

Florida Forever
Project Ranking Support Analyses
Documentation

Florida Natural Areas Inventory

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INTRODUCTION

When the Florida Forever program was established in 2000, the Florida Natural Areas Inventory (FNAI) worked with partners and experts to develop the Florida Forever Conservation Needs Assessment (FFCNA), a series of geographic natural resource data layers that corresponded to specific measures outlined in the Florida Forever Act (FNAI 2015). Each FFCNA data layer was designed to address a certain measure of the Act in order to ensure that the intent of the Act was being carried out in the identification and prioritization of natural resources for the Florida Forever program. This approach has the benefits of transparency and clarity of reporting progress in the acquisition of natural resources, but proved to be unsatisfactory for developing Florida Forever project evaluation analyses to support the Acquisition and Restoration Council (ARC) project ranking process. We found that since several measures in the Act involve functionally similar if not redundant resources, several FFCNA data layers should be combined into functional groupings for analysis. These groupings were developed as Ranking Support Analyses (RSA) and are documented in this report (see Fig. 1).

The Ranking Support Analyses inform two primary evaluations of Florida Forever Projects: Single Resource Evaluation (SRE) and the Florida Forever Tool for Efficient Resource Acquisition and Conservation (F-TRAC). Single Resource Evaluations provide decision makers concise scores of acquisition projects based on functional resource groupings, such as Species, Communities, Surface Waters, etc. Projects are scored based on their contribution to that single resource only, without regard to other resource types. F-TRAC provides a single evaluation of projects across multiple resource types and is tied to the actual amount of acreage projected to be acquired by the Florida Forever program. Project scoring based on SRE and F-TRAC is reported in the Florida Forever Project Comparative Analysis (commonly referred to as the “bubble sheet”).

In addition, the Florida Forever Act Reauthorization in 2008 added several additional criteria that should be factored into project evaluations. As part of our ongoing contract with the Florida Department of Environmental Protection (FDEP) to support Florida Forever, FNAI has begun scoring some of these additional criteria (see Fig. 1, bottom right). Methods for assessing those additional criteria are documented in this report as well.

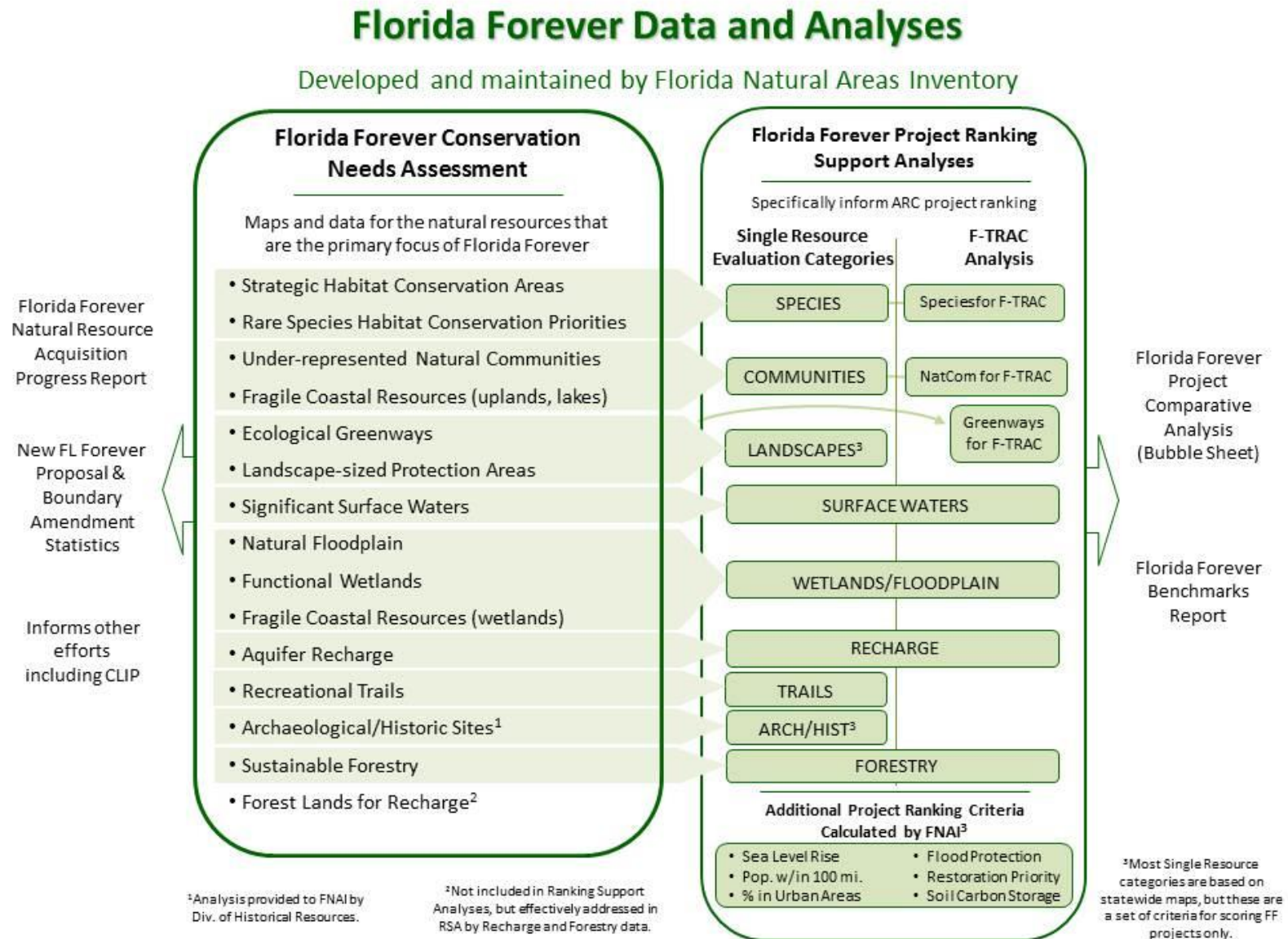


Figure 1. Relationships between Florida Forever data and analyses developed and maintained by Florida Natural Areas Inventory.

SINGLE RESOURCE EVALUATION

Standard Scoring Method

The Single Resource Evaluation (SRE) method evaluates how well a Florida Forever project protects a single resource, such as species or surface waters, relative to other projects on the list. The primary purpose of this analysis is to provide a straightforward method for comparing current and proposed land acquisition projects based on specific resource goals of the Florida Forever program. The results of the SRE appear in summarized form in the Florida Forever Project Comparative Analysis prepared every six months for the FDEP and available on the FNAI website (www.fnai.org).

Most SRE project scores are based on a “weighted score” method. For the weighted score, we calculated acres of each project in the different priority classes of each resource type. These acres were then multiplied by a weight factor corresponding to the priority class. Finally the weighted acres were summed and the sum was divided by acres of the project to eliminate size bias. This method is illustrated in Table 1. The score represents the average resource value per acre on a project.

Table 1. Example of Weighted Score evaluation method.

		ACRES IN EACH PRIORITY CLASS						WEIGHTED ACRES (acres * weight factor)						
		HIGH				LOW		10	8	6	4	2		SCORE
Project Acres	FF PROJECT	PR 1	PR 2	PR 3	PR 4	PR 5		Acres *10	Acres *8	Acres *6	Acres *4	Acres *5	sum wted acres	sum wted acres/ project acres
1,342	Project A	0	74	0	165	0	→	0	592	0	660	0	1,252	0.93
36,162	Project B	0	0	10,305	200	0	→	0	0	61,830	800	0	62,630	1.73

Alternatives to the weighted score method were used for Landscapes, Trails Network, and Cultural Resources and are described below. Appendix A lists the current project scores and groupings for each resource type. For evaluations based on the weighted score method, the weight factor for each priority class is shown as well as minimum area thresholds where applicable (i.e. to get credit for protecting the resource the project as a whole (not just remaining acres) must contain a minimum number of acres of that resource). Finally, we describe the criteria used to determine how well the projects meet each resource type (Appendix A).

Resource Category Descriptions

The following resource descriptions rely on knowledge of how some of the original Conservation Needs Assessment data layers were created. Please refer to the Conservation Needs Assessment Technical Report Version 4.2 (FNAI 2016) for complete descriptions of the original data from which the decision support data (described below) are derived.

SPECIES

The current Species model is based on species information contained in the 2009 Strategic Habitat Conservation Areas (SHCA) as modified for the Florida Forever Conservation Needs Assessment (FNAI 2016) and the FNAI Habitat Conservation Priorities (FNAIHAB) Version 4 data layers. The 2009 SHCAs identify areas of habitat that are essential to sustain a minimum viable population for focal species of terrestrial vertebrates that were not adequately protected on existing conservation lands. The SHCAs include habitat data for 62 terrestrial vertebrate species, primarily on private lands, and are prioritized into five priority classes based on rarity (FNAI State and Global ranks). The FNAIHAB layer was designed to identify areas important for species habitat based on both species rarity and species richness. FNAI mapped occurrence-based potential habitat for 281 species of plants, invertebrates, and vertebrates, including aquatic species. Twenty-eight species were included in both the final SHCA and FNAI habitat analyses. In order to minimize redundancy between these two layers we combined the data following a rules-based approach as shown in Table 2. See Appendix B for a map and acreage table for the Species RSA.

Table 2. Priority classes for the species ranking support analysis.

Priority	Description
Priority 1	Priority 1 for SHCA or FNAI Habitat Conservation Priorities
Priority 2	Priority 2 for FNAI Habitat Conservation Priorities
Priority 3	Priority 2 for SHCA or Priority 3 for FNAI Habitat Conservation Priorities
Priority 4	Priority 3 for SHCA or Priority 4 for FNAI Habitat Conservation Priorities
Priority 5	Priority 4 for SHCA or Priority 5 for FNAI Habitat Conservation Priorities
Priority 6	Priority 5 for SHCA or Priority 6 for FNAI Habitat Conservation Priorities

NATURAL COMMUNITIES

The natural community RSA combines the natural community data from the under-represented ecosystems with fragile coastal resources— fragile coastal uplands and imperiled coastal lakes. (Note that coastal wetlands are included in the Wetlands RSA). All communities are mutually exclusive, e.g. coastal scrub is included with ‘Scrub’ but excluded from ‘Coastal Uplands’. The global rank (i.e. imperilment status) of each natural community informs the single resource score. See Appendix B for a map and acreage table for the Natural Communities RSA.

LANDSCAPES

The Landscapes RSA includes the Ecological Greenways (as revised by Tom Hctor in 2016 for the Critical Lands and Water Identification Project) and a measure prioritizing projects for contribution to Large Landscapes. These datasets formerly were combined to create an overall Landscapes Ranking Support Analysis; now, however, they are retained as separate layers but used in concert to provide a single resource evaluation of projects based on Landscapes.

Ecological Greenways: The Ecological Greenways Network was prioritized into 5 priority classes based on the following criteria:

- 1) Potential importance for maintaining or restoring populations of wide-ranging species (e.g., Florida black bear and Florida panther)
- 2) Importance for maintaining a statewide, connected reserve network from south Florida through the panhandle.
- 3) Other important landscape linkages that provide additional opportunities to maintain statewide connectivity especially in support of higher priority linkages.
- 4) Importance as a riparian corridor to protect water resources, provide functional habitat gradients, and to possibly provide connectivity to areas within other states.

The top priority, Critical Linkages, was selected based on several factors, including how critical an area is to completing a connection in the Network and between existing conservation lands; the threat of land conversion; and the feasibility of acquisition. For a detailed report on critical linkages, please contact Tom Hctor, Geoplan Center, University of Florida.

Large Landscapes: The Florida Forever Act refers specifically to protection of Landscape-Sized Protection Areas, so the FFCNA measures that criterion only. For Project Ranking Support Analyses, projects are also scored for their contribution more generally toward Large Landscapes as follows.

Since many Florida Forever projects are divided into multiple non-contiguous areas, particularly when evaluating only remaining (unacquired) project areas as done here, we needed to evaluate contiguous sub-units of projects. We therefore developed Project Evaluation Units (PEUs) as the unit of analysis for this measure (PEUs are also used for the Sea Level Rise measure). Project Evaluation Units consist of the remaining areas of Florida Forever projects, with FNAI's standard "water out" data layer removed. For each project, non-contiguous areas greater than 400 meters apart are split into separate Project Sub-Units for analysis. Note that individual PSUs do not include multiple projects, even if they are contiguous.

PSUs were compared to existing managed areas to determine their contribution to landscape-size protection. For this purpose, managed areas were grouped into Managed Area Complexes (MACs). The FNAI Florida Managed Areas (FLMA) coverage was converted to raster and open water areas (approximating sovereign submerged) were removed. The raster underwent a 3-cell Expand and Shrink process to close small gaps, and the resulting raster was Region-Grouped. Each contiguous region is a separate Managed Area Complex (unlike PEUs, a MAC can contain multiple different managed areas, as long as they are contiguous after the expand/shrink process).

Each PEU was scored based on the largest MAC it was contiguous with. PEUs were scored based on three criteria: Size of MAC (in acres) currently, *without* adjacent PEU acreage; Size of PEU; and size of PEU and MAC together (as if PEU were acquired). PEUs were scored in five classes using the rule-matrix shown in Table 3. Column 3 (highlighted) represents a promotion rule that overrides scores in the remaining columns. Note that emphasis was placed on projects that, when added to a MAC currently less than 50,000 acres, would lead to a MAC greater than 50,000 acres. That emphasis corresponds to the 50,000 acre threshold explicitly noted in the Florida Forever Act and administrative rule for this

measure. PEUs added to MACs of 100,000 acres or more receive the lowest emphasis, based on the rationale that such MACs are already functioning as significant large landscapes (e.g., Everglades/Big Cypress, Apalachicola/Tate's Hell) and the PSU addition would not dramatically improve that status.

Table 3. Rule-based matrix used to score Project Evaluation Units for the Large Landscapes measure.

FF Project Sub-Unit Remaining Acres	FF Acres Class	Managed Area Complex Acres (without project)					
		<50,000 and proj. takes it over 50,000	0 (no adjacent MA Complex)	<25,000	25,000 - 49,999	50,000 - 99,999	100,000 plus
50,000 +	6	VH*	VH*	H*	VH*	VH	H
25k - 49,999	5	VH	M	M	H*	VH	M
10k - 24,999	4	VH	ML	M	M	H	M
5,000 - 9,999	3	H	L	ML	M	M	ML
1,000 - 4,999	2	M	L	L	ML	ML	L
<1,000	1	ML	L	L	L	L	L

*these are all by definition the same event as the third column (and should be overridden by the third-column promotion)

Finally, each full project is scored based on the highest-scoring of its individual PEUs. The full project and PEU scoring is in five classes corresponding to the Florida Forever Comparative Analysis table (Very High, High, Medium, Medium-Low, and Low). A map showing existing Managed Areas Complexes (by size) and Florida Forever projects (by score) is included in Appendix B.

For the Landscapes Single Resource Evaluation Category, projects are scored based on their scores for both the Ecological Greenways and Large Landscapes measures described above, as outlined in Appendix A.

SURFACE WATERS

The Surface Waters RSA is unchanged from the FFCNA Significant Surface Water data layer, which identifies significant surface waters of the state. These include the following: Outstanding Florida Waters, National Scenic Waters and National Estuaries, shellfish harvesting areas, seagrass beds, springs, water supply and waters important for imperiled fish. The data are prioritized based on proximity to a water body, stream order, downstream length, basin size and other factors. We created 7 prioritized sub-models based on the waters listed above. These sub-models were combined into a single surface water model with 7 priority classes. Detailed methodology for the surface water model may be found in the Conservation Needs Assessment Technical Report Version 4.2 (FNAI 2016). See Appendix B for a map and acreage table for the Species RSA.

WETLANDS/FLOODPLAIN

The current versions of FFCNA Functional Wetlands and Natural Floodplain data sets feature substantial overlap and are prioritized using the same criteria, so they are combined into a single RSA with 6 priority classes. The wetlands data layer is based on wetlands identified in the Cooperative Land Cover v2.3 (FNAI 2012). The natural floodplain data layer is based on 100-year floodplain identified from three primary sources: 1) FEMA Digital Flood Insurance Rate Map database 2001-2013 (DFIRM) for 49

counties; 2) FEMA Digital Q3 Flood Data 1996 for 16 counties; and 3) a surrogate floodplain dataset based on overlap of wetlands and hydric soils for gaps in FEMA data for 2 counties and FEMA ‘undetermined’ floodplain status in several other counties. Open water and developed areas were removed from the final floodplain base map. More details on development of both of these layers are documented in the Florida Forever Conservation Needs Assessment Technical Report (FNAI 2016).

Functional wetlands and natural floodplain were each assigned priorities based on natural quality using a Land Use Intensity index (LUI) developed by Tom Hctor at the University of Florida and the FNAI Potential Natural Areas (PNA).

The LUI characterizes the intensity of land use across the state on a scale of 1 – 10 with 10 being the least intense (most natural). Intensity is based on a multi-scale neighborhood analysis of five general categories of land use: natural, semi-natural (such as rangelands and pine plantation), improved pasture, agricultural/low-intensity development, and high intensity development. The assumption is that areas dominated by high intensity land uses are more likely to have severe ecological threats and much lower ecological integrity than areas dominated by natural land cover.

The Potential Natural Areas data layer identifies privately owned lands throughout the State of Florida that are not managed or listed for conservation purposes, which may contain good quality natural communities. The PNAs are ranked from P1 to P4 based on size, perceived quality, and type of natural community present. PNAs with these ranks were grouped into “high quality” natural areas. Conservation Lands were included in the P1 – P4 group. PNAs ranked P5 are areas that do not meet the criteria for P1 – P4 but are nonetheless believed to be ecologically viable tracts of land representative of Florida’s natural ecosystems.

Table 4 shows how both the LUI and PNAs were applied to help refine the prioritization of functional wetlands and natural floodplain. In order to minimize redundancy between these two layers, functional wetlands and natural floodplain were combined into a single model for evaluation purposes. See Appendix B for a map and acreage table for the Wetlands/Floodplain RSA.

Table 4. Prioritization method for wetlands and floodplain based on Land Use Intensity index and FNAI Potential Natural Areas.

Land Use Intensity Index	PNA 1 - 4	PNA 5	Non-PNA
10 (<i>lowest intensity</i>)	Priority 1	Priority 2	Priority 2
9	Priority 2	Priority 3	Priority 3
8	Priority 3	Priority 3	Priority 4
7	Priority 3	Priority 4	Priority 4
6	Priority 4	Priority 4	Priority 5
5	Priority 4	Priority 5	Priority 6
4	Priority 5	Priority 6	Priority 6
1 - 3	Priority 6	Priority 6	Priority 6

TRAILS NETWORK

The Recreational Trails RSA is based on land trail priorities and opportunities identified in the 2015 Florida Greenways and Trails System Plan. These trails are made up of existing, planned and conceptual non-motorized trails that form a connected set of linear recreational opportunities statewide (Florida Department of Environmental Protection 2013).

For Trails RSA we met with the staff of DEP/Office of Greenways and Trails to develop a version of land trail priorities and opportunities suitable for project evaluation purposes. We adjusted the 2015 Land Trail Priorities and Opportunities polylines for overlaps and assigned Priority 1 to all trail 'Priorities', and Priority 2 to trail 'Opportunities'. (Note that Paddling Trails are not included at this time). We also buffered trail lines by 0.25 miles to create half mile corridors. Both linear distance and corridor acreage were used to evaluate projects for recreational trails. See Appendix B for a map and mileage table for the Trails Network RSA.

SUSTAINABLE FORESTRY

The Sustainable Forestry RSA is unchanged from the FFCNA Sustainable Forestry data layer and identifies existing pinelands (natural and planted) and former pinelands that are potentially available for forest management. Prioritization is based on 4 criteria set by the Division of Forestry: whether trees are natural or planted, size of tract, distance to market, and hydrology. Large tracts of natural pine on mesic soils (versus very dry or wet) that are within 50 miles of a mill receive the highest score and priority. Former pinelands that currently do not have trees receive the lowest priority. Detailed methodology for the sustainable model may be found in the Conservation Needs Assessment Technical Report Version 4.2 (FNAI 2016). Table 5 describes the justification for each priority class. See Appendix B for a map and acreage table for the Sustainable Forestry RSA.

Table 5. Descriptions, scores, and acreages for the priority classes of the forestry RSA.

Priority Class	Scores	Description
Priority 1	950-990	Contains at least the top scores for all criteria except Hydrology and at least the middle score for Hydrology.
Priority 2	737-894	Contains at least the middle scores for three of the criteria and top score for Size or Distance to Market
Priority 3	522-693	Contains at least the middle scores for all criteria except Hydrology.
Priority 4	273-495	Contains remainder of pinelands not captured above.
Priority 5	N/A	Potential pinelands

AQUIFER RECHARGE

The Aquifer Recharge RSA is unchanged from the FFCNA Recharge data layer. The aquifer recharge base model was developed by Advanced Geospatial, Inc. (AGI) and further prioritized by FNAI in consult with AGI and Florida Geological Survey. The priority classes are based on the following data inputs: soil hydraulic conductivity, proximity to karst features, depth to water and overburden, and overlap with Springs Protection Areas, buffers to swallets, and buffers to public water supply wells (Table 6). Detailed methodology for the aquifer recharge model may be found in the Conservation Needs Assessment Technical Report Version 4.2 (FNAI 2016). See Appendix B for a map and acreage table for the Aquifer Recharge RSA.

Table 6. Priority classes and acreages for aquifer recharge decision support data.

Priority	Description
Priority 1	Very High Priority designation based on aquifer recharge potential & vulnerability
Priority 2	High Priority designation based on aquifer recharge potential & vulnerability
Priority 3	Medium-High Priority designation based on aquifer recharge potential & vulnerability
Priority 4	Medium Priority designation based on aquifer recharge potential & vulnerability
Priority 5	Medium-Low Priority designation based on aquifer recharge potential & vulnerability
Priority 6	Low Priority designation based on aquifer recharge potential & vulnerability

CULTURAL RESOURCES

Method: The Florida Department of State/Division of Historical Resources provides an evaluation of projects based on cultural resources.

SRE Group Assignment Criteria:

Very High	Project could be considered a stand-alone Florida Forever Project based solely on its archaeological or historic value.
High	Project exceeds satisfying objective for archaeological or historic resources.
Medium	Project will likely satisfy objective for archaeological or historic resources.
Medium-Low	Project most likely will not satisfy objective for archaeological or historic resources.
Low to None	Project does not satisfy objective for archaeological or historic resources.

F-TRAC

F-TRAC is based on a computer modeling approach to conservation reserve design known as Iterative Site Selection (ISS). The primary purpose for developing F-TRAC was to provide a concise analysis to evaluate current and potential land acquisition projects across multiple natural resource types for the Florida Forever program. The model approach could be useful for other conservation planning efforts, but the results described here were developed specifically for the needs of Florida Forever, and are not likely to apply to other programs without substantial modifications.

F-TRAC considers seven types of natural resource categories—species, communities, landscape connectivity, surface waters, wetlands, sustainable forestry, and aquifer recharge—and identifies a portfolio of sites that efficiently protects those resources. Efficiency is the key to the model; it approaches an optimal solution of the greatest resource protection in a given amount of land. Our analysis resulted in two scenarios: the 2020 Statewide Scenario, which identifies a portfolio of sites throughout the state; and the 2020 on Projects Scenario, which identifies a portfolio of sites only within existing and proposed Florida Forever Projects. Both Scenarios approximate the amount of land likely to be acquired through the twenty-year duration of the Florida Forever program. The F-TRAC modeling process and scenarios are discussed in more detail in Appendix C.

Like Single Resource Evaluation, the F-TRAC analysis is derived from the Florida Forever Conservation Needs Assessment data layers, but some layers have been modified specifically for use in F-TRAC (Fig. 1). These modifications are summarized below.

Species for F-TRAC

For the F-TRAC analysis only, the Florida Forever Expert Advisory Group was concerned that F-TRAC targets and weights do not apply equally to all species in the Species RSA, i.e. land acquisition targets for wide-ranging species could be less than for other species. The group recommended separating each priority class into wide-ranging species and all other species for the purpose of treating these differently in the F-TRAC analysis. We consulted with species experts to determine which species of those that were included in the FNAIHAB or SHCAs best fit the definition of wide-ranging. The following ten species were considered wide-ranging for the F-TRAC analysis: Eastern indigo snake, Florida panther, Florida black bear, crested caracara, woodstork, sandhill crane, swallow-tailed kite, short-tailed hawk, burrowing owl, Cooper's hawk. For details on species acreages, targets and weights for F-TRAC please see Appendix C.

Natural Communities for F-TRAC

For the F-TRAC analysis each RSA natural community was prioritized based on landscape quality using a Land Use Intensity index (LUI; developed by Tom Hctor at the University of Florida) and the FNAI Potential Natural Areas (PNA) data layer. (For a description of LUI and PNA see the Wetlands RSA description elsewhere in this document). The exceptions to this were the two G1 communities, Upland Glade and Pine Rockland: Only 40 acres of Upland Glade have been identified in the state and all of these are considered Very High priority; remaining Pine Rockland is also very limited, and we assigned

any patch ¼ acre or greater Very High priority and patches less than ¼ acre High priority. The prioritization criteria for all other communities varied depending on whether the natural community tends primarily to exist in small or large patches. Small patch communities are Coastal Uplands, Scrub, Seepage Slope, Rockland Hammock, Coastal Lakes and Sandhill Upland Lakes. Large patch communities are Dry Prairie, Sandhill, Upland Pine, Pine Flatwoods, and Upland Hardwood Forest. Priority values of Very High, High and Moderate were assigned to areas based on the LUI (Table 7). Higher LUI values correspond to more natural land uses. Some medium and low priorities were then increased if the area overlapped with high quality FNAI Potential Natural Areas (PNA 1-4; Table 7).

Table 7. Prioritization criteria for under-represented natural communities

Land Use Intensity Index Value (LUI)	Small Patch Communities		Large Extent Communities	
	Priority based on LUI	Priority based on PNA 1-4 Bonus	Priority based on LUI	Priority based on PNA 1-4 Bonus
8 - 10	Very High	Very High	Very High	Very High
7	Very High	Very High	High	Very High
6	High	Very High	High	Very High
5	High	Very High	Moderate	High
4	Moderate	High	Moderate	High
1 - 3	Moderate	Moderate	Moderate	Moderate

Greenways for F-TRAC

Prior to Fall 2011, Landscapes had not been included in the F-TRAC analysis, primarily because a major emphasis of Landscapes is to achieve connectivity through important landscape corridors across the state. F-TRAC, based on the MARXAN simulation tool, is unable to explicitly assess spatial connectivity. The current analysis focuses on a subset of the Ecological Greenways network known as Critical Linkages, and assigns conservation priorities within those linkages in a manner that approaches the goal of achieving connectivity.

Greenways Critical Linkages (Priority 1 of Ecological Greenways) were prioritized by four inputs: cost distance from managed area "hubs"; interior distance from corridor edge; elevation above sea level; and land cover suitability. Managed area "hubs" are defined as contiguous managed area regions 10,000 acres and larger.

Cost Distance from managed area hubs is similar to a buffer of the hubs, but traces distance only through critical linkages. The highest values are areas within critical linkages that are closest to MA hubs. Areas within critical linkages that are farthest from hubs (by tracing a path through the critical linkage corridor, not straight line distance) get the lowest score.

Interior buffer is a simple Euclidian buffer within the critical linkage corridors from the outside of the corridor in to the middle. The furthest distance from corridor edge receives the highest score (center of corridor), while the edges receive the lowest score.

Elevation above Sea Level focuses on low-elevation areas that are threatened by sea level rise. The source data for this input is a DEM mosaic compiled by the University of Florida GeoPlan Center, based primarily on LiDAR elevation in coastal counties and an FWC DEM in inland counties. Areas below 0.5 meters elevation receive the lowest score, while areas above 5 meters receive the highest score, with an inflection point around 1 meter (as the typical projection of sea level rise around 2100).

Land cover is classified within the critical linkages using a 5-class system: natural, plantation & unimproved pasture, improved pasture & field crops, intensive agriculture, and developed. Natural receives the highest score while developed receives the lowest.

All four inputs were classed to a common scale and overlaid with the following weights: cost distance X 3, interior buffer X 2, elevation above sea level X 1, land cover X 1. The resulting value surface was classed into six priorities with acreages roughly corresponding to the magnitude of area in other F-TRAC input classes. For more information about how this model was used in F-TRAC please see Appendix C.

ADDITIONAL PROJECT EVALUATION CRITERIA

When the Florida Forever Act was re-authorized in 2008, several additional criteria were added that are intended to be taken into consideration in prioritizing acquisitions (along with the core natural resource values already addressed in the FFCNA). Where feasible FNAI has assisted with compiling data and scoring projects for some of these additional criteria, as outlined below.

CLIMATE CHANGE

Priority List Consideration D5 (18-24.006, F.A.C): Lands that help to address the challenges of global climate change by providing opportunities to sequester carbon, provide habitat, protect coastal lands or barrier islands, and otherwise mitigate and help adapt to the effects of sea level rise, shall be given greater consideration than those that do not.

Source: Florida Natural Areas Inventory; The Nature Conservancy

Measure Definition

This measure deals with two primary aspects of climate change: carbon sequestration and sea level rise mitigation (through protection of habitat, coastal lands, barrier islands and other adaptation strategies).

Sea Level Rise

Projects are evaluated on their ability to accomplish either of two goals related to Sea Level Rise (SLR):

- *Managed Area Refuge*: the project is adjacent to an existing managed area that is vulnerable to SLR, and extends the managed area further inland to facilitate potential shifts of natural resources to higher elevations.
- *Escape Route*: the project itself extends from a coastal elevation vulnerable to SLR inland to higher elevations, facilitating potential shifts of resources away from SLR.

Input Data

- Project Evaluation Units (PEUs) – Remaining portions of Florida Forever project boundaries, broken into spatially contiguous units within each project, as described in Large Landscapes measure above.
- Managed Area Complexes (MACs) – Existing conservation lands grouped into spatially contiguous units, as described in Large Landscapes Measure above.

PEU Scoring

Part I. Managed Area Refuge				
Applies only if Managed Area Complex meets criteria for "Vulnerable":				
	- At least 25% of MAC area is below 1 meter			
	- Less than 5% of MAC area is above 2 meters			
PEU must be within 10m of a Vulnerable MAC, and:				
	- At least 5% of PEU area is above 2 meters			
	- Less than 25% of PEU area is below 1 meter			
	PEU Size			
MAC Size:	10,000+	1k-10k	100-1k	<100
10,000+	VH	H	M	ML
1,000-9,999	VH	H	M	ML
100-999	H	H	H	M*
<100	M	M	M	ML
*PEU must be at least 25acres for M, otherwise ML				
PEU that does not meet MAR criteria = Low				

Part II. Escape Route				
Applies only if PEU meets criteria:				
- At least 5% of PEU area is below 1 meter				
- At least 5% of PEU area is above 2 meters				
	Percent of PEU above 2 meters			
PEU Size:	>75%	50-75%	25-50%	5-25%
10,000+	VH	VH	VH	H
1,000-9,999	H	H	H	M
100-999	M	M	ML	ML
<100	ML	ML	ML	ML

Translating PEU Scores to Project Scores

Unlike the Large Landscapes method, Projects are scored using a modified area-weighted average of PEUs. After each PEU is assigned a score of Very High (5), High (4), Medium (3), Medium-Low (2), or Low (1), the acreage of each PEU is multiplied by its score value. Those weighted acres are summed and divided by the total acres of all PEUs in the project. Each project receives a separate Area-Weighted score for Managed Area Refuge and Escape Route.

EXAMPLE:

PEU	Acres	Score	Weighted Acres
Lower_Suwannee_River_and_Gulf_Watershed-1	19,203	1	19,202.5
Lower_Suwannee_River_and_Gulf_Watershed-2	21,413	5	107,067.0
Lower_Suwannee_River_and_Gulf_Watershed-3	5,821	4	23,283.6
Project Area-Weighted Average Score			3.22

To account for the diluting effect of averaging, the Project's Area-Weighted Score is **modified** if individual PEU scores higher:

- If any PEU scores Very High, the Project scores at least High (4.0)
- If any PEU scores High, the Project scores at least Medium (3.0)
- If any PEU scores above Low, the Project scores at least Medium-Low (2.0)

For each criterion (Managed Area Refuge and Escape Route), the modified weighted average is broken into the final five classes as follows:

4.50 – 5.00	Very High
3.50 – 4.49	High
2.50 – 3.49	Medium
1.01 – 2.49	Medium-Low
0.00 – 1.00	Low

Finally, each project receives the higher class of the two criteria.

Soil Carbon Storage

Xiong et al. (2014) at the University of Florida have modeled soil carbon stocks for the state of Florida. The research team provided soil total carbon data that was used to calculate an Average Soil Total Carbon statistic for each Florida Forever project (remaining acres). In 2016 this value ranged from 2.45 to 10.96 across projects. We divided the range into five “bubble sheet” classes using standard deviations:

Priority Class	Std Dev	Avg Soil Total Carbon
Very High	Mean +2 SD	8.67 – 10.96
High	Mean +1 SD	7.00 – 8.66
Medium	Mean +1 SD	3.68 – 7.00
Medium-Low	Mean -1 SD	2.01 – 3.68
Low	Mean -2 SD	<2.01

Note that no project qualified as Low in the 2016 scoring. Resulting project scores are included in Appendix D.

POPULATION WITHIN 100 MILES

For this analysis, remaining acres of Florida Forever projects were buffered by 100 miles. All 2010 Census Tracts intersecting each projects’ 100 mile buffer were selected, and the total population of those census tracts was attributed to each project. Resulting project scores and class breaks are listed in Appendix D.

PROXIMITY TO URBAN AREAS

For this analysis, Urban Areas were defined by an FGDL data set known as “urban areas and urban clusters”, based on 2010 census data. Remaining acres of Florida Forever projects were overlayed on this data layer and the percent of each project within the urban area was calculated. This statistic has not been included on the “bubble sheet” but calculated for a larger project scoring spreadsheet compiled by DEP staff. Project percentages are listed in Appendix D.

FLOOD PROTECTION

This measure is calculated as the percent of remaining project area that overlaps with FEMA floodplain. This analysis uses the same FEMA floodplain compilation layer developed for the FFCNA Natural Floodplain data layer (FNAI 2016). Unlike the Natural Floodplain analysis, Flood Protection includes the entire FEMA zone—we do not removed developed land uses from the zone in this case. Final project scores are listed in Appendix D.

RESTORATION PRIORITY

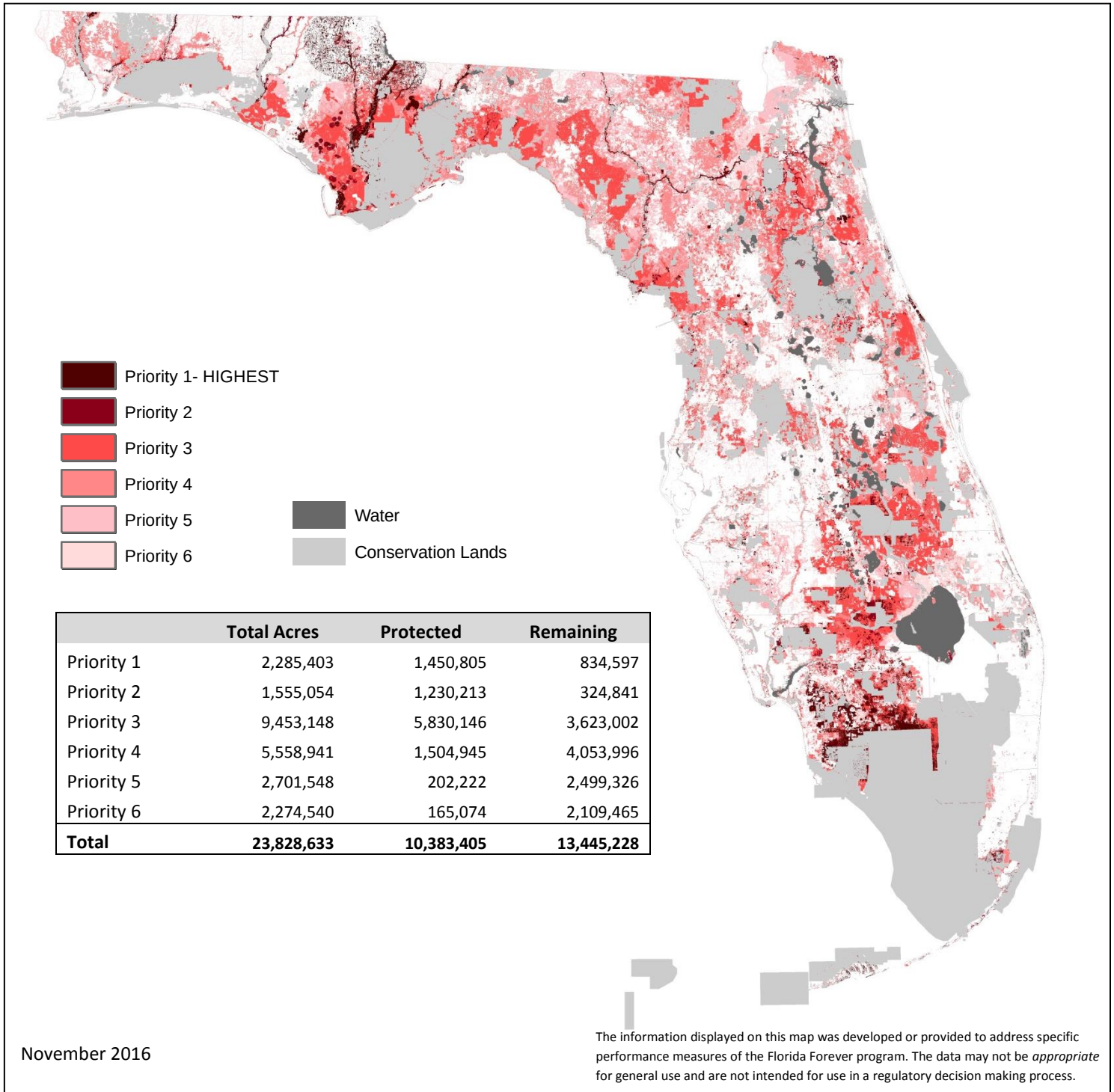
This measure is intended to assess the degree to which a Florida Forever project's management focus includes restoration efforts. It is comprised of two separate measures. First, FNAI staff reviewed management prospecti or project summaries for each project, and graded them as to restoration focus. Only project with a "strong" focus on restoration were considered for the final score. Other projects were scored based on areas designated in DEP Basin Management Action Plans (BMAP) for water restoration. Percent of project within BMAP areas was calculated. Finally, projects were given a score of High ("strong" restoration focus in FNAI analysis, or >50% of project in BMAP), Medium (10-50% of project in BMAP), or Low (<10% of project in BMAP). Final project scores are listed in Appendix D.

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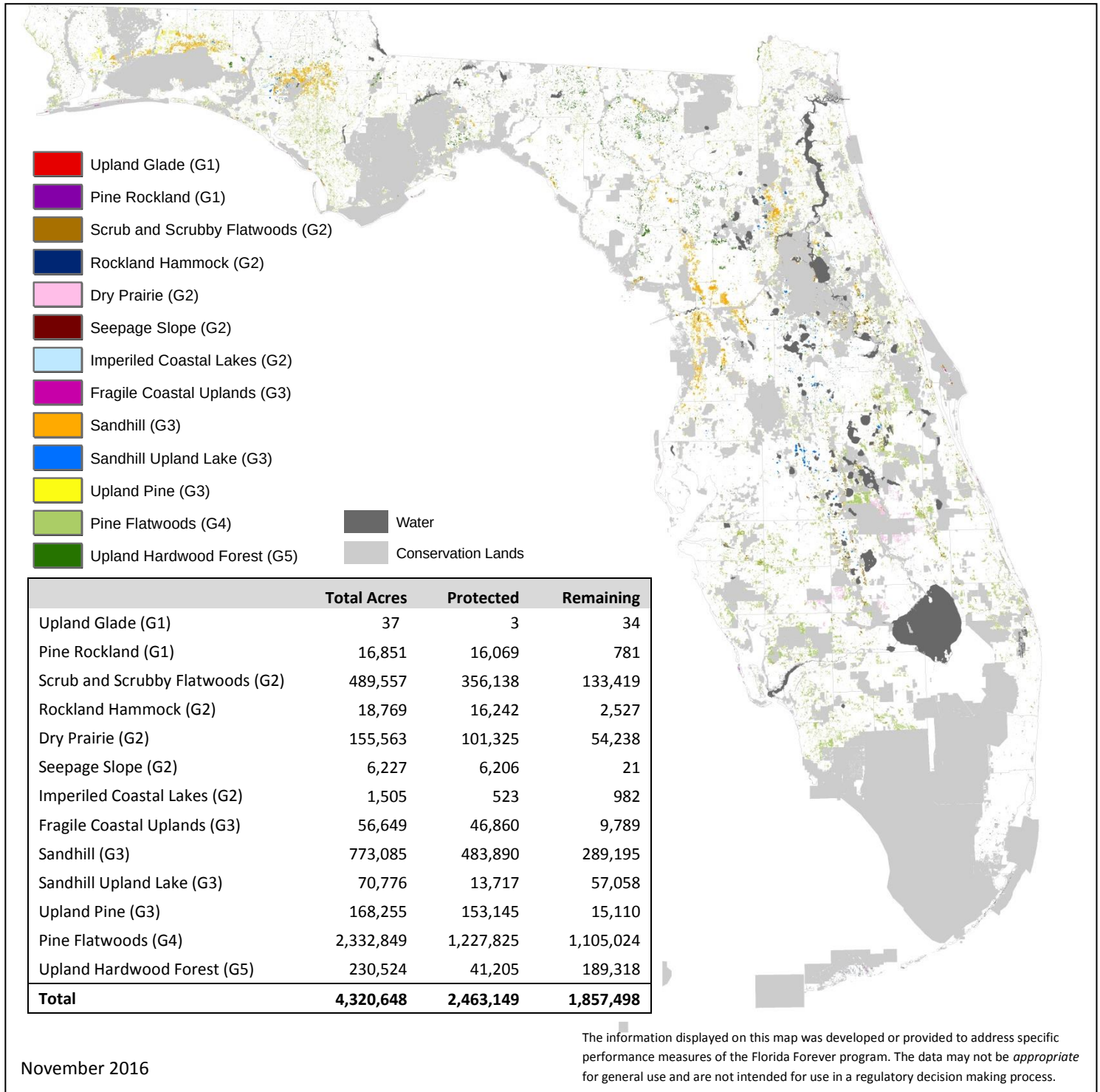
Appendix B. Ranking Support Analyses Maps

Species	Map 1
Natural Communities	Map 2
Landscapes – Ecological Greenways	Map 3
Landscapes – Large Landscapes	Map 4
Surface Waters	Map 5
Wetlands/Floodplain	Map 6
Recreational Trails	Map 7
Sustainable Forestry	Map 8
Groundwater Recharge	Map 9

Species**Combined Strategic Habitat Conservation Areas and Rare Species Habitat Conservation Priorities**

Primary Sources: Florida Fish and Wildlife Conservation Commission; Florida Natural Areas Inventory

Description: The Strategic Habitat Conservation Areas for Florida Forever and FNAI Habitat Conservation Priorities identify habitat for some of the same species. Twenty-eight species were included in both the final SHCA and FNAI habitat analyses. In order to minimize this redundancy the Species data layer combines information from these two layers. Please refer to the Decision Support Data Documentation (<http://www.fnai.org/FIForever.cfm>) for an explanation of how priority classes were assigned in the combination of the two data layers.

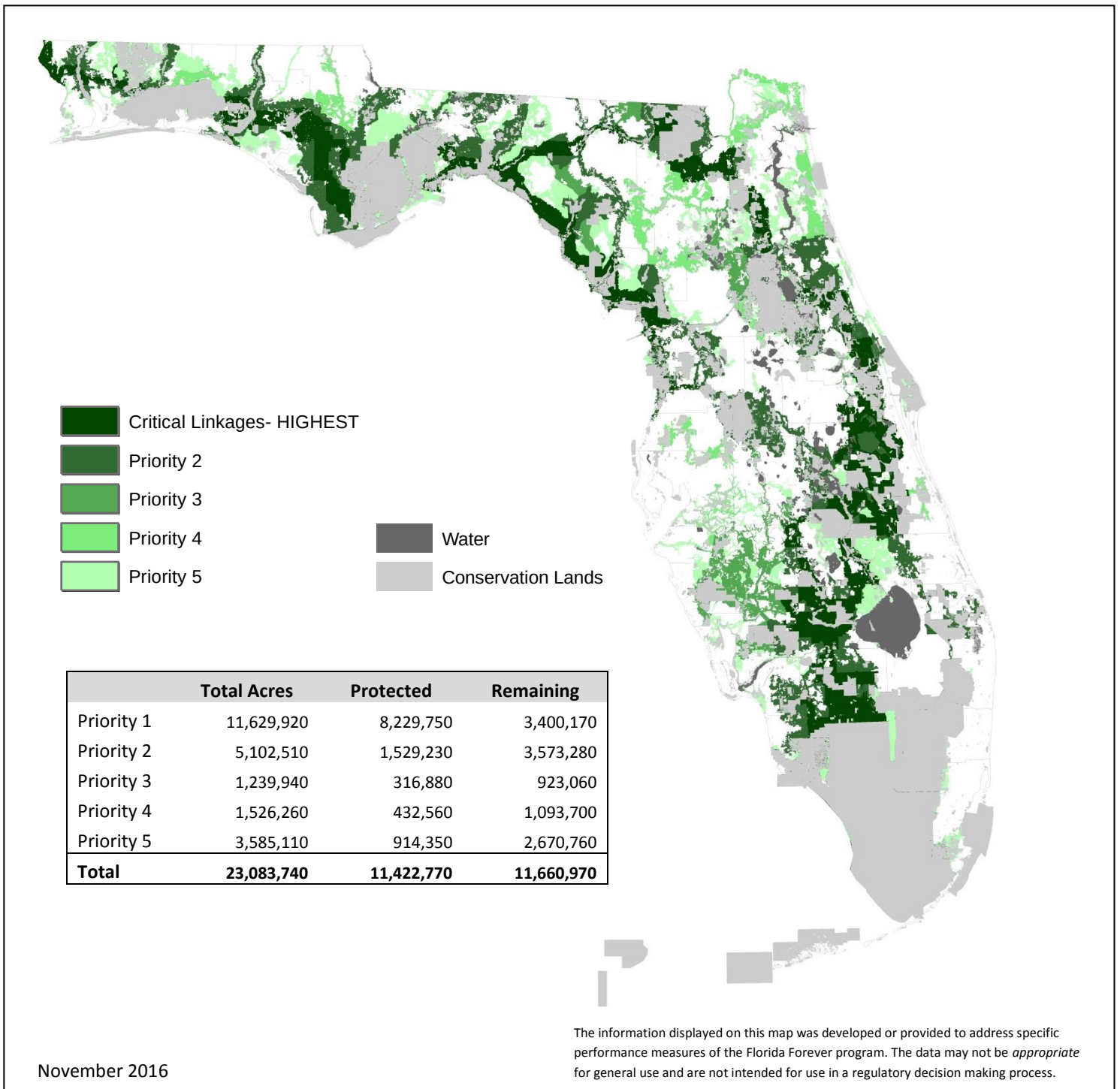
Natural Communities**Combined Under-represented Ecosystems and Fragile Coastal Resources (Uplands)**

November 2016

Primary Source: FNAI

Description: The Natural Community data layer is made up of natural communities under-represented on conservation lands, and fragile coastal resources, which include fragile coastal uplands and imperiled coastal lakes. Mangrove and Salt Marsh (G5) are included in the Functional Wetlands data layer. This data layer is prioritized based on the Global Rank of the natural communities. Please refer to the Decision Support Data Documentation (<http://www.fnai.org/FIForever.cfm>) for an explanation of how this dataset is used in Florida Forever analyses.

Landscapes - Ecological Greenways

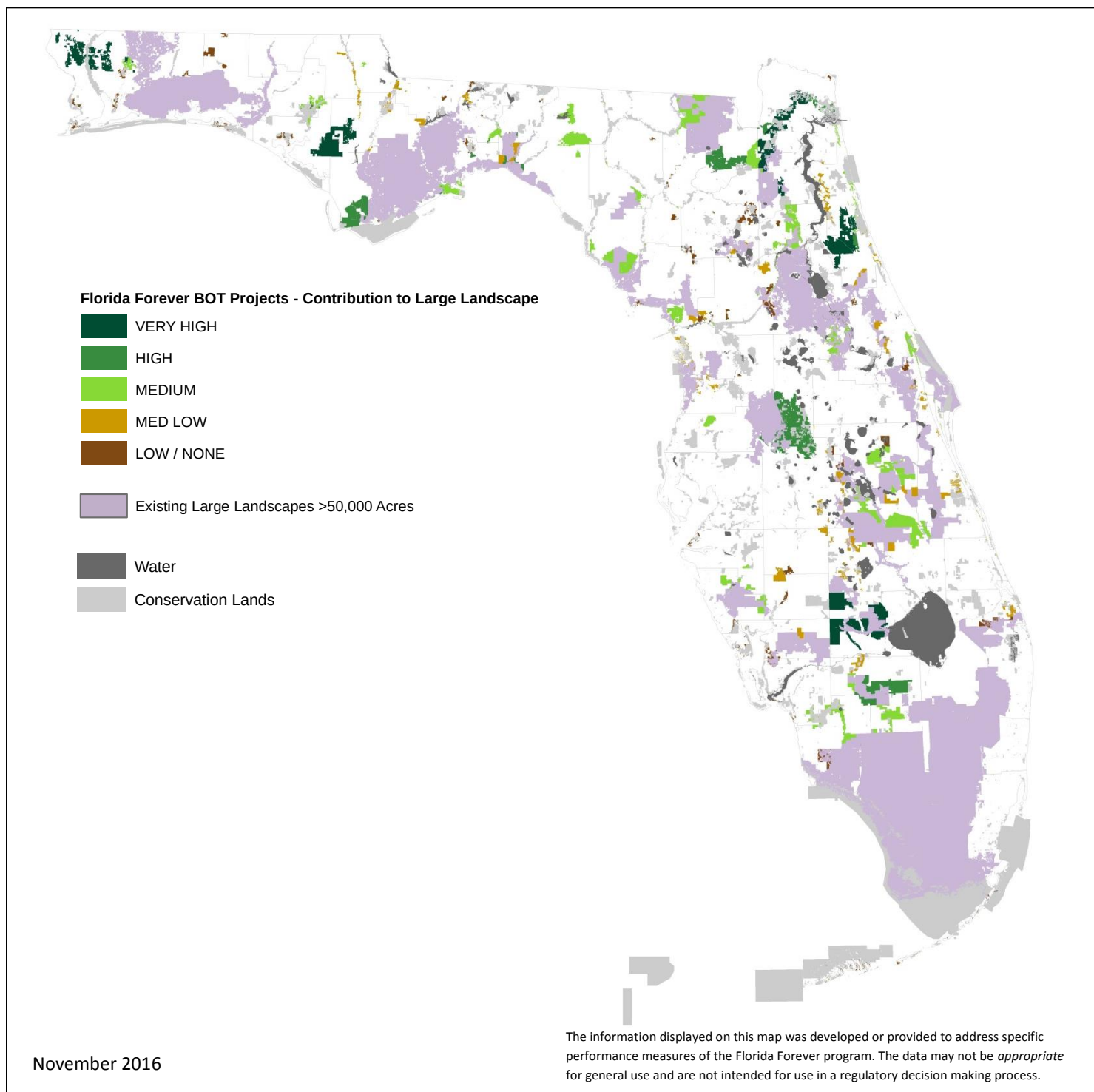


Primary Source: University of Florida; FDEP/Office of Greenways and Trails

Description: Landscape Linkages is represented by the Florida Ecological Greenways Network as revised in 2016, a statewide system of landscape hubs, linkages, and conservation corridors. Prioritization is based on factors such as importance for wide-ranging species, importance for maintaining a connected reserve network, and riparian corridors. Critical Linkages are considered most important for completing a statewide ecological network of public and private conservation lands.

Florida Forever Project Ranking Support Analyses – Appendix B

Landscapes - Large Landscapes

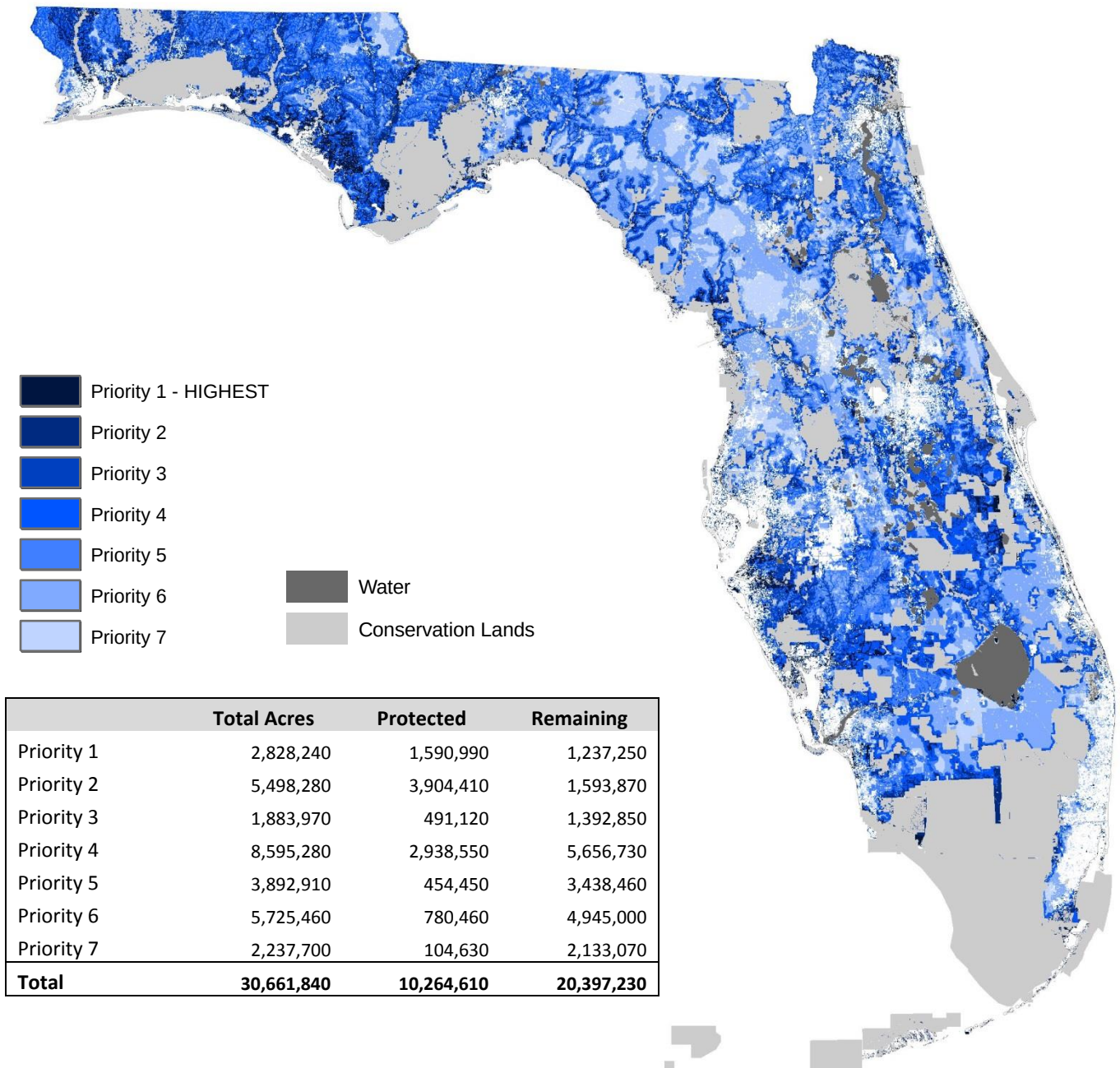


Primary Source: Florida Natural Areas Inventory

Description: The Large Landscapes dataset depicts existing conservation land complexes that comprise contiguous areas of >50,000 acres. Current Florida Forever BOT Projects are prioritized based on their potential contribution to large landscapes >50,000 acres. Protection of these areas would contribute to maintenance of ecosystem processes on a landscape level. For more information see the Conservation Needs Assessment Technical Report: <http://www.fnai.org/FIForever.cfm>.

Florida Forever Project Ranking Support Analyses – Appendix B

Surface Water Protection



November 2016

The information displayed on this map was developed or provided to address specific performance measures of the Florida Forever program. The data may not be *appropriate* for general use and are not intended for use in a regulatory decision making process.

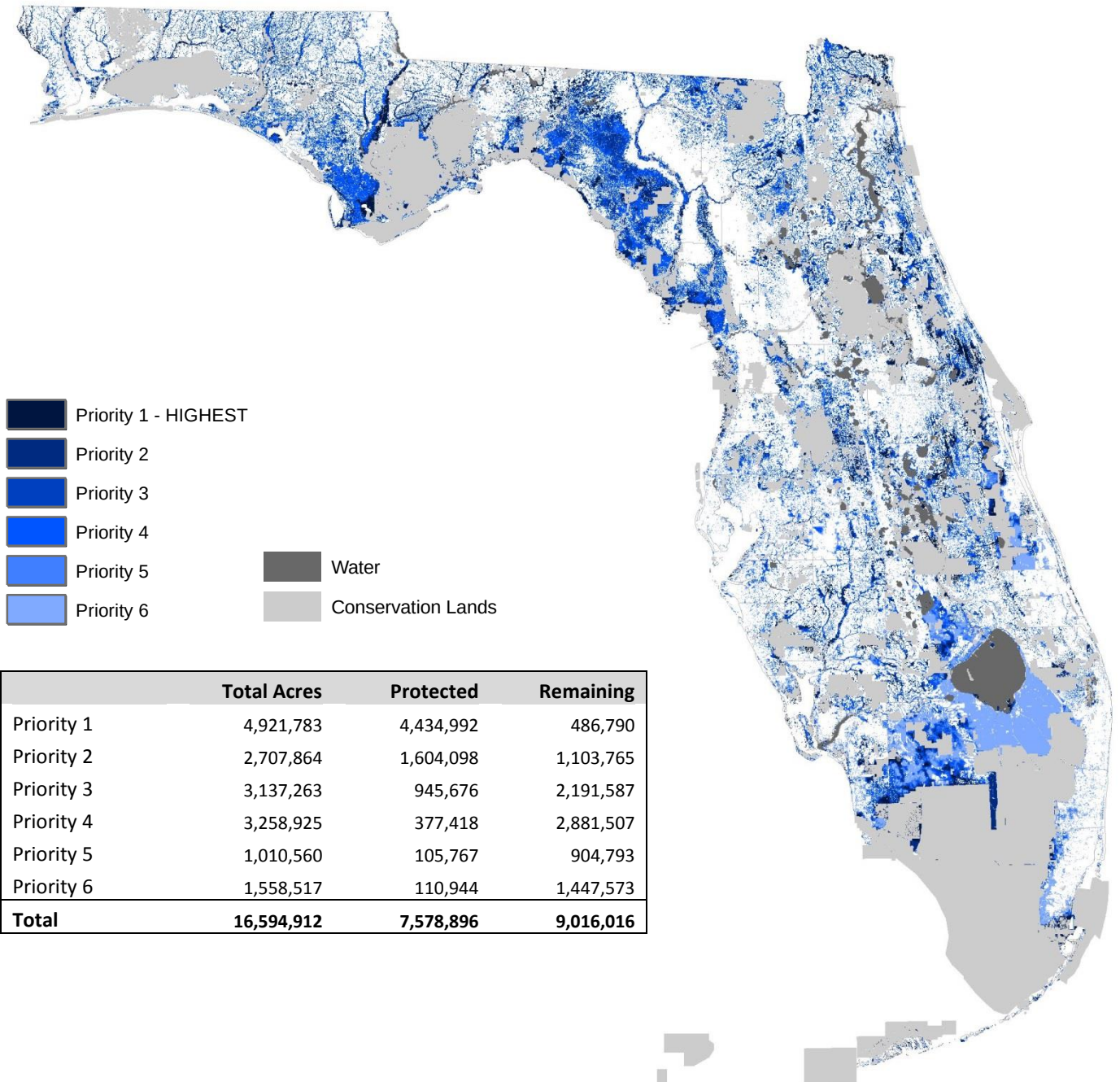
Primary Source: Florida Natural Areas Inventory in collaboration with water resource experts

Description: The surface water data identifies significant high quality surface waters of the state, which include the following: Outstanding Florida Waters, National Scenic Waters and National Estuaries, shellfish harvesting areas, seagrass beds, springs, water supply and waters important for imperiled fish. The data are prioritized based on proximity to a water body, stream order, downstream length, basin size and other factors. For more information see the Conservation Needs Assessment Technical Report: <http://www.fnai.org/FIForever.cfm>.

Wetlands/Floodplain

Wetlands/Floodplain

Combined Functional Wetlands and Natural Floodplain



November 2016

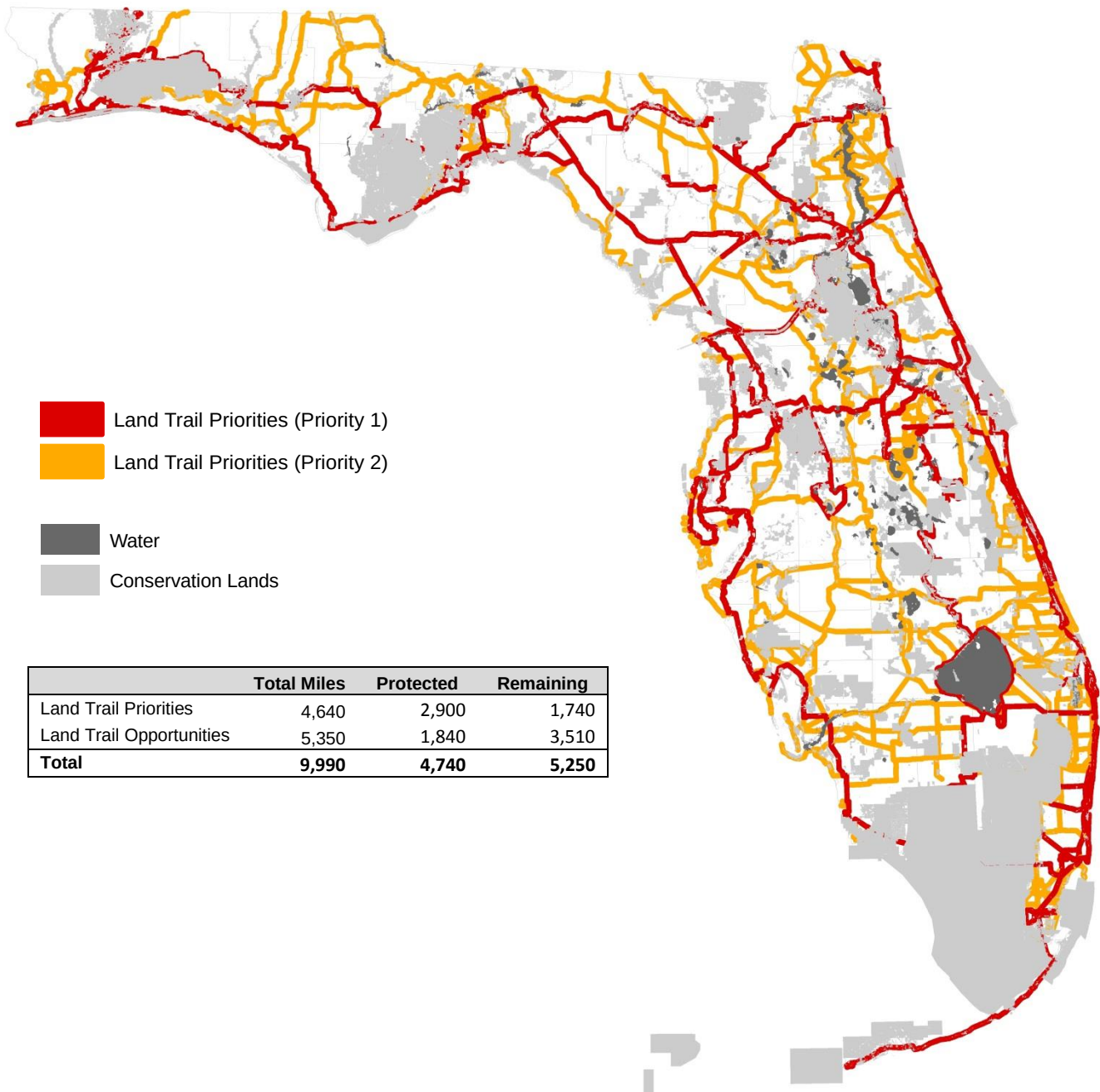
The information displayed on this map was developed or provided to address specific performance measures of the Florida Forever program. The data may not be *appropriate* for general use and are not intended for use in a regulatory decision making process.

Primary Source: FNAI

Description: The Wetlands/Floodplain data layer identifies lands that protect both functional wetlands and natural floodplain. Prioritization is based on overlap with Land Use Intensity index and FNAI Potential Natural Areas. Please refer to the Decision Support Data Documentation (<http://www.fnai.org/FIForever.cfm>) for more detailed explanation of how priority classes were assigned in the combination of the wetlands and floodplain layers.

Florida Forever Project Ranking Support Analyses – Appendix B

Recreational Trails

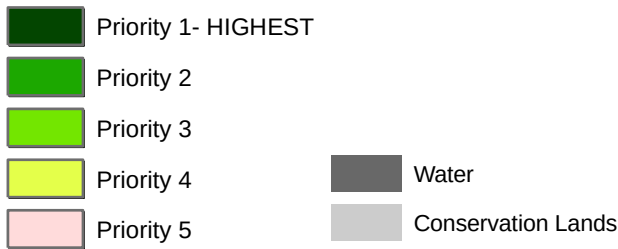
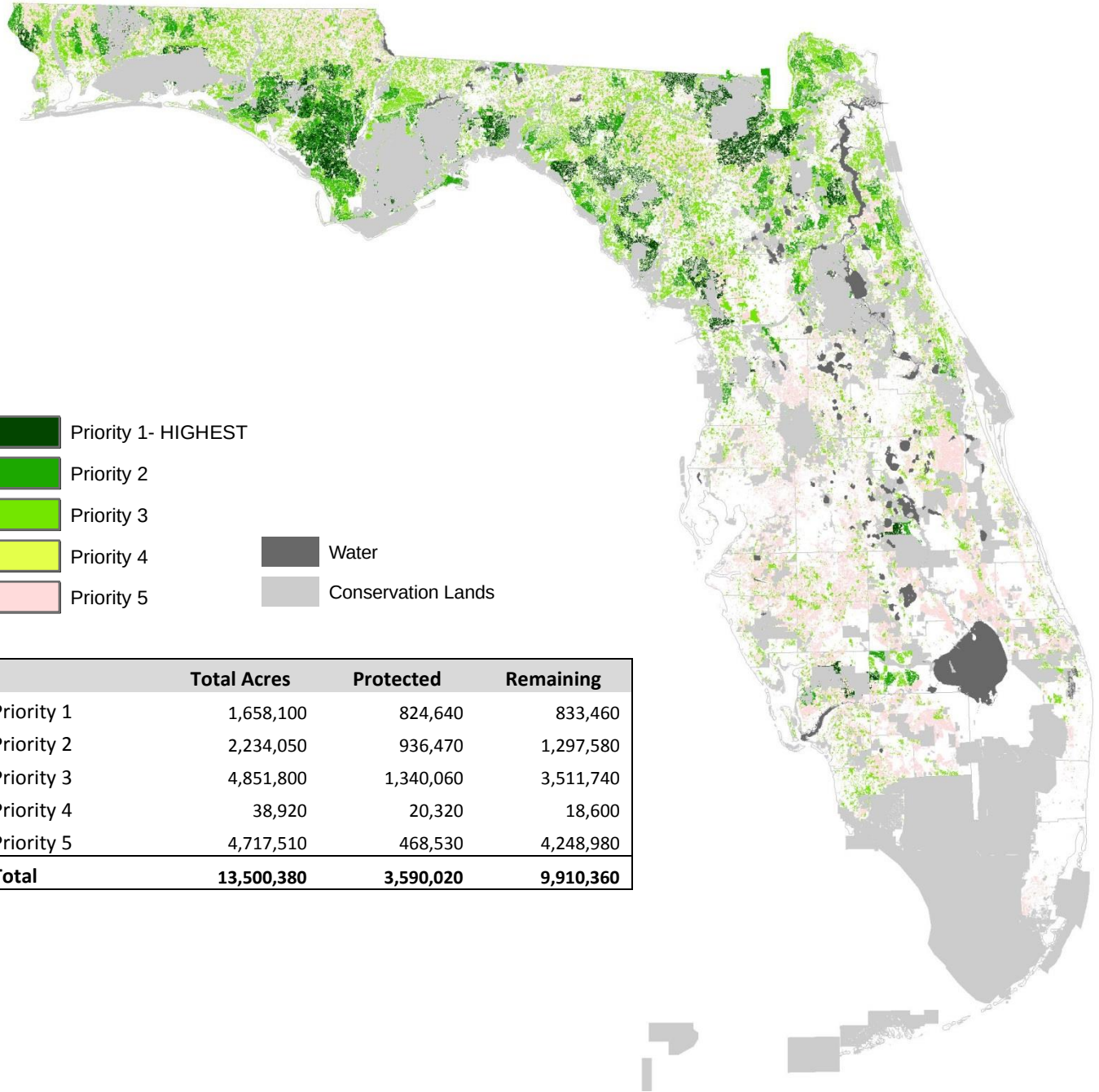


November 2016

The information displayed on this map was developed or provided to address specific performance measures of the Florida Forever program. The data may not be *appropriate* for general use and are not intended for use in a regulatory decision making process.

Primary Source: DEP/Office of Greenways and Trails

Description: The Recreational Trails data layer is based on land trail priorities and opportunities, including those for the Florida National Scenic Trail, identified in the Florida Greenways and Trails System Plan (2015 update). These trails are made up of existing, planned and conceptual non-motorized trails and paddling trails that form a connected set of linear recreational opportunities statewide. For more information: http://www.dep.state.fl.us/gwt/FGTS_Plan/default.htm.



	Total Acres	Protected	Remaining
Priority 1	1,658,100	824,640	833,460
Priority 2	2,234,050	936,470	1,297,580
Priority 3	4,851,800	1,340,060	3,511,740
Priority 4	38,920	20,320	18,600
Priority 5	4,717,510	468,530	4,248,980
Total	13,500,380	3,590,020	9,910,360

November 2016

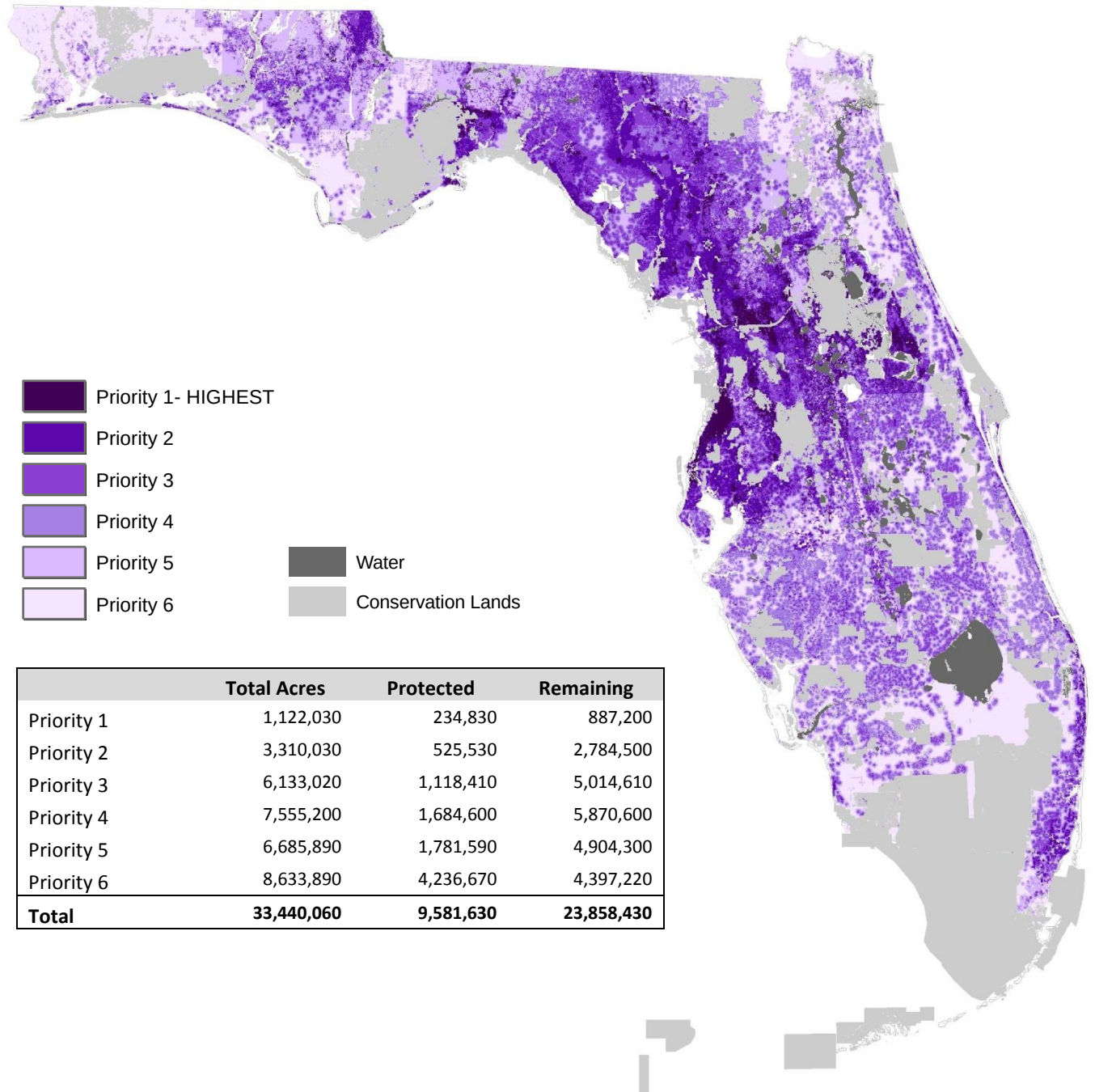
The information displayed on this map was developed or provided to address specific performance measures of the Florida Forever program. The data may not be *appropriate* for general use and are not intended for use in a regulatory decision making process.

Primary Source: Florida Forest Service; Florida Natural Areas Inventory

Description: The Sustainable Forestry data layer identifies existing pinelands (natural and planted) and former pinelands that are potentially available for forest management. Prioritization is based on 4 criteria set by the Florida Forest Service: whether trees are natural or planted, size of tract, distance to market, and hydrology. Large tracts of natural pine on mesic soils (versus very dry or wet) that are within 50 miles of a mill receive the highest priority. Former pinelands that currently do not have trees receive the lowest priority. For more information see the Conservation Needs Assessment Technical Report:

<http://www.fnai.org/FIForever.cfm>.

Groundwater Recharge



	Total Acres	Protected	Remaining
Priority 1	1,122,030	234,830	887,200
Priority 2	3,310,030	525,530	2,784,500
Priority 3	6,133,020	1,118,410	5,014,610
Priority 4	7,555,200	1,684,600	5,870,600
Priority 5	6,685,890	1,781,590	4,904,300
Priority 6	8,633,890	4,236,670	4,397,220
Total	33,440,060	9,581,630	23,858,430

November 2016

The information displayed on this map was developed or provided to address specific performance measures of the Florida Forever program. The data may not be *appropriate* for general use and are not intended for use in a regulatory decision making process.

Primary Source: Advanced Geospatial, Inc; Florida Natural Areas Inventory

Description: The ground water recharge data layer identifies areas of potential recharge important for natural systems and human use. The data are prioritized based on features that contribute to aquifer vulnerability such as swallets, thickness of the intermediate aquifer confining unit and closed topographical depressions, as well as areas within springshed protection zones and in proximity to public water supply wells. For more information see the Conservation Needs Assessment Technical Report: <http://www.fnai.org/FIForever.cfm>.

Appendix C.

F – TRAC

Florida Forever Tool for Efficient Resource Acquisition and Conservation

Model Documentation and Project Evaluation

Acknowledgments

All of the major decision points in this modeling process received consensus support from a working group of natural resource and conservation experts, who also provided guidance and important insights throughout. The original working group in 2001 – 2003 consisted of Greg Brock, Doria Gordon, Richard Hilsenbeck, Tom Hctor, Fran James, Randy Kautz, Duane Meeter, Reed Noss, David Stoms, Hilary Swain, and Jora Young. In October 2010 and November 2011 the group convened and provided recommendations for some revisions to the F-TRAC methodology. Participants in the 2010 meeting included Greg Brock, Doria Gordon, Hilary Swain, Randy Kautz, Tom Hctor, Robert Christianson, Gary Cochran, Mike Hallock-Solomon, Dennis Hardin, Jim Muller, Beth Stys, and Joe North. Greg Brock, Jim Muller, Randy Kautz, and Tom Hctor participated in the 2011 meeting.

This project was funded by a contract with the Florida Department of Environmental Protection, Division of State Lands.

INTRODUCTION

F-TRAC is an analysis conducted by the Florida Natural Areas Inventory (FNAI) for the Florida Forever environmental land acquisition program. It is based on a computer modeling approach to conservation reserve design known as Iterative Site Selection (ISS). The primary purpose for developing F-TRAC was to provide a concise analysis to evaluate current and potential land acquisition projects for the Florida Forever program. The model approach could be useful for other conservation planning efforts, but the results described here were developed specifically for the needs of Florida Forever, and are not likely to apply to other programs without substantial modifications.

F-TRAC considers six types of natural resource categories—species, communities, surface waters, wetlands, sustainable forestry, and aquifer recharge—and identifies a portfolio of sites that efficiently protects those resources. Efficiency is the key to the model; it approaches an optimal solution of the greatest resource protection in a given amount of land. Our analysis resulted in two scenarios: the 2020 Statewide Scenario, which identifies a portfolio of sites throughout the state; and the 2020 on Projects Scenario, which identifies a portfolio of sites only within existing and proposed Florida Forever Projects. Both Scenarios approximate the amount of land likely to be acquired through the twenty-year duration of the Florida Forever program. These scenarios are discussed in more detail below.

F-TRAC is the culmination of efforts by the Florida Natural Areas Inventory to provide scientific support for the Florida Forever program. This effort began with the Florida Forever Conservation Needs Assessment (G. Knight et al. 2000) first produced in December 2000, and since updated on a regular basis (FNAI 2016a). Reports detailing these efforts and other documents relating to the Florida Forever program are available on the FNAI website (www.fnai.org).

The Conservation Needs Assessment includes data layers for 14 natural resource categories corresponding to specific goals and measures established for Florida Forever by the Florida Forever Advisory Council. These goals and measures are closely based on suggested goals for the program set out by the Florida Legislature in the Florida Forever Act (§259.105, F.S.). The Needs Assessment data layers allow FNAI to report progress of the program in terms of ha of resources acquired, and provide a means of evaluating Florida Forever projects based on any single resource. We continue to evaluate projects in this manner using the Single Resource Evaluation (SRE) method (FNAI 2016b).

Despite the utility of the Single Resource Evaluation method, our analysis prior to F-TRAC lacked a method for evaluating a project's overall value for protecting all resources concerned. This can be viewed in terms of both a project's value relative to other projects on the Florida Forever list (needed for prioritizing projects for acquisition), and a project's value relative to the distribution of resources statewide (needed for establishing whether a potential project warrants addition to the list, or whether areas not yet proposed should be considered as projects). F-TRAC addresses both facets in a single evaluation that allows concise reporting and relatively transparent interpretation of results.

To guide our work through the modeling process, we formed a working group of natural resource and reserve design experts. The original group from 2001 – 2003 included 11 members with a broad range of experience from the following organizations: Florida Department of Environmental Protection, Florida State University, The Nature Conservancy, University of Florida, Florida Fish & Wildlife Conservation Commission, University of Central Florida, Archbold Biological Station, and University of California – Santa Barbara. The group reconvened in 2009 – 2011 and was expanded to include Florida Forestry Service, St. Johns River Water Management District (WMD), Northwest Florida WMD, and

experts in the private sector. The working group proved invaluable to the process, and offered critical input and feedback throughout. We were able to achieve expert consensus on virtually all facets of F-TRAC.

As with all models, F-TRAC should be interpreted with appropriate discretion. The results should not be considered a final evaluation of projects for acquisition, but a tool to inform decision-making. No model can fully capture all nuances of a problem. Nevertheless, models such as F-TRAC are powerful because they synthesize a large amount of information in an objective manner, allowing decision-makers to focus on the most critical points of evaluation.

ITERATIVE SITE SELECTION

Iterative Site Selection (ISS) refers to a family of computational algorithms that evaluate large numbers of potential combinations of sites to find a set, or portfolio, that protects the largest amount of resources for the least cost. The algorithms most commonly used are heuristic, meaning that they do not evaluate every possible combination of sites (which is generally not feasible given contemporary computing technology), but proceed through a subset of combinations most likely to include the optimal solution. Each iteration involves the evaluation of one possible portfolio of sites. Generally, if the current portfolio being considered scores “better” than the previous “best” portfolio considered, the current portfolio becomes the “best,” and is compared against others in each future iteration, until a better portfolio is found. Eventually a portfolio is found that cannot be improved upon, and is put forward in the model results as the best solution. Because the algorithms are heuristic, there is no guarantee that the solution found is the optimal solution (best among all possible combinations of sites), but by refining the model parameters through successive runs, users can be confident that the solution offered approaches the optimal solution closely enough for practical purposes.

The software we used to run ISS is known as Marxan, and was developed by Ian Ball and Hugh Possingham at the University of Queensland in Australia (Ball et al. 2009, Ball 2000, Ball and Possingham 2000). Marxan and its predecessor Spexan (also known as Sites, an ArcView user interface for Spexan, Andelman et al. 1999) have been used in many conservation planning studies (e.g. Ardron et al. 2002, Kelley et al. 2002, Leslie et al. 2002, Noss et al. 2002). Marxan offers a number of heuristic algorithms, the most commonly used being Simulated Annealing (Kirkpatrick et al. 1983). Simulated annealing is generally recognized to be the most effective algorithm available for ISS, and is the algorithm we used for all modeling in F-TRAC.

The central equation used to evaluate site portfolios in Marxan is known as the Objective Function. Simply put, the Objective Function is as follows:

$$\text{Score} = \text{Portfolio Cost} + \text{Resource Shortfall Penalty}$$

Score is a unit-less value that the algorithm attempts to minimize. Portfolio Cost is the cost of the selected portfolio in terms of either area (e.g. ha, acres) or dollars. Resource Shortfall Penalty is a penalty received for not meeting conservation targets for resources. Targets are an important element of the model that will be discussed further below. Additional operands can be added to the basic function, such as a cost threshold penalty (penalty for exceeding a set portfolio budget), a boundary modifier (for clustering sites within the portfolio), etc. Basically, as more sites are added to the portfolio, cost increases while shortfall penalty decreases. The optimal portfolio will contain the most resource features for the least cost.

F-TRAC MODEL INPUTS

Although a variety of parameters can be adjusted in the model, there are six main inputs essential to the process: planning units, conservation features, targets, weights, minimum area threshold, and cost threshold.

Planning Units

An essential feature of ISS modeling is the use of discrete sites, or planning units. These can take a variety of forms, and previous studies have used everything from grids to hexagons to watersheds. The only requirements are that the planning units are mutually exclusive, they have definable area or monetary cost, and that the distribution of resources across planning units is known.

We used hexagons as planning units because we found that the model works better if planning units are of uniform size and shape. From May 2003 – May 2010 we used the smallest hexagons possible given that Marxan version 1.8.7 software does not function correctly with more than approximately 65,000 planning units. For the 2020 Statewide Scenario, which operates on planning units covering the state of Florida, we used hexagons of 220 ha resulting in more than 68,000 planning units. For the 2020 on Projects Scenario, which operates only within the boundaries of unacquired Florida Forever projects, hexagons were 20 ha resulting in ca. 40,000 planning units. The latest version of Marxan (version 2.4.3) does not have the same limitation on number of planning units and in November 2010 we began using 100 ha hexagons for both Statewide (ca. 125,000 planning units) and on Projects (ca. 11,000 planning units) Scenarios so that these two analyses would be more consistent with each other.

An important exception to the regular hexagons was our use of actual boundaries for existing managed areas and Florida Forever projects in the 2020 Statewide Scenario. Contiguous managed areas were dissolved into a single planning unit that was locked into the model portfolio (since they are already protected lands). Managed area boundaries were from the FNAI Florida Managed Areas database as of October 2016.

Using precise managed areas boundaries, together with an irregular coastline, left many of our statewide hexagons in incomplete segments, some of which were tiny slivers. To correct for this, we selected all polygons outside of the managed area units that were smaller than 50 ha, or half the size of the standard planning unit. These small polygons were then dissolved into the smallest adjacent planning unit. The result was that for all planning units outside of managed areas and projects, planning unit size ranges from 50 – 150 ha (with the exception of small isolated planning units, such as outparcels within managed area boundaries, which could not be dissolved into adjacent polygons). As a final detail, any isolated managed areas smaller than 0.5 ha were dissolved into the surrounding hexagon unit and considered unprotected. Likewise, any isolated outparcels smaller than 0.5 ha surrounded by managed areas were dissolved into the surrounding managed area and considered protected. Figure 1 shows a subset of statewide planning units in Northeast Florida, illustrating the standard hexagon units as well as the irregular managed area units.

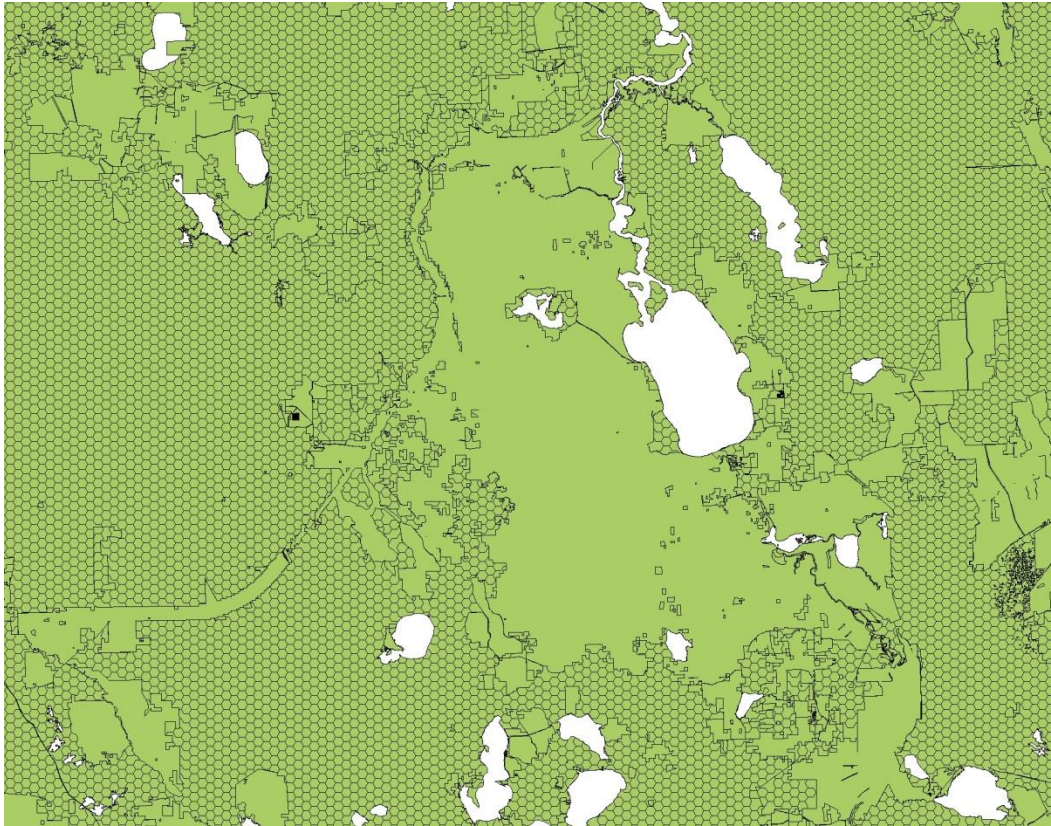


Figure 1. Example of planning units used in the 2020 Statewide Scenario.

All of these manipulations were done to keep planning unit size as uniform as possible, simplify planning unit boundaries, and reduce the total number of planning units. Number of planning units is a significant factor because it is directly related to model running time. Finally, because there is not sufficient statewide land value data for Florida, we used area as our planning unit cost.

Planning Unit Status

Each planning unit is assigned a status that determines how it is evaluated in the final portfolio. Most units are assigned a status of “0” meaning they receive full evaluation in the iterative process and may or may not be selected for a portfolio. Units may also be ‘locked in’ or ‘locked out’ of the final portfolio. Prior to November 2010, managed areas were ‘locked out’ of the on Projects Scenario so that the amount of each conservation feature (i.e resource) that was already protected was not factored into the final portfolio selection. In October 2010, FNAI and the expert working group recognized that the on Projects portfolio should represent areas that most efficiently protect target resources *in addition* to what is already protected. Therefore, beginning in November 2010, the status of managed areas was ‘locked in’ for both Statewide and on Projects scenarios, so that remaining planning units were evaluated in light of the amount of resources already protected. Tribal lands were ‘locked out’ of both Statewide and on Projects scenarios.

Conservation Features

Conservation features are the actual natural resources to be considered in the model. Often they are individual species and natural community occurrences or habitats. If occurrences are used, all planning units having an occurrence of a given species or community will score a 1 for that resource, while other

planning units will score 0. If habitat area is used, planning units are scored in terms of acres or ha of habitat on the planning unit.

For F-TRAC, we were faced with a very different set of conservation features. Rather than individual species or community models, we needed to use the existing Florida Forever Ranking Support Analyses Data Layers derived from the Conservation Needs Assessment data (FNAI 2016a). These data layers were required for two reasons. First, we needed to be able to report model results in terms of the standard data layers being used for all other Florida Forever analysis and reporting. Second, breaking the resource data layers down into individual species habitat models (of which there are about 300) and other individual resource types would have created an impractical number of conservation features (like planning units, the number of conservation features directly influences model running time). As a result, our conservation features represent priority classes of seven different resource types: species, communities, surface waters, wetlands, sustainable forestry, aquifer recharge, and ecological greenways. We did divide the natural community priorities into individual communities, so that we could set targets for each community separately. Several Decision Support Data Layers were further prioritized for input into F-TRAC, including Species, Natural Communities, and Ecological Greenways (described in the Florida Forever Project Ranking Support Analyses Documentation, FNAI 2016b). Table 1 shows these resources broken down into their respective conservation features.

Not all of the Florida Forever Ranking Support Data Layers were included in F-TRAC. Archaeological and Historical Sites, and Recreational Trails did not fit well with the ISS/Marxan modeling environment for various reasons. Cultural sites were not included because cultural resource experts have not identified a method for prioritizing these sites in a quantifiable manner. Recreational Trails were omitted because they are linear rather than area features, and also depend on feature connectivity. All of these resources are still used to evaluate Florida Forever projects using the Single Resource Evaluation method (FNAI 2016b).

Targets

Marxan requires that a target be set for each conservation feature in the model. The target is necessary so that the Resource Shortfall Penalty can be calculated. For each conservation feature, the shortfall penalty is based on the difference between the target for that feature and the actual amount of the feature held in the current portfolio. The penalty is at its maximum if none of the resource is held in the portfolio. If the portfolio includes at least as much of the resource as specified in the target, the shortfall penalty is zero.

Targets for the resources used in F-TRAC were set with consensus of our expert work group, and are shown in Table 1. These are working targets set by informed expert opinion. They are not acquisition targets, and were not set with the acquisition scope of Florida Forever in mind. Rather, the experts considered an ideal conservation scenario for Florida. The targets are set higher for higher priority resources, as these represent the rarest and most sensitive and/or highest quality resources that will likely require managed area protection in order to persist. Also, the targets were not set with current protection status in mind. Some lower priority resources already have more area protected than prescribed by the target (pine flatwoods, surface waters 5 - 6, wetland/floodplain 6, forestry 4, recharge 3 – 6). To keep those conservation features as factors in the model, we added an additional 5 percent of the original target ha for those resources to the final target used in the model (as shown in the Target Ha column).

Table 1. Conservation Features, Targets, and Weights Used in F-TRAC in November 2016

Conservation Feature	Total ha	Protected ha	% Protected	Target (% Total ha)	Target (unprotected ha only)	Target (incl. protected)	2020 Weight
species 1 Wide-ranging	119,646	63,782	53%	50%	2,991	66,773	49
species 2 Wide-ranging	42,924	19,535	46%	50%	1,927	21,462	25
species 3 Wide-ranging	2,477,878	1,338,915	54%	40%	49,558	1,388,472	9
species 4 Wide-ranging	1,590,152	220,872	14%	25%	176,666	397,538	1
species 5 Wide-ranging	1,041,585	77,532	7%	13%	52,666	130,198	0.5
species 6 Wide-ranging	885,171	60,964	7%	10%	27,554	88,517	0.25
species 1 Standard	803,036	523,160	65%	98%	263,815	786,976	100
species 2 Standard	586,013	478,313	82%	98%	95,980	574,293	64
species 3 Standard	1,346,371	1,020,337	76%	80%	56,759	1,077,097	36
species 4 Standard	654,965	387,988	59%	50%	16,374	404,362	16
species 5 Standard	49,144	4,244	9%	25%	8,042	12,286	9
species 6 Standard	32,569	5,822	18%	10%	163	5,985	4
upland glade- Very High	15	1	8%	98%	14	15	100
pine rockland- Very High	6,815	6,493	95%	98%	186	6,679	100
pine rockland- High	4	3	82%	75%	0	3	56
scrub- Very High	186,956	142,078	76%	95%	35,530	177,608	81
scrub- High	9,222	1,578	17%	75%	5,339	6,917	42
scrub- Moderate	1,959	304	16%	50%	675	979	25
rockland hammock-k Very High	7,185	6,295	88%	95%	531	6,825	81
rockland hammock- High	306	153	50%	75%	77	230	42
rockland hammock- Moderate	104	89	86%	50%	3	92	25
dry prairie- Very High	59,663	40,413	68%	95%	16,267	56,680	81
dry prairie- High	3,126	594	19%	75%	1,751	2,345	42
dry prairie- Moderate	29	11	38%	50%	3	15	25
seepage slope- Very High	2,519	2,510	100%	95%	120	2,630	81
coastal lakes- Very High	571	212	37%	80%	245	457	36
coastal lakes- High	38	0	0%	67%	25	25	20
coastal uplands- Very High	21,944	18,540	84%	80%	878	19,418	36
coastal uplands- High	963	394	41%	67%	252	645	20
coastal uplands- Moderate	18	6	36%	40%	1	7	9
sandhill- Very High	276,383	188,128	68%	95%	74,436	262,564	36
sandhill- High	33,107	6,982	21%	75%	17,849	24,830	20
sandhill- Moderate	3,368	573	17%	50%	1,111	1,684	9
sandhill lake- Very High	19,766	5,460	28%	95%	13,318	18,778	36
sandhill lake- High	4,878	85	2%	75%	3,573	3,659	20
sandhill lake- Moderate	794	7	1%	50%	390	397	9
upland pine- Very High	65,600	60,813	93%	95%	1,507	62,320	36
upland pine- High	2,132	1,100	52%	75%	499	1,599	20

upland pine- Moderate	352	61	17%	50%	115	176	9
pine flatwoods- Very High	806,748	478,444	59%	50%	20,169	498,613	16
pine flatwoods- High	117,854	16,705	14%	33%	22,187	38,892	12
pine flatwoods- Moderate	21,578	1,704	8%	25%	3,691	5,395	4
upland hardwood- Very High	51,653	15,595	30%	25%	646	16,241	16
upland hardwood- High	37,562	909	2%	15%	4,725	5,634	12
upland hardwood- Moderate	4,056	172	4%	10%	234	406	4
surface waters 1	1,143,460	643,030	56%	90%	386,083	1,029,114	81
surface waters 2	2,221,422	1,579,779	71%	70%	77,750	1,657,529	64
surface waters 3	762,098	198,491	26%	50%	182,558	381,049	49
surface waters 4	3,475,932	1,187,832	34%	30%	52,139	1,239,971	25
surface waters 5	1,574,980	183,810	12%	10%	7,875	191,685	9
surface waters 6	2,315,921	315,408	14%	5%	5,790	321,198	1
surface waters 7	904,801	42,303	5%	5%	2,937	45,240	0.25
wetlands/floodplain 1	1,990,542	1,794,805	90%	90%	89,574	1,884,380	81
wetlands/floodplain 2	1,086,310	649,097	60%	70%	111,320	760,417	49
wetlands/floodplain 3	1,265,480	382,655	30%	50%	250,085	632,740	25
wetlands/floodplain 4	1,315,625	152,688	12%	30%	242,000	394,687	9
wetlands/floodplain 5	408,162	42,776	10%	10%	2,041	44,817	1
wetlands/floodplain 6	630,375	44,888	7%	5%	1,576	46,464	0.25
forestry 1	671,009	333,694	50%	60%	68,911	402,605	81
forestry 2	897,614	378,745	42%	55%	114,943	493,688	49
forestry 3	1,951,297	541,472	28%	35%	141,482	682,954	25
forestry 4	15,748	8,212	52%	15%	118	8,330	9
forestry 5	1,908,815	189,340	10%	10%	1,541	190,882	0.25
recharge 1	453,008	94,835	21%	50%	131,669	226,504	49
recharge 2	1,336,073	212,486	16%	25%	121,532	334,018	25
recharge 3	2,475,007	452,253	18%	10%	12,375	464,628	9
recharge 4	3,049,090	681,126	22%	5%	7,623	688,749	4
recharge 5	2,694,064	720,251	27%	3%	4,041	724,293	1
recharge 6	3,479,551	1,714,239	49%	1%	1,740	1,715,979	0.25
greenways critical linkage 1	223,004	2,366	1%	80%	176,037	178,404	49
greenways critical linkage 2	283,028	1,585	1%	60%	168,231	169,817	25
greenways critical linkage 3	296,062	1,247	0%	40%	117,178	118,425	9
greenways critical linkage 4	276,693	1,022	0%	20%	54,317	55,339	1
greenways critical linkage 5	197,653	511	0%	10%	19,255	19,765	0.5
greenways critical linkage 6	140,257	228	0%	5%	6,785	7,013	0.25

Weights

Whereas targets tell the model how much of a resource to search for in assembling a portfolio, weights tell the model how hard to search for that resource compared to other conservation features. In model terms, the weight acts as a multiplier on the shortfall between a conservation feature's target and amount held in a portfolio. The higher the weight, the greater the penalty for not meeting the target.

Weights are most important when model parameters are set so that not all targets can be met. In such a case weights prioritize which conservation features will come closest to meeting their targets.

As with targets, the weights used in F-TRAC, shown in Table 1, were set with the consensus of our expert workgroup. The weights used were originally based on weights developed for the Single Resource Evaluation, with adjustments made to fit the modeling environment. The weights began as a 10-point scale, but these were squared in order to calibrate them to the model. In general, weights were set based on resource priority (higher priority, higher weight) and the characteristics of each resource class.

Minimum Area

With some resource types it is desirable to establish a minimum area threshold; that is, to get credit for protecting the resource the project must contain a minimum number of acres of that resource.

Minimum area is not a required model input. Although Marxan is set up to handle minimum area thresholds, we were unable to get this function to work properly in an early version of the software. Instead we manually adjusted the amount of resource per hexagon in the conservation feature input files. If the minimum area threshold was not met for the entire Florida Forever project (including areas already acquired plus remaining areas in the project), all hexagons that occurred within the remaining area of that project were assigned a zero value for that resource. These adjustments were made prior to running both the 2020 Statewide and On Projects scenarios. The minimum area thresholds are shown in Table 2.

Table 2. Minimum area thresholds applied in F-TRAC scenarios.

Conservation Feature	Minimum Area (acres)
pine flatwoods	50
watershed 1	500
watershed 2	500
watershed 3	1000
watershed 4	1000
watershed 5	1000
watershed 6	1000
watershed 7	1000
forestry 1	500
forestry 2	1000
forestry 3	1000
forestry 4	1000
forestry 5	1000

Cost Threshold

Cost Threshold is not a required model input, but is needed if the model scenario is to be based on a limited budget or land area. The cost threshold takes the form of a penalty added to the objective function (increasing the portfolio score) if the portfolio exceeds the threshold. For the 2020 scenarios, the aim was to set a cost threshold so that the final portfolio would equal the amount of land likely to be acquired through the Florida Forever program. Prior to 2016 we used estimates based on projections from the Florida Department of Environmental Protection that approximately 824,600 acres could be acquired on Florida Forever Board of Trustees (FFBOT) projects from July 2008-2021 assuming full

Florida Forever funding throughout that time. Of that total, 379,800 acres have been acquired (July 2001 – Sep 2016), leaving an estimated acreage of 444,800 acres that could potentially be acquired during the remaining legislative authorization of the program (through FY 2010-21). Due to uncertainties of this estimate, in 2016 we used a threshold of 500,000 acres as the amount of land to be identified by the current F-TRAC 2020 scenarios.

MODEL RESULTS

In the course of model development we ran dozens of scenarios to determine the effect of different parameter settings. Some scenarios were designed to test model sensitivity and optimize the model result, while others focused on alternative conservation scenarios. One of the more important sensitivity tests was conducted to determine the effect of increasing the number of iterations in each model run. Typical uses of Marxan set the number of iterations to 1 million for cases of around 10,000-15,000 planning units (D. Stoms, personal communication), while the largest study we found used 10 million iterations for a case involving 32,000 planning units (Ardron et al., 2002, J. Ardron, personal communication). We ran several tests to determine the appropriate number of iterations for a case of 44,000 planning units. Figure 2 shows the results of our tests.

These results indicate that the model score could be substantially reduced by increasing the number of iterations beyond 10 million. The results show diminishing returns with increasing iterations, and due to the amount of time required to run the model we chose 1 billion iterations as our final setting. These tests also showed that increasing the number of model runs (with the same number of iterations) has much less effect on the final score than increasing iterations (with the same number of runs). We plan to conduct additional sensitivity tests with the current set of 120,000 planning units.

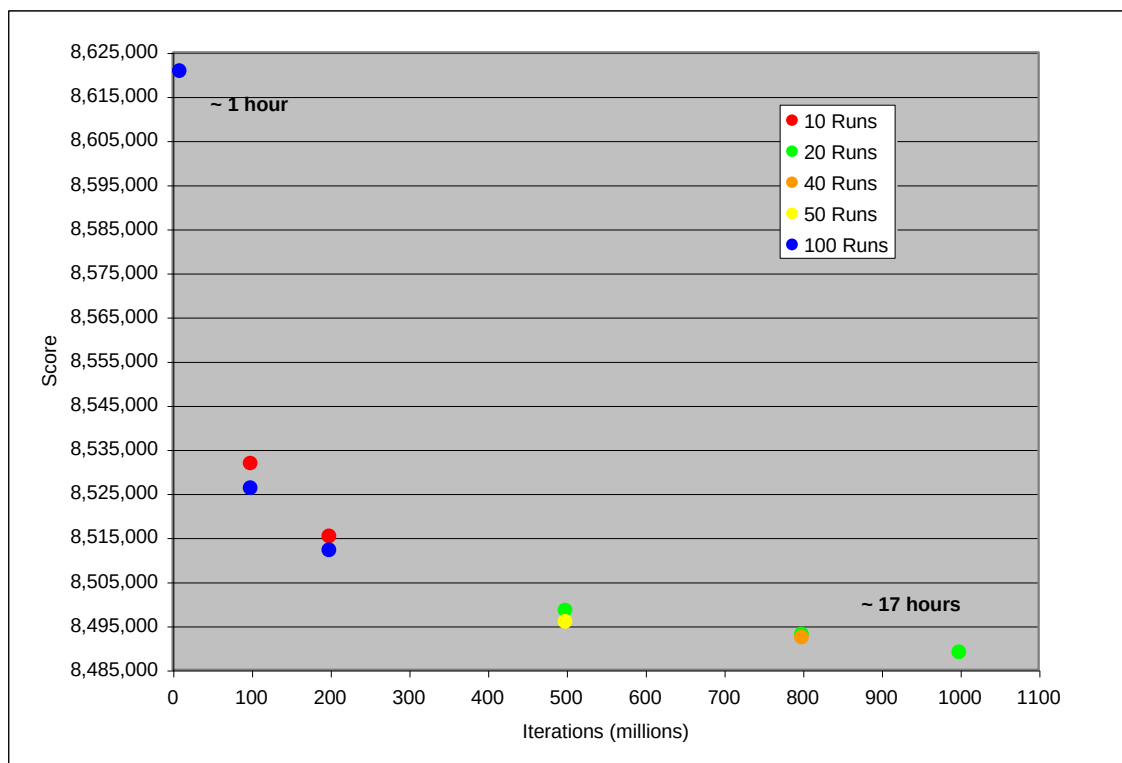


Figure 2. Effect of iterations vs. runs on model results

2020 Statewide Scenario

As noted above, the purpose of the 2020 Statewide scenario was to identify a portfolio of lands statewide with a total area limited to the amount of land expected to be acquired on Florida Forever BOT projects through the 20-year duration of the program. Table 3 lists the amount of each conservation feature included in the portfolio. With conservation lands excluded, the portfolio consists of 202,329 ha which approximates the cost threshold described above.

Not all targets could be achieved in the 2020 Scenario, but many targets were exceeded. These “surplus” ha were due to overlap between these resources and other resources whose targets the model was still trying to achieve. Also note that lower priority resources tended to come closer to meeting their targets. This is due to the fact that lower priorities generally had lower targets to begin with.

2020 On Projects Scenario

The purpose of the 2020 On Projects scenario was to identify a portfolio of lands within the unacquired portions of Florida Forever BOT projects with a total area limited to the amount of land expected to be acquired on Florida Forever BOT projects through the 20-year duration of the program. Table 3 lists the amount of each conservation feature included in the portfolio.

Table 3. Resources included in the 2020 Statewide and On Projects Scenarios in November 2016

	2020 Statewide Portfolio					2020 On Projects Portfolio			
Conservation Feature	Total Resource Ha Statewide	Ha in Portfolio (includes protected)	Percent of Total Resource	Percent of Target		Total Resource Ha On Projects	Ha in Portfolio (excludes protected)	Percent of Resource On Projects that is in Portfolio	Percent of Target
species 1 Wide-ranging	119,646	66,773	56%	100%		15,499	4,022	26%	102%
species 2 Wide-ranging	42,924	21,509	50%	100%		9,532	5,138	54%	115%
species 3 Wide-ranging	2,477,878	1,362,944	55%	98%		280,974	71,221	25%	102%
species 4 Wide-ranging	1,590,152	234,608	15%	59%		168,383	29,235	17%	63%
species 5 Wide-ranging	1,041,585	92,729	9%	71%		95,293	14,130	15%	70%
species 6 Wide-ranging	885,171	74,419	8%	84%		51,872	6,953	13%	77%
species 1 Standard	803,036	542,277	68%	69%		44,762	19,701	44%	69%
species 2 Standard	586,013	485,247	83%	84%		19,973	10,476	52%	85%
species 3 Standard	1,346,371	1,037,231	77%	96%		57,148	20,266	35%	97%
species 4 Standard	654,965	397,556	61%	98%		31,389	7,683	24%	98%
species 5 Standard	49,144	8,636	18%	70%		2,071	1,493	72%	47%
species 6 Standard	32,569	6,579	20%	110%		2,414	722	30%	109%
upland glade Very High	15	15	100%	102%		7	7	100%	55%
pine rockland Very High	6,815	6,679	98%	100%		90	90	100%	99%
pine rockland High	4	3	82%	97%		0	0	78%	96%
scrub- Very High	186,956	150,321	80%	85%		9,177	5,568	61%	83%
scrub- High	9,222	6,812	74%	98%		493	490	99%	30%
scrub- Moderate	1,959	979	50%	100%		18	18	100%	33%
rockland hammock Very High	7,185	6,825	95%	100%		467	467	100%	99%
rockland hammock High	306	230	75%	100%		38	38	100%	83%
rockland hammock Moderate	104	92	88%	100%		0	0	0%	97%
dry prairie Very High	59,663	56,374	94%	99%		11,939	11,589	97%	92%
dry prairie High	3,126	2,345	75%	100%		621	618	99%	52%
dry prairie Moderate	29	26	90%	180%		0	0	0%	76%
seepage slope Very High	2,519	2,512	100%	96%		0	0	0%	95%
coastal lakes Very High	571	457	80%	100%		0	0	101%	46%
coastal lakes High	38	26	70%	104%		0	0	0%	0%
coastal uplands Very High	21,944	19,418	88%	100%		367	336	92%	97%
coastal uplands High	963	645	67%	100%		3	3	100%	61%
coastal uplands Moderate	18	8	43%	108%		0	0	0%	89%
sandhill Very High	276,383	194,213	70%	74%		10,489	7,010	67%	74%
sandhill High	33,107	13,266	40%	53%		212	159	75%	29%
sandhill Moderate	3,368	1,684	50%	100%		3	3	100%	34%
sandhill lake Very High	19,766	14,436	73%	77%		687	675	98%	33%
sandhill lake High	4,878	3,656	75%	100%		7	7	100%	3%
sandhill lake Moderate	794	397	50%	100%		0	0	0%	2%
upland pine Very High	65,600	61,744	94%	99%		327	203	62%	98%
upland pine High	2,132	1,599	75%	100%		1	0	71%	69%
upland pine Moderate	352	176	50%	100%		0	0	0%	35%
pine flatwoods Very High	806,748	484,249	60%	97%		81,699	21,285	26%	100%
pine flatwoods High	117,854	18,974	16%	49%		7,503	2,135	28%	48%
pine flatwoods Moderate	21,578	2,327	11%	43%		98	13	13%	32%
upland hardwood Very High	51,653	16,243	31%	100%		2,378	651	27%	100%
upland hardwood High	37,562	5,634	15%	100%		173	127	73%	18%
upland hardwood Moderate	4,056	407	10%	100%		1	1	100%	43%
surface waters 1	1,143,460	652,616	57%	63%		76,598	16,564	22%	64%
surface waters 2	2,221,422	1,597,468	72%	96%		87,723	24,884	28%	97%
surface waters 3	762,098	205,311	27%	54%		48,940	11,546	24%	55%
surface waters 4	3,475,932	1,245,768	36%	100%		301,982	81,029	27%	102%
surface waters 5	1,574,980	200,778	13%	105%		117,232	18,816	16%	106%
surface waters 6	2,315,921	352,382	15%	110%		165,319	32,901	20%	108%
surface waters 7	904,801	62,544	7%	138%		55,973	9,268	17%	114%
wetlands 1	1,990,542	1,803,994	91%	96%		58,072	16,270	28%	96%
wetlands 2	1,086,310	661,863	61%	87%		96,683	27,576	29%	89%

wetlands 3	1,265,480	396,111	31%	63%		155,456	34,791	22%	66%
wetlands 4	1,315,625	166,762	13%	42%		144,547	27,933	19%	46%
wetlands 5	408,162	48,645	12%	109%		28,852	5,526	19%	108%
wetlands 6	630,375	48,805	8%	105%		10,700	1,002	9%	99%
forestry 1	671,009	340,663	51%	85%		72,666	24,615	34%	89%
forestry 2	897,614	387,763	43%	79%		98,380	15,479	16%	80%
forestry 3	1,951,297	563,732	29%	83%		169,177	31,899	19%	84%
forestry 4	15,748	8,489	54%	102%		2,336	670	29%	107%
forestry 5	1,908,815	207,312	11%	109%		113,234	22,597	20%	111%
recharge 1	453,008	125,850	28%	56%		17,340	9,935	57%	46%
recharge 2	1,336,073	247,159	18%	74%		45,805	12,352	27%	67%
recharge 3	2,475,007	492,366	20%	106%		145,954	31,785	22%	104%
recharge 4	3,049,090	726,330	24%	105%		226,485	62,279	27%	108%
recharge 5	2,694,064	746,705	28%	103%		194,978	46,142	24%	106%
recharge 6	3,479,551	1,730,185	50%	101%		205,307	29,002	14%	102%
greenways critical linkage 1	223,004	34,338	15%	19%		89,155	85,406	96%	49%
greenways critical linkage 2	283,028	18,297	6%	11%		104,788	56,994	54%	34%
greenways critical linkage 3	296,062	9,422	3%	8%		87,418	14,249	16%	13%
greenways critical linkage 4	276,693	4,410	2%	8%		74,562	4,267	6%	10%
greenways critical linkage 5	197,653	2,654	1%	13%		45,931	2,024	4%	13%
greenways critical linkage 6	140,257	1,261	1%	18%		25,565	1,157	5%	20%

EVALUATING FLORIDA FOREVER PROJECTS

The main purpose of the F-TRAC analysis is to provide a comprehensive means of evaluating current and potential Florida Forever projects across several resource types. The 2020 Statewide scenario provides a picture of what the program could achieve under optimal conditions. We recognize that the achievements of the statewide scenario may not translate into realistic goals for the Florida Forever program. Not all landowners falling within the statewide portfolio will be willing sellers, for example, and of course not all natural resources were included in the model. But the scenario is a reasonable (and challenging) benchmark by which to compare actual program accomplishments.

The 2020 On Projects scenario evaluates planning units only within existing and proposed Florida Forever projects (remaining ha only) for the best places to acquire resources. An evaluation of projects based on this scenario provides a means of comparing projects relative to one another but does not provide a statewide context.

Because Iterative Site Selection works through random sets of planning units to assemble a portfolio that approaches an optimal collection of resources, each model run will achieve slightly different results. The standard procedure therefore is to include multiple runs for each scenario (as discussed in the documentation below). Marxan also provides a “summed solutions” result, tabulating how many times each planning unit was included in the best portfolio for each run. This statistic has been used by other modelers as a measure of “irreplaceability” of planning units (Ardron et al. 2002; Noss et al. 2002), and is considered to be more robust than using the single best portfolio from one run.

Our final 2020 Scenarios included 50 runs of 1 billion iterations each. We grouped the planning units into six classes based on the number of runs in which they were included in each portfolio. Table 4 provides details of how planning units were grouped. To evaluate Florida Forever projects, we treated the six planning unit classes the same as priority classes of one of our original Ranking Support Analyses Data Layers, and scored the projects using the “weighted score” method (described in FNAI 2016b). Weights are shown in Table 4.

Table 4. How planning units in 2020 Scenarios were classed and weighted for project evaluation.

Summed Solutions Class	Number of Runs	Project Scoring Weight
Class 1	50	10
Class 2	40-49	8
Class 3	30-39	6
Class 4	20-29	4
Class 5	10-19	2
Class 6	1-9	1

Finally, the projects were broken into five groups for concise scoring on the Florida Forever Project Comparative Analysis. The breaks differed for the Statewide versus On Projects evaluation. Because the statewide portfolio planning units were not limited to Florida Forever project boundaries the scores overall were much lower than with the On Projects portfolio. Because the On Projects F-TRAC is intended to evaluate projects relative to each other we set the breaks based a comparison of the cost threshold to the total acres on the list. The 2016 cost threshold of 500,000 acres was 24% of the total remaining acres of projects in 2016; thus we expect an ‘average’ or medium ranked project to score at least 2.4. The breaks for the On Projects evaluation were set based on this rationale. The project groups

as determined by scoring breaks for each scenario are shown in Table 5. Table 6 shows the final scoring and group of Florida Forever projects Florida Forever projects for the November 2016 evaluation.

Table 5. Project group based on scoring breaks for Statewide and On Projects Scenarios

Project Group	Scoring Breaks for Statewide Scenario	Scoring Breaks for On Projects Scenario
Very High	≥2.50	≥7.20
High	1.00-2.49	4.80-7.19
Medium	0.20-0.99	2.40-4.79
Medium-Low	0.01-0.19	0.01-2.39
Low to None	0	0

Table 6. Project scores and final grouping for Florida Forever Evaluation Summary Table, November 2016

Project	2020 Statewide Scenario		2020 on Projects Scenario	
	Score	Final Grouping	Score	Final Grouping
Adams Ranch	3.816	VH	7.459	VH
Annutteliga Hammock	2.253	H	3.852	M
Apalachicola River	1.482	H	2.130	ML
Arbuckle Creek Watershed	0.000	L	0.000	L
Archie Carr Sea Turtle Refuge	6.679	VH	7.442	VH
Atlantic Ridge Ecosystem	0.037	ML	0.037	ML
Ayavalla Plantation	0.000	L	0.540	ML
Baldwin Bay/St. Marys River	0.000	L	0.000	L
Battle of Wahoo Swamp	0.000	L	0.000	L
Bear Creek Forest	0.069	ML	1.183	ML
Bear Hammock	0.000	L	3.994	M
Belle Meade	0.660	M	1.225	ML
Big Bend Swamp/Holopaw Ranch	0.069	ML	1.783	ML
Blue Head Ranch	3.548	VH	6.647	H
Bombing Range Ridge	4.186	VH	6.837	H
Brevard Coastal Scrub Ecosystem	0.304	M	2.442	M
Caber Coastal Connector	0.038	ML	8.513	VH
Caloosahatchee Ecoscape	0.000	L	0.208	ML
Camp Blanding to Raiford Greenway	0.000	L	2.063	ML
Carr Farm/Price's Scrub	0.000	L	0.000	L
Catfish Creek	0.006	ML	1.405	ML
Charlotte Harbor Estuary	0.185	ML	1.173	ML
Charlotte Harbor Flatwoods	0.009	ML	0.009	ML
Clay Ranch	0.000	L	0.696	ML
Clear Creek/Whiting Field	1.296	H	2.394	ML
Coastal Headwaters Longleaf Forest	0.000	ML	0.604	ML
Conlin Lake X	0.000	L	0.000	L
Corkscrew Regional Ecosystem Watershed	1.261	H	3.335	M
Coupon Bight/Key Deer	3.722	VH	5.866	H
Crossbar/Al Bar Ranch	0.000	L	1.702	ML
Dade County Archipelago	5.142	VH	6.666	H
Devil's Garden	0.033	ML	2.946	M
Dickerson Bay/Bald Point	0.004	ML	3.348	M

Eastern Scarp Ranchlands	1.225	H	3.466	M
Escribano Point	0.006	ML	0.000	L
Estero Bay	0.000	ML	0.459	ML
Etoniah/Cross Florida Greenway	0.184	ML	3.558	M
Fisheating Creek Ecosystem	0.956	M	4.592	M
Flagler County Blueway	0.596	M	2.993	M
Florida's First Magnitude Springs	1.259	H	5.844	H
Florida Keys Ecosystem	4.317	VH	7.100	H
Florida Springs Coastal Greenway	0.003	ML	2.363	ML
Garcon Ecosystem	0.000	L	0.400	ML
Green Swamp	0.000	ML	0.019	ML
Gulf Hammock	0.000	L	2.020	ML
Half Circle L Ranch	1.860	H	7.680	VH
Hall Ranch	0.000	L	0.327	ML
Heather Island/Ocklawaha River	0.001	ML	0.015	ML
Hixtown Swamp	0.000	L	0.000	L
Horse Creek Ranch	0.000	L	0.000	L
Hosford Chapman's Rhododendron Protection Zone	0.000	L	0.000	L
Ichetucknee Trace	0.017	ML	3.450	M
Indian River Lagoon Blueway	0.178	ML	1.073	ML
Kissimmee-St. Johns River Connector	0.994	M	3.793	M
Lafayette Forest	0.000	L	0.492	ML
Lake Hatchineha Watershed	0.000	L	0.000	L
Lake Santa Fe	0.000	L	0.000	L
Lake Wales Ridge Ecosystem	2.287	H	5.802	H
Limestone Ranch	0.000	L	0.000	L
Little River Conservation Area	0.000	L	0.000	L
Lochloosa Forest	0.000	ML	0.000	L
Lochloosa Wildlife	0.000	L	0.000	L
Longleaf Pine Ecosystem	0.509	M	6.802	H
Lower Perdido River Buffer	0.000	L	0.000	L
Lower Suwannee River and Gulf Watershed	0.049	ML	3.847	M
Matanzas to Ocala Conservation Corridor	0.000	L	0.033	ML
Maytown Flatwoods	0.000	ML	8.906	VH
Middle Chipola River	0.000	L	1.049	ML
Mill Creek	0.000	L	0.000	L
Millstone Plantation	0.000	L	0.000	L
Myakka Ranchlands	0.248	M	0.703	ML
Natural Bridge Creek	0.000	L	0.000	L
Northeast Florida Blueway	0.002	ML	0.016	ML
Northeast Florida Timberlands and Watershed Reserve	0.018	ML	1.083	ML
Ochlockonee River Conservation Area	0.000	L	0.000	L
Okeechobee Battlefield	0.000	L	0.000	L
Old Town Creek Watershed	0.000	L	0.000	L
Osceola Pine Savannas	0.157	ML	5.105	H
Pal-Mar	0.000	L	0.000	L
Panther Glades	0.532	M	2.520	M
Peace River Refuge	0.000	L	0.000	L
Perdido Pitcher Plant Prairie	0.000	L	0.000	L
Pierce Mound Complex	0.000	ML	0.000	L

Pine Island Slough Ecosystem	1.621	H	3.818	M
Pineland Site Complex	0.000	L	0.000	L
Pinhook Swamp	0.003	ML	6.591	H
Pringle Creek Forest	0.000	L	0.000	L
Pumpkin Hill Creek	0.177	ML	0.313	ML
Raiford to Osceola Greenway	0.012	ML	2.379	ML
Rainbow River Corridor	0.027	ML	4.641	M
Ranch Reserve	0.010	ML	6.600	H
San Felasco Conservation Corridor	0.000	L	0.000	L
San Pedro Bay	0.000	L	0.018	ML
Sand Mountain	3.243	VH	6.821	H
Save Our Everglades	0.000	L	9.232	VH
Shoal River Buffer	0.000	L	0.000	L
South Goethe	1.363	H	5.819	H
South Walton County Ecosystem	0.363	M	4.123	M
Southeastern Bat Maternity Caves	0.000	L	1.311	ML
Spruce Creek	2.249	H	9.383	VH
St. Joe Timberland	0.038	ML	0.921	ML
St. Johns River Blueway	0.000	L	0.083	ML
Suwannee County Preservation	0.000	L	0.000	L
Terra Ceia	0.003	ML	3.046	M
Three Chimneys	0.000	L	0.000	L
Tiger/Little Tiger Island	0.000	L	0.000	L
Triple Diamond	6.617	VH	7.868	VH
Twelvemile Slough	0.442	M	3.613	M
Upper Shoal River	0.000	L	2.411	M
Upper St. Marks River Corridor	0.000	L	2.988	M
Volusia Conservation Corridor	0.001	ML	4.471	M
Wacissa/Aucilla River Sinks	0.002	ML	4.229	M
Wakulla Springs Protection Zone	3.991	VH	8.636	VH
Watermelon Pond	0.000	L	4.769	M
Wekiva-Ocala Greenway	1.080	H	2.950	M
West Aucilla River Buffer	0.000	L	0.000	L
West Bay Preservation Area	0.000	L	0.350	ML
Wolfe Creek Forest	0.000	L	0.000	L

In summary, F-TRAC is a valuable tool to help decision makers evaluate a large amount of natural resource data in a concise format. We reiterate here that F-TRAC does not represent a final acquisition plan for the state of Florida, but is a tool to inform those who must make the final decisions regarding land acquisition projects. Also, F-TRAC is designed to be the primary tool to evaluate Florida Forever projects, but should be used in conjunction with the Florida Forever Single Resource Evaluation, and any other relevant information not captured by quantitative natural resource data.

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SUB-APPENDIX A

Marxan Input Parameters for November 2016 F-TRAC Scenarios

2020 Statewide Scenario

Number of Planning Units:	124,487
Runs:	50
Boundary Modifier:	0
Run Options:	Simulated Annealing only
Iterations:	1,000,000,000
Temperature Decreases:	10,000
Annealing Schedule:	Adaptive
Cost Threshold:	5,194,103 ha
Penalty Factor A:	2660
Penalty Factor B:	0.01
Starting Proportion:	0.01
Random Seed:	No

2020 On Projects Scenario

Number of Planning Units:	11,740 (excluded 'locked out' units outside of FFBOT remaining areas from original set of 124,487)
Runs:	50
Boundary Modifier:	0
Run Options:	Simulated Annealing only
Iterations:	1,000,000,000
Temperature Decreases:	10,000
Annealing Schedule:	Adaptive
Cost Threshold:	5,194,103 ha
Penalty Factor A:	1875
Penalty Factor B:	0.01
Starting Proportion:	0.01
Random Seed:	no

**Appendix D. Results of Project Ranking Support Analyses for Additional Criteria and Measures:
Urban Service Areas, Flood Protection, Sea Level Rise, Restoration, and Soil Carbon**

Category	Project Acres Remaining	Project	Percent within Urban Areas	Percent within 100- year Floodplain	Percent Inundated at 1-meter Sea Level Rise	Restoration			Soil Carbon	
						Restoration Emphasis of Project	Percent in BMAP	Final Restoration Group	Average soil total carbon (0- 20 cm) value (kg/m2)	Final Soil Carbon Group
LTF	9,506	Adams Ranch	0%	50%	0%	none	95%	High	4.45	Medium-Low
PRI	8,395	Annettella Hammock	11%	19%	0%	weak	13%	Medium	3.29	Medium-Low
CNL	10,986	Apalachicola River	0%	43%	0%	moderate	0%	Low	3.93	Medium-Low
LTF	11,981	Arbuckle Creek Watershed	0%	28%	0%	none	92%	High	6.18	Medium
CCL	221	Archie Carr Sea Turtle Refuge	40%	68%	34%	weak	71%	High	1.09	Low
PRI	8,192	Atlantic Ridge Ecosystem	5%	37%	1%	none	24%	Medium	5.07	Medium
LTF	5,903	Ayavalla Plantation	0%	35%	0%	none	100%	High	3.96	Medium-Low
PRI	8,395	Baldwin Bay/St. Marys River	0%	43%	0%	moderate	0%	Low	5.58	Medium
CHR	853	Battle of Wahoo Swamp	0%	91%	0%	none	0%	Low	7.86	High
CNL	100,425	Bear Creek Forest	0%	49%	0%	moderate	0%	Low	4.99	Medium
CNL	4,680	Bear Hammock	1%	29%	0%	weak	90%	High	4.06	Medium-Low
CNL	7,148	Belle Meade	0%	98%	7%	weak	0%	Low	8.49	Very High
LTF	47,741	Big Bend Swamp/Holopaw Ranch	0%	65%	0%	weak	76%	High	6.06	Medium
CNL	43,051	Blue Head Ranch	0%	24%	0%	none	92%	High	4.56	Medium-Low
CNL	31,863	Bombing Range Ridge	0%	35%	0%	none	100%	High	5.03	Medium
PRI	21,052	Brevard Coastal Scrub Ecosystem	18%	53%	0%	weak	65%	High	4.28	Medium-Low
CCL	1,761	Caber Coastal Connector	0%	98%	86%	strong	0%	High	5.12	Medium
CNL	10,704	Caloosahatchee Ecoscape	0%	62%	0%	moderate	0%	Low	3.64	Medium-Low
CNL	32,440	Camp Blanding to Raiford Greenway	0%	50%	0%	moderate	45%	Medium	5.51	Medium
PRI	305	Carr Farm/Price's Scrub	0%	20%	0%	weak	76%	High	3.71	Medium-Low
PRI	7,769	Catfish Creek	0%	56%	0%	none	100%	High	6.51	Medium
SC	6,274	Charlotte Harbor Estuary	6%	89%	64%	moderate	0%	Low	1.35	Low
PRI	4,429	Charlotte Harbor Flatwoods	0%	23%	0%	weak	0%	Low	1.06	Low
LTF	2,460	Clay Ranch	0%	67%	0%	none	100%	High	6.54	High
PRI	2,872	Clear Creek/Whiting Field	0%	6%	0%	none	0%	Low	3.27	Medium-Low
LTF	99,501	Coastal Headwaters Longleaf Forest	0%	17%	0%	strong	0%	High	4.07	Medium-Low
LTF	9,041	Conlin Lake X	0%	83%	0%	none	100%	High	6.87	High
PRI	37,221	Corkscrew Regional Ecosystem Water	0%	79%	0%	moderate	8%	Low	5.26	Medium
CCL	1,186	Coupon Bight/Key Deer	30%	98%	95%	moderate	0%	Low	3.43	Medium-Low
PRI	12,371	Crossbar/Al Bar Ranch	0%	29%	0%	strong	100%	High	3.76	Medium-Low
PRI	307	Dade County Archipelago	53%	55%	5%	moderate	0%	Low	10.29	Medium
CNL	71,339	Devil's Garden	0%	88%	0%	moderate	16%	Medium	4.41	Medium-Low
CCL	19,641	Dickerson Bay/Bald Point	0%	58%	22%	weak	0%	Low	3.85	Medium-Low
LTF	2,214	Eastern Scarp Ranchlands	0%	13%	0%	none	100%	High	4.59	Medium-Low
SC	296	Escribano Point	0%	86%	79%	weak	0%	Low	5.80	Medium

			Percent within Urban Areas	Percent within 100- year Floodplain	Percent Inundated at 1-meter Sea Level Rise	Restoration			Soil Carbon	
Category	Project Acres Remaining	Project				Restoration Emphasis of Project	Percent in BMAP	Final Restoration Group	Average soil total carbon (0- 20 cm) value (kg/m2)	Final Soil Carbon Group
SC	1,886	Estero Bay	52%	99%	93%	weak	5%	Low	6.57	High
CNL	59,274	Etoniah/Cross Florida Greenway	0%	36%	0%	weak	83%	High	4.83	Medium-Low
LTF	115,647	Fisheating Creek Ecosystem	0%	46%	0%	none	76%	High	4.24	Medium-Low
PRI	3,915	Flagler County Blueway	15%	59%	26%	moderate	0%	Low	5.14	Medium
PRI	6,564	Florida's First Magnitude Springs	2%	29%	0%	moderate	66%	High	3.28	Medium-Low
CCL	6,188	Florida Keys Ecosystem	38%	96%	94%	moderate	0%	Low	5.28	Medium
CCL	6,735	Florida Springs Coastal Greenway	0%	97%	89%	moderate	23%	Medium	6.07	Medium
CCL	3,403	Garcon Ecosystem	0%	15%	5%	weak	0%	Low	5.83	Medium
PRI	161,788	Green Swamp	1%	55%	0%	weak	26%	Medium	5.99	Medium
LTF	25,611	Gulf Hammock	0%	99%	16%	moderate	0%	Low	5.45	Medium
CNL	11,182	Half Circle L Ranch	0%	100%	0%	strong	0%	High	3.43	Medium-Low
PRI	7,517	Hall Ranch	0%	23%	0%	moderate	23%	Medium	3.05	Medium-Low
PRI	13,690	Heather Island/Ocklawaha River	1%	25%	0%	strong	100%	High	5.68	Medium
CNL	22,399	Hixtown Swamp	0%	61%	0%	weak	0%	Low	6.41	Medium
LTF	16,316	Horse Creek Ranch	0%	13%	0%	weak	0%	Low	3.99	Medium-Low
LTF	6,923	Hosford Chapman's Rhododendron Pr	0%	46%	0%	moderate	60%	High	3.88	Medium-Low
CNL	1,886	Ichetucknee Trace	0%	12%	0%	strong	100%	High	3.22	Medium-Low
PRI	19,459	Indian River Lagoon Blueway	6%	47%	37%	moderate	86%	High	5.70	Medium
LTF	34,288	Kissimmee-St. Johns River Connector	0%	38%	0%	strong	44%	High	4.56	Medium-Low
PRI	10,259	Lafayette Forest	0%	64%	0%	strong	100%	High	5.86	Medium
CNL	5,413	Lake Hatchineha Watershed	2%	37%	0%	weak	100%	High	5.63	Medium
PRI	9,508	Lake Santa Fe	0%	41%	0%	weak	88%	High	5.37	Medium
CNL	22,518	Lake Wales Ridge Ecosystem	3%	25%	0%	weak	83%	High	5.22	Medium
LTF	6,382	Limestone Ranch	0%	18%	0%	none	0%	Low	4.15	Medium-Low
LTF	2,057	Little River Conservation Area	0%	34%	0%	weak	100%	High	4.66	Medium-Low
PRI	4,693	Lochloosa Forest	0%	30%	0%	weak	100%	High	4.38	Medium-Low
SC	4,569	Lochloosa Wildlife	0%	62%	0%	weak	100%	High	4.76	Medium-Low
CNL	9,610	Longleaf Pine Ecosystem	0%	8%	0%	strong	93%	High	2.43	Medium-Low
LTF	2,326	Lower Perdido River Buffer	9%	22%	2%	none	0%	Low	5.97	Medium
LTF	50,384	Lower Suwannee River and Gulf Water	0%	73%	11%	weak	26%	Medium	5.22	Medium
LTF	108,118	Matanzas to Ocala Conservation Corri	0%	39%	4%	weak	79%	High	6.06	Medium
LTF	4,944	Maytown Flatwoods	0%	53%	0%	none	0%	Low	6.07	Medium
PRI	11,955	Middle Chipola River	0%	58%	0%	none	0%	Low	3.67	Medium-Low
LTF	12,293	Mill Creek	0%	59%	0%	none	100%	High	5.90	Medium
LTF	56	Millstone Plantation	101%	6%	0%	none	100%	High	3.14	Medium-Low
LTF	32,407	Myakka Ranchlands	0%	21%	0%	weak	0%	Low	4.46	Medium-Low
CNL	1,797	Natural Bridge Creek	0%	25%	0%	none	0%	Low	4.38	Medium-Low
CCL	12,113	Northeast Florida Blueway	46%	74%	67%	moderate	34%	Medium	7.20	High
PRI	83,598	Northeast Florida Timberlands and Wa	0%	23%	5%	strong	52%	High	4.77	Medium-Low

			Percent within Urban Areas	Percent within 100- year Floodplain	Percent Inundated at 1-meter Sea Level Rise	Restoration			Soil Carbon	
Category	Project Acres Remaining	Project				Restoration Emphasis of Project	Percent in BMAP	Final Restoration Group	Average soil total carbon (0- 20 cm) value (kg/m2)	Final Soil Carbon Group
LTF	3,269	Ochlockonee River Conservation Area	0%	61%	0%	weak	100%	High	4.21	Medium-Low
CHR	89	Okeechobee Battlefield	100%	93%	0%	weak	100%	High	7.49	Medium
LTF	7,303	Old Town Creek Watershed	0%	33%	0%	weak	0%	Low	6.39	Medium
CNL	27,501	Osceola Pine Savannas	0%	48%	0%	moderate	14%	Medium	5.89	Medium
PRI	9,558	Pal-Mar	0%	63%	0%	weak	44%	Medium	4.04	Medium-Low
CNL	39,384	Panther Glades	0%	92%	0%	weak	0%	Low	4.29	Medium-Low
LTF	3,850	Peace River Refuge	1%	94%	2%	none	0%	Low	3.96	Medium-Low
CNL	2,378	Perdido Pitcher Plant Prairie	72%	48%	2%	weak	0%	Low	7.53	High
CHR	558	Pierce Mound Complex	1%	77%	76%	none	0%	Low	5.77	Medium
CNL	48,973	Pine Island Slough Ecosystem	0%	35%	0%	moderate	77%	High	4.45	Medium-Low
CHR	145	Pineland Site Complex	0%	99%	82%	none	0%	Low	4.15	Medium-Low
CNL	53,806	Pinhook Swamp	0%	60%	0%	moderate	0%	Low	6.65	High
PRI	8,446	Pringle Creek Forest	0%	50%	0%	none	11%	Medium	5.60	Medium
PRI	9,697	Pumpkin Hill Creek	6%	44%	37%	weak	21%	Medium	6.82	High
LTF	67,702	Raiford to Osceola Greenway	0%	52%	0%	weak	51%	High	5.98	Medium
PRI	1,138	Rainbow River Corridor	8%	13%	0%	weak	100%	High	3.31	Medium-Low
LTF	12,515	Ranch Reserve	0%	33%	0%	weak	0%	Low	4.97	Medium-Low
LTF	376	San Felasco Conservation Corridor	1%	38%	0%	none	100%	High	5.28	Medium
CNL	44,999	San Pedro Bay	0%	93%	0%	moderate	21%	Medium	7.76	High
PRI	14,444	Sand Mountain	0%	23%	0%	moderate	0%	Low	2.90	Medium-Low
SC	73	Save Our Everglades	0%	75%	0%	moderate	0%	Low	8.11	Medium
CNL	2,180	Shoal River Buffer	12%	52%	0%	moderate	0%	Low	4.96	Medium-Low
CNL	11,652	South Goethe	0%	33%	0%	strong	48%	High	3.95	Medium-Low
SC	2,697	South Walton County Ecosystem	29%	47%	3%	moderate	0%	Low	4.31	Medium-Low
CNL	589	Southeastern Bat Maternity Caves	0%	56%	0%	weak	18%	Medium	3.89	Medium-Low
SC	365	Spruce Creek	24%	55%	15%	weak	0%	Low	4.67	Medium-Low
CCL	79,722	St. Joe Timberland	0%	91%	40%	none	3%	Low	6.80	High
CCL	19,352	St. Johns River Blueway	13%	39%	33%	weak	100%	High	6.83	High
LTF	1,254	Suwannee County Preservation	0%	36%	0%	weak	12%	Medium	3.75	Medium-Low
CCL	2,266	Terra Ceia	15%	96%	80%	strong	0%	High	6.27	Medium
CHR	56	Three Chimneys	100%	89%	65%	weak	0%	Low	5.12	Medium
CCL	1,137	Tiger/Little Tiger Island	0%	99%	100%	weak	0%	Low	9.85	Very High
CNL	7,998	Triple Diamond	0%	51%	0%	none	100%	High	4.40	Medium-Low
CNL	8,128	Twelvemile Slough	0%	98%	0%	moderate	0%	Low	3.75	Medium-Low
CNL	12,027	Upper Shoal River	0%	16%	0%	moderate	0%	Low	4.05	Medium-Low
CNL	11,022	Upper St. Marks River Corridor	0%	78%	0%	moderate	3%	Low	5.70	Medium
PRI	18,310	Volusia Conservation Corridor	0%	59%	1%	moderate	97%	High	5.80	Medium
CNL	17,292	Wacissa/Aucilla River Sinks	0%	52%	9%	weak	0%	Low	5.84	Medium
PRI	3,647	Wakulla Springs Protection Zone	10%	11%	1%	moderate	100%	High	2.99	Medium-Low

			Percent within Urban Areas	Percent within 100- year Floodplain	Percent Inundated at 1-meter Sea Level Rise	Restoration			Soil Carbon	
Category	Project Acres Remaining	Project				Restoration Emphasis of Project	Percent in BMAP	Final Restoration Group	Average soil total carbon (0- 20 cm) value (kg/m2)	Final Soil Carbon Group
PRI	5,707	Watermelon Pond	0%	15%	0%	moderate	49%	Medium	2.61	Medium-Low
CNL	23,427	Wekiva-Ocala Greenway	0%	37%	6%	weak	87%	High	5.63	Medium
LTF	710	West Aucilla River Buffer	0%	22%	0%	none	0%	Low	3.78	Medium-Low
CCL	4,347	West Bay Preservation Area	0%	84%	37%	weak	0%	Low	4.02	Medium-Low
CNL	10,069	Wolfe Creek Forest	0%	11%	0%	moderate	0%	Low	3.59	Medium-Low