The Impact of Development and Projected Sea-Level Rise on Florida's Ecoregional Portfolio

The Florida Portfolio is the combined product of individual ecoregional assessments conducted for the Tropical Florida, Florida Peninsula, East Gulf Coastal Plain and South Atlantic Coastal Plain ecoregions. We have examined the impact of land development and projected sea-level rise (SLR) on the ability of the portfolio to effectively conserve the ecoregional conservation targets by comparing land cover composition of the portfolio when it was initially mapped (1995-1999, depending on the ecoregion) with more current composition[i], and by identifying portions of the portfolio that would be inundated by a 1-meter rise in sea-level. Because we had insufficient data to include impacts of storm surge, erosion, etc. that are associated with SLR, direct inundation is the only impact addressed.

Table 1 shows the cumulative impact of land development and projected SLR as a total percentage of the Florida portfolio affected in each ecoregion. For development, these range from a low of only 0.6% in the South Atlantic Coastal Plain (SACP) section of the portfolio to a high of 4.7% in the Florida Peninsula section, and a total of 8% (1,270,000 acres) across the entire Florida portfolio. Projected SLR impacts range from a low of 0.3% in the SACP to a high of 3.8% in the Tropical Florida section of the Florida portfolio, and a total of 7% (1,087,000 acres).

Table 1. Impacts of Development and Projected Sea Level Rise on the Florida Portfolio

Ecoregion	Acreage of Portfolio	% Portfolio area developed (2008)*, **	% of Portfolio area inundated with 1m sea level rise*
Tropical Florida	3,526,877	0.9%	3.8%
Peninsula Florida	7,663,509	4.7%	1.9%
South Atlantic Coastal Plain	878,714	0.6%	0.3%
East Gulf Coastal Plain	3,792,268	1.9%	0.9%
Total Acreage of Florida Portfolio =	15,861,368		
Total Portfolio Converted		1,270,000 acres = 8%	1,087,000 acres = 7%

*Percentages were calculated using statewide portfolio acreage, so the statistics presented in the table are based on the portfolio as a whole, rather than as stand- alone ecoregional portfolios.

''Developed' is defined as intensive agriculture, low intensity development, and high intensity development (CWCS Land Use Intensity index). This definition also includes areas converted to improved pasture after the original creation of the portfolio.

Table 2 quantifies the impacts of land development and projected SLR by individual ecoregion and estimates the effects of development and SLR on ecoregional targets by indicating how many targets can (or will, for SLR) no longer meet ecoregional goals as a result of the impacts. Land development impacts range from a low of 4% in Tropical Florida to a high of 11% in SACP. Although the impacts of land development on the SACP portfolio appear low (0.6%) when considered as just a segment of the entire Florida portfolio, they actually exceed the level of impact in other ecoregions when considered at the ecoregional scale because the SACP portfolio is smaller in total size than the others. The impacts of projected SLR range from a low of 4% in both the Florida Peninsula and East Gulf Coastal Plain (EGCP) ecoregions to a high of 17% in Tropical Florida.

Table 2. Impacts of Development and Projected Sea Level Rise on the Ecoregional Portfolio

Ecoregion	Acreage of Ecoregion	Acreage of Portfolio	Acreage Developed*	Acreage Inundated (1m SLR)	# of targets originally meeting goals	# of targets meeting goals w/ development and inundation**
Tropical Florida	5,097,396	3,526,877	145,606 (4%)	594,124 (17%)	83 (26%)	76 (24%)
Florida Peninsula	17,653,465	7,663,509	731,879 (10%)	304,924 (4%)	111 (30%)	110 (29%)
South Atlantic Coastal Plain	2,183,544	878,714	101,017 (11%)	52,347 (6%)	39 (31%)	39 (31%)
East Gulf Coastal Plain	10,159,604	3,792,268	292,450 (8%)	135,144 (4%)	100 (28%)	100 (28%)

* 'Developed' is defined as intensive agriculture, low intensity development, and high intensity development (CWCS Land Use Intensity index). This definition also includes areas converted to improved pasture after the creation of the original portfolio.

**All but one of the changes in the number of targets meeting goals are all due to SLR.

The ecoregional assessment process includes the establishment of conservation goals for each species or ecological system designated as a conservation target, with the goal being inclusion of a minimum number of viable occurrences in the portfolio. Land development and projected SLR had relatively little impact on the ability of the portfolio to meet the minimum conservation goals established for the ecoregional targets: no targets failed to achieve goals as a result of development or SLR impacts in the SACP and EGCP ecoregions. For the Florida Peninsula and Tropical Florida ecoregions, a total of 1 and 7 species, respectively, may no longer meet conservation goals as a result of projected SLR (not development) in those ecoregions (Table 3). If coastal habitats can migrate (as discussed below for much of south Florida), some of these target occurrences on the peninsula may not be lost. The only loss of a target occurrence due to land conversion was an inland wading bird rookery lost to mining impacts (Hardee County Wading Bird Rookery).

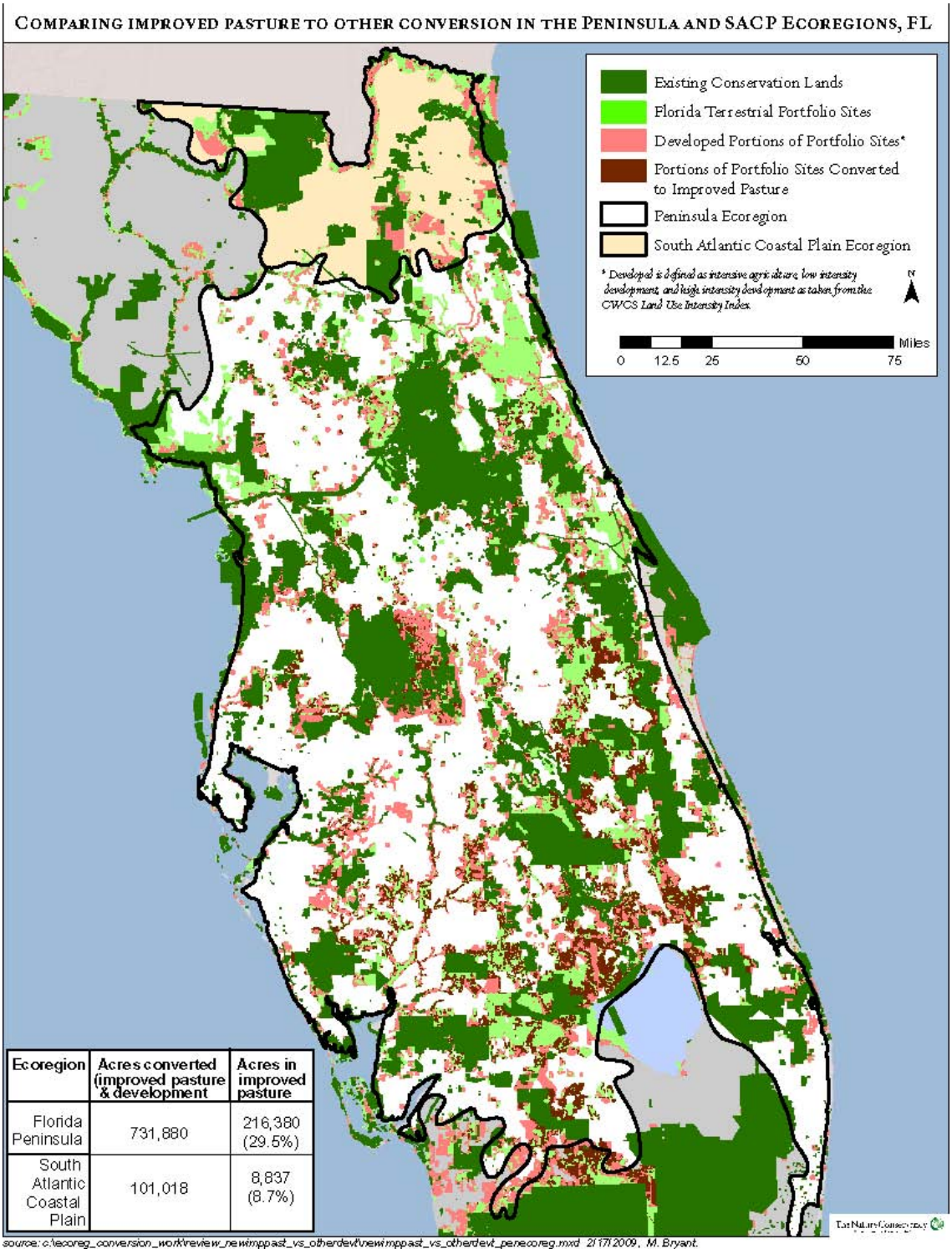

Figure 1. The relative importance of development versus pasture creation as a source of land conversion in the South Atlantic Coastal Plain and Florida Peninsula ecoregions.

Table 3. Targets That No Longer Meet Goals In Response To Projected SLR

Ecoregion	Scientific Name	Common Name	# of Occurrences when Portfolios were Developed	# of Occurrences After SLR Impacts
Florida Peninsula	*Ammodramus maritimus peninsulae*	Scott's Seaside Sparrow	10	9
Tropical Florida	*Coccyzus minor*	Mangrove Cuckoo	23	7
Tropical Florida	*Dendroica discolor paludicola*	Florida Prairie Warbler	12	3
Tropical Florida	*Gossypium hirsutum*	Upland Cotton	13	9
Tropical Florida	*Gyminda latifolia**	False Boxwood	10	9
Tropical Florida	*Hippomane mancinella*	Machineel	11	9
Tropical Florida	*Malaclemys terrapin rhizophorarum*	Mangrove Diamondback Terrapin	11	4
Tropical Florida	*Vireo altiloquus*	Black-whiskered Vireo	24	5

* Denotes a species restricted to the Florida Keys

We examined the high percentages of portfolio lands lost to development in SACP and the Florida Peninsula (731,879 acres) to discern the level of conversion that was attributable to urbanization versus conversion to improved pasture. As illustrated in Figure 1, urbanization accounted for nearly all land development in SACP (91.3%), whereas conversion to pasture accounted for a more significant proportion (29.5%) of total land development in the Florida Peninsula. Given the relatively small land area of the SACP, the portfolio in this ecoregion has been the one most affected by development among all Florida ecoregions.

The Tropical Florida ecoregion will be affected most severely by projected SLR impacts with 17% of the portfolio, or nearly 600,000 acres, estimated to be inundated by a 1-meter rise. Mangrove swamp is the community type that will suffer the greatest impact (206,000 acres), followed by salt marsh (53,000 acres). Much of the tropical hardwood hammock in the ecoregion may also be lost. All the target occurrences predicted to be lost to the projected 1-meter rise in sea level are highly dependent on one or more of these community types.

However, projections of inundation alone are insufficient for predicting the impacts of SLR or providing a sound basis for informed conservation planning. Many coastal wetlands will migrate inland in response to SLR, provided the affected shorelines have not been hardened by sea walls or other development. Figure 2 delineates the portion of the Tropical Florida portfolio that will be inundated by a 1-meter SLR relative to managed areas, or lands protected through some form of conservation status. These protected lands account for much of the coastal wetland of mainland south Florida. The upland migration of coastal wetlands in the Florida Keys will be much more constrained due to the limited land mass. We plan to conduct more rigorous analyses of coastal habitat changes using the Sea-Level Affecting Marshes Model (SLAMM) in high priority coastal sites (already completed for Big Pine Key). This tool will allow more accurate prediction of actual wetland losses and migration, which we will use to better identify impacts to ecoregional targets.

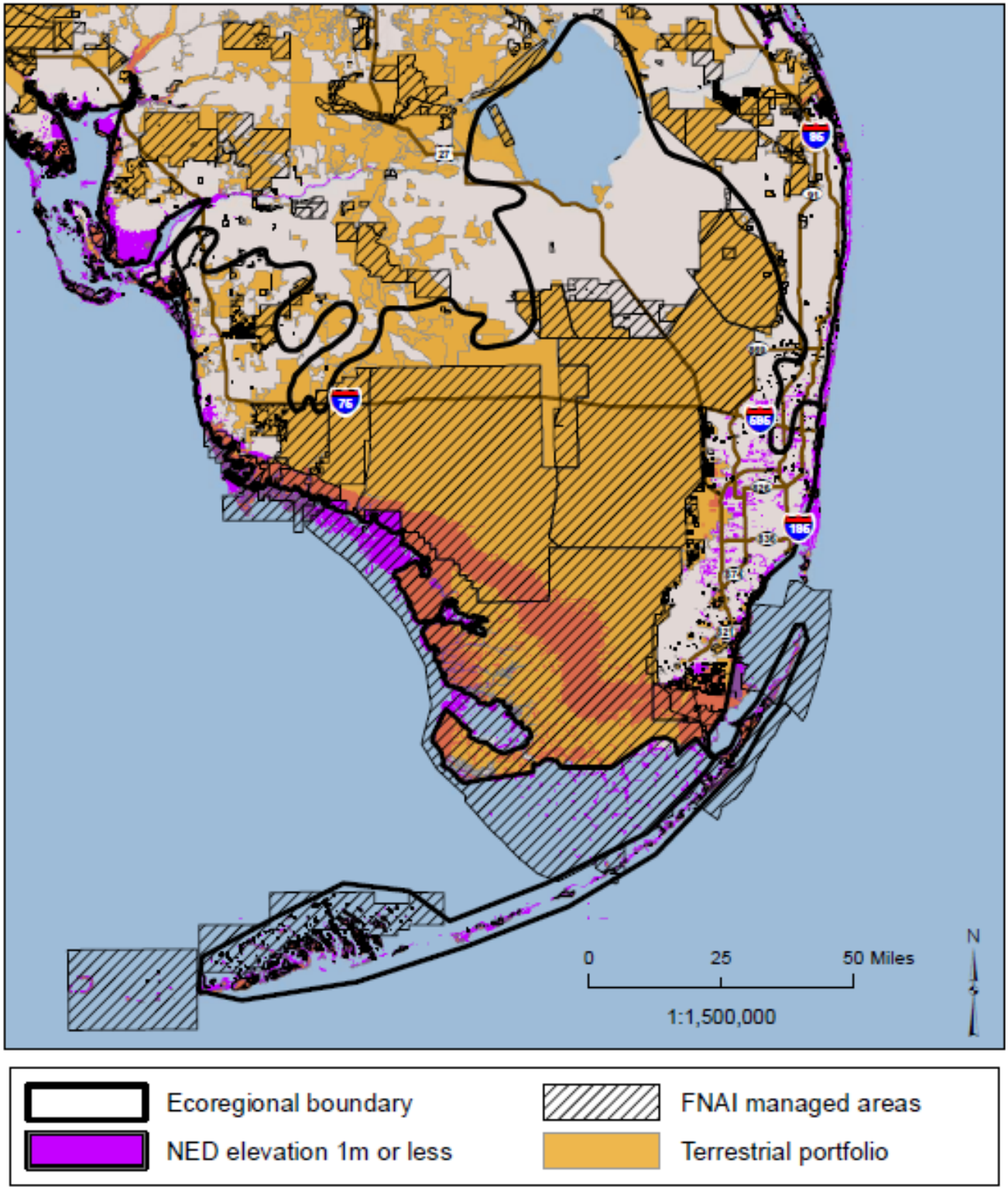

Figure 2. The extent of inundation predicted to occur with a 1-meter rise in sea level, relative to the distribution of conservation lands in South Florida. The rose color shows terrestrial portfolio that will be inundated under these conditions.

Predicted impacts to ecoregional targets focused largely on identifying those targets that would no longer meet conservation goals as a result of changes since the ecoregional portfolios were developed (Table 3). However, even when the portfolios were initially mapped, a number of targets did not meet the standard goal of 10 viable occurrences because they were always naturally rare or already limited in distribution. These natural limitations were especially common in the Tropical Florida ecoregion, where a large number of ecoregional targets are species more closely affiliated with the tropics that reach the northern limit of their natural range in south Florida. Table 4 lists ecoregional targets that have never met goals, but whose precarious status is even more imperiled by predicted SLR. The only habitat within the Florida portfolio supporting seven species-level targets will be inundated by SLR, and three additional species may be reduced to only one viable occurrence in their respective ecoregions. Losses of occurrences in the Florida Keys (identified in Tables 3 and 4) are likely irreversible, as habitat migration is less possible.

Table 4. Increased Threats from Sea-Level Rise to Targets Already Not Meeting Goals

Ecoregion	Scientific Name	Common Name	# of Occurrences when Portfolios were Developed	# of Occurrences After SLR Impacts
EGCP	*Leitneria floridana*	Corkwood	5	4
EGCP	*Salix floridana*	Florida Willow	2	1
Florida Peninsula	*Gossypium hirsutum*	Upland Cotton	3	2
SACP	*Spartina alterniflora* Carolinian Zone	South Atlantic Coast Salt Marsh	3	2
Tropical Florida	*Ammodramus maritimus mirabilis*	Cape Sable Seaside Sparrow	5	4
Tropical Florida	*Aristolochia pentandra*	*Aristolochia pentandra*	1	0
Tropical Florida	Coastal Rock Barren		19	12
Tropical Florida	*Crocodylus acutus*	American Crocodile	3	0
Tropical Florida	*Cupania glabra**	American Toadwood	2	0
Tropical Florida	*Dendroica petechia gundlachi**	Cuban Yellow Warbler	3	1
Tropical Florida	*Gambusia rhizophorae*	Mangrove Gambusia	3	0
Tropical Florida	*Heraclides aristodemus ponceanus*	Shaus' Swallow-Tail Butterfly	6	2
Tropical Florida	*Opuntia corallicola**	Semaphore Cactus	3	1
Tropical Florida	*Opuntia tricantha**	Three-Spined Prickly Pear	7	6
Tropical Florida	*Passiflora multiflora*	Whitish Passionflower	5	4
Tropical Florida	*Pilosocereus robinii**	Key Tree Cactus	8	6
Tropical Florida	*Pseudophoenix sargentii*	Florida Cherry Palm	2	0
Tropical Florida	*Rallus longirostris insularum**	Mangrove Clapper Rail	3	1
Tropical Florida	*Rivulus marmoratus*	Mangrove Rivulus	8	4
Tropical Florida	*Savia bahamensis*	Bahama Maidenbush	3	2
Tropical Florida	*Selaginella eatonii*	Eaton's Spike Moss	5	4
Tropical Florida	*Trichocentrum maculatum*	Spotted Mule-Eared Orchid	1	0
Tropical Florida	*Vallesia antillana**	Pearl Berry	4	3
Tropical Florida	*Vanilla barbellata*	Worm-Vine Orchid	7	3

* Denotes a species restricted to the Florida Keys.

Recommendations

1) Although portfolio has been lost to development in all ecoregions, the overall loss is less than 10% and has had negligible impact on our ability to meet goals for ecoregional targets. As a result, we do not recommend revision of the ecoregional assessments to address development impacts. However, the relatively high development that has increased fragmentation in the SACP Ecoregion suggests that we prioritize protection within that ecoregion and watch for continued loss that might suggest the need for review of the portfolio across the OUs involved.

2) The impacts of a projected 1-meter rise in sea level are concentrated primarily on a small subset of coastal habitats (mangroves and salt marsh). The species-level targets dependent on these systems may suffer severe impacts and possible extirpation. Fortunately, the largest expanse of coastal wetlands in the Tropical Florida ecoregion occurs in the Everglades area, where contiguity of the coastal wetlands with protected conservation lands may be especially conducive to accommodating wetland migration. The same may be true of other sections of priority coastline (e.g., the Big Bend), where publicly protected conservation lands adjoin the shoreline. As a result, we do not recommend revision of the ecoregional assessments based on these data. However, the small land mass and insular nature of the Florida Keys will limit the ability of additional protected conservation lands to abate the impacts of SLR in that landscape.

   We will undertake a more rigorous analysis in priority coastal sites (e.g., Nassau/St. Johns River Estuaries, East Bay, Choctawhatchee Bay, Charlotte Harbor, Southern Big Bend, and Apalachicola Bay; Big Pine Key analysis already completed) that allows for potential inland migration of coastal wetlands in response to SLR to more accurately predict the severity of impacts to ecoregional targets and to support informed decisions about making additions or deletions to the portfolio.

3) We recommend up-dating the ecoregional portfolios to:
   a. remove areas that have been subjected to the most intensive forms of land conversion since the original assessments were produced, while retaining new pasture areas in the portfolio since they still provide habitat value for some targets and could be identified for protection and restoration;
   b. incorporate the Active Rivers Area assessments to refine the boundaries of portfolio sites around the Choctawhatchee, Nassau and St. Mary's Rivers and Pensacola Bay; and
   c. incorporate managed areas and TNC preserves acquired since the portfolio was assembled that are not currently part of the portfolio, provided they are contiguous with current portfolio or meet a minimum size threshold.

4) Florida's ecoregional portfolios were assembled prior to the consideration of climate change strategies. Beyond the analysis of SLR impacts associated with climate change, the Chapter could consider possible additions to the portfolio that improve coastal–inland and north-south connectivity for potential migration of targets in response to changes. Portions of the Florida Greenways layer may provide basis for these additions.

[i] Land developed or converted to pasture was determined using Tom Hoctor's Land Use Intensity Index, developed for TNC under our FWCC contract on the Comprehensive Wildlife Conservation Strategy (2005). As he reported, the data were "from WMDs where 2004 data is available (SJRWMD, SWFWMD, and part of SFWMD) and then a hybrid between either 1995 or 2000 land use, the 2003 FWC landcover data, and the 2004 FNAI development layer wherever 2004 land use data was not available."