraine Deposits
Farm Soils
Forest
Glacial Deposits
High Points
Natural Diversity Database
Thick Till

The twelve identified resources are not protected by law and are therefore vulnerable to damage or destruction by future development. Resources were identified and located through expert consultation, citizen feedback, and GISystem data collection from three sources: Connecticut Department of Environmental Protection, UConn's Center for Landuse Education and Research, and East Lyme's database as compiled by *Tighe & Bond*.

Designing Green Infrastructure

---Step 4: Designing the Green Infrastructure Network---

The thirteen resources identified in the inventory process were highlighted as important to the town from both a cultural and environmental perspective. The list was presented to the steering committee for verification and/or modification. Table 3.2 breaks down each of the resources into developed, controlled, and undeveloped. This gives a sense of how much of each resource has already been developed and how much is vulnerable to degradation through future development. this helped to inform prioritization. For instance, of the 2754.72 acres of Aquifer Protection Area in East Lyme, 1213.58 has already been built on, 955.02 acres are on controlled lands, and 541.08 acres are vulnerable to future development. Because this is such an important resource to the

town, and so much of it has already been developed, it is important that the open space plan incorporates the resource into the open space plan as much as possible.

Resource	*Total*	*Controlled*	*Developed*	***Undeveloped***
Agricultural Land Use	3284.92	289.15	352.9	**2634.62**
Aquifer Protection Area	2754.72	955.02	1213.58	**541.08**
Aquifer Recharge	5671.35	1704.2	3009.52	**851.31**
Coastal Boundary*	3393.53	837.11	1686.81	**439.29**
Critical Habitat	36.01	19.7	15.89	**0.4**
End Moraine Deposits	399.22	70.81	239.87	**91.61**
Farm Soils	3940.03	785.43	2155.83	**787.52**
Forests	12049.32	5726.25	1149.68	**5167.84**
Glacial Deposits†	4442.2	1145.12	2599.53	**663.34**
High Points	138 (pts)	55	32	**51**
Natural Diversity Database*	3967.51	1025.99	1515.56	**923.49**
Thick Till	1359.45	208.22	657.79	**493.44**

Table 3.2) Existing conditions of critical cultural/natural resources

The resources identified as valuable to the town were evaluated using mapping overlays in order to find patterns and opportunities for protection. Each resource was mapped in GISystems, and each layer set to 50% opacity so that where they overlapped the color would be more intense. The more intense color therefore indicated areas where multiple resources occupied the same space. (see Figure 3.14) These areas of overlap present opportunities to integrate multiple resource priorities; an area of dedicated open space that encompasses more than one resource. Study of the overlay mapping provided the final piece needed to appropriately allocate dedicated open space to enhance the cultural and natural systems of town. (Bryan et. al., 2010)

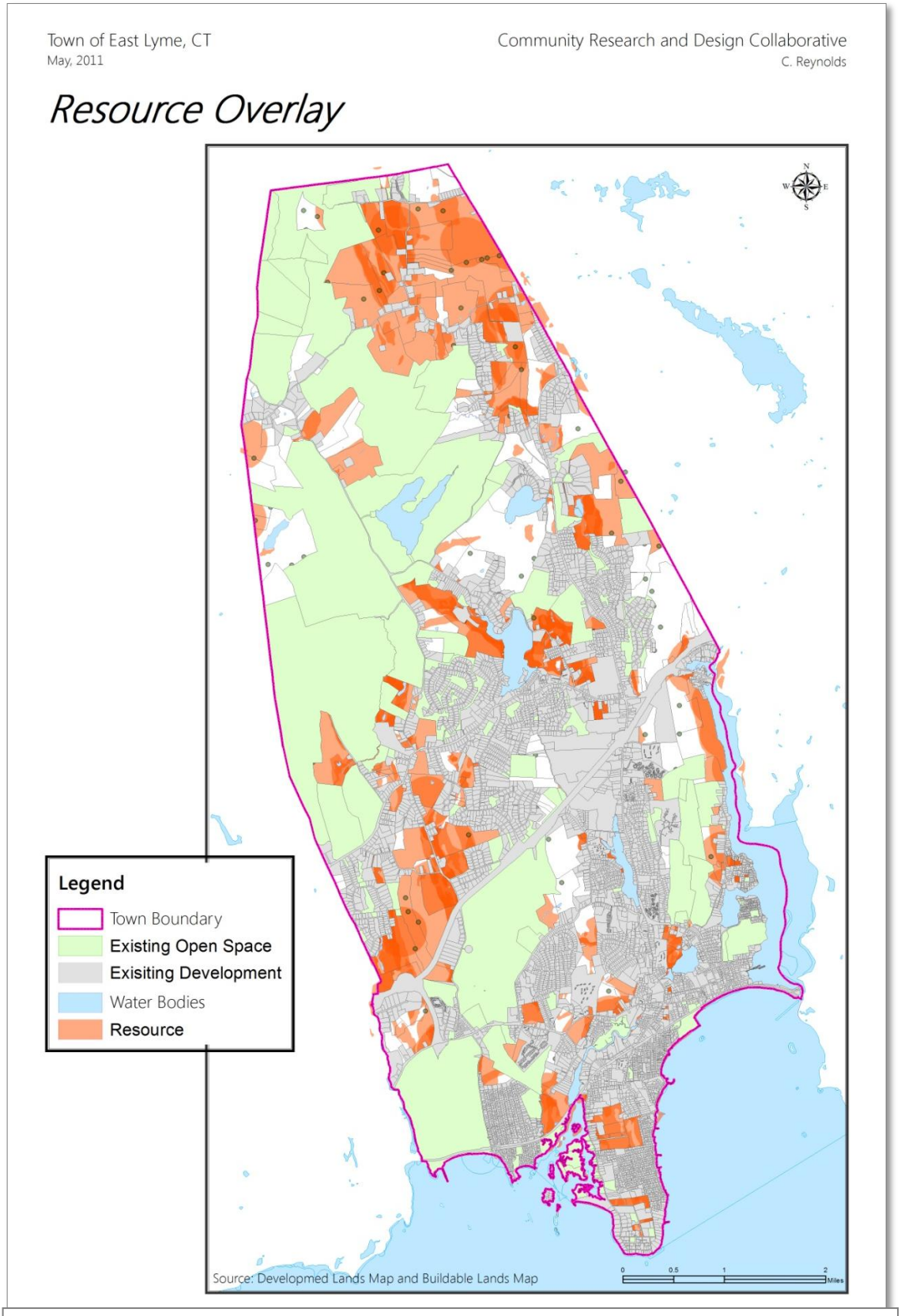


Figure 3.14) Overlapping resources

As East Lyme was evaluated for the green infrastructure network, it was found that some parcels were simply too valuable for the CRDC to recommend development. Technically, development could be located on the site, but to do so would violate the land ethic of the CRDC team members. For this reason the lands identified for open space have been prioritized to help guide town officials and conservation agencies to direct their energy where they will have the greatest impact. The prioritization is based on type and quantity of resource present on each parcel, and communicated by classifying the lands based on if/how they should be developed.

Type 1: Flexible Preservation

Parcels with drainage into water bodies and overlapping resources were marked as inappropriate for development of any kind. These parcels should remain in their natural condition and should be purchased by the town for dedicated open space. The term 'Flexible Preservation' was used as opposed to simply 'Preservation' in order to reflect the need for management.

Type 2: Conservation

These are parcels with intensive resource overlap but no direct drainage into a water body. Such parcels could be developed with low impact land uses such as playing fields, pavilions or picnic areas.

Type 3: Strategic Open Space

Parcels in this category have resources spread out over the site in such a way that protecting them would require more than 50% of the site, and may inhibit unit yield of the development. These parcels are identified so that the town can and developer can

look at potential development design scenarios and decide what is the most appropriate layout; creating a balance of community quality and environmental protection.

Type 4: Open Space

Parcels with *open space* located on them contain resources that are readily protected with 50% or less of the site being dedicated open space.

Category Summation

The classification system of types of open space into categories provides a prioritized framework that does not inhibit development, clearly communicating which sites are suitable for development, and which would be highly valuable as dedicated open space.

--Step 5: Evaluating Proposed Green Infrastructure Network---

Evaluating land use plans is challenging because implementation happens over the course of years, if not decades depending on speed of development. In order to evaluate how effective the East Lyme Open Space Plan could be at preserving natural and cultural resource, two approaches of review were taken. The first was to determine how many resources would be developed upon with standard development versus cluster subdivision/green infrastructure patterns. The second approach was obtain expertise from multiple environmental disciplines. A meeting was organized as a forum for review the process, methods and results of the open space design.

The goal of the East Lyme open space plan is to protect cultural and natural resources from degradation caused by development, The first evaluative approach is therefore centered on quantifying how the resources would be impacted if the plan is

properly implemented. This is done by determining what portion of the resources are already developed, what portion could be developed given standard development practices, and what portion would be developed if the proposed plan is followed. By compiling the layers of information in GISystems, the acreages of various resources and their conditions were calculated. The results are seen in Table 3.3.

Resource	*Total Acreage*	(Total) *Controlled*	(Total) *Developed*	*(Residential)* Undeveloped Lands	*(Residential)* Unbuildable Lands	*(Residential)* Buildable Lands
Agricultural Land Use	3276.26	289.15	352.50	2431.70	226.06	2205.64
Aquifer Protection Area	2756.53	955.02	1213.58	460.80	22.59	438.21
Aquifer Recharge	5621.43	1704.29	3009.52	649.40	92.28	557.12
Coastal Boundary*	3393.24	837.12	1686.81	424	46.07	377.93
Critical Habitat	35.98	19.70	15.88	1.92	1.91	.01
End Moraine Deposits	402.29	70.80	239.87	88.87	4.87	84
Farm Soils	3736.26	785.43	2155.83	781.88	5.35	776.53
Forests	12045.76	5726.25	1149.68	4628.70	235.16	4393.54
Glacial Deposits†	4427.13	1145.12	2599.39	632.61	153.56	479.05
High Points	138	55	32	49	4	45
Natural Diversity Database*	3967.26	1025.99	1515.56	826.22	38.74	787.48
Thick Till	1359.44	208.22	657.79	488.77	48.03	440.74

Table 3.3) Resources found on buildable lands

Once the vulnerable acreages had been determined, scenarios were conducted to evaluate what resources could be protected by using the LUV Study green infrastructure open space plan.

In order to determine how much of the thirteen resources were protected by the LUV green infrastructure network, development scenarios were modeled in GISystems. In standard subdivisions, every acre of land would be impacted by the development, and therefore , only the '*unbuildable*' lands would remain in their natural condition. Thus, the resources which remain after standard development takes place would be the existing

undeveloped residentially-zoned lands, minus the unbuildable area. In conservation subdivisions however, the planned open space would be avoided during layout and construction, mitigating impact on the resources present. Therefore, the remaining resources are calculated by taking the existing undeveloped residentially-zoned lands and subtracting the unbuildable lands as well as the green infrastructure areas. The results of this are seen in Table 3.4. The potential success of the green infrastructure network is seen in that the acreage of remaining resources in the conservation development scenario is at least three times that of the standard development patterns.

Resource	*Existing Undeveloped*	*Future - Standard Development*	*Future - Conservation Development*
Agricultural Land Use	2431.70	226.06	1430.1
Aquifer Protection Area	460.80	22.59	274.22
Aquifer Recharge	649.40	92.28	473.74
Coastal Boundary*	424	46.07	368.82
Critical Habitat	1.92	1.91	1.92
End Moraine Deposits	88.87	4.87	47.03
Farm Soils	781.88	5.35	439.03
Forests	4628.70	235.16	2975.35
Glacial Deposits†	632.61	153.56	482.58
High Points	49	4	43
Natural Diversity Database*	826.22	38.74	560.03

Table 3.4) Resources remaining after future development

CHAPTER 4: RESULTS

East Lyme Open Space Plan

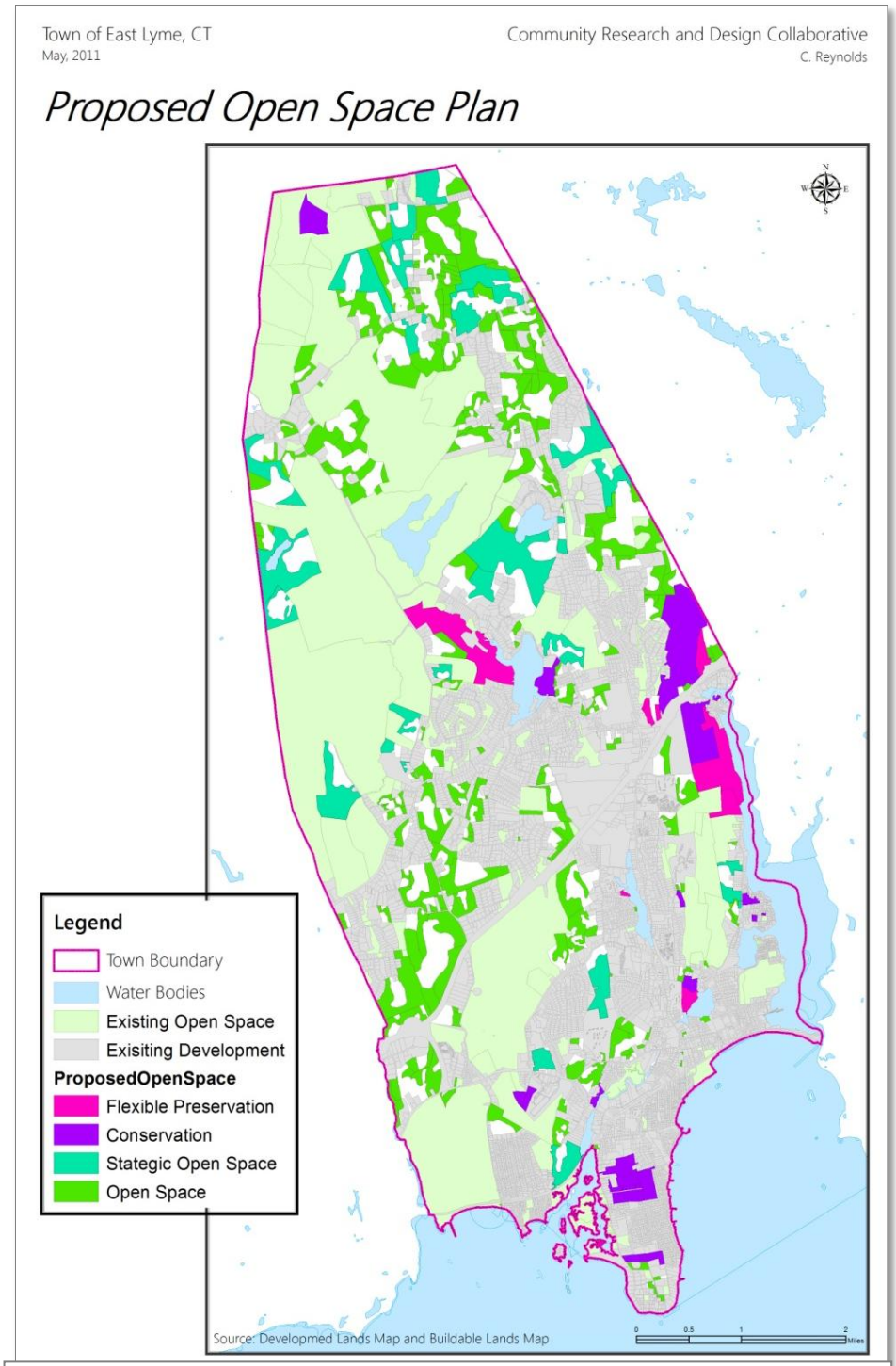


Figure4.1) CRDC Open Space Plan for East Lyme, CT

Lands encompassed by green infrastructure network (acres)		
Total	4227.32	100%
Flexible Preservation	346.73	8.2%
Conservation	520.18	12.3%
Strategic Open Space	1128.68	26.7%
Open Space	2231.74	52.8%

Table 4.1) Breakdown of proposed open space into the CRDC classification system

Open Space Recommendations:

1.) Developers should allocate 50% of the each parcel to open space before subdividing and locating buildings/street network. The open space should be arranged to maintain East Lyme vernacular as seen from public roads unless to do so would isolate or compromise the integrity of natural habitats.

2.) High Points provide views for those standing on them as well as those looking at them. Protect them.

3.) Procure ownership of parcels adjacent to surface water bodies for preserved open space land use.

4.) Many areas are important for public access, ecosystem health, and corridor creation. Maintain these parcels as undeveloped.

5.) Maintain green corridors between water bodies wherever possible.

Corridors should be a minimum of 200-300 feet wide.

a. Between Powers Lake and Pattagansett Lake

b. Between Powers Lake and Darrow Pond.

6.) Existing open space on Black Point, The Golden Spur, and Saunders Point provide vital water runoff mitigation and community open space. It should remain undeveloped.

7.) Protect Latimer Brook Watershed where it drains into the Niantic River by preserving the remaining adjacent undeveloped parcels.

-----Evaluation of East Lyme Open Space Plan------

The forested areas create an interesting study as they are directly impacted by proximity to development regardless of how dense it is. Figure 4.1 shows the current conditions; East Lyme has 7,087 acres of core forest, 4,955 acres of edge forest. These create different habitats, with the larger, more reclusive animals living in the core, and smaller, more tolerant species living in the edge habitat. With core forests dwindling across the state, the LUV Study attempted to maintain as much of it as possible. This was done by locating open space along existing dedicated open space in order to keep the patches as large as possible. Using conservation development practices, the core forest area would be 4,880 acres, versus the conservation development leaving 3,467 acres. The conservation development pattern protects 1400 acres of core forested areas that standard development would eliminate. Edge forests are also

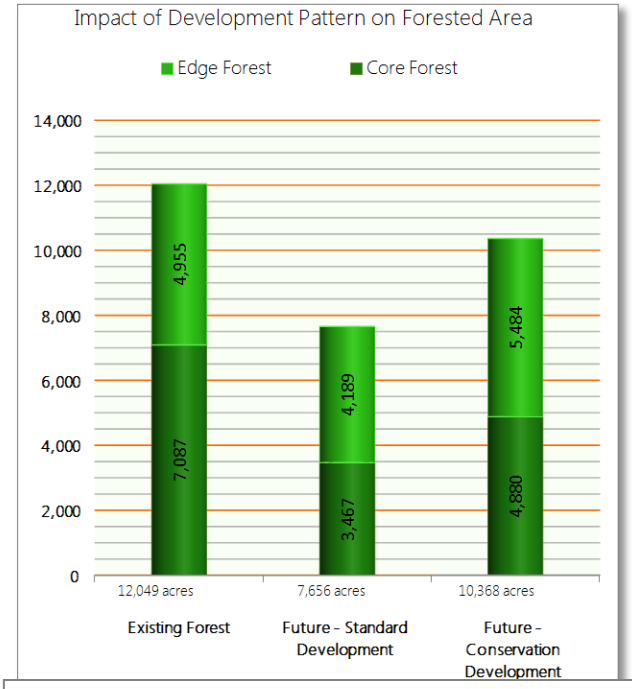


Figure 4.1) Core and Edge forest acreage

better maintained, with 5,484 acres remaining with conservation development versus 4,189 acres after standard development. I had expected more of the core forest area to be protected by the LUV open space plan methodology. While this evaluation shows it is significantly preferable to standard practices, there is still room for improvement.

The following three pages contain bar charts comparing resource consumption of standard development practices versus the conservation development/green infrastructure plan provided by the CRDC in the LUV open space recommendations map. The bars each contain four categories; *Controlled Land, Dedicated Open Space, Existing Development and Future Development*. *Controlled Land* and *Existing Development* are current resource conditions of the resource. Lands that are 'controlled' are existing dedicated open space; meaning that the land is deeded as open space in perpetuity, or is owned by a stable organization such as a land trust, which collects land with the intent of preventing development from occurring. *Existing Development* identifies the acreage of a resource that is encompassed by a parcel identified as developed earlier in this study. The other two categories (*Dedicated Open Space* & *Future Development*) shows the potential condition of each resource based on either standard development practices or conservation subdivision practices.

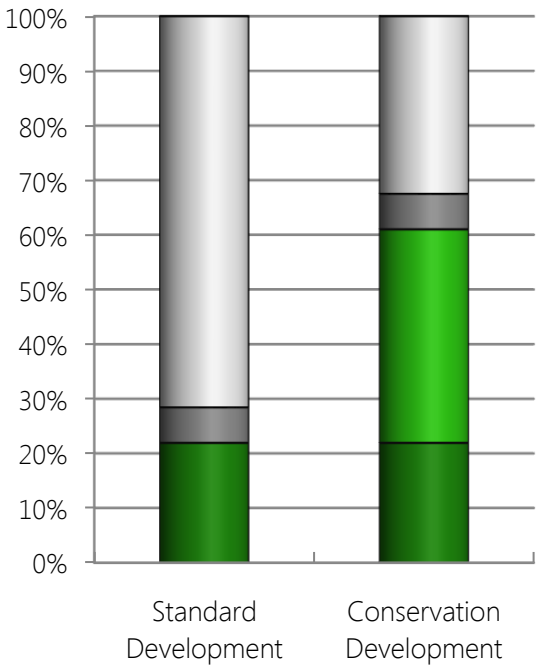
The resources are categorized as 'culturally defined' or 'environmentally defined'. These were observed earlier as being two types of resource that was identified. They were organized this was for ease of comparison among the resource types. For instance, the agricultural land use and high points were fairly well protected; a bit more than half of the remaining agricultural lands are protected using the conservation development

pattern, and about 85% of the remaining high points are protected. When comparing this with the other culturally defined resources, one can see that though much less of the resource is currently undeveloped, a similar percentage of the remaining was protected.

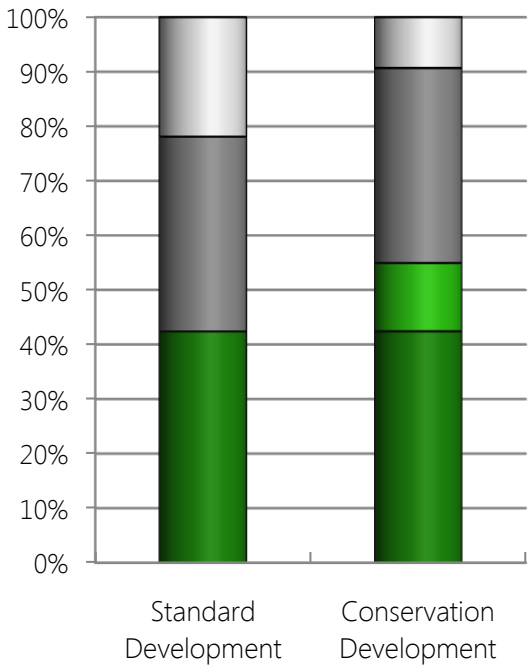
When looking at the environmentally defined resource, one can see how little of these system-specific resources are left. For instance the critical habitat chart shows that nearly all of the resource is directly impacted by development. Aquifer recharge areas are also very much impacted already, so whatever bit could be protected is highly important. Each chart shows the success and limitations of the LUV open space methodology. While it is clearly better than the alternative, resources are still being consumed.

Culturally Defined Resources

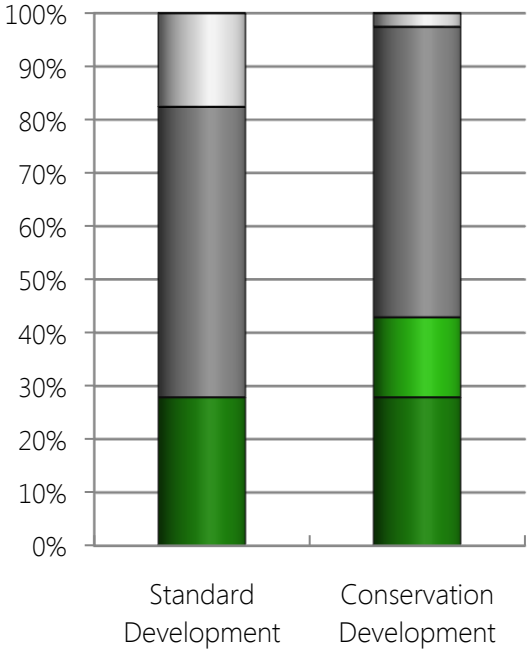
Impact of Development on
Agricultural Land Use



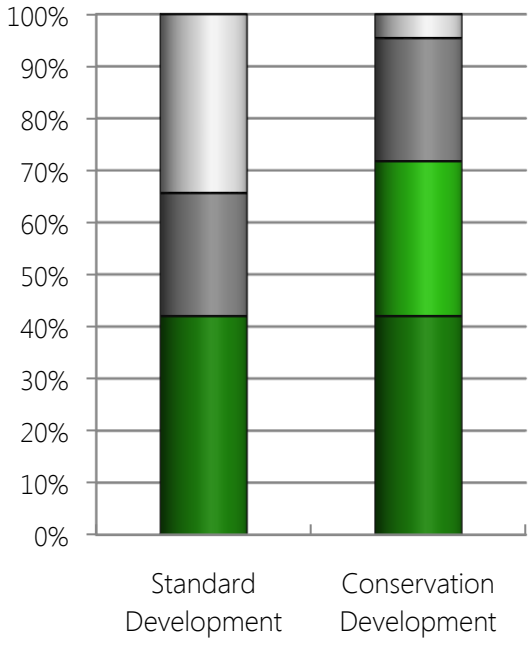
Impact of Development on
Aquifer Protection Area



Impact of Development on
Coastal Boundary

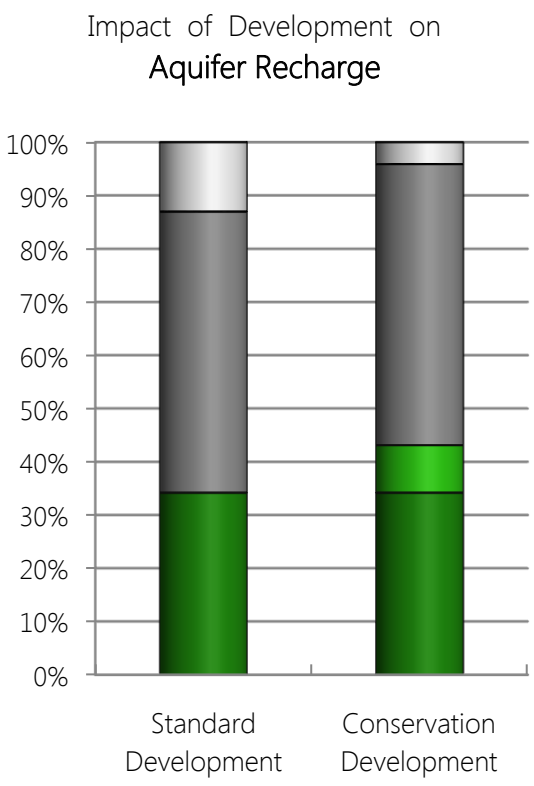


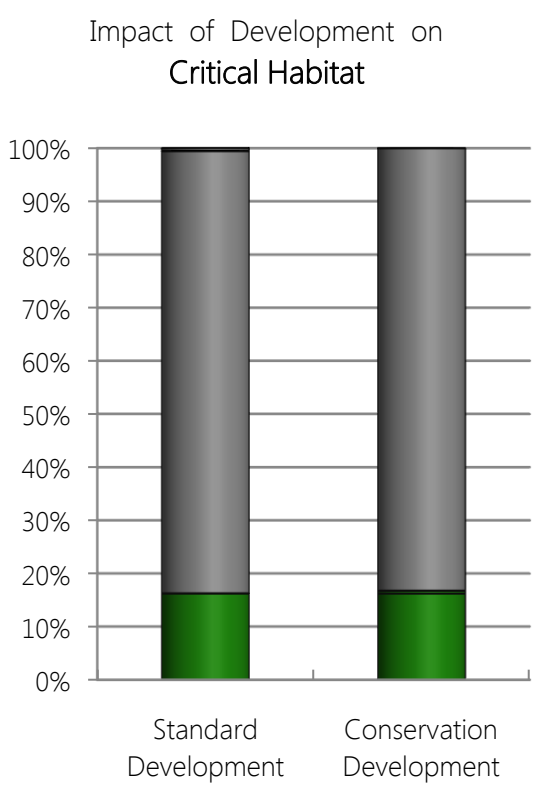
Impact of Development on
High Points

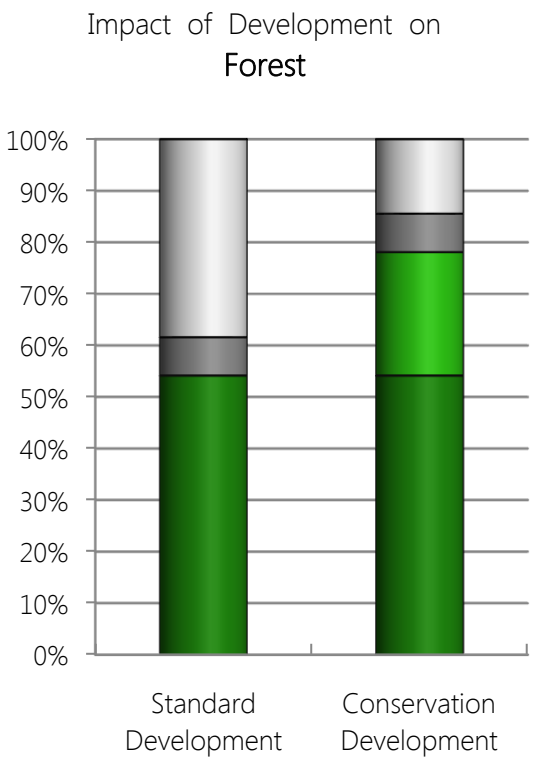


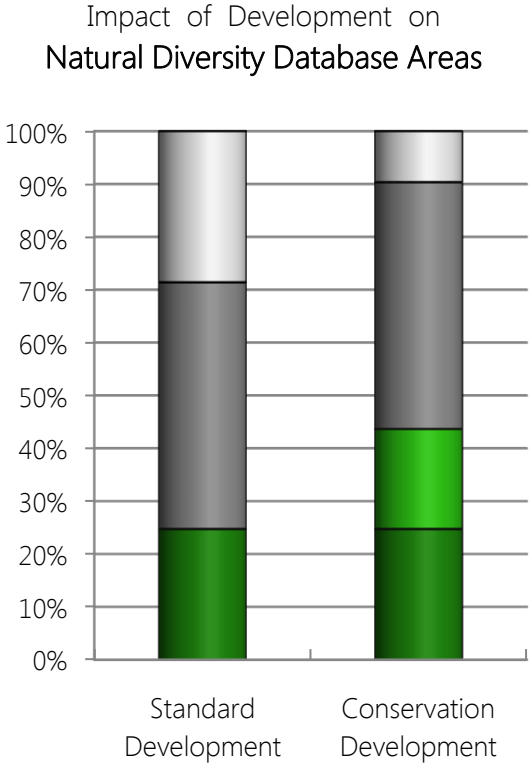
Controlled Land | Dedicated Open Space | Existing Development | Future Development

Environmentally Defined Resources



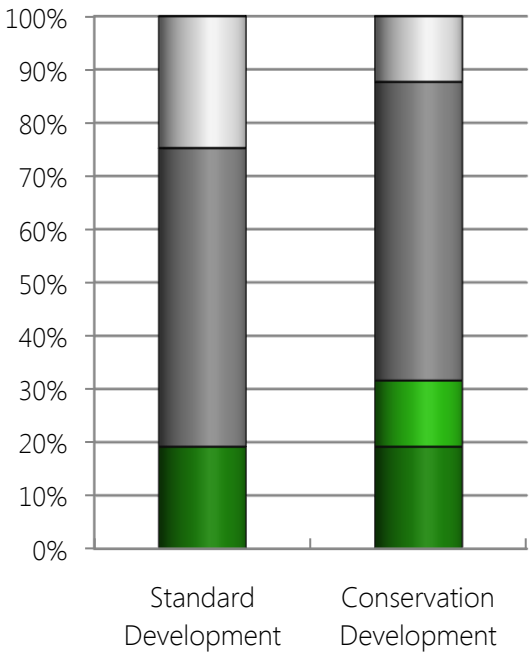




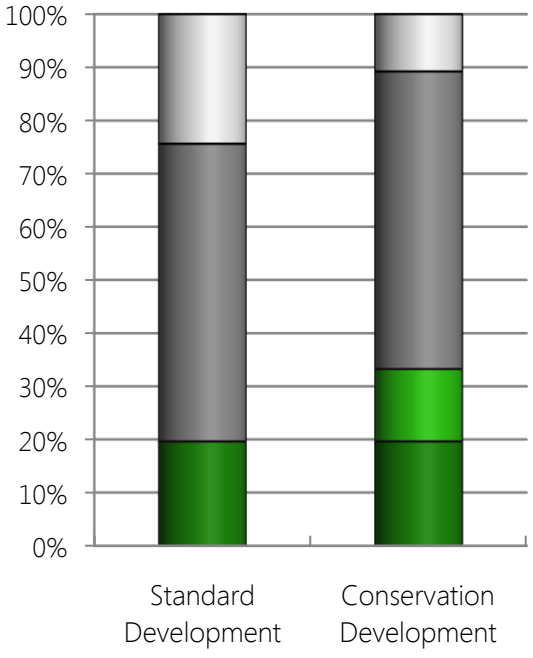


Environmentally Defined Resources (Cont'd)

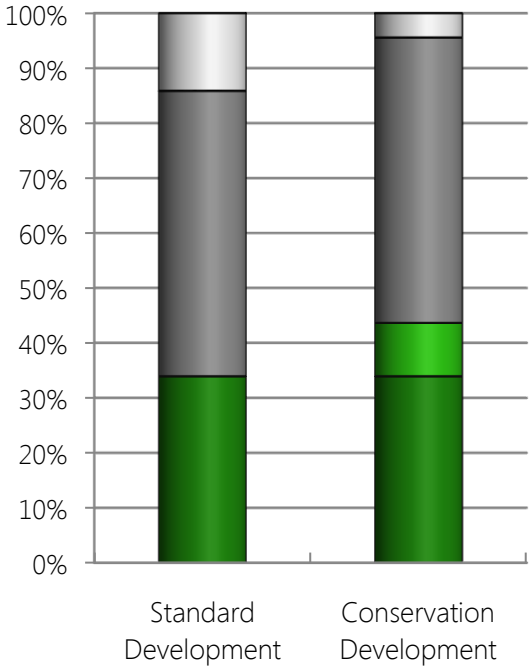
Impact of Development on
End Moraine Deposits



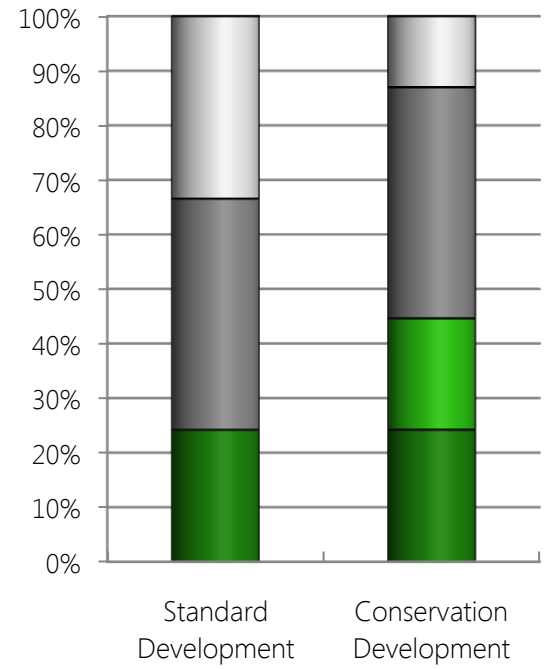
Impact of Development on
Farm Soils



Impact of Development on
Glacial Deposits



Impact of Development on
Thick Till



Interdisciplinary Review

---Independent Study---

In an effort to improve the open space methods and identify factors which were overlooked or misrepresented on the East Lyme Open Space Plan (EL Open Space Plan), an independent study was organized through the NRE department. The study was intended to function as another avenue of research towards a report on the methods and effectiveness of the EL Open Space Plan. The idea was to facilitate interaction with environmental experts in anticipation that feedback and discussion regarding the East Lyme Open Space Plan would critique the process and results, thereby informing the report as well as future open space planning projects. At the outset, the independent study was meant to involve three meetings with the student, professor and environmental experts. As the meetings were intended to facilitate discussion of the issues, it was labeled an Open Space Discussion Panel. The student was to present the plan at the beginning of the semester and open the panel for discussion on project and process. Comments from that meeting were to help inform the report. Mid-semester would have been a second panel to discuss report topics and issues as determined by the initial meeting as well as literature research. A final meeting at the end of the semester would have been held to discuss the conclusions of the report.

Independent Study: How it went

The independent study did not go as planned. Weekly meetings between student and professor opened discussion of three shortcomings of the project which should be addressed. The first issue was a lack of contextual evaluation. The student

was encouraged to explore eco-regions as an important aspect open space planning. Secondly, a literature review of open space planning methodology was recommended to give a frame of reference regarding a typical process. Defining the term 'open space' as used in the LUV Study was the third issue raised at these meetings. Research into these issues progressed through the first half of the semester, the second half focused on scheduling the discussion panel.

During research into the aforementioned issues, the professor identified colleagues who could be included in the Discussion Panel, and the student attempted to contact the suggested experts via email and knocking on doors. Unfortunately, by the time the other professors had been contacted and scheduling begun, mid-terms, Thanksgiving and Winter Break followed in quick succession. As it was, one meeting was held during the last week of the semester. Attendees were Dr. John Volin, Dr. Morty Ortega, Dr. Jason Vokoun and Dr. Jack Clausen, experts in ecology, wildlife management, forestry and hydrology respectively. While the meeting did not go as well as hoped, some useful points were brought forward, and a second meeting suggested.

Suggested Exploration: Regional Scale

Concern was expressed by the discussion panel that the East Lyme Open space Plan does not address issues of regional planning/ecology. The consensus was that it would be difficult to critique the effectiveness of the plan without seeing how it fits into the regional systems. The issue was raised beforehand by Dr. Clausen as a flaw in the process. He suggested eco-regions as an appropriate unit of study. This has the benefit of having an environmental focus, and inherently fitting the area into the larger system

classification. The EPA provides extensive mapping and data on ecoregions throughout the United States, including Level IV regions. The pertinent eco-region for the LUV study would be the Level IV New England eco-region identification, and the Level III state eco-region identification. For example, the New England eco-regions identify East Lyme as being in the Northeastern Coastal Zone and describes this zone and sub-zones in terms of terrain, vegetation and climate. This provides an excellent summary of the local environment and highlights unique characteristics to the area. Figures 4.2 & 4.3 show how East Lyme fits into the EPA eco-region classification. Knowing how the local ecosystems fit into the region informs critical area identification. For instance there may be particular resource which is quite plentiful in the town, and therefore seem like a low protection priority. However, when looking at the larger ecological scale, it could be that the same resource is scarce in the region, and therefore a higher priority for conservation.

It is agreed that a regional scope would be important to include in future studies of this kind, however, planning at the town level can be highly effective at engaging citizens and accomplishing community goals. Robert Mason advocates for town-scale planning, arguing that "...working relationships among stakeholders in place-based planning processes at relatively small geographic scales are likely to generate shared ways of knowing." This scale is more intimate, and those involved are more invested in the process as it has a direct impact on their own community. Thus, it would be fitting that future LUV Studies include a review of regional issues, but use a town-scale process.

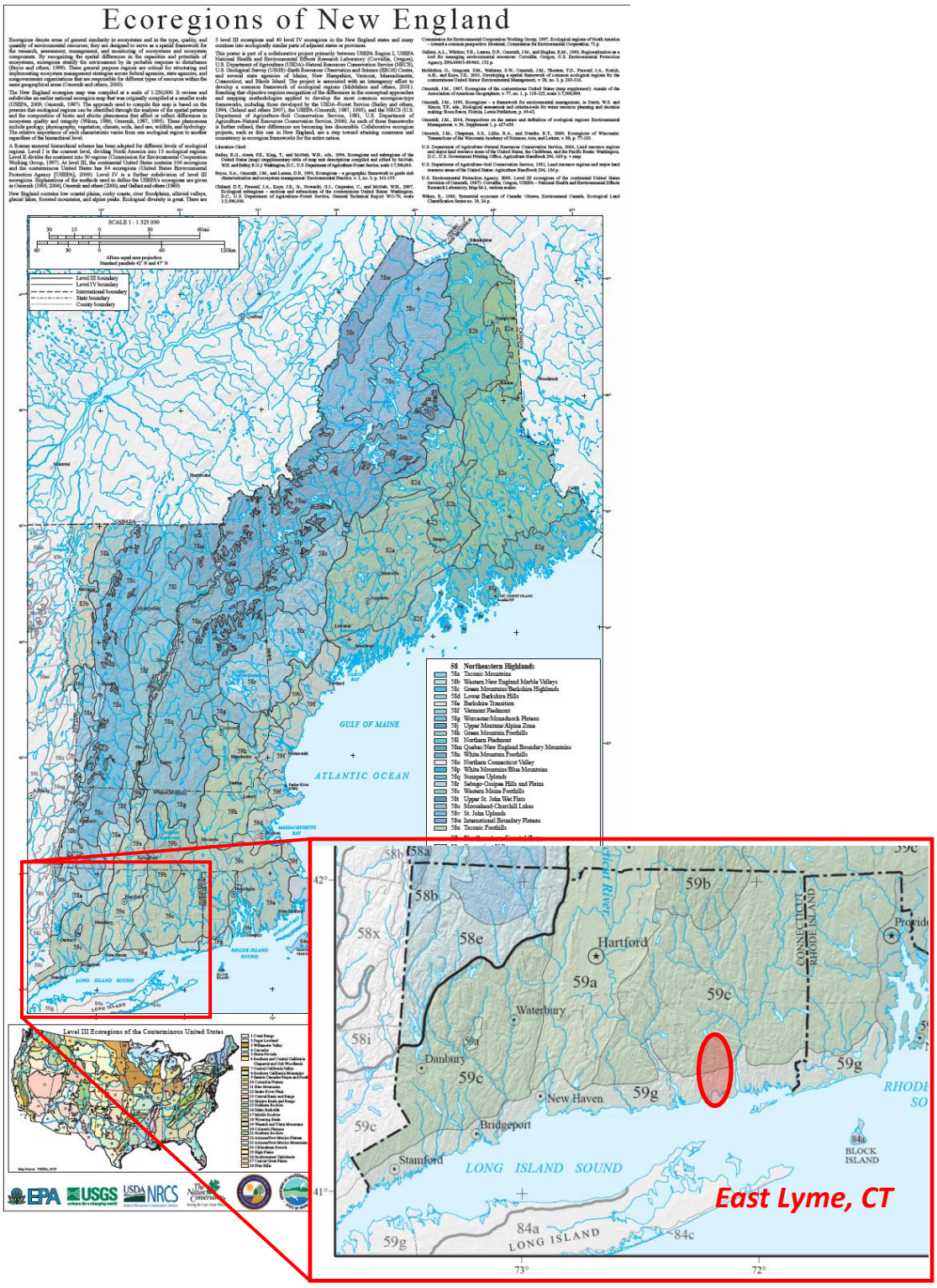


Figure 4.2) Map of Level IV eco-regions; New England with a close-up of Connecticut.

Figure 4.3) Summary information of Level IV eco-regions; East Lyme contains both 59c and 59g zones

Suggested Exploration: Literature Review of POCD guidelines in Connecticut

During initial meetings, Dr. Jack Clausen observed the need to investigate open space planning in Connecticut. A review of how other towns are protecting their natural and cultural resources could have informed methods and priorities of the East Lyme open space planning. Through the process, this aspect of the LUV Study process was informed by project lead Peter Miniutti's experience. However, as a student researcher, reviewing implementation and terminology utilized in planning documents would give additional perspective on the process. Such a review may also lead to a greater understanding of what tactics have been effective.

Coventry and Brooklyn are towns in Connecticut which were suggested as good examples of aggressive open space plans. A brief review of these open space plans was encouraging as they had similar goals and basic conclusions to the work done in the LUV Study. An essential element of each plan is the focus on identifying and locating natural and cultural resources that need to be protected. As expected, there were also several differences. The Coventry and Brooklyn plans take greater care with defining what resources they are discussing, whereas the CRDC plan made the inappropriate assumption that definitions were unnecessary. The CRDC plan instead focused on the overall design of a green infrastructure network (open space network), and explaining the importance of such connectivity/circuitry.

An in depth review of town open space planning would be a time-consuming, but highly valuable study to undertake. At the most basic level, determining the purpose of various open space plans would be valuable. For instance, some plans are designed for parks and hiking trails, others for specific resource protection, and others

designed for a combination of many goals. It would be interesting to categorize methods and how implementation is to go forward; how much did the public participate? Are the recommendations based on town purchasing land or on encouraging private dedication? It could be useful for understanding and improving the process of open space planning in future LUV Studies. It is therefore highly recommended that a critical review and analysis of open space planning be conducted before, or concurrent to the next LUV Study.

Suggested Exploration: Terminology

The issue of defining open space led to the realization that terms used in the East Lyme Open Space Plan were not clearly defined as used in the study. With a plethora of terms associated with land use planning and conservation, in addition to multiple disciplines which use the terms in various contextual situations, it is useful to define some of the key terms as they are understood in this research.

- *Cultural Resource*
    - An artifact of human existence which contributes positively towards the understanding of past and present land uses/habitation.
      Such artifacts are the visual history of a community.
- *Natural Resource*
    - A naturally occurring process or condition, regardless of ownership or economic potential, which contributes to the health of environmental systems and the species which inhabit the lands near said process or condition.
        - Most of these resources are finite, meaning that once lost they cannot be replaced. Other resources are renewable, meaning that

given time and effort they may be reestablished as part of healthy, functioning system.

- *Development*
    - The alternation of the natural environment through the construction of buildings or transportation corridors for the purpose of human use/habitation. Developed land refers to structures and transportation corridors, as well as the lands directly impacted by those elements.
- *Undeveloped Land*
    - Public or private land which has not been directly altered by the construction of buildings or transportation corridors for the purpose of human use/habitation.
- *Open Space*
    - Parcels with little to no development, which directly or indirectly provide an interface between humans and the environment.
- *Types of Open Space*
    - Cultural Open Space (Parks)
        - Areas designed and maintained for agriculture or recreation; this includes hayfields, horse corrals, baseball fields, golf courses, and other such activities which provide vernacular identity and/or community oriented spaces.
        - These lands are generally not protected from future resource degradation and are often prime locations for development in terms of geology and accessibility
    - Dedicated Open Space
        - Public or private land which is in some way legally preserved, protected and/or has defined use restrictions preventing future degradation of existing natural and cultural resources.
            - These lands include specifically protected features such as wetlands, parcels owned by a land trust or conservation

authority, portions of residential developments (as required by subdivision regulations), and areas that are protected through deed restriction, easement, or other legally binding agreement.

- Natural Open Space (Nature Reserves, etc.)
  - Areas which remain in their natural condition with minimal physical manipulations for purposes of human use/activities.
- Public Open Space
  - Lands which are controlled by a governing agency through ownership, easement, lease or deed. Citizens have access to the land and may use it for activities as stipulated by the controlling agency; this may include hiking, biking, hunting, fishing, camping, swimming or other site-appropriate activities.

Suggested Exploration: Terminology for types of recommended open space

One of the issues open for discussion was the use of various terminology in the LUV Study. Terms such a 'Natural Resources' and 'Open Space' can be ambiguous and it was important in evaluating the study to determine if the concepts were appropriately conveyed through the vocabulary. Early on in the independent study, it was observed that some terms are too vague and need to be defined as used in the LUV Study. The most prominent of these was 'open space'. In landscape architecture the term generally refers to the undeveloped portion of the site. In the LUV Study, the term was modified to 'dedicated open space' in order to differentiate between planned open space and merely undeveloped land. However, the various types of dedicated open space had not been considered. For instance the difference between a nature preserve and a recreational park. Both are considered open space, but differ greatly in maintenance and use. In large part, the LUV Study addresses natural open spaces such as wooded areas.

Cultural open spaces such as ball parks and historic sites are already effectively managed and therefore did not need further attention. The issue is complicated however with the consideration of farm fields which lack structures, yet are not natural spaces. In future LUV Studies, descriptive categories of existing open space should be compiled during the inventory phase.

Terminology used to describe the types of open space recommended in the Open Space Plan was questioned during the discussion panel. The original types were labeled Key Preservation, Preservation, Conservation, and Open Space. While the labels conveyed the idea that the lands should be treated differently, with some more sensitive than others, the commonly understood definitions of the terms does not correlate with the intent of the plan. For this reason the labels were reworked to what was seen in Table 1; Flexible Preservation, Conservation, Strategic Open Space, and Open Space. *Flexible preservation* was chosen in response to the desire to limit use of the site to trails, yet the need to maintain the lands for the health of the ecosystem. The idea behind *Flexible Preservation* is that structural alteration of the land is strictly controlled, yet the health of the local ecosystems can be managed as necessary over time. (The need for the distinction between preserved lands and preserved land which can be managed was revealed in during a meeting discussed in the following paragraphs.) The new labels better suit the intent of the recommendations while being true to the commonly understood meaning of the terms themselves.

Consultation with expert from DEP

---Additional Feedback---

At the suggestion of Dr. Isaac (Morty) Ortega, a participant of the Open Space Discussion Panel, the CRDC team contact Howard Kilpatrick, a biologist with the Connecticut Department of Environmental Protection. Mr. Kilpatrick has been working with the CT-DEP forestry agency for over 20 years now, specializing in deer habitat management across the state. In this capacity he has gained a broad understanding of Connecticut ecological needs and habitat considerations. The CRDC team contacted Mr. Kilpatrick via email, and he agreed to a meeting at which he could review and discuss the open space plan designed for East Lyme. The meeting was informative, providing a different perspective on issues to be considered in open space allocation.

Foremost of the questions asked of Mr. Kilpatrick was whether the open space network as designed for East Lyme would maintain viable ecological connections. His opinion of the system judging by form was that it provided suitable connectivity and circuitry. This was stated with an emphatic note that the vegetative type/condition should be inventoried in order to verify the suitability of land through which the corridors/patches are placed. He explained that vegetation conditions (meadow, thicket, non-understory forest...) influence what species will utilize the spaces, and how they will do so. In addition, a greater understanding of the native species for which the network is being designed should be sought. Knowing what species are present and which should be encouraged in the area, one can find minimum habitat size and vegetative needs to inform allocation of ecological patches/corridors.

Determining patch size depends on vegetation type and species to inhabit the patch. If a wildlife inventory is not available, a species which is commonly found in diverse ecosystems can be used; hereafter referred to as a 'bench-mark species'. Most native animals have been observed, and their habitat needs are known. Thus, once an appropriate bench-mark species has been determined, minimum patch and corridor dimensions can be set. In addition, vegetation types can be prioritized for inclusion in the open space network as a wildlife habitat resource. For this study, Mr. Kilpatrick suggests Cottontail rabbits as a potential bench-mark species (field verification would be needed to support this choice). The habitat needs for this species would identify patches of approximately five acres of thicket or dense vegetation, as potential wildlife habitat resources.

According to Mr. Kilpatrick and previous research for this project, the importance of patch size differs with connectivity to the network. A well connected patch of a particular size can support a larger/more diverse animal population than an unconnected patch of the same size. Patches are generally connected via ecological corridors. The dimensions for the ecological corridors designed for the East Lyme network was based on literature from landscape ecologist Richard TT Foreman, as well as work from UConn's Center for Landuse Education and Research (CLEAR). This work led to setting a minimum width of 200 feet for the corridors. According to Mr. Kilpatrick, this is an acceptable conclusion, and corridors designed to this width should accommodate wildlife movement, again depending on animal species present and corridor vegetation.

An issue which was beyond the scope of the LUV Study, but which merits discussion is the issue of maintaining areas of designated open space, such as those recommended in for the East Lyme network. When asked his thoughts on land preservation and conservation, Mr. Kilpatrick commented that while preservation is a wonderful thing, it can lead to unhealthy habitats. By his explanation, preserved lands in Connecticut cannot be altered by humans in any way; this includes removal of invasive species, animal population control, or general habitat management. One of the important issues is that habitats such as meadows and shrub lands are growing into first generation forest, leaving many species, like the Cottontail Rabbit without a habitat. In response to this, some agencies have begun to classify lands as 'wildlife management areas', or something similar which allows for maintenance of the vegetation while preventing intense alteration of site form, function, and/or character of the land.

The conclusion reached from the discussion with Mr. Kilpatrick, the East Lyme Open Space Plan is a reasonable solution to the issues of wildlife habitat protection. However there are areas which should be addressed to ensure its success. To improve implementation of the network, the town should invest in mapping the existing land cover in town (in terms of vegetation type and condition), as well as a survey of wildlife species and movement patterns. This would identify areas of lesser or greater importance to the health of the wildlife system, and may alter how the *Strategic Open Space* and *Open Space* is allocated. The *Flexible Preservation* and *Conservation* lands would not be changed as they have been identified as highly valuable from a cultural and natural resource standpoint.

CHAPTER 5: DISCUSSION

To protect both development rights and environmental protection, planners must stop oversimplifying land use relationships to a dichotomy of development and conservation. Instead, land use planning should be based on how cultural and natural systems interact across the landscape. Planning for sustainability requires a systems approach to land use planning which simultaneously addresses community priorities and environmental health. The East Lyme LUV Study methodology attempts this by creating synergy between open space planning and conservation development planning. Evaluated through the open space plan, the LUV Study methodology is seen to be successful. Furthermore, the LUV Study was enthusiastically adopted by East Lyme officials and citizens, indicating it to be a feasible framework for community planning. The document is intended to provide a foundation of information and methods for the promotion of community vision. Its success or failure in practice will be seen in the years to come.

Evaluation of East Lyme Open Space Plan

------*LUV Study Limitations and Successes*------

As a community planning tool, the LUV Study promises to be successful. The document was well received by both town officials and citizens. This being said, there are ways in which the process could be improved upon. In order to make this a truly effective development framework, three aspects of land use planning need special attention. First, zoning must be rewritten to promote desired patterns, making it

economically feasible for developers. Secondly, following principles of landscape ecology, green infrastructure should be planned to enhance existing naturalized areas and to ensure continuity across parcel boundaries (Forman,1995; Miller et. al., 2009). Thirdly, transportation infrastructure must be re-established as part of the community landscape. These three issues are central to creating a sustainable community from network to site scales.

The LUV Study addressed the three issues in the recommendation maps; Future Development, Open Space, and Transportation. The Future Development recommendations addressed the issue of rewriting zoning to accommodate desired development patterns. Three drastic changes to the town zoning were recommended; increase land use intensity in/near commercial areas, create an agriculture zone in which residential development would require a special permit, and make conservation subdivisions mandatory throughout town. These three recommendations focus on zoning-related regulations which need to be reworked for the sustainability of the town. However, the LUV Study does not go into detail as to how new regulations should be phrased, how to integrate them with the existing system, or how to address conflicts with projects that are underway.

Planning the green infrastructure network was based on the Future Development recommendations that conservation subdivisions become mandatory. This too would have benefitted from an evaluation of how to phrase development regulations to ensure that the intent of the network is understood and adhered to by designers/developers. The plan also fails to address whether the dedicated open space is to be public, private

or private with public easements. This issue could become very important in communities which value or lack public spaces.

The Transportation Recommendations focused on promoting multi-modal transportation corridors, increasing connectivity, and designing context-sensitive 'complete streets' with on-site storm water infiltration. This portion of the LUV Study has much room for improvement. One valuable aspect would be locating where streets could be redesigned to be more efficient, both culturally and environmentally. Also, design standards for future roadway construction could have been addressed, with guidelines on lane width and traffic calming techniques. As part of the community landscape, future LUV Studies should take a closer look at the street network and how it impacts the health of the community.

The fact is that time constraints and project scope prohibited the more detailed studies presented in the previous paragraphs. A mitigating solution could be to include non-landscape architects on the CRDC research team. Transdisciplinary collaboration is growing in academia, being encouraged more and more as a means for efficient and holistic research. Though the LUV Study involved collaboration among town officials, residents, professor and graduate students, it did not involve experts from other disciplines as part of the core research team. As a land use planning study, this process lends itself to a diverse research team. Landscape architects are well versed in spatial relationships and systems planning, however the details such as the vocabulary of legal guidelines, animal habitat prioritization and roadway speed and volume capacity are beyond most landscape architects. Beyond facilitating more detailed research, a

collaborative approach is also useful for gaining credibility with the citizens of the research area.

> " This could favor collaborative approaches, even in a political climate not nurturing of environmental innovation. Regardless of economic influences, collaboration might well be the best way to go in such political circumstances. ... As this example suggests, collaborative approaches are likely to enjoy continued support across the political spectrum."
> Robert J. Mason

By including experts from other fields related to community landscape planning, the process becomes more efficient, more informed and overall more effective.

It is important to note that even though the patterns suggested in the paper are much preferable to standard subdivision patterns, conservation subdivisions still contribute to sprawl development. Issues of disconnected street networks and isolated neighborhoods are still problematic. And though conservation subdivisions consume less resources than standard patterns, finite resources are still being consumed. It would therefore be preferable for new development to occur among the existing development. Implemented conservation subdivisions could be modified to enhance connectivity by creating low imprint pedestrian/bicycle pathways among nodes and neighborhoods. Utilizing best management practices in subdivision design can limit and treat storm water runoff, thereby lessening associated pollution issues.

Participatory Action Research

------*LUV Study As Participatory Action Research*-------

The most successful aspect of the LUV Study was how it engaged citizens and responded to their vision of East Lyme's future. Involved citizens and open-minded researches led to town recommendations which were sustainable and supported by the

community. This is essential to a successful land use planning document. The success of the LUV Study in reaching the citizens was seen in the public workshops, meetings and interaction with various residents. Participants voiced concerns and opinions freely, discussing relative values of resources and impacts of development patterns on town character. In order to facilitate open discussion, the CRDC sought to make the LUV Study as transparent as possible. This worked to prevent some of the hindrances to successful public participation; distortions in communication, imbalanced power dynamics and unequal distribution of knowledge (Laurian et al., 2008). In order to maintain equal distribution of information, notes were taken at every meeting, summarized and presented at the following meeting. The CRDC presented material and requested feedback from the meeting attendees, adjusted the work according to the feedback and then presented the material again, explaining how they attempted to accommodate the comments. Additional feedback was then requested.

Another aspect of the LUV Study that aids in citizen engagement is that the process was conducted as Participatory Action Research (hereto after PAR). PAR is a form of service learning which focuses on public involvement in projects which have tangible results. PAR works well on community planning projects where residents and officials are attempting to plan a system or network to meet the needs and desires of the municipality and the diverse citizenry. In East Lyme, it created a highly effective land use planning methodology. Initial skepticism towards the CRDC was quickly released as citizens observed the students as exploratory researchers. The time devoted to the research by the students was visible in the presentations and feedback opportunities; for

instance when citizens expressed concern of agricultural land use being overlooked, students took the time, trips and effort to fully explore the issue.

Additional Research: Participatory Action Research

Experiential education dominates the curriculum of architecture and landscape architecture programs. This type of education functions under the philosophy that knowledge results from a combination of grasping an experience and transforming it into conceptual understanding (Hedin, 2010). In architecture and landscape architecture programs, predominant forms of this include internships, design studios, and service learning. Internships and design studios are both well established teaching methods with predictable curriculum structure. Service learning on the other hand is a more recent addition to curricula, and therefore lacks the standardization seen in traditionally practiced teaching methods.

The addition of service learning to curricula enhances landscape architecture education by providing valuable insight into professional and social dynamics which surround projects impacting multiple publics; insights not to be found in typical design studios. (Brown, 2003) A symptom of its lack of standardized expectations is that the term 'Service learning' is at times used synonymously with 'public outreach' to describe projects in which the students work with a client outside of the studio classroom. This is an inaccurate substitution. Though public outreach projects often lend themselves to becoming service learning projects, they do not always function as such. Service learning is differentiated from public outreach in that it goes beyond the project itself to focus on transforming the experience into a conceptual understanding through reflection on the

service activity (Forsyth, 1999). The difference is subtle but crucial. Learning from experience, as one does in non-curricular outreach, relies on incidental experiences to enlighten the observer (student). Experiential learning involves a structured process that is consciously observed and those observations transformed through critical thought into knowledge. (Hedin, 2010) With these criteria in mind, the term *service learning* applies only to public outreach projects that engages students in critical observation.

Participatory Action Research (hereto after PAR) is a form of service learning. An important variance between PAR and other service learning models is the focus on citizen participation and empowerment. The need to focus on citizen participation is an ongoing issue as many decision-makers find involving citizens to require extensive energy with poor results. For this reason, citizen participation in political processes is often relegated to what Sherry Arnstein refers to as "non-participation", wherein meeting attendees are told about a project, perhaps allowed to comment, but without opportunity to actually impact the project outcome. By encouraging public participation as a partnership with the researchers and a free flow of information, PAR is able to bring citizen power up into the realm of high-level 'tokenism', and at times 'full citizen power', depending on the project type and location. (Arnstein,1969; Rearden, 1998; Baum, 2006) This is done by promoting transparent information sharing, thereby dispersing power among the participants until the researched joins the researchers (Baum,2006).

Another way in which a PAR methodology differs expands on service learning is that it puts more emphasis on facilitating action based on and equitable democratic process of researcher and research community collaboration (Walter,2010). This close

observation of power dynamics contributes to the development of students' social consciousness as they discover how a policy or action may affect various social groups in varied and perhaps undesirable ways. As landscape architecture does not have a specified stance on social consciousness, it is essential that students are exposed to such situations in order to allow them to develop awareness of demographic disparities and tools to mitigate injustice (Brown,2003).

Participatory Action Research in East Lyme

The basic role of the students as exploratory researchers reinforced the CRDC claim that the citizens were to be an integral part of the process. Students would ask questions and attentively listen to the responses; attempting to understand all view points. There were several occasions where students would ask citizen opinions and the person responded with a lengthy explanation of the topic and its importance. Generally these explanations adopted a tutorial tone; the citizens became more involved with the process knowing that they were valued as local experts.

As a student working in a PAR project, the most important thing that I learned was the need to facilitate discussion, not dictate desired outcomes. People don't want to be told what to do in their own town, but by sharing information and raising questions citizens will become invested in the project and even begin to raise the important questions themselves. Helping citizens communicate their needs and prioritize their goals allows for informed decision making. By providing that foundation, the longevity, flexibility and suitability of sustainable practices is ensured.

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APPENDIX "A": GISystems Data layers

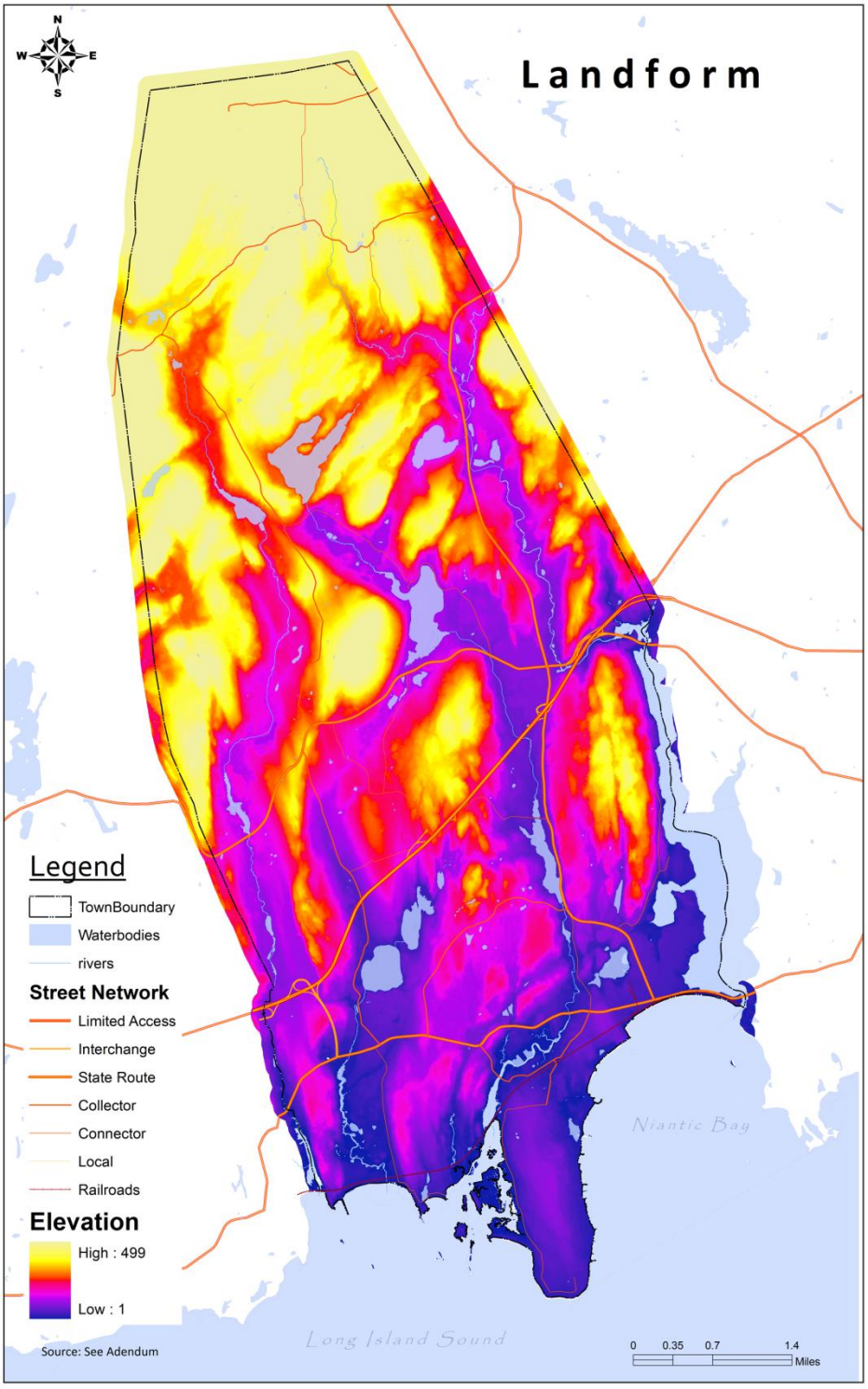
	Base Map	
Resource	Datalayer	Source
Railroad	Railroads	Town of East Lyme
Street Network	RoadCen	Town of East Lyme
Town Boundary	TownBound_Buf500ft_Clip	Town of East Lyme
Water Body	Waterbodies	Town of East Lyme
	Landform	
Resource	Datalayer	Source
Elevation	East_Lyme_DEM	UConn's CLEAR website
Contour	East_Lyme_DEM	UConn's CLEAR website
	Geology	
Resource	Datalayer	Source
Beach & Dune Deposites	Quaternary Geology and Surficial Materials Polygon	CT DEP GIS Data
End Moraine Deposits	Quaternary Geology and Surficial Materials Polygon	CT DEP GIS Data
Farm Soils	Soils	Town of East Lyme
Rocks	Quaternary Geology and Surficial Materials Polygon	CT DEP GIS Data
Thick/Thin Till	Quaternary Geology and Surficial Materials Polygon	CT DEP GIS Data
	Hydrology	
Resource	Datalayer	Source
Aquifer	Aquifer	Town of East Lyme
Coastal Boundary	Coastal Boundary	CT DEP GIS Data
Flats	Hydrography Polygon	CT DEP GIS Data
Marsh	Hydrography Polygon	CT DEP GIS Data
Rivers	Rivers	CRDC Aerial Analysis
Streams	Streams	Town of East Lyme
Tidal Marsh Soils	Wetlands	Town of East Lyme
Upland Wetland Soils	Wetlands	Town of East Lyme
Watersheds	Subregional Drainage Basin	CT DEP GIS Data
Wetlands	Soils	Town of East Lyme
	Ecosystems	
Resource	Datalayer	Source
Forests	Forest	CRDC Aerial Analysis
Natural Diversity Database	Natural Diversity database Areas	CT DEP GIS Data
Wetlands	Wetlands	Town of East Lyme

Cultural Artifacts		
Resource	Datalayer	Source
Antique Buildings	AntiqueBuildings	Town of East Lyme
Antique Building Parcel	AntiqueBuildings	Town of East Lyme
Archeological Sites	Archeologicalsites	Town of East Lyme
Boardwalk.Path	Boardwalk.Path	CRDC Aerial Analysis/Field Work
Children's Museum	Civic Buildings	CRDC Field Work
Church	Civic Buildings	CRDC Field Work
Community Center	Civic Buildings	CRDC Field Work
Farm Fields	Farm Fields	CRDC Aerial Analysis/Field Work
Fire Station	Civic Buildings	CRDC Field Work
General Recreation	Recreation	CRDC Field Work
High School	Civic Buildings	CRDC Field Work
Historic Sites	HistoricSites	CRDC from Historical Society
Historic Building Parcel	HistoricBldg	CRDC from Historical Society
Landfill	Landfill	CRDC Aerial Analysis
Major Intersections	intersections	CRDC Mapping Analysis
Marina	Marina	CRDC Aerial Analysis/Field Work
Middle School	Civic Buildings	CRDC Field Work
Police Station	Civic Buildings	CRDC Field Work
Rail Road Crossing	Rail Crossing	CRDC Mapping Analysis
Stone Walls	Stone Walls	Town of East Lyme
Town Garage	Civic Buildings	CRDC Field Work
Town Hall	Civic Buildings	CRDC Field Work

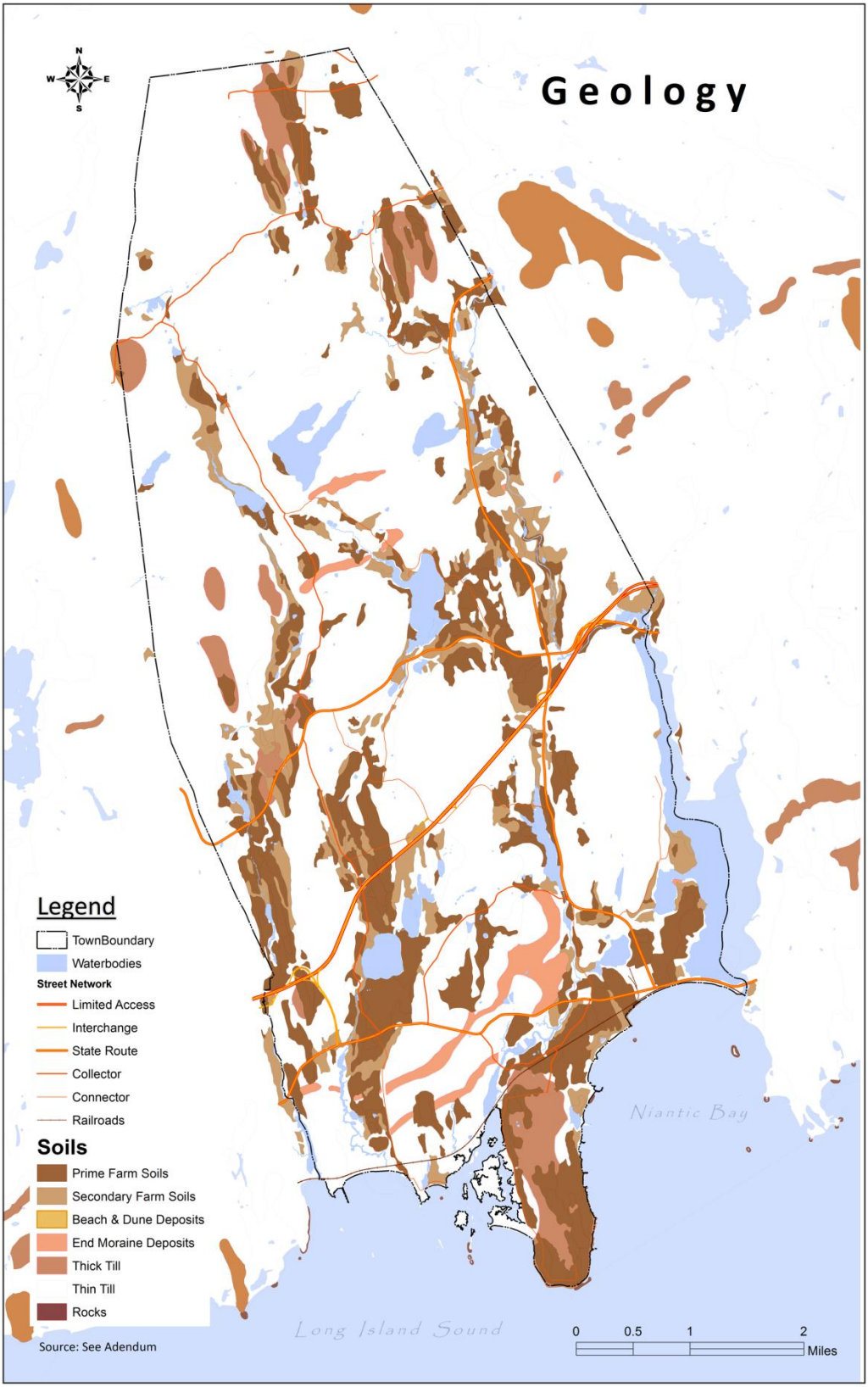
Cultural Controls		
Resource	Datalayer	Source
DEP Lands	DEP Property	CT DEP GIS Data
Municipal Land	Municipal Property	CT DEP GIS Data & CRDC Field Work
OpenSpace_Dedicated	1997 Municipal and Private Open Space	CT DEP GIS Data
Sewer	Sewer Service Area	CT DEP GIS Data
State	State_Federal_Land	CRDC Field Work
Utilities	UtilPoles	Town of East Lyme
YaleProperty	ParcelPolygon	Town of East Lyme
Zoning	Zoning	Town of East Lyme

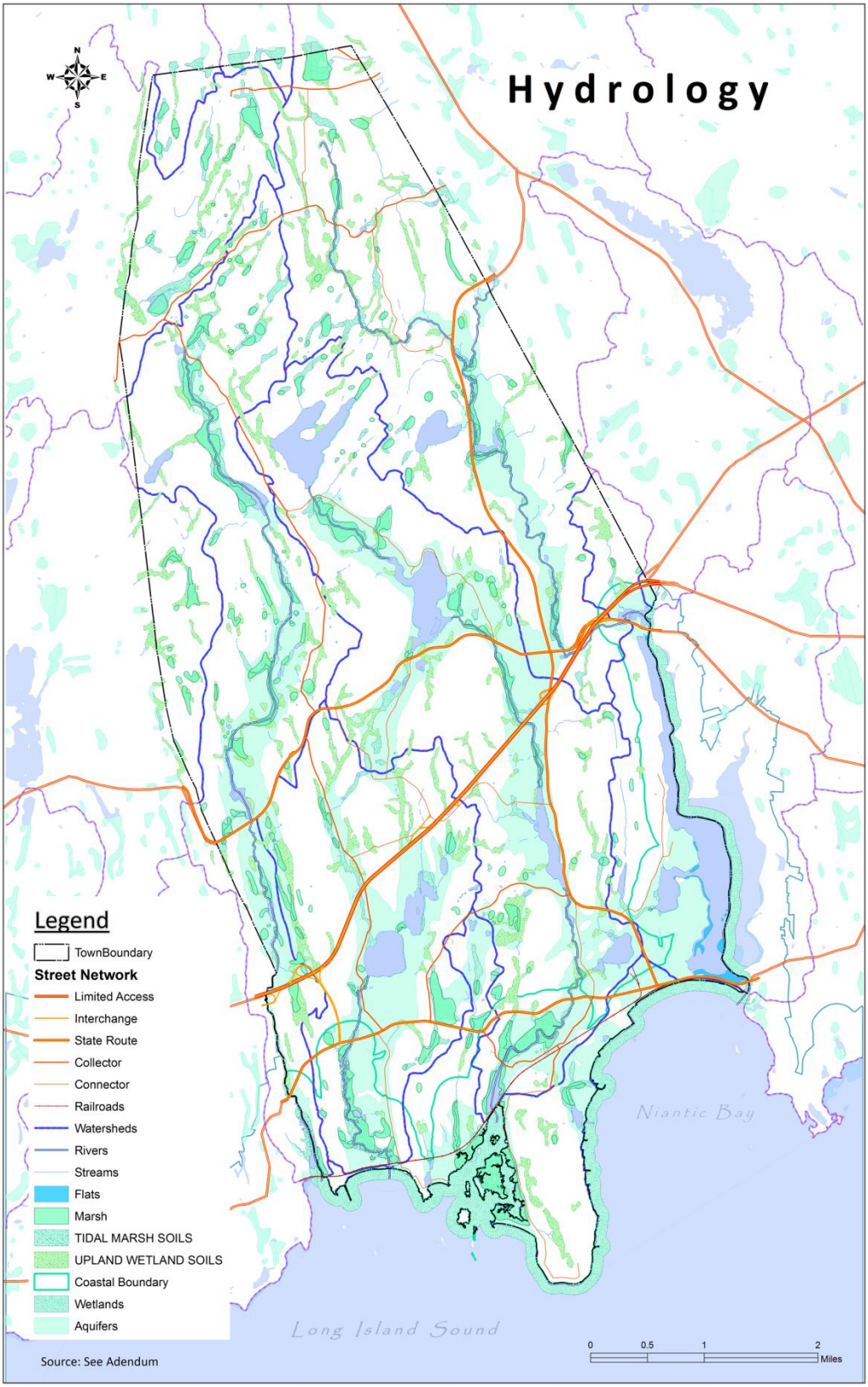
Development		
Resource	Datalayer	Source
Development	Development_town	CRDC Parcel Analysis

APPENDIX "B": Inventory Mapping

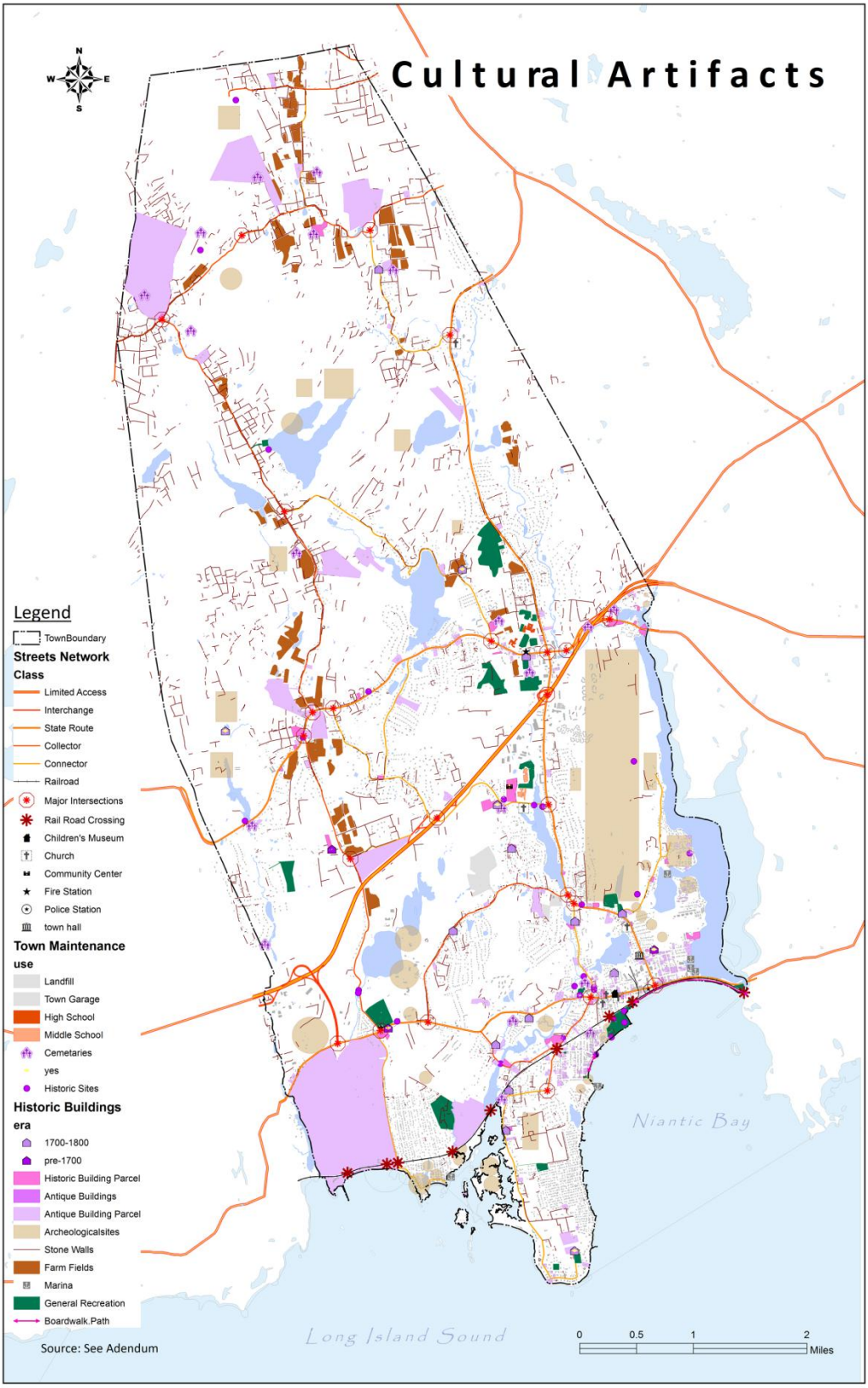


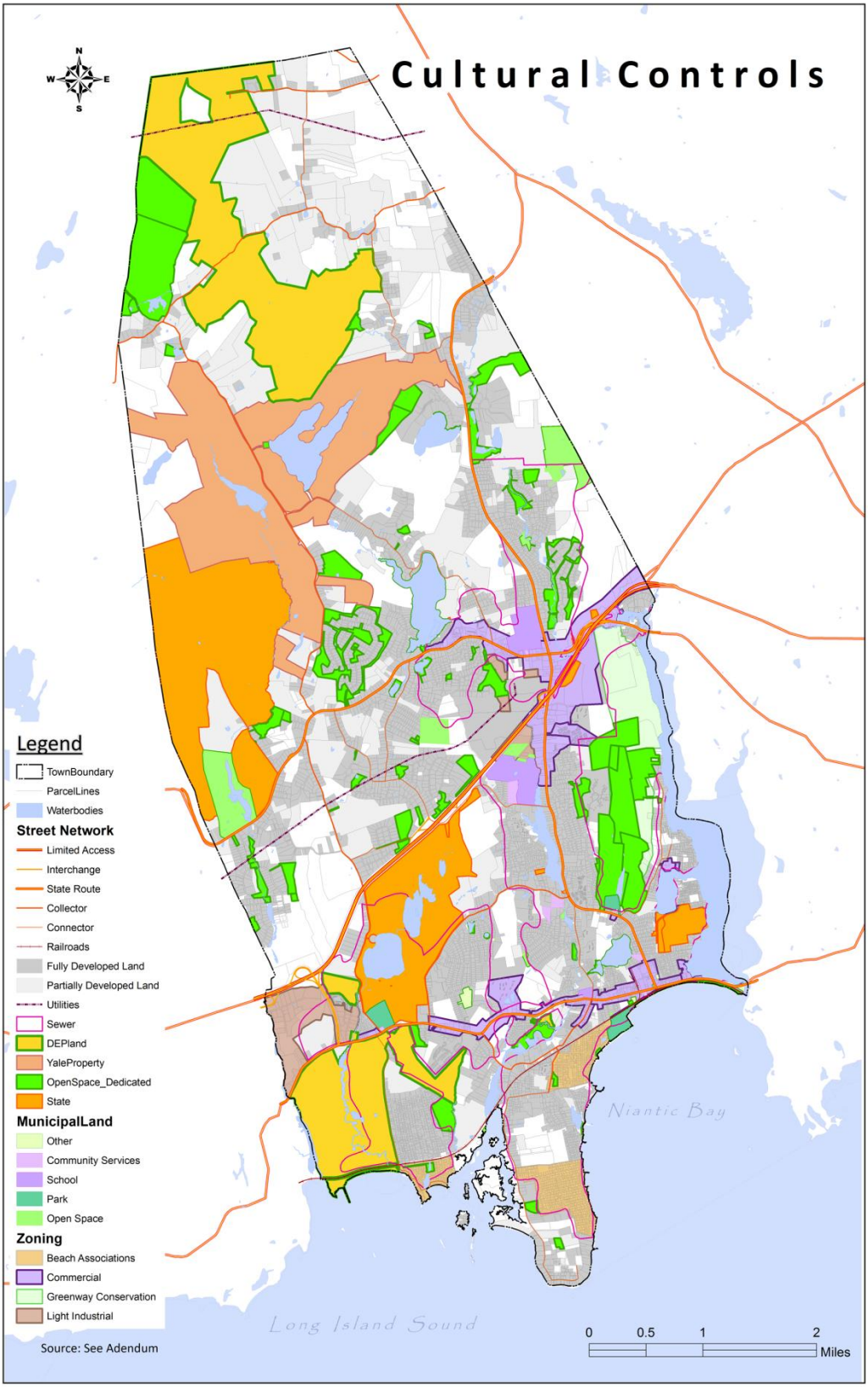

Topography
N
W
E
S
Legend
TownBoundary
Railroads
Waterbodies
rivers
Slope
0-5
5-8
8-12
12-16
16+
Source: See Adendum
Niantic Bay
Long Island Sound
0 0.35 0.7 1.4
Miles

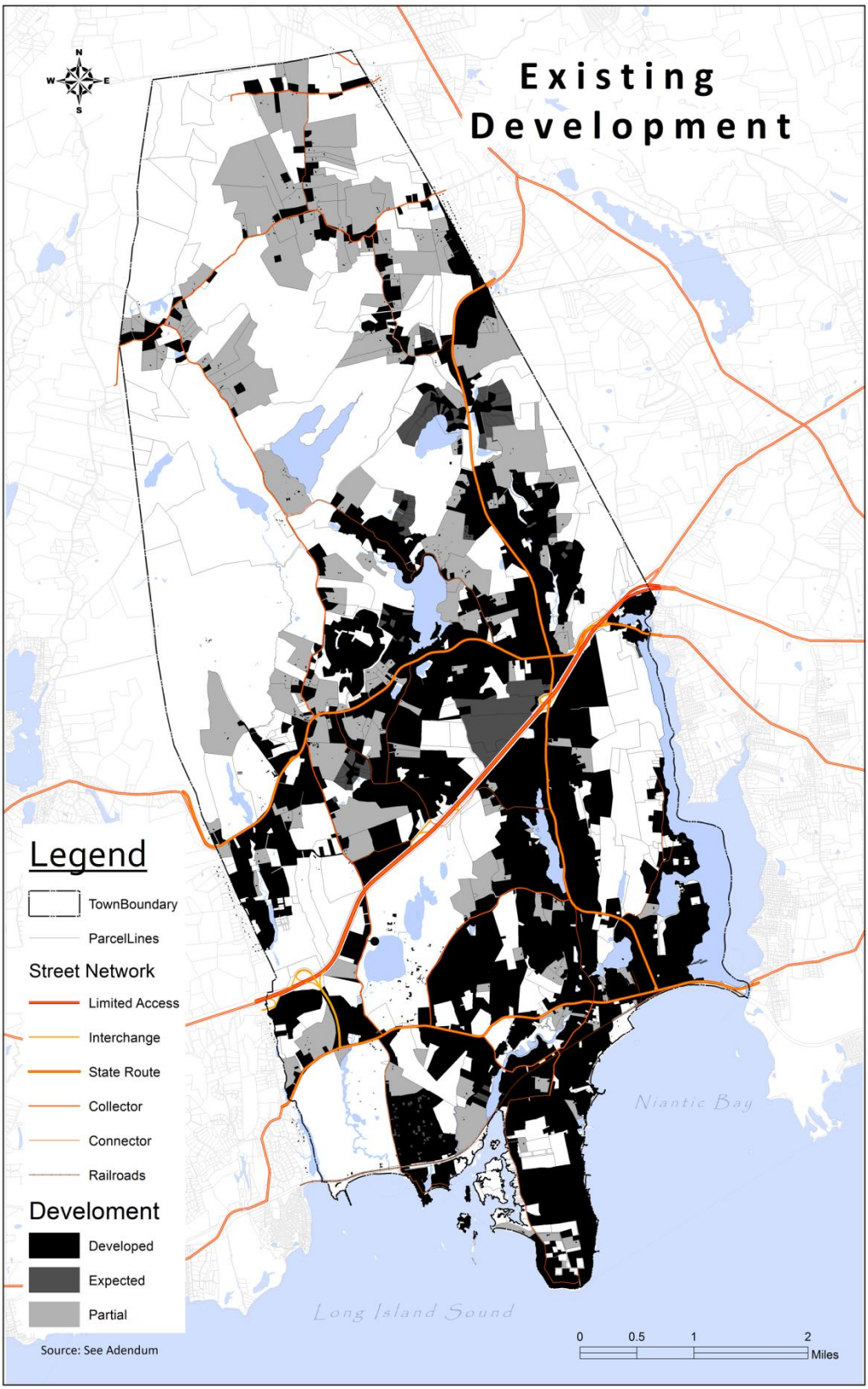

Geology
N
W
E
S
Legend
TownBoundary
Waterbodies
Street Network
Limited Access
Interchange
State Route
Collector
Connector
Railroads
Soils
Prime Farm Soils
Secondary Farm Soils
Beach & Dune Deposits
End Moraine Deposits
Thick Till
Thin Till
Rocks
Source: See Adendum
Niantic Bay
Long Island Sound
0
0.5
1
2
Miles


Hydrology
N
W
E
S
Legend
TownBoundary
Street Network
Limited Access
Interchange
State Route
Collector
Connector
Railroads
Watersheds
Rivers
Streams
Flats
Marsh
TIDAL MARSH SOILS
UPLAND WETLAND SOILS
Coastal Boundary
Wetlands
Aquifers
Source: See Adendum
Niantic Bay
Long Island Sound
0
0.5
1
2
Miles


Ecosystems
N
W
E
S
Legend
TownBoundary
Street Network
Limited Access
Interchange
State Route
Collector
Connector
Railroads
Natural Diversity DB
Waterbodies
Wetlands
Forests
Source: See Adendum
Niantic Bay
Long Island Sound
0
0.5
1
2
Miles


Cultural Artifacts
N
W
E
S
Legend
TownBoundary
Streets Network
Class
Limited Access
Interchange
State Route
Collector
Connector
Railroad
Major Intersections
Rail Road Crossing
Children's Museum
Church
Community Center
Fire Station
Police Station
town hall
Town Maintenance
use
Landfill
Town Garage
High School
Middle School
Cemetaries
yes
Historic Sites
Historic Buildings
era
1700-1800
pre-1700
Historic Building Parcel
Antique Buildings
Antique Building Parcel
Archeologicalsites
Stone Walls
Farm Fields
Marina
General Recreation
Boardwalk.Path
Source: See Adendum
Niantic Bay
Long Island Sound
0
0.5
1
2
Miles


Cultural Controls
N
W
E
S
Legend
TownBoundary
ParcelLines
Waterbodies
Street Network
Limited Access
Interchange
State Route
Collector
Connector
Railroads
Fully Developed Land
Partially Developed Land
Utilities
Sewer
DEPland
YaleProperty
OpenSpace_Dedicated
State
MunicipalLand
Other
Community Services
School
Park
Open Space
Zoning
Beach Associations
Commercial
Greenway Conservation
Light Industrial
Source: See Adendum
Niantic Bay
Long Island Sound
0
0.5
1
2
Miles


Existing Development
N
W
E
S
Legend
TownBoundary
ParcelLines
Street Network
Limited Access
Interchange
State Route
Collector
Connector
Railroads
Develoment
Developed
Expected
Partial
Source: See Adendum
Niantic Bay
Long Island Sound
0
0.5
1
2
Miles

APPENDIX "C": Natural and Cultural Resources

Agricultural Land Use

Data Layer	AgrParcel.shp
Source	CRDC
Dated	4/12/2009
Accuracy	Very Good: Agriculture land use utilizes parcels to delineate land use boundaries.
Notes	Land use was established over the course of several interviews with local experts, cross referenced with aerial imagery, and presented at public town meeting for feedback and/or correction.

Aquifer Protection Area

Data Layer	Aquifer_Protection_Areas.shp
Source	**State of Connecticut, Dept. of Environmental Protection (data compiler, editor & publisher)**
Dated	4/21/2010
Accuracy	Good: Not intended for maps printed at map scales greater or more detailed than 1:24,000 scale (1 inch = 2,000 feet.)
Notes	Creation of this layer was completed well into the LUV project by the state DEP.

Aquifer Recharge

Data Layer	AqRecharge.shp
Source	Town of East Lyme Geodatabase
Dated	Unknown
Accuracy	Good: Compiled by Meg Parulis for the Town of East Lyme. Dataset derived from a map entitled "Geohydrologic Map in the Lower Thames and Southeastern Coastal River Basins" by the United States Geological Survey. No date was found on the map.
Notes	

Coastal Boundary

Data Layer	Coastal_Boundary.shp
Source	State of Connecticut, Dept. of Environmental Protection (data compiler, editor & publisher)
Dated	1995
Accuracy	Good: Not intended for maps printed at map scales greater or more detailed than 1:24,000 scale (1 inch = 2,000 feet.)
Notes	

Critical Habitat

Data Layer	Critical_Habitat_Poly.shp
Source	State of Connecticut, Dept. of Environmental Protection (data compiler, editor & publisher)
Dated	7/1/2009
Accuracy	Good: Not intended for maps printed at map scales greater or more detailed than 1:24,000 scale (1 inch = 2,000 feet.)
Notes	

End Moraine Deposits

Data Layer	Quaternary_Geology_and_Surficial_Materials_Polygon.shp
Source	State of Connecticut, Dept. of Environmental Protection (data compiler, editor & publisher)
Dated	2005
Accuracy	Fair: This data layer was digitized from 1:24,000-scale compilation sheets for the 1:125,000-scale Surficial Materials Map of Connecticut, Stone and others, 1992 and the Quaternary Geologic Map of Connecticut and Long Island Sound Basin, Stone and others, 2005.
Notes	

Farm Soils

Data Layer	Farmland_Prime.shp
Source	Town of East Lyme Geodatabase: Planning_Zoning
Dated	Unknown
Accuracy	Good
Notes	Assumed to be adapted from CT Surface Material dataset

Forest

Data Layer	ExForest.shp
Source	CRDC
Dated	5/3/2010
Accuracy	Good
Notes	Aerial Imagery Analysis

Glacial Deposits

Data Layer	Quaternary_Geology_and_Surficial_Materials_Polygon.shp
Source	State of Connecticut, Dept. of Environmental Protection (data compiler, editor & publisher)
Dated	2005
Accuracy	Fair: This data layer was digitized from 1:24,000-scale compilation sheets for the 1:125,000-scale Surficial Materials Map of Connecticut, Stone and others, 1992 and the Quaternary Geologic Map of Connecticut and Long Island Sound Basin, Stone and others, 2005.
Notes	Quaternary Geologic Map of Connecticut and Long Island Sound Basin

High Points

Data Layer	HighPoint
Source	CRDC
Dated	5/3/2010
Accuracy	Fair
Notes	Visual analysis of topographic map derived from CLEAR Digital Elevation Model, LiDAR-derived 10-foot spatial resolution, produced in 2000

Natural Diversity Database

Data Layer	Natural_Diversity_Database_Areas.shp
Source	State of Connecticut, Dept. of Environmental Protection (data compiler, editor & publisher)
Dated	12/1/2010
Accuracy	Good
Notes	

Thick Till

Data Layer	Quaternary_Geology_and_Surficial_Materials_Polygon.shp
Source	State of Connecticut, Dept. of Environmental Protection (data compiler, editor & publisher)
Dated	2005
Accuracy	Good
Notes	