Planning for Sea Level Rise in the Matanzas Basin

Appendix E:
Matanzas Future Development Scenarios

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Future Development Scenarios for the Matanzas Basin

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Introduction

This paper describes the basic technical concepts employed to accomplish the land use analysis support for a two county study area that contains the Guana Tolomato Matanzas National Estuarine Research Reserve (GTMNERR). The author provides a summary description of the Land Use Conflict Identification Strategy (LUCIS) land use conflict analysis as a decision making tool. It begins with a brief review of the LUCIS five-step process, including a short discussion of four relevant terms: suitability, community preference, conflict, and opportunity. For a more complete understanding of the LUCIS modeling process please see "Smart Land-Use Analysis: The LUCIS Model" Esri Press, 2007 M. Carr and P. Zwick. Two main scenarios have been created. The first is an existing and future land use scenario for the year 2060, including 1 meter of sea level rise, developed at current development rates. The second is an existing and future land use scenario for the year 2060, including 1 meter of sea level rise, with development avoiding high priority conservation lands.

Methodology

The original LUCIS concept provides 27 categories for major land-use conflict between agriculture, conservation, and urban and is employed to define conflict or overlapping preference for land use between three major categories. For example areas within the GTMNERR or the surrounding counties may have lands with high potential for urban development that also have a high potential for conservation. This conflict may arise because of the areas habitat and because the area is close to existing residential development with accessibility to other urban uses – such as shopping, entertainment, or a combination of many urban proximity factors. A new implementation of this overlapping LUCIS conflict **matrix** (simple a spreadsheet for land use selection) is the development of a mixed use opportunity matrix which provides a means of identifying combinations of overlapping land-use opportunity for mixed-use redevelopment in urban and suburban areas. The LUCIS mixed-use opportunity matrix also utilizes multiple combinations (27 opportunities) of three uses; 1) multifamily residential, 2) retail or service employment opportunity, and 3) commercial employment opportunity. The intent of the mixed use opportunity matrix is to make better mixed use land use identification within urban or urbanizing areas that provide greater opportunity for increase development density combined with employment opportunity.

The paper also briefly explains how to create and utilize a "Criteria Evaluation Matrix" (CEM) for more complex land-use analysis. The CEM utilizes conflict, mixed-use opportunity, and other variables to analyze complex land use decisions include the allocation of employment (commercial, retail, service, institutional and industrial); residential population (single family and multifamily); as well as urban and suburban mixed-use development (employment and population). Equally exciting are the opportunities within the CEM because of the addition of variables representing development policy or development incentives thereby creating allocation opportunities that can be guided by planning scenarios.

The Five Step LUCIS Process

In “Smart Land Use Analysis: The LUCIS Model” (ESRI Press 2007) Carr and Zwick put forth a five step process to identify and thereby develop a better understanding of land use conflict. The process included: 1) defining goals and objectives, 2) data inventory and preparation, 3) defining and mapping land use suitability, 4) integrating community values to determine land use preference, and 5) identifying potential land use conflict.

Step 1 -- Defining Goals and Objectives

Land use planning and the design process should never result from a plan-as-you-go mentality (Carr and Zwick, 2007). The land use planning process, by its fundamental nature, requires a statement of intent, goals, and objectives that provide direction for the sound (efficient and effective) allocation of future lands. To paraphrase, any road will suffice if it doesn’t matter where you are going. The land use planning process should result in the allocation of lands for urban, agriculture, and conservation use that are representative of the community and result in a product guided by sound land use goals and objectives.

To assure that a plan-as-you-go mentality is not incorporated within LUCIS, the first step of the LUCIS process requires a land use modeler to develop a statement of intent and the goals and objectives required to support that statement of intent. The LUCIS *statement of intent* describes concisely the task at hand. For example, “The intent of this project is to develop a set of land use alternatives that assist community leaders and citizens as they visualize future land use alternatives (with and without sea level rise) for the Guana Tolomato Matanzas study. Each scenario must provide for the allocation of a 2060 proposed population and employment as a result of an increase of 511,000 new people in the “study region” shown as black areas in Figure 1.

A set of goals and supporting objectives are developed in support of the statement of intent. The goals and objectives are hierarchical and define what is to be attained (the goals) and how each goal is to be accomplished (the objectives). For example the LUCIS urban suitability models are structured within a set of goals to identify the most suitable areas for residential (both multi-family and single family), commercial, retail, industrial, service, and institutional land use. Each goal has an accompanying set of objectives and sub-objectives. The single family residential goal has four suitability *objectives* for: 1) physical characteristics of the area, 2) proximal characteristics of neighboring uses, 3) the historical residential growth pattern, and 4) local existing residential density. The single family residential physical objective has five suitability *sub-objectives*: 1) noise, 2) soils construction characteristics, 3) air quality, 4) surface drainage, and 5) hazardous materials.

Step 2 -- Data Inventory and Preparation

Step 2 in LUCIS modeling is essentially a traditional step for a GIS activity and requires the analyst to collect and prepare the data required for land use modeling. (See Chapter 7 in “Smart Land Use Analysis: The LUCIS Model” (ESRI Press 2007) for a detailed discussion of the subject.)

Step 3 -- Defining and Mapping Land Use Suitability

Before reviewing the mapping of land use suitability, some definitions for the terms suitability, preference, conflict, and opportunity are in order:

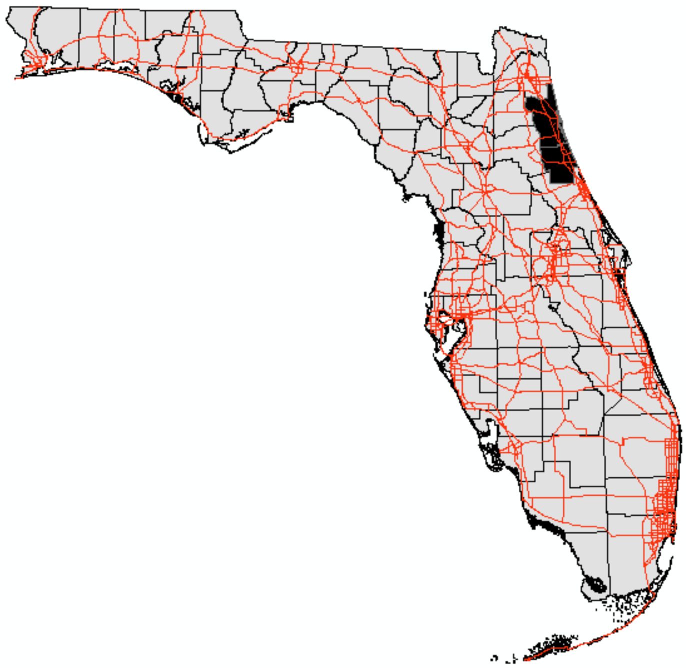

Figure 1: The study region for land use modeling and population and employment allocations.

***Suitability* is simply a categorization of the usefulness of a particular spatial unit of area (a raster cell) in levels of utility for a specific land use.** There are two types of raster suitability. The first is called “Single Utility Assignment” (SUA) which is created by assigning a level of utility (normally ranging from 1-low utility to 9-high utility) for a single land use category by asking a single specific question. For example one may assign a physical residential utility for soils drainage based upon the drainage characteristic of the soil. SUA suitability may also be assigned a utility for the proximity of a location to a community service – for example the nearest hospital. The second type of suitability is called a “Multiple Utility Assignment” (MUA), which is created by combining multiple SUAs to form an aggregate MUA for a particular category. One example of an MUA is the combination of the following three SUAs: 1) an SUA for proximity to interstate highway intersections, 2) an SUA for proximity to state and county roads, and 3) an SUA for proximity to local roads. This combination creates a MUA for proximity to automobile transit opportunities. The MUA represents the combined utility for access to transit from any location within a suitability layer.

***Preference* is the weighted combination of goal suitability data where the individual weights often but not always represent community values**. The individual weights represent a value that community stakeholders place upon a specific goal or objective data when combined with other goals or objectives data. For example, when using a set of community values an urban preference layer may be created by combining transit opportunities, land values, proximity to community and social services, proximity to employment opportunities, areas subject to physical flooding, and proximity to amenities and hazardous areas, all to support the identification of areas that are of value to the community for a major land use, in this case urban development.

***Conflict* is the spatial combination of community land use preference to identify where the community's values are preferred or not preferred for individual land use categories.** The original LUCIS model identified conflict between three major land use categories, agriculture, conservation and urban. A description of LUCIS conflict follows in a later section of this paper.

***Opportunity* is the spatial combination of community land use preference to identify where the community's values are preferred for multiple land use categories.** While the original LUCIS model identified conflict between three major land use categories, agriculture, conservation and urban; land use opportunity is used to find locations where uses are mutually beneficial. An example of mutual benefit for land use is the colocation of commercial employment preference, multi-family residential preference, and retail employment preference for mixed use development.

The LUCIS modeling process requires the development of individual sub-objective models that create a unique suitability layer (SUA) for a specific land use's physical characteristics, proximal characteristics, historic growth pattern, and feature density. Figure 2 is a conceptual diagram of the objective modeling process and depicts model components that include four sub-objective models which contain eight input data sets (the blue boxes), four tools (the yellow circles) and output or intermediate layer data (the green boxes). The proximal characteristic model, depicted in this figure, processes input data using distance or proximity to create a specific "sub-objective" suitability layer -- for example proximity to interstate highway intersection features. Other examples for proximity might include: proximity to railroads, proximity to race tracks, and proximity to county and local roadways. The aggregation of the sub-objective suitability layer data creates an objective suitability layer for example residential proximity to transit access.

Additional sub-objective models might process the region's development suitability for historic residential growth patterns using residential features. Still another sub-objective model may be used to identify the suitability for residential density. The combination of the sub-objectives for physical, proximal, historic growth, land values and density suitability may then be combined to identify the region's residential suitability.

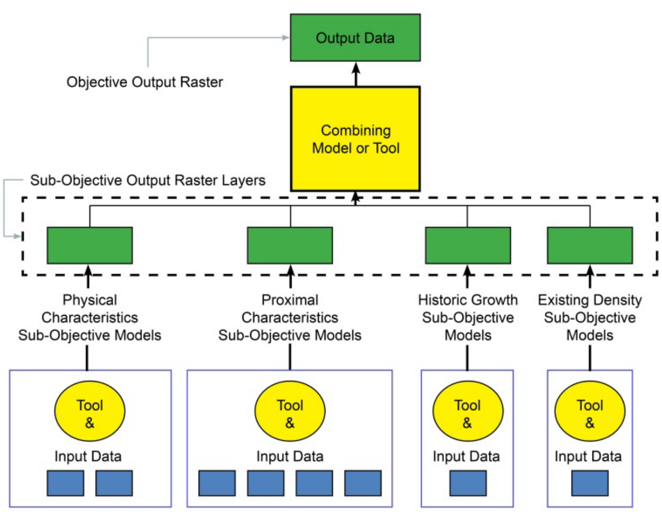

Figure 2: A conceptual land use model for an objective with four sub-objectives.

Multiple *objective* suitability (MUA) layers (physical, proximity, historic growth patterns, and land use density) may then be combined to produce a single "goal" layer (a complex MUA), for single family residential suitability. Finally suitability layers for multiple urban goals (i.e., single family residential, multi-family residential, commercial, service, retail, industrial, and institutional) can then be combined using community values and/or other criteria to create a single complex urban preference layer which represents the spatial preference for urban land use.

Step 4 -- Integrating Community Values to Determine Land Use Preference

With respect to land use planning, sound regional and local land use analysis supported by a functional visioning component can be conceptualized as "the best environmental planning is sound urban planning". Integrating community values into any land use allocation process is important. Visualizing future land use change is important for:

A community's transportation plan,
The creation of a future sustainable development pattern,
The development of functional strategies that will decrease urban sprawl,
Protection of the region's biodiversity,
Local and regional agricultural preservation,
The creation of a vibrant urban redevelopment strategy,
A better understanding of the land use relationships between the built and natural environments, and
Analysis of present and future land use impacts resulting from sea level rise and/or storm surge.

The reason for visualizing land use alternatives is to produce, through informed decision making, a more realistic long-term plan for the region that is considered valid by its varied communities and local interest groups. **However, a fallacy that should be put to rest is the idea that community values are required to develop a land use future trend model for a region. It is not necessary to include exercises in community visioning when determining the areas trend development pattern.** Data analysis of existing and historic land use patterns and conditions is the best method for trend identification. In fact, the author argues that capturing actual spatial statistics (i.e. the time sensitive historic density patterns of single family development) through property analysis is more important when analyzing trend land use patterns. The trend is not a vision for land use analysis it is a reflection of current conditions extrapolated into the future. LUCIS relies on trend analysis to set a baseline for any alternative visioning scenario comparisons. Ultimately scenarios are compared to the trend more often than compared to one another.

At this point it is important to understand the difference between LUCIS land use visioning and land use prediction. LUCIS is a process for land use planning and visioning not prediction. Land use prediction is not land use visioning nor planning it is an exploration of the components deemed significant with respect to an existing land use pattern; it is not a tool for community leaders, planners or other professionals to envision, test, or change the land use possibilities. The problem with prediction is its specific limitation to existing data which for example doesn't contain information for alternative scenarios (i.e. sea level rise). Another often used example by the author is proximity to sewage treatment facilities. When the author has asked an audience how many would like to live next to a sewage treatment facility the answer is always no, however prediction models indicate that proximity to sewage treatment is not a valid predictor for land use. The reason is the proximity to sewage treatment is relatively localized and not felt across the region. LUCIS models utilize localized spatial data as well as regional spatial data for land use preference identification. Normally, the LUCIS modeling of community values produces a variety of land use visioning alternatives that may then be compared to the trend or pattern extrapolation to assess alternative planning options and land use futures.

The LUCIS process incorporates community values using a pairwise comparison process called the Analytical Hierarchy Process (AHP), (Satty 1980). Within LUCIS the AHP process is normally implemented when combining goal data to create the major land use ***preference*** layers, and has been completed for many locations in Florida. Incorporating pairwise comparisons within a visioning session can be done in a number of ways. The process for incorporating community values is fundamentally easy to comprehend but complicated to organize and difficult to complete without GIS tools to assist the process.

Step 5 -- Identifying Potential Land Use Conflict

Step five in the LUCIS process is the creation of a conflict layer used to spatially identify the conflict between major land use categories. The following sections of this chapter will review LUCIS conflict and expand the use of LUCIS conflict for urban mixed use analysis. In the remaining chapters the LUCIS conflict is used to analyze and develop land use alternatives for urban infill and redevelopment, urban mixed use strategies, to analyze the transportation land use linkage, and to assist in the analysis of hurricane and flood impacts on future land use scenarios.

The LUCIS Land Use Conflict Concept

LUCIS land use conflict is a methodology by which community preference layers (agriculture, conservation, and urban) are each reclassified into three levels (high, moderate, and low) and combined to generate a conflict matrix containing 27 land use conflict or preference values between those layers.

LUCIS used the "equal interval reclassification" method for the GTNMERR project. Equal interval reclassification does exactly as the name implies it reclassifies the collection of individual preference values in a layer into equal intervals, again the three categories of preference for LUCIS low, moderate, and high. The up-side of an equal interval reclassification is the fact that almost everyone has an intuitive understanding of equal intervals. The down side to this type of reclassification is its inability to adjust skewed data. Table 1 provides a complete listing of reclassification methods available within ArcGIS software, and Figures 3 and 4 show LUCIS conflict

TABLE 1: Ways to classify data in ArcGIS	
Manual	Allows you set the class breaks manually. Use this choice if, for example, you want to emphasize particular patterns by placing breaks at important threshold values, or if you need to comply with a particular standard that demands certain class breaks. The Classes dropdown list is disabled when you chose this method. You specify the classes by working with the histogram in this dialog: To insert a class break, right-click in this histogram and choose Insert Break. To remove a class break, select it by clicking in the histogram or in the break values list to the right of the histogram (it will turn red when selected) and then right-click it in the histogram and choose Delete Break. To move a class break, either click on it in the histogram and drag, or edit its value in the break values list to the right of the histogram.
Equal Interval	This method divides the attribute range into equally sized classes, and is best applied to familiar data ranges such as percentages and temperature. Use this method to emphasize the relative amount of attribute values compared to other values.
Defined Interval	This method is similar to the Equal Interval method, except here you define the size of the interval. The Classes dropdown list is disabled when you choose this method because it adjusts automatically to reflect the number of classes needed for the entire interval size you defined once you've pressed OK on the Classification dialog.
Quantiles	Each class will contain an equal number of features. This method is well suited to linearly distributed data.
Natural Breaks (Jenks)	Classes are based on natural groupings of data values. In this method, data values are arranged in order. The class breaks are determined statistically by finding adjacent feature pairs, between which there is a relatively large difference in data value. This is the default classification method.
Standard Deviation	Use this method to emphasize how much feature values vary from the mean. Best used on normally distributed data.

Once a reclassification of land use preference into low, moderate and high ranges has been accomplished the three layers containing the land use preferences are aggregated to create the LUCIS conflict layer.

For example, a conflict value 313 represents a high preference for agriculture ("3"13), a low preference for conservation (3"1"3) and a high preference for urban development (31"3"). Additionally when two of the three digits in the conflict value are equal that represents a "Moderate Conflict". Therefore the conflict value 313 can be labeled as "Moderate Conflict with High Agriculture-Urban Preference". The conflict value 333 indicates a high preference for all three major land use categories. Since all three digits in the conflict value are equal that is referred to a "Major Conflict". Alternatively, the conflict value 222 indicates "Major Conflict with Moderate Preference". It is important to identify that conflict can be categorized as "Major" even if the three preference values indicate a low or moderate preference. "Major Conflict" is defined as equal preference between the three land use categories. Understanding the conflict values and preference levels allow LUCIS modelers to make simple land allocations quickly and within a standardized selection process. It is also important to realize some conflict values represent no conflict; for example the conflict value 113 represents "Urban High

Preference" which by definition is a no conflict value, and therefore is a prime area for urban land use or future urban development. Table 2 presents the 27 land use conflict categories and the 3-digit values associated with those categories. Figures 3 and 4 depict the land use preferences and conflicts for St. Johns and Flagler County, respectively.

TABLE 2: LUCIS conflict matrix values and their individual conflict identification description.

Areas of Conflict		Areas of No Conflict	
Code	Description	Code	Description
111	Major Conflict Low Preferences	112	Urban Moderate Preference
122	Minor Conflict Conservation and Urban with Moderate Preferences	113	Urban High Preference
133	Minor Conflict Conservation and Urban with High Preferences	121	Conservation Moderate Preference
212	Minor Conflict Agriculture and Urban with Moderate Preferences	123	Urban High Preference
221	Minor Conflict Agriculture and Conservation with Moderate Preferences	131	Conservation High Preference
222	Major Conflict with Moderate Preferences	132	Conservation High Preference
233	Minor Conflict Conservation and Urban with High Preferences	211	Agricultural Moderate Preference
313	Minor Conflict Agriculture and Urban with High Preferences	213	Urban High Preference
323	Minor Conflict Agriculture and Urban with High Preferences	223	Urban High Preference
331	Minor Conflict Agriculture and Conservation with High Preferences	231	Conservation High Preference
332	Minor Conflict Agriculture and Conservation with High Preferences	232	Conservation High Preference
333	Major Conflict with High Preferences	311	Agricultural High Preference
		312	Agricultural High Preference
		321	Agricultural High Preference
		322	Agricultural High Preference

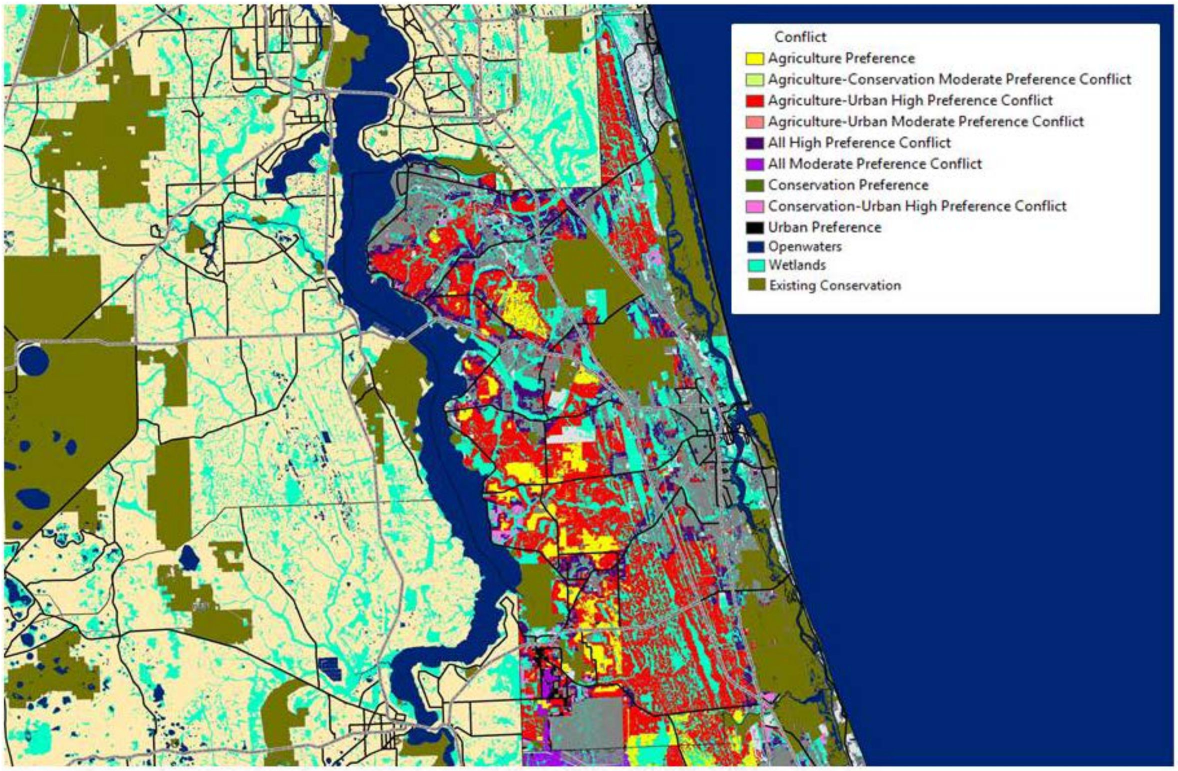

Figure 3: St. Johns County Greenfields Conflict Layer.

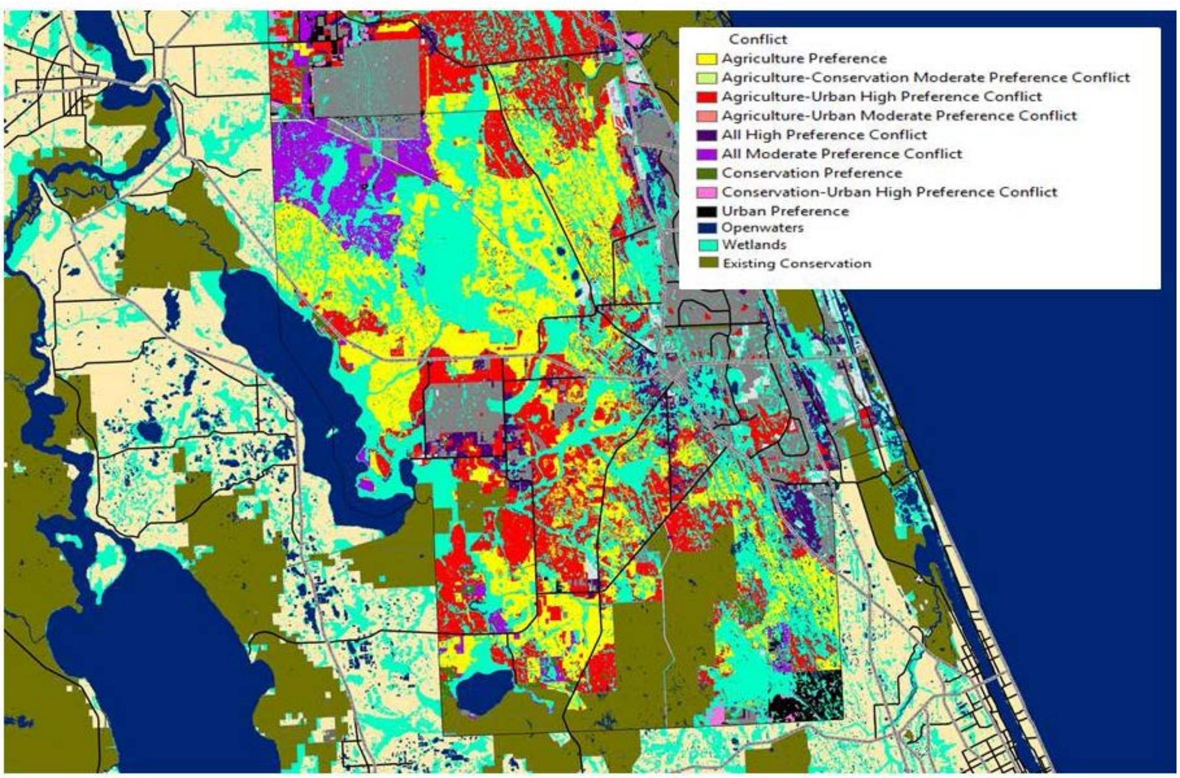

Figure 4: Flagler County Greenfields Conflict Layer.

Redefining LUCIS Conflict for Mixed Use Opportunity Land Use Decision Making

Clearly the base LUCIS conflict matrix when created as a layer identifies the spatial conflict between the three major land use categories employed for decision making within the land use analysis process. While the selection of locations from the LUCIS conflict layer is extremely effective at identifying areas within the base 27 conflict categories; land use selections can become more complicated and may often be directed more towards a search for opportunity and not the identification of conflict. To resolve the need for the analysis of more complex land use issues the LUCIS urban mixed use opportunity matrix lists multiple preference criteria in a single matrix for a mixed use opportunities. Not surprisingly, the basic LUCIS conflict matrix may be adapted to identify opportunity instead of conflict. The base LUCIS conflict matrix can be easily modified to identify potential opportunities for mixed use redevelopment within an existing urban core, and remain true with concepts from the original conflict matrix. The newly developed mixed use opportunity matrix is a tool designed to tackle the more complex issue of mixed use redevelopment. To remain true to the LUCIS concept the matrix needs to provide a mechanism that identifies opportunities between commercial, retail, service, and/or multi-family residential uses. The evolution occurs when combining the three reclassified preference layers (commercial, multi-family residential and retail or service) to identify mixed use opportunity, instead of conflict. Again, the values representing low, moderate, and high preference are Low = 1, Moderate = 2, and High = 3. Three urban use preference layers for commercial, multi-family residential and retail can be combined in exactly the same process used to combine the agriculture, conservation, and urban major land use preference surfaces. Table 3 lists 27 urban mixed use opportunities with their associated mixed use preferences. The urban mixed use opportunity matrix will be utilized to analyze mixed use redevelopment.

TABLE 3: LUCIS urban mixed use opportunity matrix values and their mixed use preference definitions.

Mixed Use Value	Description
111	Mixed Use with Low Preference
112	Retail Moderate Preference
113	Retail High Preference
121	Multifamily Moderate Preference
122	Multifamily and Retail with Moderate Preferences
123	Retail High Preference
131	Multifamily High Preference
132	Multifamily High Preference
133	Multifamily and Retail with High Preferences
211	Commercial Preference
212	Commercial and Multifamily with Moderate Preferences
213	Retail High Preference
221	Commercial and Multifamily with Moderate Preferences
222	All with Moderate Preferences
223	Retail High Preference
231	Multifamily High Preference
232	Multifamily High Preference
233	Multifamily and Retail with High Preferences
311	Commercial High Preference
312	Commercial High Preference
313	Commercial and Retail with High Preferences
321	Commercial High Preference
322	Commercial High Preference
323	Commercial and Retail with High Preferences
331	Commercial and Multifamily with High Preferences
332	Commercial and Multifamily with High Preferences
333	All with High Preferences

Creating a Multi-Variable Matrix for Land Use Decision Making

Figure 5 illustrates the general process for creation of a multi-variable layer; many of the fields in the layer attribute table (the top layer in the figure) were added to the table using the Add Field Tool after its creation. Using a complex multi-variable spreadsheet attribute table for land use employment or residential population allocation can be as complicated or easy as you want to make it, as adding fields allow characterization of areas for many purposes. For example, a field created that is linked to census block information would allow for new urban allocations at densities consistent with census information.

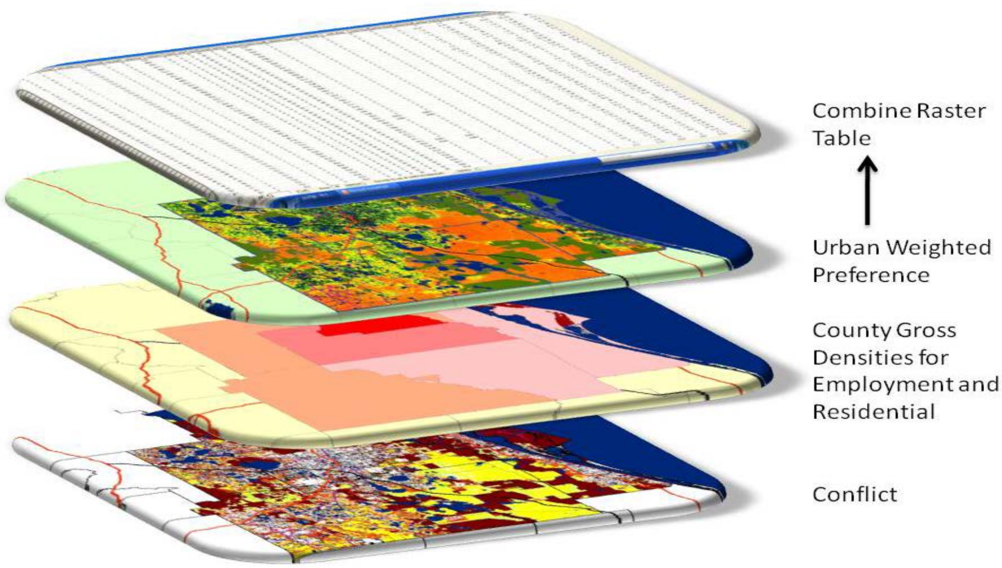

Figure 5: Creating a multi-variable matrix. The Conflict surface, layer representing county gross densities for employment and residential development, and urban weighted surface are combined into a single table. Ultimately the matrix (spreadsheet) is used to make selections for land use allocations. Additional fields can be added to the spreadsheet and calculated to assist in employment or population allocations.

Study Region Population Projections 2010 to 2060

Table 4 shows the study region population projections. The red numbers are the 2060 projections for Flagler and St. Johns' populations and the total study region population projection – 511,051 new persons by the year 2060. The total population by 2060 is 295,224 persons for Flagler County and 501,562 persons for St. Johns County.

Table 4: Study Region Population Projections 2010 to 2060.

County	2010	2020	2030	2040	2050	2060
Flagler	95,696	136,900	178,600	215,400	257,809	295,224
St. Johns	190,039	254,200	320,000	377,600	444,170	501,562
Totals	285,735	391,100	498,600	593,000	701,979	796,786
Change Flagler by 2060						**199,528**
Change St. Johns by 2060						**311,523**
Total Change by 2060						**511,051**

Table 5 shows the study region employment projections for Flagler and St. Johns counties. The number of jobs in the light green column is the additional new jobs allocated for the year 2060 and represent the change in employment from 2010 to 2060.

Table 5: Study Region Employment Projections 2010 to 2060. Projections include Industrial; Commercial, Retail, Service; and Institutional Employment.

Flagler	**2010**	**2020**	**2030**	**2040**	**2050**	2060
Industrial	1,468	2,100	2,740	3,304	3,955	4,529
Commercial, Retail, Service	10,480	14,992	19,559	23,589	28,234	32,331
Institutional	2,842	4,066	5,304	6,397	7,656	8,768
Total	14,790	21,158	27,603	33,290	39,845	45,627
St. Johns	**2010**	**2020**	**2030**	**2040**	**2050**	2060
Industrial	3,174	4,246	5,345	6,307	7,418	8,377
Commercial, Retail, Service	32,038	42,855	53,948	63,658	74,881	84,557
Institutional	8,382	11,212	14,114	16,655	19,591	22,122
Total	43,594	58,312	73,406	86,620	101,890	115,056

Table 6A: Flagler property statistics as generated from Department of Revenue 2010 Data. Some categories excluded e.g. subsurface rights.									
Description	**Frequency**	**Value**	**Acres**	**Percent Acres**	**Percent Value**	**Percent Frequency**	**Density**	**Value Per Acre**	**Average Size**
Acreage Not Zoned For Agriculture	520	$145,763,720	16,383	5.46%	1.30%	0.73%	n/a	$8,897.25	31.51
Industry	225	$97,399,160	1,720	0.57%	0.87%	0.32%	n/a	$56,627.42	7.64
Institutional	98	$411,828,492	1,210	0.40%	3.69%	0.14%	n/a	$340,354.13	12.35
Commercial, Retail, or Service	661	$588,344,819	1,846	0.61%	5.27%	0.93%	n/a	$318,713.34	2.79
Residential	40,335	$7,219,779,810	24,852	8.28%	64.63%	56.98%	1.62	$290,511.02	0.62
Recreational	111	$224,171,181	12,979	4.32%	2.01%	0.16%	n/a	$17,271.84	116.93
Government	893	$340,167,348	12,130	4.04%	3.05%	1.26%	n/a	$28,043.47	13.58
Agriculture	1,607	$654,837,767	211,071	70.31%	5.86%	2.27%	n/a	$3,102.45	131.34
Vacant Commercial	475	$215,172,526	3,260	1.09%	1.93%	0.67%	0.15	$66,003.84	6.86
Vacant Institutional	2	$974,842	17	0.01%	0.01%	0.00%	0.12	$57,343.65	8.50
Vacant Industry	139	$38,263,480	1,454	0.48%	0.34%	0.20%	0.10	$26,316.01	10.46
Vacant Residential	25,727	$1,234,084,652	13,267	4.42%	11.05%	36.34%	1.94	$93,019.12	0.52
Global Statistics	70,793	$11,170,787,797	300,189	100%	100%	100%	n/a	$37,212.52	4.24

Table 6A: Property statistics for Flagler County. The developed residential use has the highest percentage of use with 56.98% representing 40,335 parcels with a market value of 7.3 trillion dollars. When vacant residential frequency is added to the developed residential frequency the total represents 93.32% or the parcels with approximately 8.5 trillion dollars of value. The average residential value per acre is also close to $300,000 with an average density at 1.62 units per acre. Agriculture has the largest number of acres with over 200,000 acres of Flagler in agricultural uses.

Table 6B: St. Johns property statistics as generated from Department of Revenue 2010 Data. Some categories excluded e.g. subsurface rights.									
Description	**Frequency**	**Value**	**Acres**	**Percent Acres**	**Percent Value**	**Percent Frequency**	**Density**	**Value Per Acre**	**Average Size**
Acreage Not Zoned For Agriculture	1,574	$2,236,473,176	12,936	4.24%	2.37%	1.16%	n/a	$172,891.07	8.22
Industry	1,324	650,675,351	2,181	0.72%	0.69%	0.97%	n/a	$298,290.01	1.65
Institutional	2,469	25,921,930,167	3,406	1.12%	27.49%	1.81%	n/a	$7,609,648.99	1.38
Commercial, Retail, or Service	5,116	9,082,472,307	4,530	1.49%	9.63%	3.76%	n/a	$2,005,124.73	0.89
Residential	84,382	23,568,180,527	46,271	15.18%	25.00%	61.96%	1.82	$509,350.98	0.55
Recreational	2,756	19,535,791,585	12,655	4.15%	20.72%	2.02%	n/a	$1,543,671.92	4.59
Government	3,465	2,120,880,240	10,763	3.53%	2.25%	2.54%	n/a	$197,048.57	3.11
Agriculture	4,390	7,489,734,297	190,053	62.34%	7.94%	3.22%	n/a	$39,408.62	43.29
Vacant Commercial	1,723	967,318,388	3,322	1.09%	1.03%	1.27%	0.52	$291,149.95	1.93
Vacant Institutional	213	60,886,466	487	0.16%	0.06%	0.16%	0.44	$124,947.07	2.29
Vacant Industry	217	33,772,244	308	0.10%	0.04%	0.16%	0.71	$109,775.61	1.42
Vacant Residential	28,562	2,614,348,602	17,949	5.89%	2.77%	20.97%	1.59	$145,651.97	0.63
Global Statistics	136,191	$94,282,463,350	304,863	100.00%	100.00%	100.00%	n/a	$309,262.08	2.24

Table 6B: Property statistics for St. Johns County. The developed residential use has the highest percentage of use with 61.96% representing 84,382 parcels with a market value of 23.5 trillion dollars. When vacant residential frequency is added to the developed residential frequency the total represents 82.93% or the parcels with approximately 26.2 trillion dollars of value. The average residential value per acre is also close to $510,000 with an average density at 1.82 units per acre. Agriculture has the largest number of acres with over 190,000 acres of St. Johns in agricultural uses.

Table 7: Existing urban – suburban acres remaining with some loss for a 1 meter sea-level rise. Government includes only municipal and military because county, state and federal often include large conservation areas.						
Description	Parcel Frequency	Acres Total Acres	Remaining Acres (Not Inundated Acres)	Percent Remaining(Not Inundated Acres)	Percent Loss (Inundated Acres)	Flood Acres (Inundated Acres)
Industry	1,420	2,953	2,829	95.77%	4.23%	125
Institutional	2,651	4,933	4,667	94.62%	5.38%	265
Commercial, Retail, or Service	5,718	6,483	6,133	94.60%	5.40%	350
Residential	120,893	54,908	52,384	95.40%	4.60%	2,524
Recreational	447	7,220	6,041	83.68%	16.32%	1,178
Government*	908	2,203	1,594	72.37%	27.63%	609
Vacant Commercial	2,123	6,423	5,629	87.64%	12.36%	794
Vacant Institutional	214	503	499	99.32%	0.68%	3
Vacant Industry	355	1,761	1,681	95.42%	4.58%	81
Vacant Residential	51,946	29,761	28,039	94.22%	5.78%	1,721
Global Statistics	186,675	117,148	109,497	93.47%	6.53%	7,651

Table 7: Existing urban suburban lands within the Matanzas buffer area. Of the urban suburban lands slightly impacted by a 1-meter sea-level rise government, vacant commercial and recreational lands have the highest percentage of loss.

Table 8: Region -- 1 Meter sea-level rise study region parcels impacted acres, flooded acres and percent of flooded area. Percent flooded equals the flooded acres divided by the impacted acres. Government includes only municipal and military because county, state and federal often include large conservation areas.				
Description	**Frequency**	**Impacted Acres Total Acres**	**Flooded Acres (Inundated Acres)**	**Percent Flooded Flood Acres / Impacted Acres**
Acreage Not Zoned For Agriculture	472	4,830.72	2,698.06	55.85
Industry	236	373.15	208.04	55.75
Institutional	336	818.65	437.03	53.38
Commercial, Retail, or Service	1,754	1,984.99	1,099.79	55.41
Residential	22,682	11,890.67	7,602.81	63.94
Recreational	2,310	17,405.87	9,734.26	55.93
Government*	670	1,488.04	1,156.91	77.75
Agriculture	815	57,981.83	17,892.48	30.86
Vacant Commercial	383	1,120.13	921.19	82.24
Vacant Institutional	55	31.27	27.70	88.59
Vacant Industry	11	191.92	68.76	35.83
Vacant Residential	6,655	5,401.39	3,405.68	63.05
Global Statistics	36,379	103,518.62	45,252.70	43.71

Table 8: The regional land area impacted by a 1 meter sea-level rise. The table indicates that 45,252 acres are impacted which represents 43.7% of the impacted land use area in the region. The most impacts by percentage occur on vacant commercial, vacant institutional, government, vacant residential and residential uses.

Table 9: Acres of selected land use within the Matanzas Buffer Area.		
Land Use Description	Frequency	Acres
Acreage Not Zoned For Agriculture	467	8,613.63
Industry	855	1,633.71
Institutional	1,108	2,854.74
Commercial, Retail, or Service	4,551	4,890.89
Residential	72,696	22,343.24
Recreational	416	12,918.92
Government*	1,164	2,270.76
Agriculture	1,013	119,747.78
Vacant Commercial	1,489	3,906.89
Vacant Institutional	171	415.64
Vacant Industry	230	1,088.03
Vacant Residential	28,824	11,993.69
Global Statistics	36,379	103,518.62

Table 9: Total acres of selected major category land uses within the Matanzas buffer area. The largest frequency of properties is for residential and vacant residential. According to the DOR property files for 2010 there are 72,696 residential properties on 22,343 acres for a gross unit density of 3.25 units per acre. Interestingly, there are 28,824 vacant residential properties on 11,994 acres for a gross residential density of 2.4 units per acre.

Table 10: Inundated acres for a 1-meter sea-level rise within the Matanzas Buffer Area.		
Land Use Descriptions	**Frequency**	**Acres**
Acreage Not Zoned For Agriculture	246	1,690
Industry	117	94
Institutional	268	238
Commercial, Retail, or Service	1,446	609
Residential	13,362	2,456
Recreational	189	2,371
Government*	641	1,140
Agriculture	27	257
Vacant Commercial	310	268
Vacant Institutional	46	12
Vacant Industry	11	69
Vacant Residential	4,518	1,637
Global Statistics	21,181	10,842

Table 10: Flooded acres within the Matanzas buffer area. The categories with the most impact by frequency are residential and vacant residential with 2,456 acres and 1,637 acres flood respectively, or 38% of the area.

Table 11: Study Region Government Acres		
DESCRIPT	Frequency	Acres
GOV. OWNED LEASED BY NON-GOV. LESSEE	78	55.85
MILITARY	9	5.83
OTHER COUNTIES	2,854	16,857.41
OTHER FEDERAL	790	1,527.87
OTHER MUNICIPAL	1,275	2,631.51
OTHER STATE	6,426	46,968.08

Table 12: Matanzas Buffer Area Government Acres before and after 1-meter sea-level rise.			
Matanzas Buffer Area Before Sea-Level Rise			
DESCRIPT	Frequency	Acres	Buffer Acres
GOV. OWNED LEASED BY NON-GOV. LESSEE	3	1.50	1.50
MILITARY	9	5.84	5.84
OTHER COUNTIES	1,593	9,044.69	7,788.80
OTHER FEDERAL	780	1,517.56	1,513.81
OTHER MUNICIPAL	1,152	2,306.14	2,263.43
OTHER STATE	3,402	24,912.48	23,509.65
Matanzas Buffer Area After Sea-Level Rise			
DESCRIPT	Frequency	Acres	Buffer Acres
GOV. OWNED LEASED BY NON-GOV. LESSEE	3	1.50	1.48
MILITARY	2	1.57	0.63
OTHER COUNTIES	618	3,748.37	1,990.74
OTHER FEDERAL	712	1,427.61	1,141.73
OTHER MUNICIPAL	636	1,464.74	1,138.29
OTHER STATE	2,274	8,702.59	4,772.74

Tables 11 and 12: Government acres within the study region. These are broken out separately because government can include conservation or mitigation lands, especially in the federal, state, and county categories. The government category in other tables represents municipal and military lands.

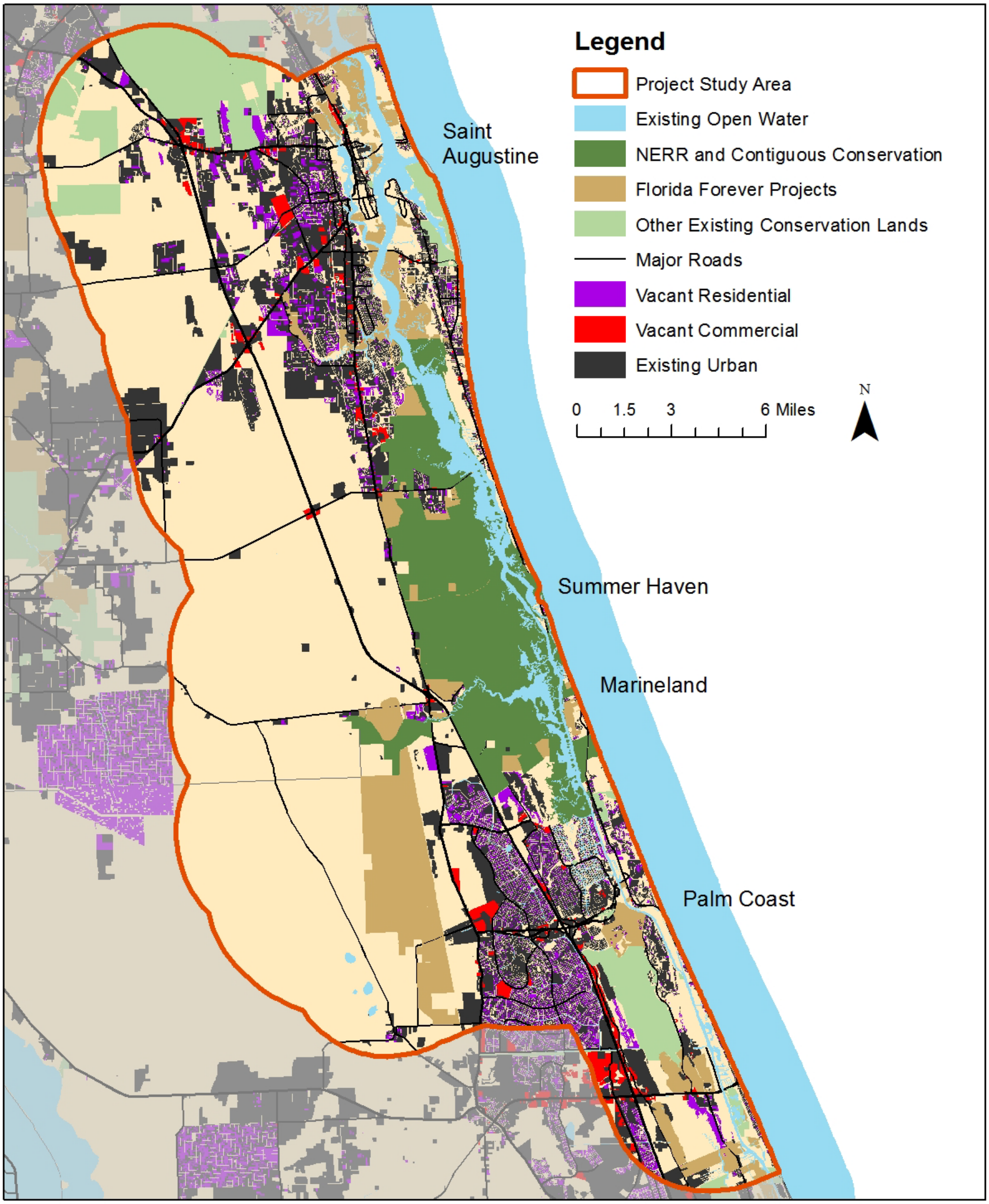

Figure 6: Matanzas Buffer Area (Project Study Area) existing vacant commercial and vacant residential land.

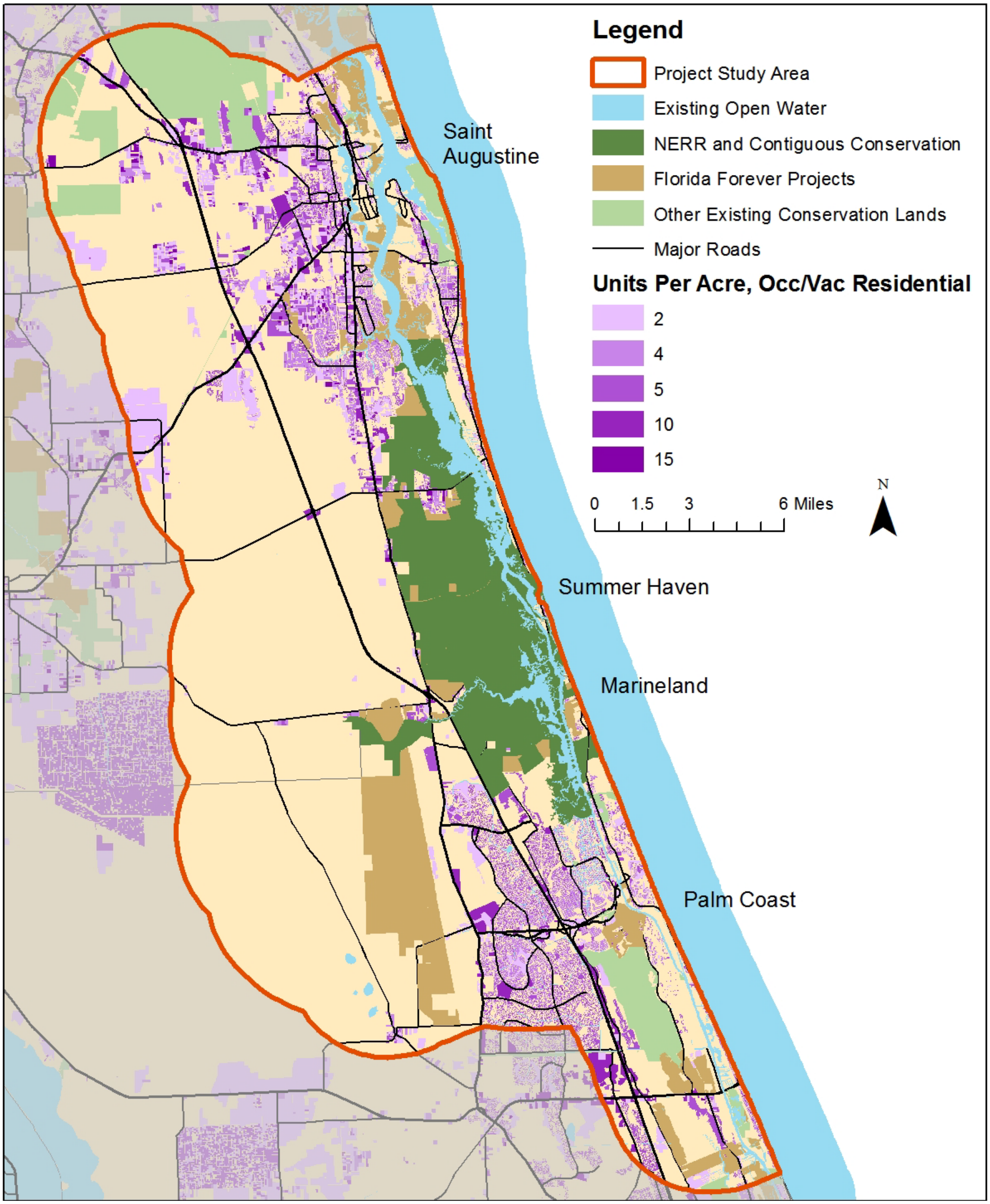

Figure 7: The built and unbuilt existing residential lot density, in units per acre, for the Matanzas Buffer Area (Project Study Area). Most of the buffer area is within the lower density range between 1 unit per 10 acres and 4 to 5 units per acre. There are however small areas within the buffer where densities increase significantly to as many as 19 or 20 units per acre. Condominium density can significantly exceed the 20 unit per acre density especially along the coastline.

Two Future Land Use Scenarios

The product of the five step LUCIS land use analysis and the multi-variable matrix are the two scenarios that follow. The first is an existing and future land use scenario for the year 2060, including 1 meter of sea level rise, developed at current development rates (may be referred to as the Trend Scenario). The second scenario is existing and future land use for the year 2060, including 1 meter of sea level rise, with development avoiding high priority conservation lands (may be referred to as the Conservation Scenario).

The Trend Scenario

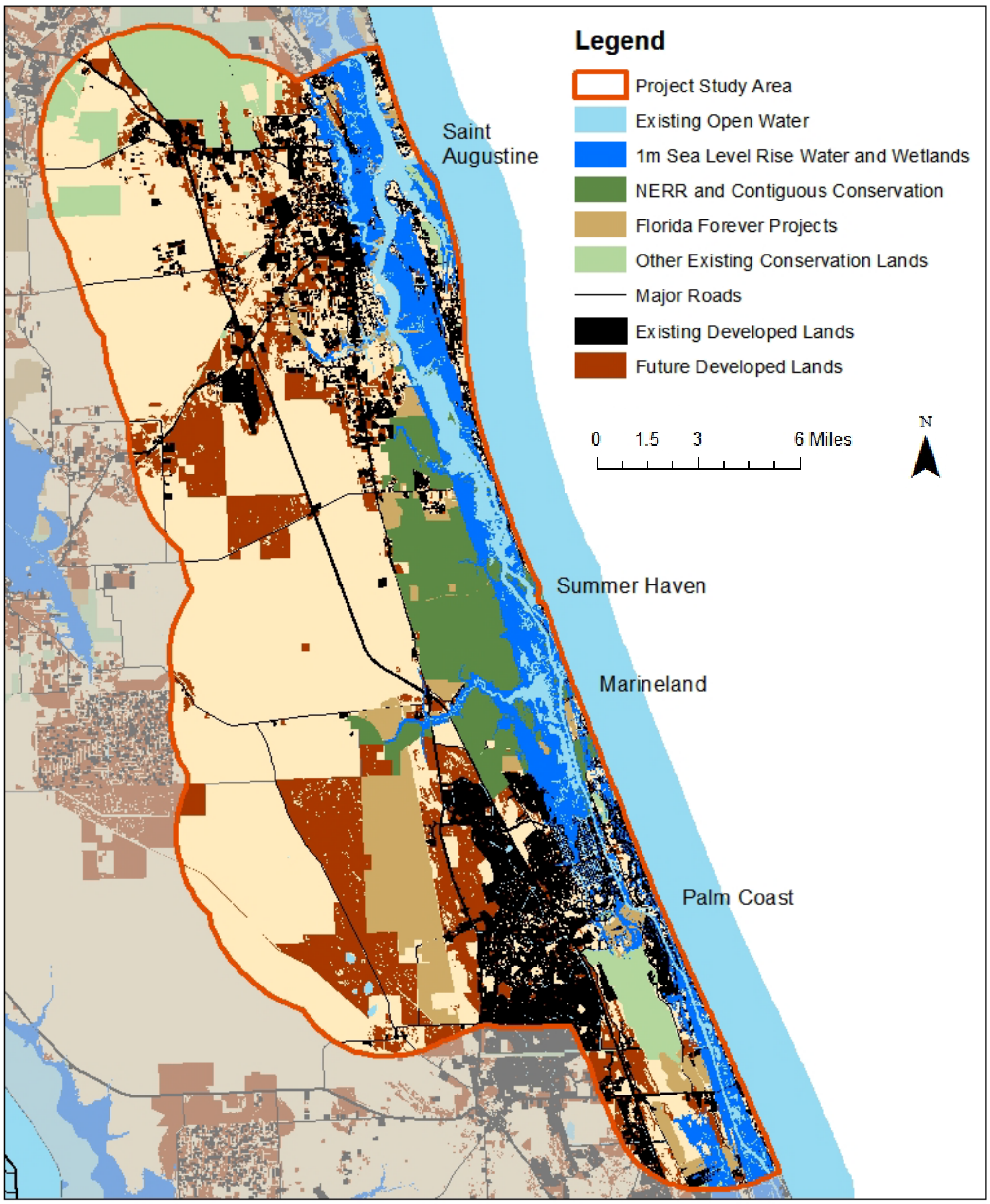

Figure 8: Existing and future land use scenario for the year 2060, including 1 meter of sea level rise, developed at current development rates.

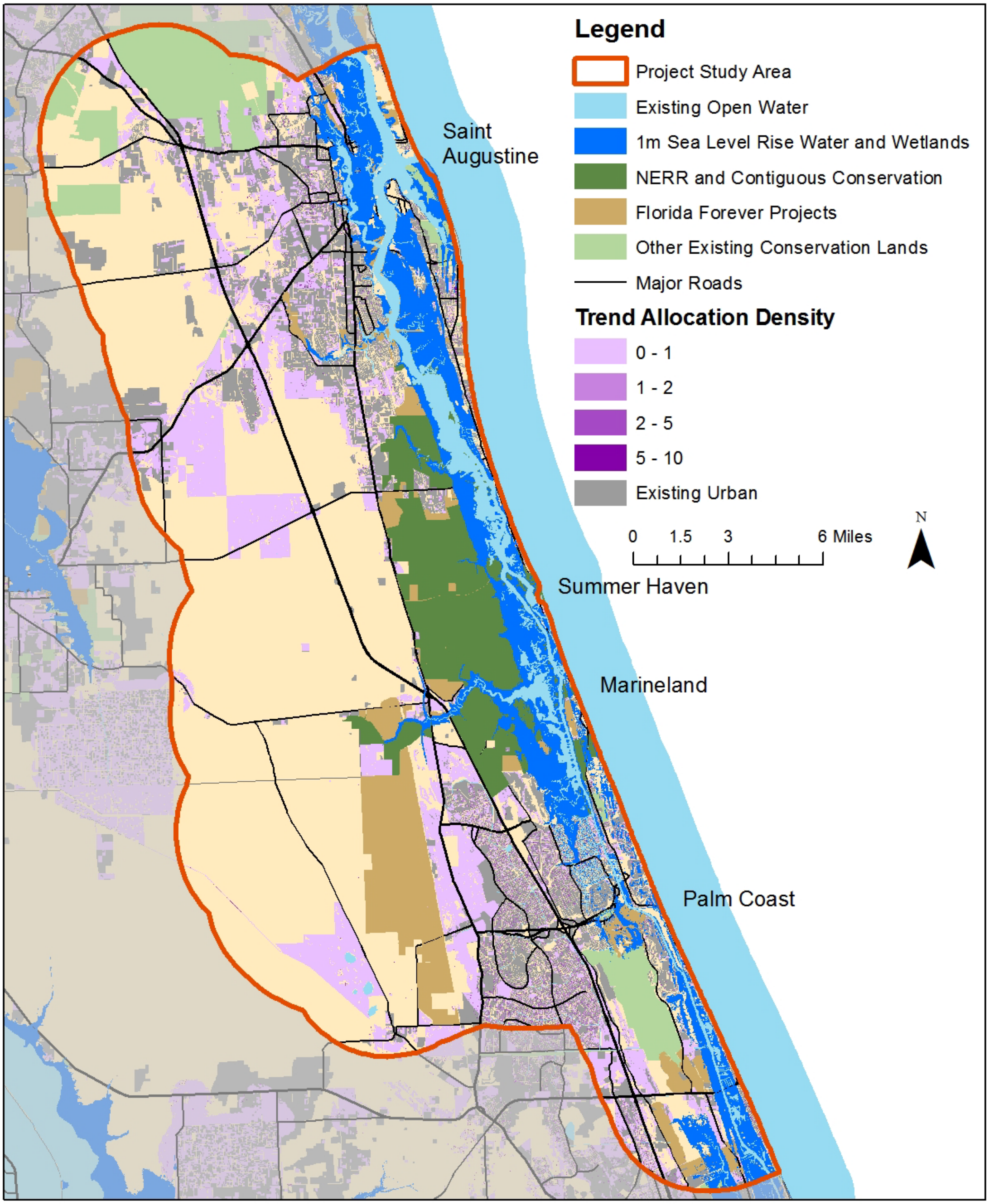

Figure 9: The density (parcels per acre) of allocation is shown for the Trend Scenario.

The Conservation Scenario

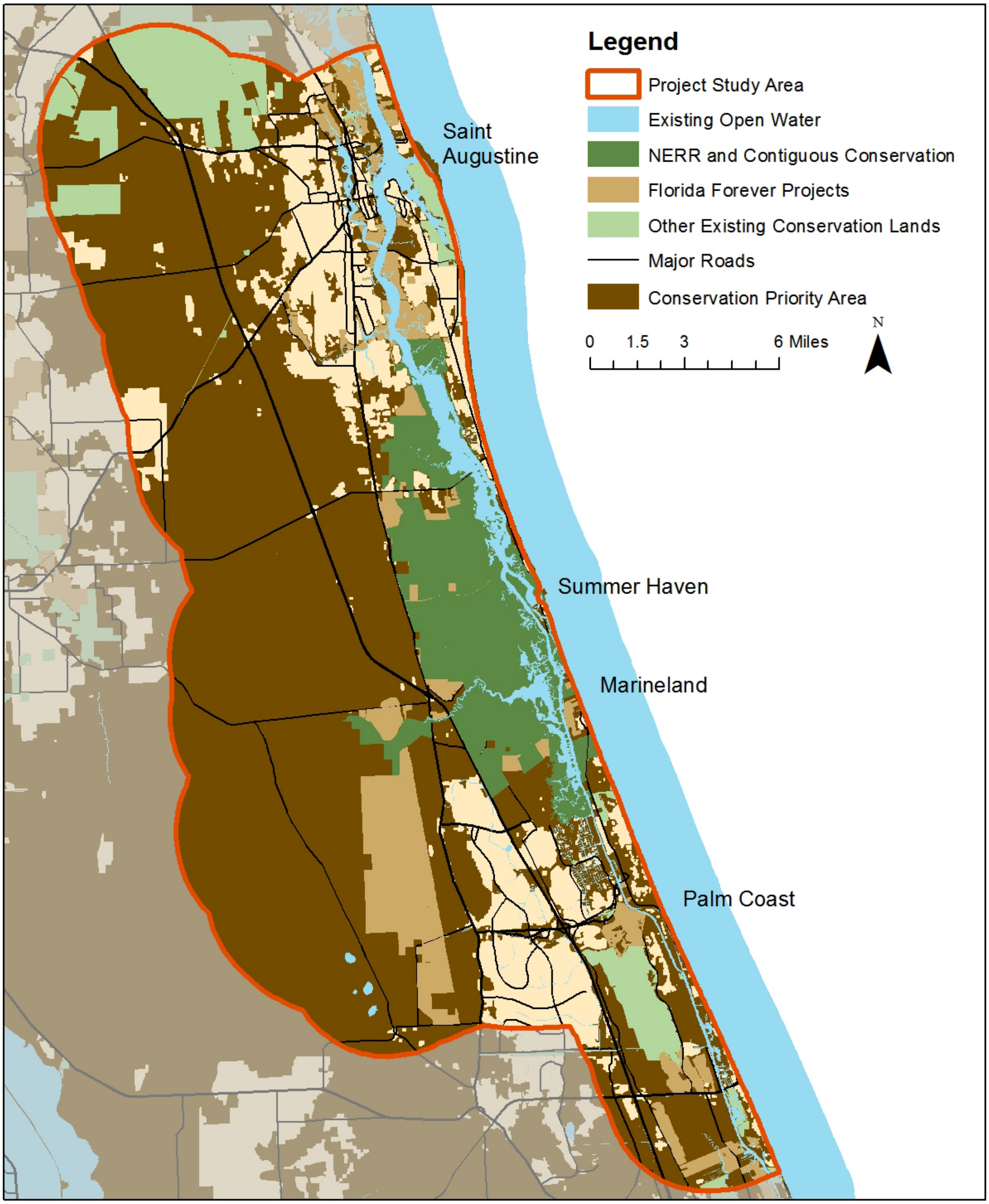

Figure 10: The area of high priority conservation lands. In the creation of the future land use scenarios where development avoided high priority conservation land (Figures 12 and 14), much of this area was avoided.

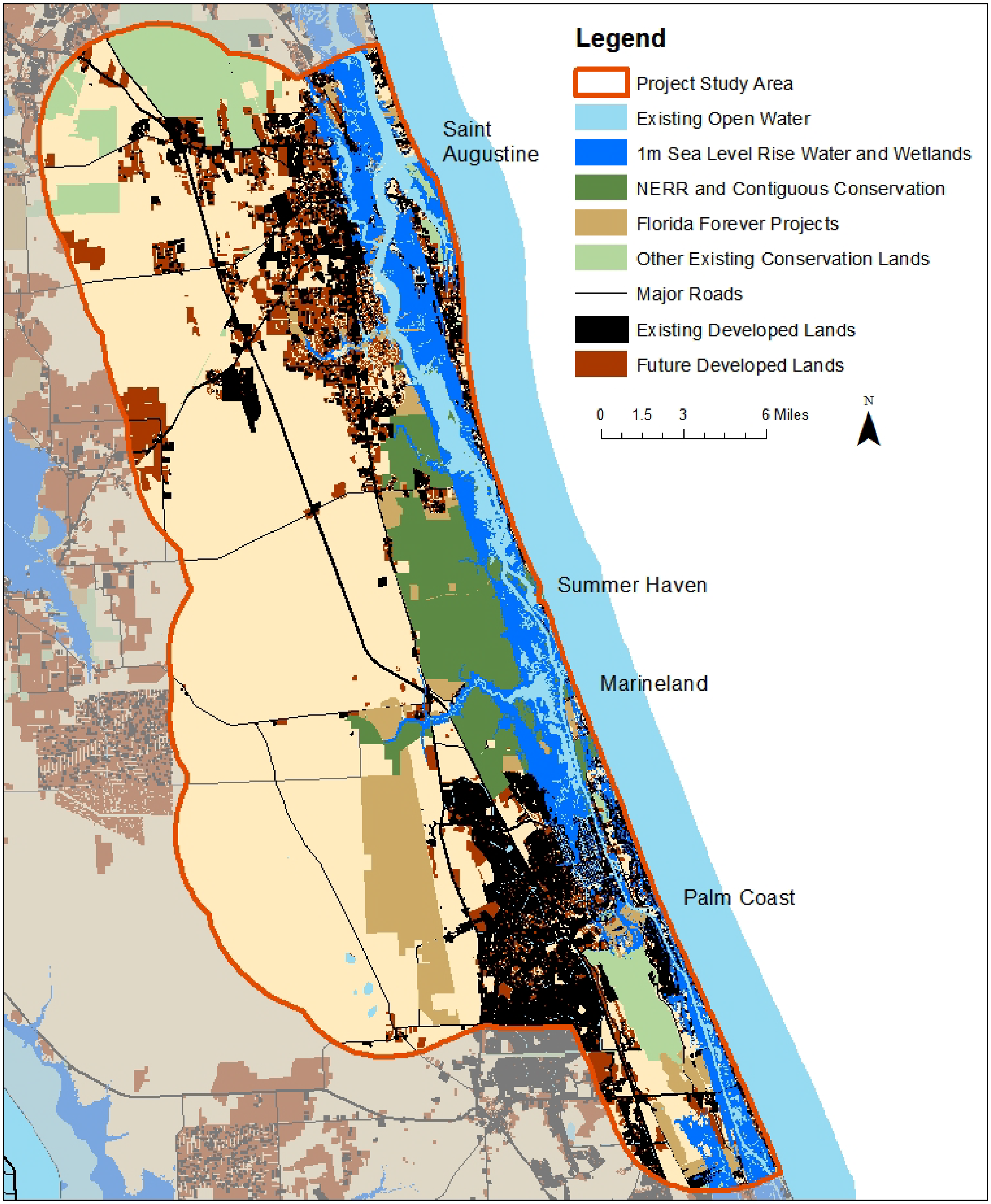

Figure 11: Existing and future land use scenario for the year 2060, including 1 meter of sea level rise, with development avoiding high priority conservation lands.

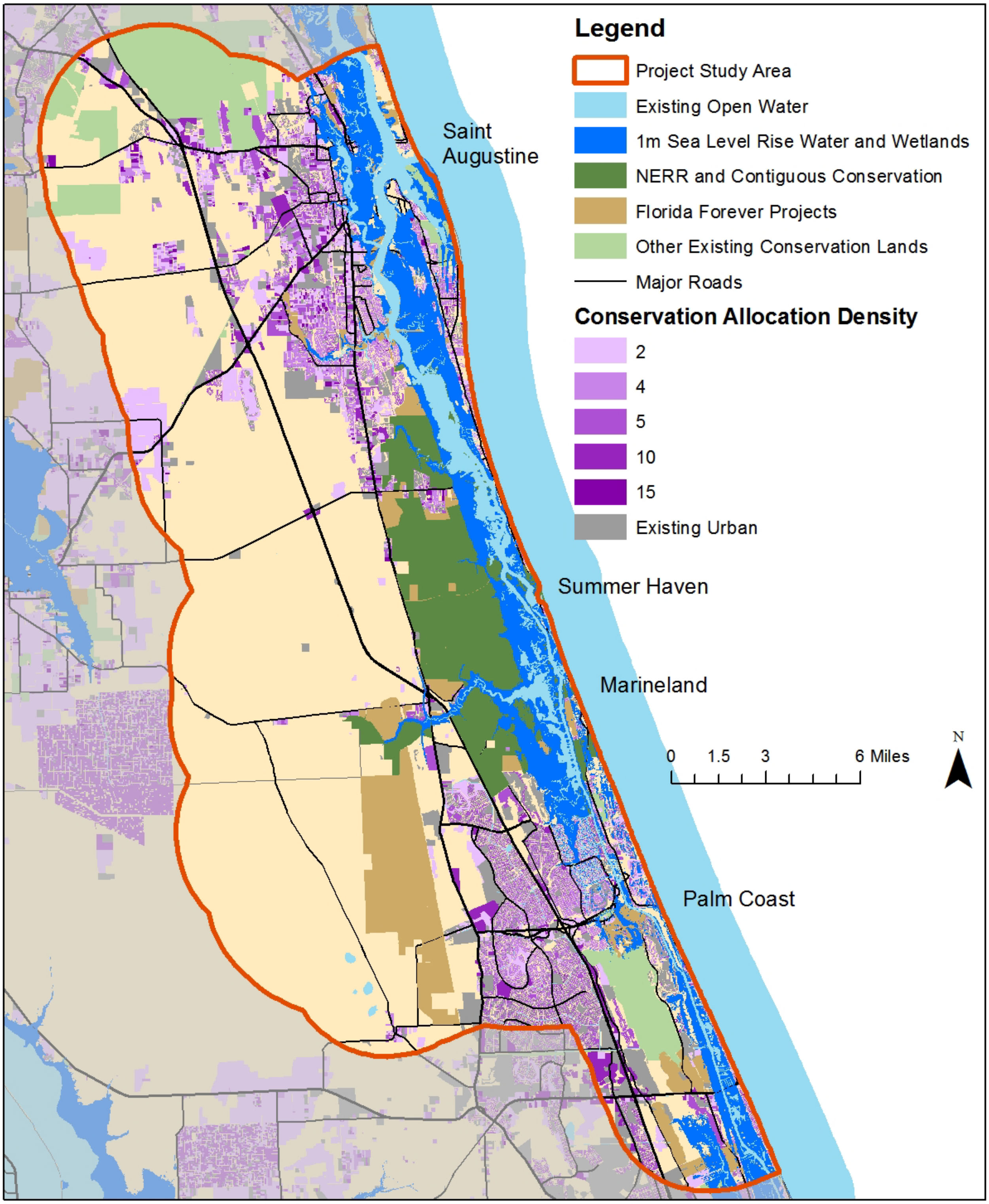

Figure 12: The density (parcels per acre) of allocation is shown for the Conservation Scenario.

The following tables and figures detail some specifics of the Conservation Scenario, including specific land uses.

Table 13: Allocations for new population and employment acres within the study region for existing and future use category.							
Existing Use	Future Use	Frequency	Population	Acres	Min Density	Max Density	Mean Density
Vacant Residential	Residential Only	92013	310,695	27,016.94	5	5	5.00
Vacant Commercial	Commercial Employment	2082	0	1,722.43	0	0	0.00
Vacant Institutional	Institutional Employment	374	0	476.97	0	0	0.00
Vacant Industrial	Industrial Employment	1184	0	1,667.10	0	0	0.00
Vacant Commercial	MU Commercial-Multifamily	1661	27,817	1,243.38	2	10	9.49
Acreage Not Zoned for Agriculture	Residential Only	1037	40,748	4,429.16	4	4	4.00
Acreage Not Zoned for Agriculture	Residential Minor Conflict	2157	43,998	4,782.39	4	4	4.00
Acreage Not Zoned for Agriculture	MU Commercial-Multifamily-Retail	935	13,489	1,466.15	4	4	4.00
Acreage Not Zoned for Agriculture	MU Retail-Service-Single Family	1487	26,561	2,887.01	4	4	4.00
Timberlands	Residential Only	3128	31,952	6,946.17	2	2	2.00
Vacant Commercial	MU Commercial-Retail-Multifamily	1700	57,445	2,553.61	2	10	9.79

Table 13: Population allocations and acreage allocations for population and employment within the study region.

Table 14: Allocations for new population and employment acres within the Matanzas Buffer Area for existing and future use category.							
Current Use	Future Use	Frequency	Population	Acres	Min Density	Max Density	Mean Density
Vacant Residential	Residential Only	45278	109,946	9,560.50	5	5	5.00
Vacant Commercial	Commercial Employment	1036	0	862.61	0	0	0.00
Vacant Institutional	Institutional Employment	276	0	405.71	0	0	0.00
Vacant Industrial	Industrial Employment	726	0	1,048.88	0	0	0.00
Vacant Commercial	MU Commercial-Multifamily	1340	20,734	922.28	2	10	9.43
Acreage Not Zoned for Agriculture	Residential Only	270	532	57.81	4	4	4.00
Acreage Not Zoned for Agriculture	Residential Minor Conflict	764	14,980	1,628.26	4	4	4.00
Acreage Not Zoned for Agriculture	MU Commercial-Multifamily-Retail	313	6,017	654.00	4	4	4.00
Acreage Not Zoned for Agriculture	MU Retail-Service-Single Family	391	9,994	1,086.30	4	4	4.00
Timberlands	Residential Only	729	5,705	1,240.18	2	2	2.00
Vacant Commercial	MU Commercial-Retail-Multifamily	1010	40,258	1,771.47	2	10	9.87

Table 14: The population allocations and acreage allocations for population and employment within the Matanzas Buffer area.

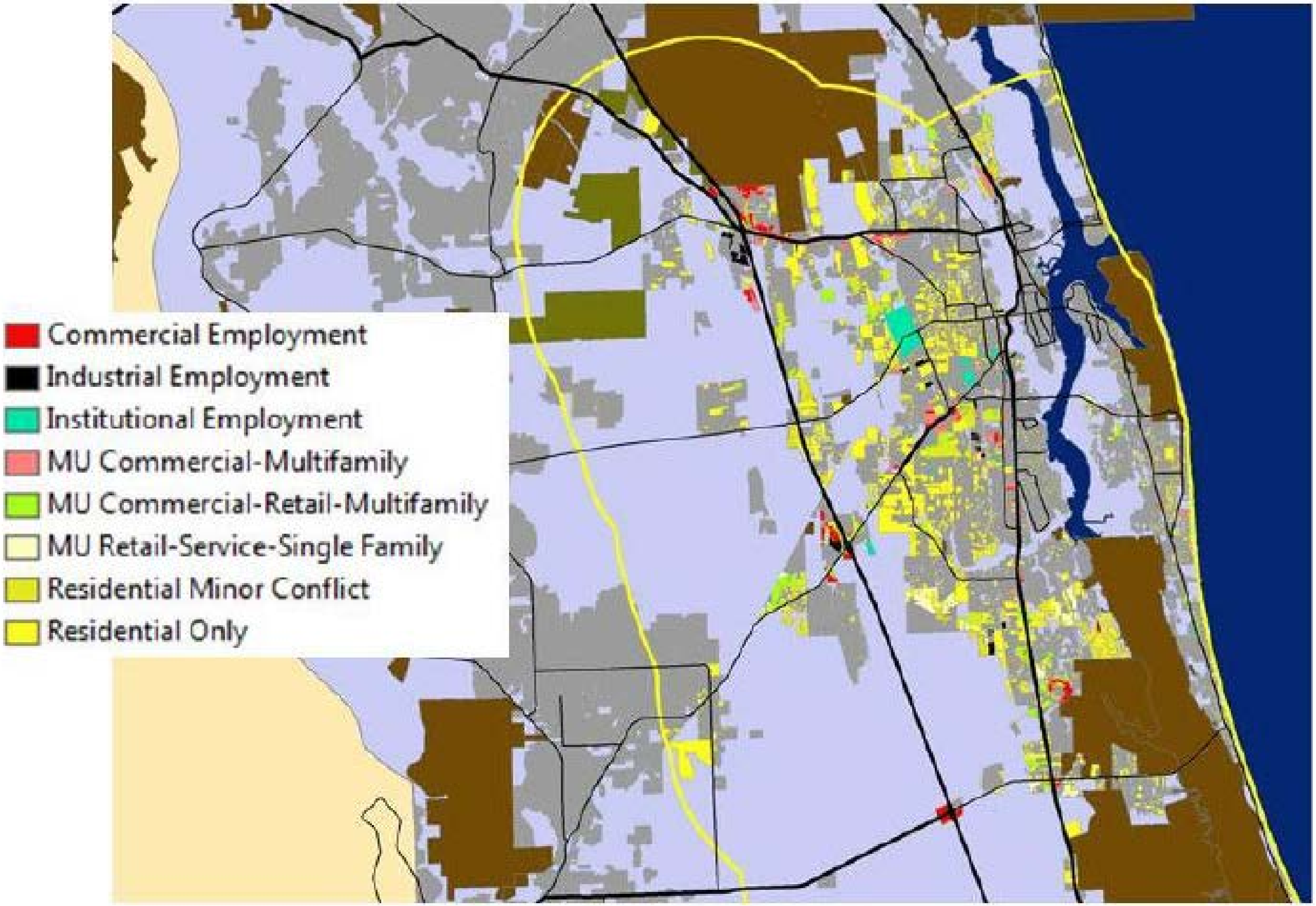

Figure 13: New land use allocations for the North Matanzas Buffer Area. The gray is existing urban area.

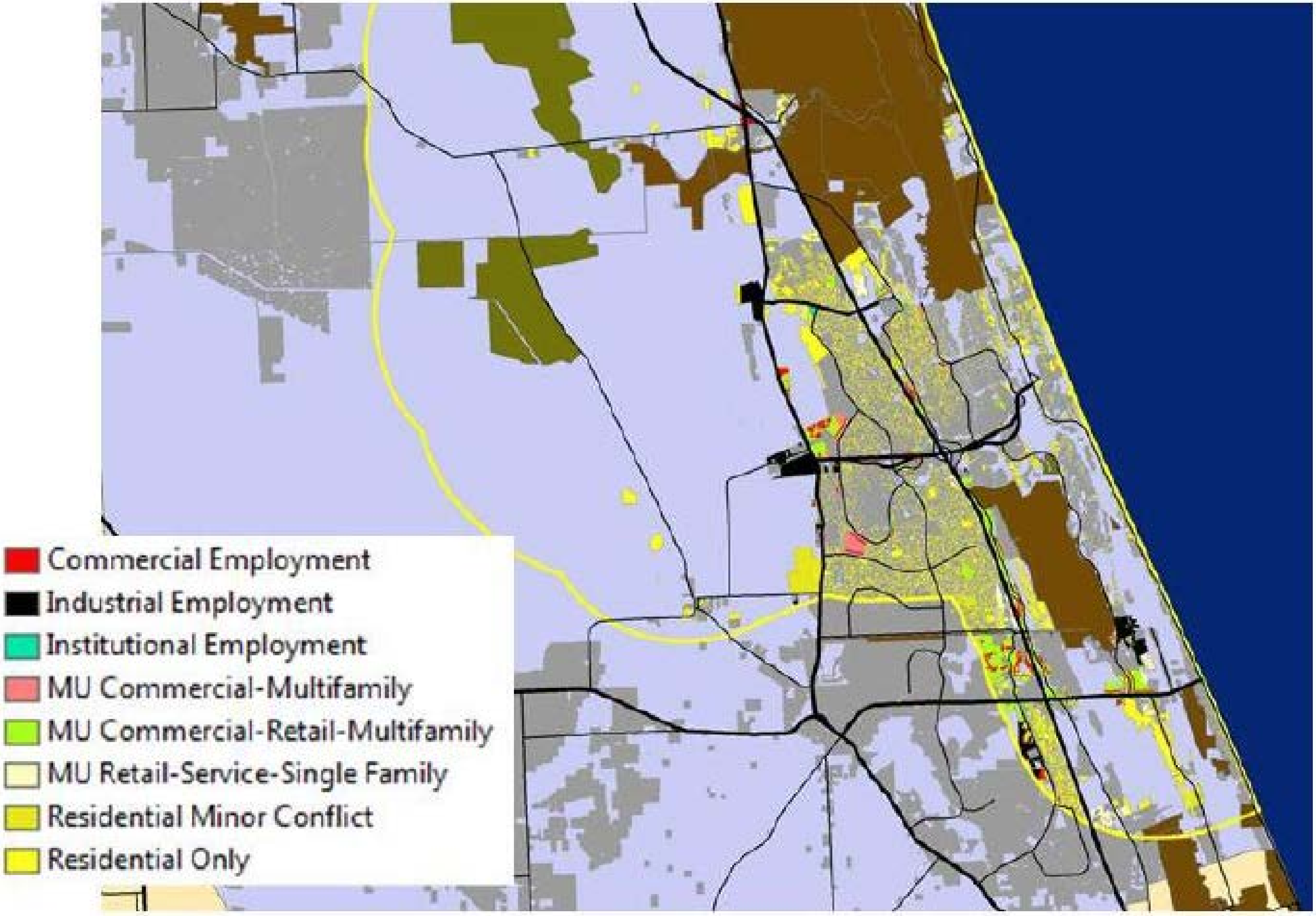

Figure 14: New land use allocations for the South Matanzas Buffer Area. The gray is existing urban area.

Supplementary Scenarios

Two supplementary scenarios have been created for the purposes of overlay analysis. They show future developed lands for the year 2060 without sea level rise. Similar to the previous scenarios, they are derived from the same suitability analysis and LUCIS conflict identification process. The first scenario is existing and future land use for the year 2060, not including sea level rise, developed at current development rates. The second scenario is existing and future land use for the year 2060, not including sea level rise, with development that avoids high priority conservation lands. The population allocation for these scenarios is based on gross urban density figures from the Bureau of Economic and Business Research for St. Johns and Flagler Counties. Because of this, these scenarios do not specify types of urban land use or variations in development density. The gross urban densities for St. Johns and Flagler Counties are 3.70 and 2.27 people per acre, respectively. Therefore, the allocation of the 311,523 and 199,528 people in St. Johns and Flagler Counties, respectively, require 172,092 acres in total. The first scenario (Figure 15) allocates this required acreage, matching the current gross urban density. This is referred to as current development rates. The second scenario (Figure 16) avoids high priority conservation lands, limiting the land available for development. In this scenario, future developed land area is 104,481 acres; which is 60.1% of the land needed for population allocation at current development rates. This can be interpreted to ways. Either only 60.1% of the population increase by 2060 would be accommodated at current development rates in the reduced urban area or the gross urban density would rise to an average 4.89 people per acre across the study area to accommodate the projected 511,051 additional people in 2060.

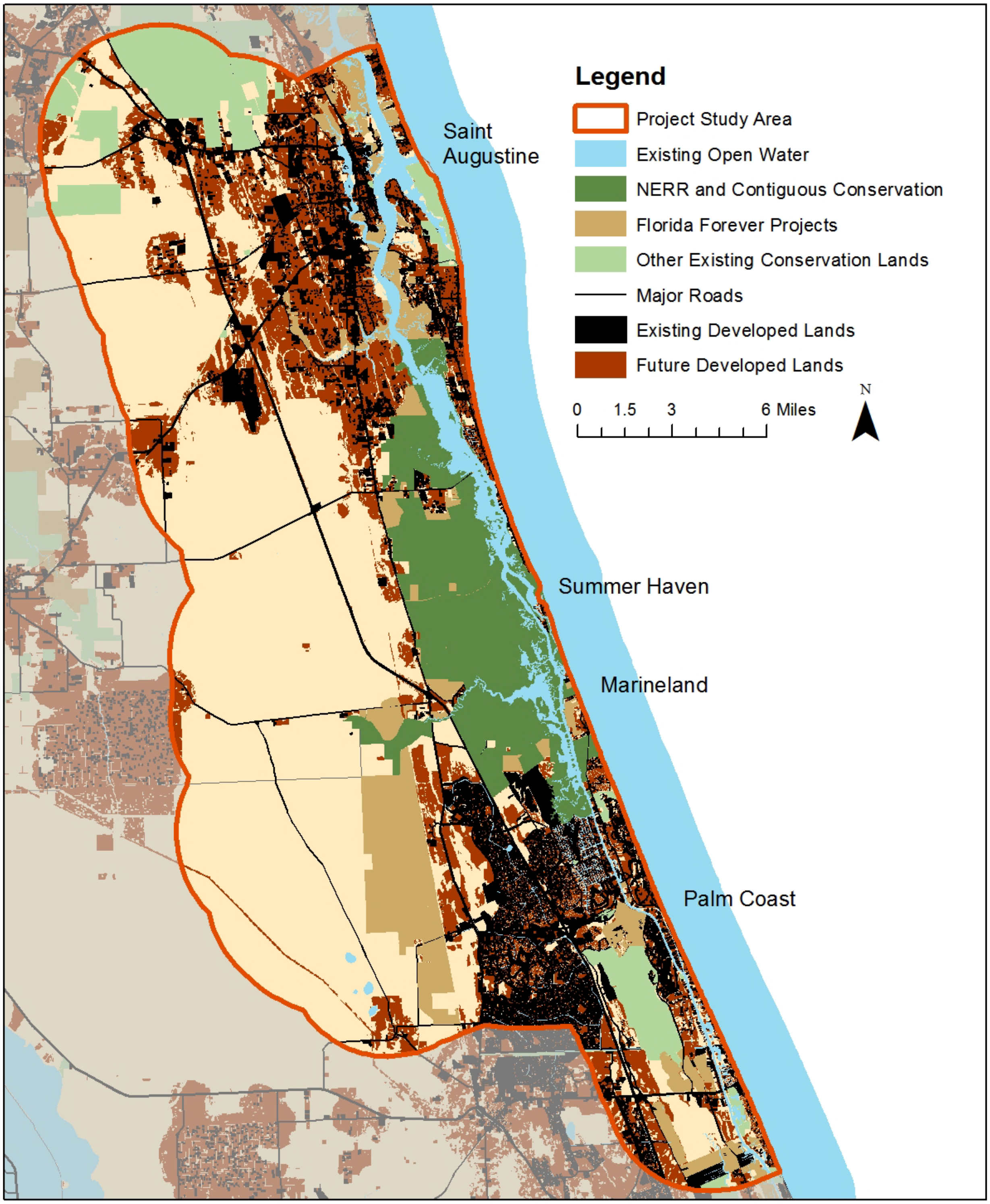

Figure 15: Existing and future land use scenario for the year 2060, not including sea level rise, developed at current development rates.

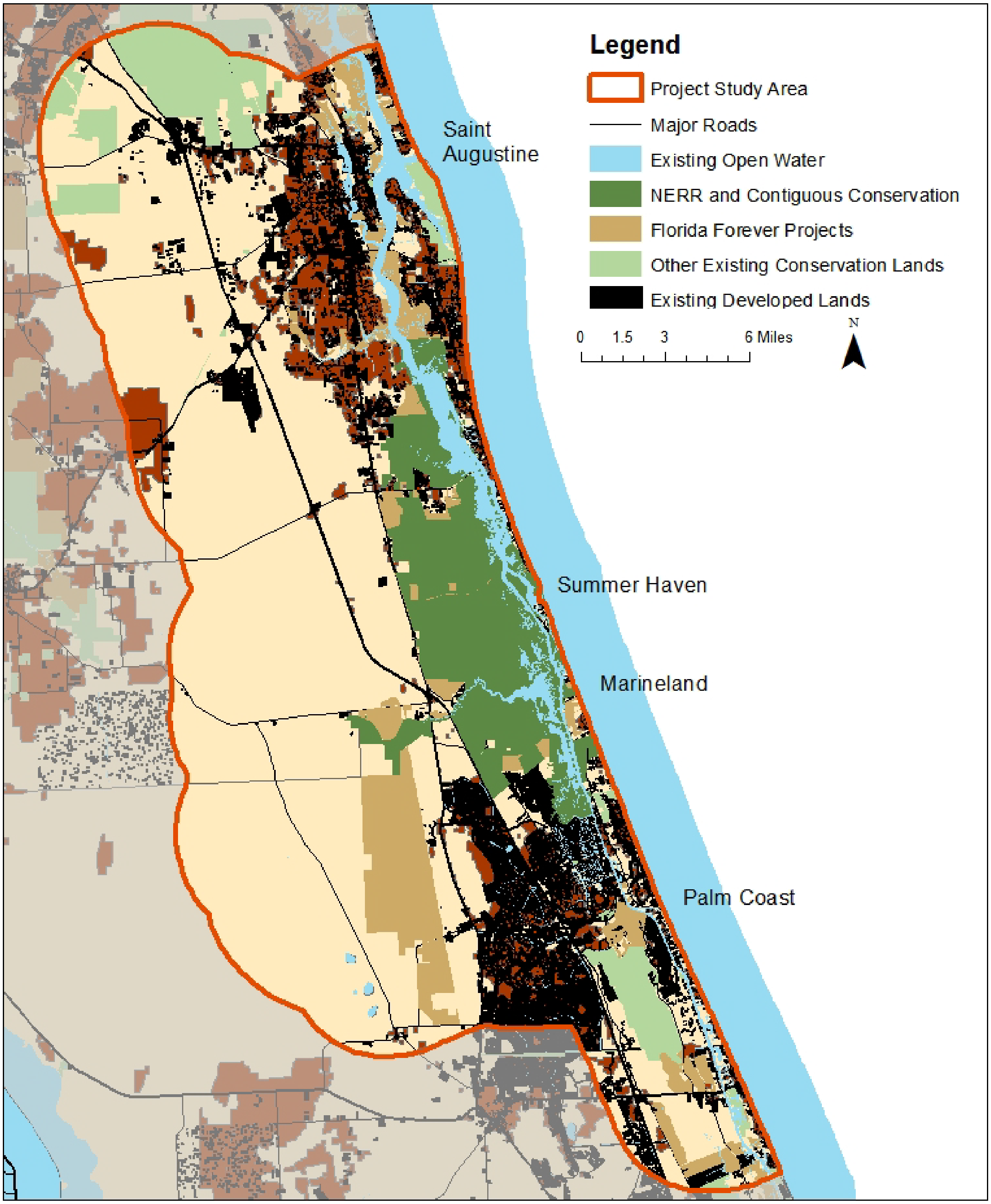

Figure 16: Existing and future land use scenario for the year 2060, not including sea level rise, with development that avoids high priority conservation lands.