Performance Measures Names and Numbers Used For Habitat Units Scoring
LOWRP PM# 1– Lake Okeechobee Watershed Wetlands Restoration
Justification

Historically the Lake Okeechobee Watershed project (LOWRP) area was about 40 percent wetlands. Today about 15 percent remains resulting in a loss of about 330,000 acres of wetlands. Historically these were cypress and bay tree forests, inland swamps, freshwater marsh, wet prairie, and sawgrass marsh (Davis 1943). Land use changes over the last 150 years have resulted in a general conversion to agriculture, primarily pasture (51 percent of the area). This loss of wetland habitat has resulted in less water storage on the landscape, increased storm-water runoff, and more flashy hydroperiods in Fisheating Creek, Kissimmee River, Taylor Creek and Nubbin Slough. According to the Lake Okeechobee Conceptual Ecological Model (Havens 2003), conversion to agricultural and residential land uses in the watershed along with water management have resulted in increased nutrient and sediment concentrations and more extreme and frequent high and low stages in Lake Okeechobee. These stressors can negatively affect waterfowl and wading birds, fish and other aquatic fauna, and native aquatic vegetation.

Wetland restoration in LOWRP supports the following CERP Objectives:

1. Increase Habitat and Functional Value;
2. Increase Native Plant and Animal Species Abundance and Diversity; and
3. Increase Economic and Social Well Being via a) Reducing flood damages; b) providing recreational opportunities; and c) increasing groundwater recharge for water supply.

Wetland restoration also supports the following LOWRP Objectives:

1. Increase Habitat Within the Watershed;
2. Increase Water Supply in the Watershed;
3. Increase Recreational Opportunities; and
4. Restudy target = minimum of 3,500 acres.

Indicator Regions: The Lake Okeechobee Watershed has no CERP Indicator Regions other than the Lake itself. The sub watersheds (Fisheating Creek, Indian Prairie, Kissimmee River, and Taylor Creek and Nubbin Slough) have varying hydrology (and flashiness) due to their overall size and varying ecological conditions due to the level of previous land use changes. Fisheating Creek has conservation easements throughout its watershed resulting in generally better habitat for fish and wildlife. Habitat within the Brighton Seminole Reservation is also in a much more native state than the remainder of the Indian Prairie basin. Kissimmee River is a large watershed and provides most of the surface flow to Lake Okeechobee on annual basis. The upper portion is being restored and is upstream of the LOWRP project area, but should reduce the flashiness of its hydroperiod as restoration is completed in a few years. Taylor Creek and Nubbin Slough tend to be the flashiest watersheds, and at times no surface flow is visible.

CERP Evaluation Target

The Restudy target was a minimum of 3,500 acres of wetlands restored with no stated maximum goal. The study team, realizing that about 330,000 acres of wetlands have been lost in the LOWRP area, did not use size as a constraint, but rather decided that more wetland acres restored would generally be better. One of the goals of the LOWRP is to achieve appropriate depth, duration and frequency targets in the Lake Okeechobee watershed wetlands. This will serve to increase habitat, water supply, and recreation in the watershed. The performance measure has five sub-metrics that establish the wetland targets. Each sub-metric uses the top-scoring and lowest-scoring wetland candidates as the determinants for the zero to 1.0 score. The sub-team also agreed to target potential restoration lands that possessed at least 85 percent hydric soils (historic and current combined) in an effort to minimize acquisition of large areas of non-hydric soils that could undermine wetland restoration potential. Nine sites were evaluated **(Figure 1**). Other constraints included:

1. No or minimal adverse impacts to T&E species as a result of restoration activities;
2. Site does not have potential for high chemical contaminant load based on historic land use that would interfere with restoration; and
3. Site does not have significant archaeological or cultural resources that would be adversely impacted by restoration activities.

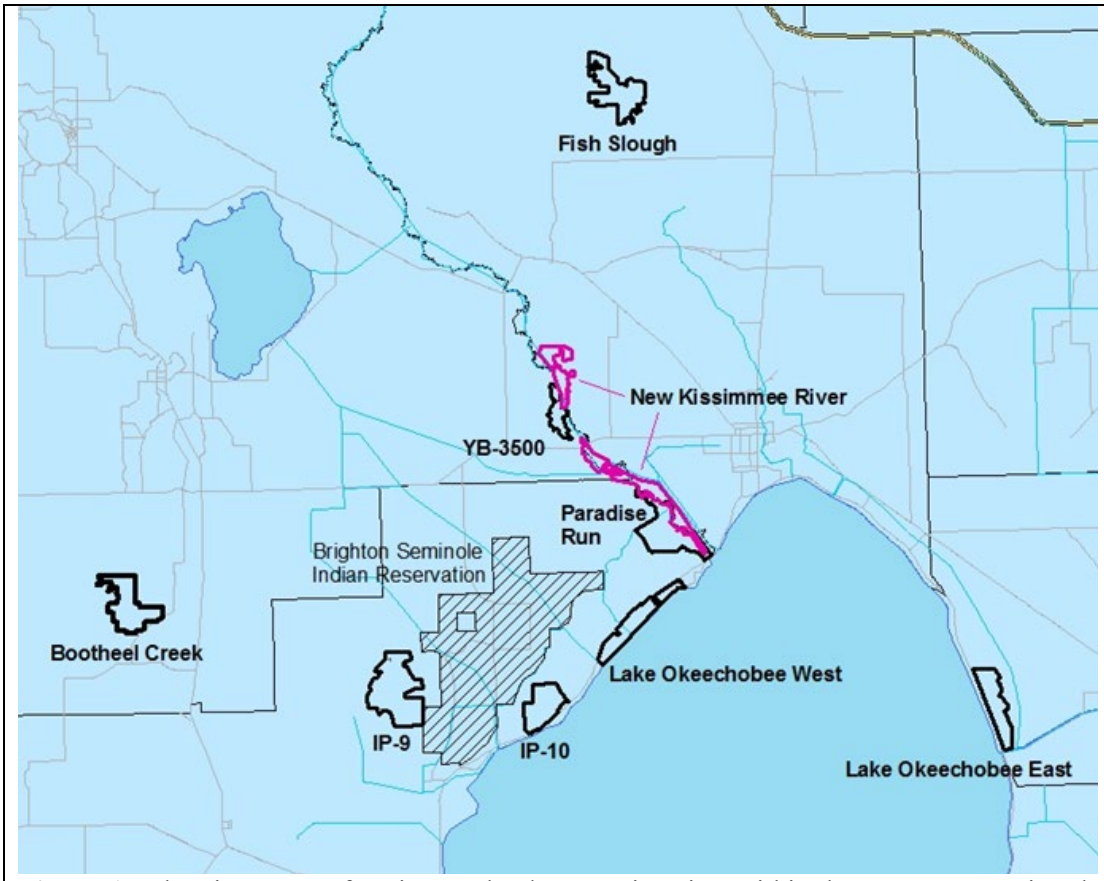

Figure 1. The nine top-performing wetland restoration sites within the LOWRP area in relation to the Brighton Seminole Indian Reservation. The wetland site in pink (New Kissimmee River) is underlain by SFWMD-owned land. The remainder of the sites are on privately-owned land.

Five sub metrics for the wetland restoration performance measure were developed.

1. Wading Bird Support: **Site is within 15 km of an active wading bird colony and would possess the proper hydrologic characteristics after restoration to support that colony.** Based on information in Cox et al (1994), wading birds typically forage in wetlands that are within 15 km of their nesting area during the breeding season. The 15 km distance is measured as the shortest distance from the colony center to the closest edge of the potential wetland site (**Figure 2**). The number of active wading bird colonies that would be supported by a potential wetland site ranged from 0 to 17; therefore, the site with the most colonies (*e.g.,* IP-10) received a score of 1.00 and the sites with no colonies (*e.g.,* Bootheel Creek and Fish Slough) received scores of 0.00 (**Table 1**).

Table 1. Scores for the number of active colonies for the remaining sites.

Site Name	Acres of Site	Active Colonies	Score
Bootheel Creek	3432	0	0.00
Lake O West	2750	11	0.65
Fish Slough	3742	0	0.00
IP-9	5370	8	0.47

IP-10	2595	17	1.00
New Kiss River	4315	8	0.47
Lake O East	2713	2	0.12
Paradise Run	3847	8	0.47
YB-3500	1145	1	0.06

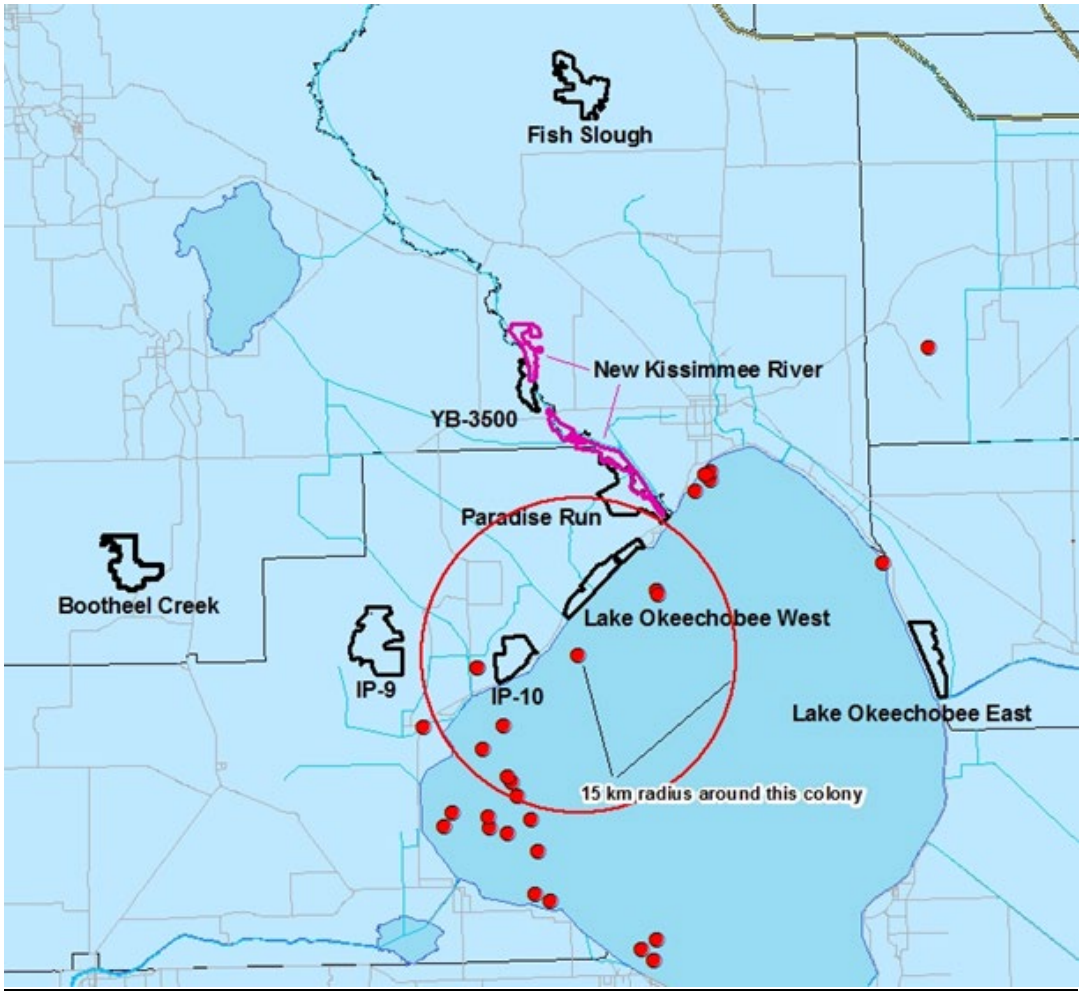

Figure 2. The active wading bird colony data, including two wood stork colonies and the 15 km buffer used to score the wetland sites.

2. Percent Connectivity: **Site is connected to lands with environmental protections such as conservation easements.** Connecting a restoration site to an existing natural area should increase the success of the restoration component by maximizing patch size. We therefore, attempted to maximize direct perimeter connectivity to other public or privately protected high ecological value lands. Connectivity was measured as a percentage of the potential restoration site's perimeter that was connected to public lands [as described in Florida Natural Areas Inventory's Florida Lands Managed Areas (FLMA) spatial data file] (**Figure 3**). Percent Connectivity for all the potential wetland sites ranged from 0 percent to 41 percent (see table below). Scores were calculated as a percentage of the maximum connectivity. For example, the Lake O West site had the maximum amount of connectivity (41 percent), and so received a score of 1.00. The intervening sites were scored based on their percentage of maximum; therefore, a 20 percent connectivity = 20/41 = score of 0.49 (**Table 2**).

Table 2. Percent Connectivity scores for all the sites.

Site Name	Perimeter (meters)	Perimeter connected to conservation lands (meters)	Percent connected to conservation lands	Score
Bootheel Creek	24661	7880	0.32	0.79
Lake O West	24768	10070	0.41	1.00
Fish Slough	32592	6428	0.20	0.49
IP-9	26355	4215	0.16	0.39
IP-10	14942	1562	0.10	0.26
New Kiss River	65059	4194	0.06	0.16
Lake O East	18957	0	0.00	0.00
Paradise Run	28730	0	0.00	0.00
YB-3500	13938	0	0.00	0.00

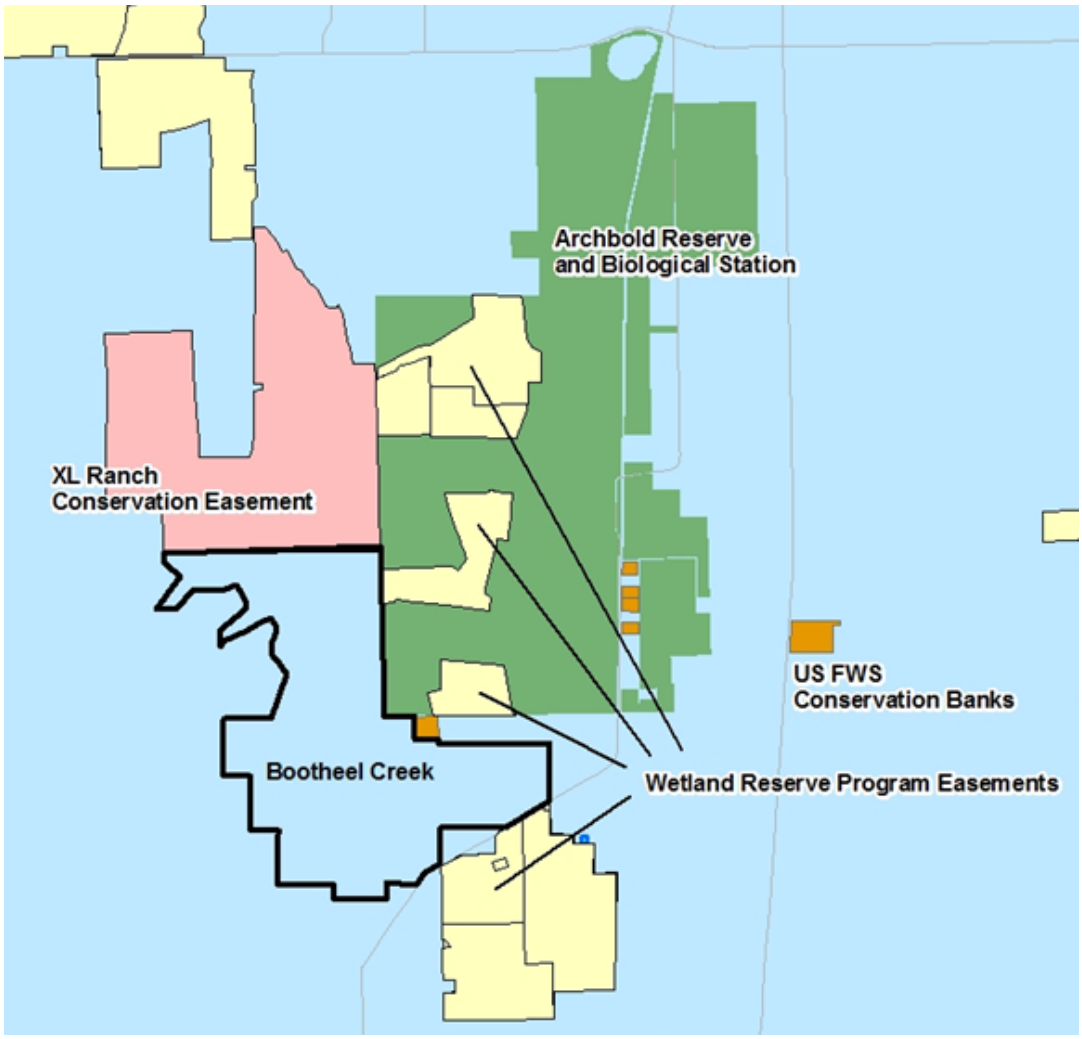

Figure 3. The placement of the Bootheel Creek wetland restoration site in relation to adjacent lands that are under conservation easements (Conservation Land Connectivity metric).

3. Surface Water Connection: **Site has a surface water connection to another water body (lake, creek, river, canal, or wetlands) and would improve hydrologic connectivity and maintain surface water quality.** This performance measure

was based on the percentage of the perimeter of the site that had connectivity to adjacent surface water. Determinations were based on USGS hydrography spatial data layer and 2015 land use data (**Figure 4**). Shoreline measurements for sites that were connected to both sides of a water body would be doubled. Surface Water Connection for all the potential wetland sites ranged from 0 percent to 59 percent (**Table 3**). Scores were calculated as a percentage of the maximum connectivity. For example, the Paradise Run site had the maximum amount of connectivity (59 percent), and so received a score of 1.00. The other sites were scored based on their percentage of the maximum connectivity.

Table 3. Surface water connection for wetland sites.

Site Name	Perimeter (meters)	Percent of wet adjacent	Score
Bootheel Creek	24661	0.30	0.52
IP-9	24768	0.06	0.10
IP-10	32592	0.18	0.30
Lake O West	26355	0.43	0.74
Lake O East	14942	0.00	0.00
Paradise Run	65059	0.59	1.00
YB-3500	18957	0.18	0.31
Fish Slough	28730	0.11	0.18
New Kiss River	13938	0.44	0.75

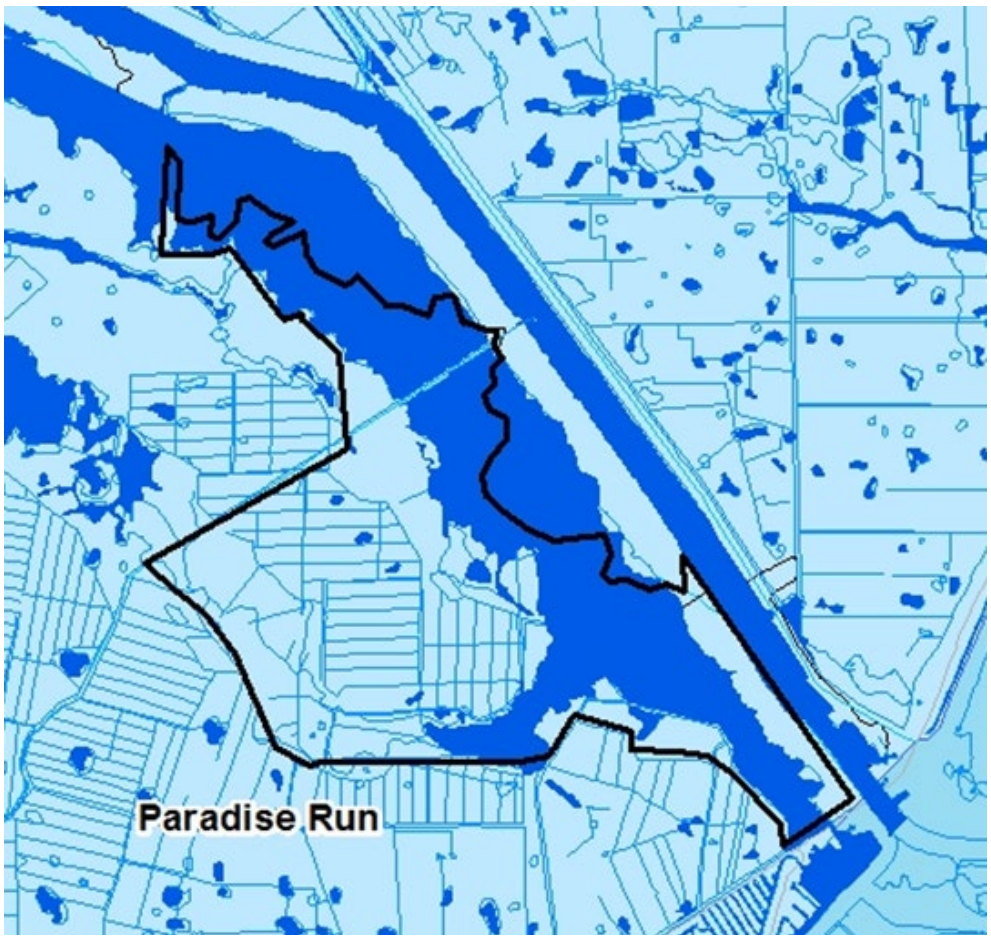

Figure 4. The hydrology in and around the Paradise Run wetland restoration site showing a high degree of surface water connectivity (open water, wetlands, and ditching land use codes are shown in dark blue).

4. Restoration Potential Percent: **Site has a high percentage of lands needing restoration as opposed to lands currently**

in native habitat that could be preserved (with project). Sites with higher restoration potential are likely to result in maximum project benefits following restoration and may be easier to justify than sites with high preservation value (*i.e.*, sites already possessing high ecological quality). Restoration potential was measured as the percentage of non-native habitats (based on SFWMD 2015 land use data) (**Figure 5**). All potentially restorable land uses (*i.e.,* we excluded urban and residential areas) were assigned a value between 0 and 0.99 based on the degree to which the study team believed the land cover diverged from the fully restored condition (**Table 4**). For example, more disturbed land uses like sod farms, or row crops received higher values and highly functioning wetlands received lower values. **Table 6** lists the values (i.e., Restoration Potential Value) per land use code. Then the spatial percentages of each land cover were summed and divided by the total acreage of the site to estimate the overall restoration potential. For example, a 100 acre site with 90 percent improved pasture (restoration potential value of 0.80) and 10 percent freshwater marsh (value of 0.00), received a score of: (0.8 x 90%) + (0.0 x 20%) = 0.72. The sites ranged from a low of 32 percent (New Kissimmee River) to a maximum of 97 percent restorable (Lake O East). The scores were normalized (see table below) and ranged from 0.33 to 1.00.

Table 4. Restoration potential of wetland sites.

Site Name	Restoration Potential Percent	Score
Bootheel Creek	0.39	0.40
Fish Slough	0.64	0.66
IP-10	0.69	0.71
IP-9	0.51	0.53
Lake O East	0.97	1.00
Lake O West	0.74	0.76
New Kiss River	0.32	0.33
Paradise Run	0.48	0.49
YB-3500	0.56	0.58

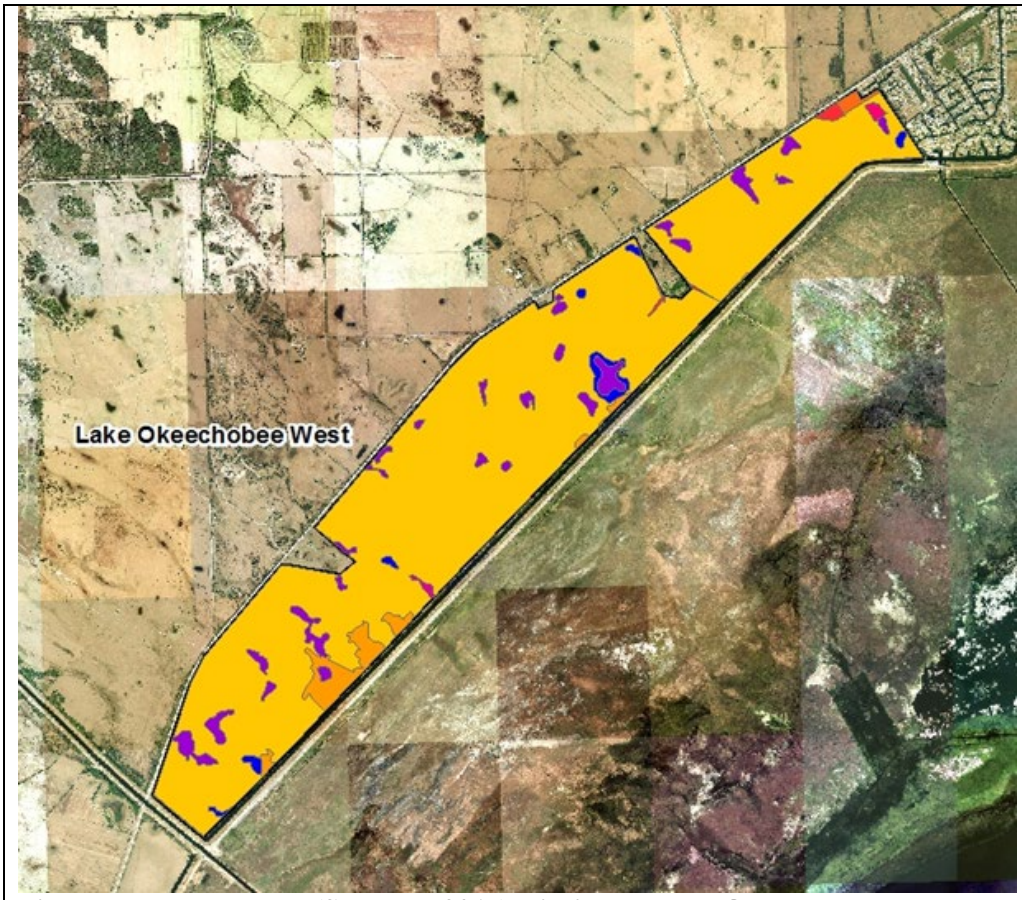

Figure 5. The land use (SFWMD 2015) within the Lake Okeechobee West wetland restoration site displayed on 2012 natural color aerial photography. The site has a high restoration potential because it is primarily improved and unimproved pasture (yellow and gold), with scattered freshwater marsh (purple) and wet prairie (blue) wetlands.

5. Public Access: **Site has high potential for public access and would support wildlife-related recreation thereby supporting a goal of the original C&SF Project as well as the CERP's Master Recreation Plan.** Sites will be evaluated based on their distance from existing population centers. Ten population centers were identified and split into two classes based on US Census Bureau classification scheme and population data. The larger population centers, possessing greater than 10,000 people were City of Okeechobee-Taylor Creek, Sebring, Avon Park, Fort Pierce, and Port St. Lucie. The smaller population centers, possessing between 5,600 and 8,000 people, were Pahokee, Clewiston, Arcadia, and Indiantown. Population centers with less than 2,500 people (*e.g.*, Lake Placid, Buckhead Ridge, and Moore Haven) were excluded from this analysis. Around each analyzed population center, a 120-mile diameter "bulls-eye" (*i.e.,* a series of six, 10-mile radial-interval concentric circles) was drawn (**Figure 6** shows an example for the City of Okeechobee). Points within each 10-mile band were ascribed as follows. For the larger population centers, a potential wetland site that fell within the innermost circle scored a 10. For each successive 10-mile increment, the scores were 8, 6, 4, 2, and 0. For the smaller population centers, a potential wetland site that fell within the innermost circle scored a 5. For each successive 10-mile increment, the scores were 4 3, 2, 1, and 0. Then, the number of points each potential wetland site received for all the bull's-eyes were then summed. The scores ranged from a low of 20 (Bootheel Creek Site) to a maximum of 35 points (New Kissimmee River Site). As with the previous metrics, an interim scoring site would be based on how well they compared percentage-wise to the highest scoring site. The points and scores are presented in **Table 5**.

Table 5. Public access points and scores for each wetland site.

Site Name	Okeechobee	Sebring	Avon	Fort	Port St. Lucie	Pahokee	Clewiston	Arcadia	Indiantown	Total Points	Score
Bootheel Creek	4	6	4	0	0	1	2	3	0	20	0.57
Fish Slough	8	6	4	4	0	0	0	0	1	23	0.66
IP-10	8	4	2	2	2	3	4	0	2	27	0.77
IP-9	8	4	2	0	0	2	3	1	1	21	0.60
Lake O East	8	0	0	4	6	4	3	0	5	30	0.86
Lake O West	10	2	2	2	2	3	3	0	3	27	0.77
New Kiss River	10	6	4	4	2	3	3	0	3	35	1.00
Paradise Run	10	4	2	4	2	3	3	0	3	31	0.89
YB-3500	8	4	4	2	2	2	2	0	2	26	0.74

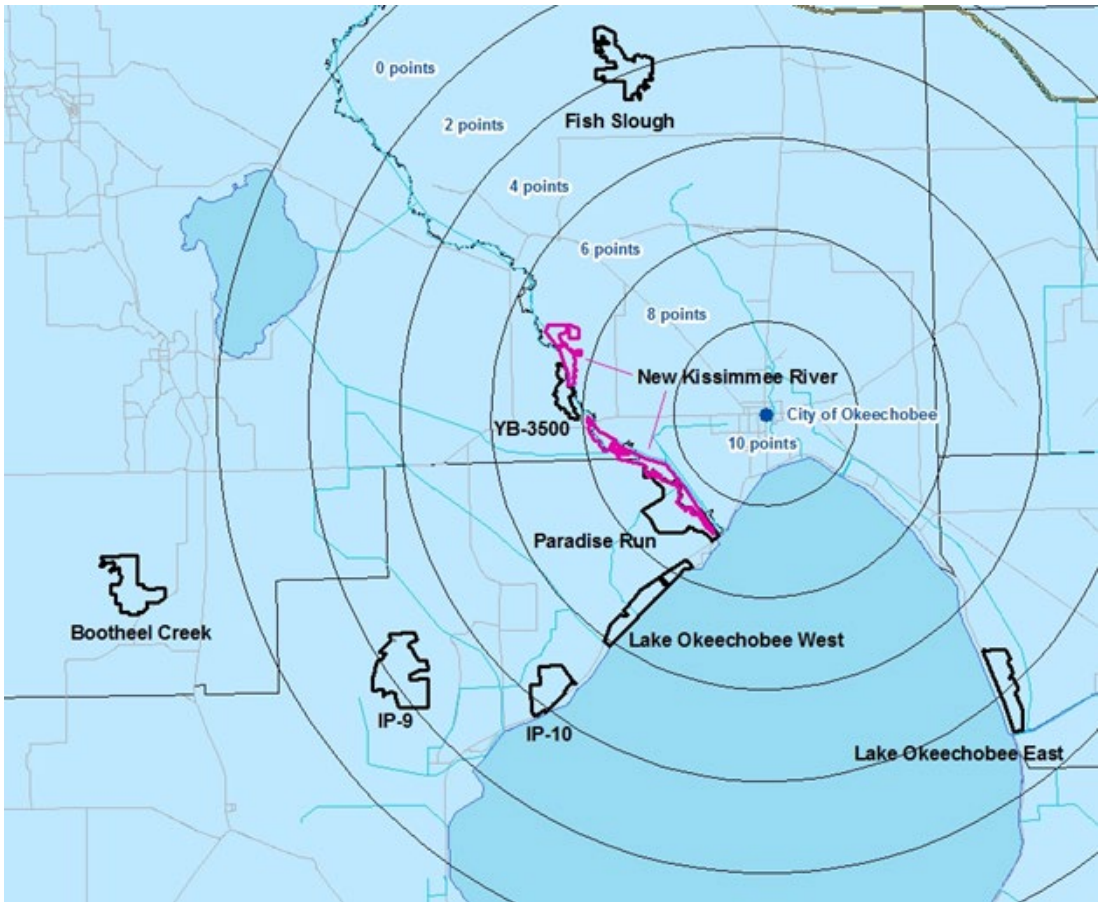

Figure 6. The "bulls-eye" scoring method used for the Public Access metric using the City of Okeechobee as an example.

Table 6. Land use (FLUCCS) codes and their Restoration Potential Score for Performance Measure Sub-metric #4.

FLUCCS Level 4 Code	FLUCCS Code Description	FLUCCS Code Description Category	Restoration Potential Score
1009	Mobile Home Units Any Density	Residential	0.99
1100	Residential Low Density <2 du/ac	Residential	0.80
1110	Fixed Single Family Units <2 du/ac	Residential	0.80
1130	Mixed Units (Fixed and mobile home units)<	Residential	0.80
1190	Low Density Under Construction<2 du/ac	Residential	0.99
1200	Residential Medium Density 2-5 du/acre	Residential	0.99
1210	Fixed Single Family Units 2-5 du/ac	Residential	0.99
1230	Mixed Units (Fixed and mobile home units)	Residential	0.99
1290	Medium Density Under Construction 2-5 du/a	Residential	0.99
1300	Residential High Density	Residential	0.99
1310	Fixed Single Family Units	Residential	0.99
1320	Mobile Home Units (6 or more du/acre)	Residential	0.99
1330	Multiple Dwelling Units Low Rise	Residential	0.99
1340	Multiple Dwelling Units High Rise	Residential	0.99
1350	Mixed Units <Fixed and mobile home units>	Residential	0.99
1400	Commercial and Services	Commercial & Services	0.99
1410	Retail Sales and Services	Commercial & Services	0.99
1411	Retail Sales and Services - Shopping Centers	Commercial & Services	0.99
1420	Wholesale Sales and Services	Commercial & Services	0.99
1423	Wholesale Sales and Services - Junk Yards	Commercial & Services	0.99
1430	Professional Services	Commercial & Services	0.99
1440	Cultural and Entertainment	Commercial & Services	0.99
1450	Tourist Services	Commercial & Services	0.99
1453	Travel Trailer Parks	Commercial & Services	0.90
1470	Mixed Commercial and Services	Commercial & Services	0.99
1480	Cemeteries	Commercial & Services	0.90
1500	Industrial Under Construction	Industrial	0.99
1510	Food Processing	Industrial	0.99
1550	Other Light Industrial	Industrial	0.99
1560	Other Heavy Industrial	Industrial	0.99
1600	Extractive	Industrial	0.99
1620	Sand and Gravel Pits	Industrial	0.99
1700	Institutional	Institutional	0.99
1710	Educational Facilities	Institutional	0.99
1720	Religious	Institutional	0.99
1730	Military	Institutional	0.70
1740	Medical and Health Care	Institutional	0.99
1750	Governmental	Institutional	0.99
1761	State Prisons	Institutional	0.90
1763	Juvenile Centers	Institutional	0.90
1800	Recreational	Recreational	0.70
1820	Golf Courses	Recreational	0.80
1830	Race Tracks	Recreational	0.99
1840	Marinas and Fish Camps	Recreational	0.80
1841	Marinas (Basins)	Recreational	0.80
1850	Parks and Zoos	Recreational	0.70
1860	Community Recreational Facilities	Recreational	0.90
1890	Other Recreational	Recreational	0.80
1900	Open Land	Open Land	0.50
1910	Undeveloped Land within urban areas	Open Land	0.80

1920	Inactive Land with street pattern	Open Land	0.99
1930	Urban Land in transition	Open Land	0.90
1940	Other Open Land	Open Land	0.50
2100	Cropland and Pastureland	Cropland/Pastureland	0.99
2110	Improved Pastures	Pastureland	0.80
2120	Unimproved Pastures	Pastureland	0.50
2130	Woodland Pastures	Pastureland	0.40
2140	Row Crops	Cropland	0.99
2150	Field Crops	Cropland	0.99
2156	Field Crops - Sugar Cane	Cropland	0.99
2200	Tree Crops	Tree Crops	0.80
2210	Citrus Groves	Tree Crops	0.80
2220	Fruit Orchards	Tree Crops	0.80
2230	Other Groves	Tree Crops	0.80
2320	Poultry Feeding Operations	Feeding Operations	0.90
2400	Nurseries and Vineyards	Nurseries & Vineyards	0.80
2410	Tree Nurseries	Nurseries & Vineyards	0.80
2420	Sod Farms	Nurseries & Vineyards	0.90
2430	Ornamentals	Nurseries & Vineyards	0.90
2450	Floriculture	Nurseries & Vineyards	0.80
2500	Specialty Farms	Specialty Farms	0.80
2510	Horse Farms	Specialty Farms	0.80
2520	Dairies	Specialty Farms	0.90
2540	Aquaculture	Specialty Farms	0.70
2549	Aquaculture	Specialty Farms	0.70
2600	Other Open Lands Rural	Open Land	0.70
2610	Fallow Crop Land	Cropland	0.80
3100	Herbaceous Rangeland	Rangeland	0.40
3200	Shrub and Brushland	Rangeland	0.40
3210	Palmetto Prairies	Rangeland	0.40
3290	Other Shrubs and Brush	Rangeland	0.40
3300	Mixed Rangeland	Rangeland	0.40
4000	Upland Forests	Upland Forests	0.30
4100	Upland Coniferous Forest	Upland Forests	0.30
4110	Pine Flatwoods	Upland Forests	0.30
4119	Pine Flatwoods - Melaleuca Infested	Upland Forests	0.50
4120	Longleaf Pine - Xeric Oak	Upland Forests	0.30
4130	Sand Pine	Upland Forests	0.30
4140	Pine - Mesic Oak	Upland Forests	0.30
4200	Upland Hardwood Forest	Upland Forests	0.30
4210	Xeric Oak	Upland Forests	0.30
4220	Brazilian Pepper	Upland Forests	0.80
4230	Oak - Pine - Hickory	Upland Forests	0.30
4240	Melaleuca	Upland Forests	0.80
4250	Temperate Hardwood	Upland Forests	0.30
4270	Live Oak	Upland Forests	0.30
4280	Cabbage Palm	Upland Forests	0.30
4310	Beech - Magnolia	Upland Forests	0.30
4320	Sand Live Oak	Upland Forests	0.30
4330	Western Everglades Hardwoods	Upland Forests	0.30
4340	Hardwood Conifer Mixed	Upland Forests	0.30
4350	Dead Trees	Upland Forests	0.50
4370	Australian Pine	Upland Forests	0.80
4380	Mixed Hardwoods	Upland Forests	0.30

4400	Tree Plantations	Silvaculture	0.60
4410	Coniferous Plantations	Silvaculture	0.60
4430	Forest Regeneration Areas	Silvaculture	0.60
5100	Streams and Waterways	Open Water	0.00
5200	Lakes	Open Water	0.00
5210	Lakes larger than 500 acres	Open Water	0.00
5220	Lakes larger than 100 acres - less than 50	Open Water	0.00
5230	Lakes Larger than 10 acres - less than 100	Open Water	0.00
5240	Lakes less than 10 acres	Open Water	0.00
5300	Reservoirs	Open Water	0.50
5310	Reservoirs larger than 500 acres	Open Water	0.50
5320	Reservoirs larger than 100 acres - less than 500 acres	Open Water	0.50
5330	Reservoirs larger than 10 acres - less than 100 acres	Open Water	0.50
5340	Reservoirs less than 10 acres	Open Water	0.50
5600	Slough Waters	Open Water	0.00
6100	Wetland Hardwood Forest	Wetlands	0.00
6110	Bay Swamps	Wetlands	0.00
6120	Mangrove Swamps	Wetlands	0.00
6140	Titi Swamps	Wetlands	0.00
6150	Stream and Lake Swamps (Bottomland)	Wetlands	0.00
6160	Inland Ponds and Sloughs	Wetlands	0.00
6170	Mixed Wetland Hardwoods	Wetlands	0.00
6171	Mixed Wetland Hardwoods - Willows	Wetlands	0.00
6172	Mixed Wetland Hardwoods - Mixed Shrubs	Wetlands	0.00
6200	Wetland Coniferous Forest	Wetlands	0.00
6210	Cypress	Wetlands	0.00
6218	Cypress - Melaleuca Infested	Wetlands	0.30
6219	Cypress - with Wet Prairies	Wetlands	0.00
6220	Pond Pine	Wetlands	0.00
6240	Cypress - Pine - Cabbage Palm	Wetlands	0.00
6300	Wetland Forested Mixed	Wetlands	0.00
6400	Vegetated Non-Forested Wetlands	Wetlands	0.00
6410	Freshwater Marshes	Wetlands	0.00
6411	Freshwater Marshes - Sawgrass	Wetlands	0.00
6412	Freshwater Marshes - Cattail	Wetlands	0.30
6420	Saltwater Marshes	Wetlands	0.00
6430	Wet Prairies	Wetlands	0.00
6439	Wet Prairies - with Pine	Wetlands	0.00
6440	Emergent Aquatic Vegetation	Wetlands	0.00
6520	Shorelines	Wetlands	0.00
6530	Intermittent Ponds	Wetlands	0.00
7200	Sand Other Than Beaches	Barren Land	0.90
7400	Disturbed Land	Barren Land	0.90
7410	Rural land in transition	Barren Land	0.80
7420	Borrow Areas	Barren Land	0.50
7430	Spoil Areas	Barren Land	0.90
7450	Burned Areas	Barren Land	0.80
8000	Transportation, Communication, Utilities	Transportation, Communication and Utilities	0.99
8100	Transportation	Transportation, Communication and Utilities	0.99
8110	Airports	Transportation, Communication and	0.99

		Utilities	
8120	Railroads	Transportation, Communication and Utilities	0.99
8140	Roads and Highways	Transportation, Communication and Utilities	0.99
8160	Canals and Locks	Open Water	0.90
8213	Antenna Farms	Transportation, Communication and Utilities	0.99
8300	Utilities Under Construction	Transportation, Communication and Utilities	0.99
8310	Electrical Power Facilities	Transportation, Communication and Utilities	0.99
8320	Electrical Power Transmission Lines	Transportation, Communication and Utilities	0.99
8340	Sewage Treatment	Transportation, Communication and Utilities	0.99
8349	Sewage Treatment	Transportation, Communication and Utilities	0.99
8350	Solid Waste Disposal	Transportation, Communication and Utilities	0.99

Evaluation Protocol

As a result of the scoring, up to five sites were considered to be the best sites to carry on for additional planning **(Table 7**). They were Lake O West, IP-10, Paradise Run, New Kissimmee River, and Bootheel Creek. All sites will be evaluated for potential for chemical contamination based on historic land uses. A cultural resources review by a Corps' archeologist will also indicate if any recorded sites occur within the top candidates.

Table 7. Combined wetland PM scores for wetland sites.

		Wading Birds	Percent Connectivity	Surface Water Connectivity	Restoration Potential	Public Access	Total Score (out of 5)
Rank	**Sites**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**
1	Lake O West	0.65	1.00	0.74	0.76	0.77	**3.92**
2	IP-10	1.00	0.26	0.30	0.71	0.77	**3.04**
3	Paradise Run	0.47	0.00	1.00	0.49	0.89	**2.85**
4	New Kiss River	0.47	0.16	0.75	0.33	1.00	**2.71**
5	Bootheel Creek	0.00	0.79	0.52	0.39	0.57	**2.27**
6	IP-9	0.47	0.39	0.10	0.53	0.60	**2.09**
7	Fish Slough	0.00	0.49	0.18	0.66	0.66	**1.99**
8	Lake O East	0.12	0.00	0.00	1.00	0.86	**1.98**
9	YB-3500	0.06	0.00	0.31	0.56	0.74	**1.67**

Benefits Analysis:
With Project Calculations of Habitat Units

Using the scores from the wetland metrics, the top 5 potential restoration sites were selected. A "quality factor"(called Ecological Value; EV) was assigned for each habitat type within all of the potential restoration sites based on land use code (FLUCCS; from the 2015 SFWMD shapefile) **(Table 6**) using best professional judgment, supplemented by limited field evaluations. FLUCCS that are more ecologically degraded received lower EVs, but more native or natural habitats received higher EVs (on a scale of 0.0 to 1.0). FLUCCS that indicated permanent inundation (*e.g.,* 6440 Emergent Aquatic Vegetation, and 5600 Slough Waters) were assigned the highest EVs of 0.7. Other wetlands were assumed to show some level of adverse impact (due to a high percentage of non-native land uses around these wetlands); therefore, received a maximum EV of 0.5. Using ArcGIS, the size of each FLUCCS polygon within each potential restoration site was measured and multiplied by its EV to arrive at a HU for that polygon (**Figure 7**). All polygons inside the restoration site were then summed to calculate the total HUs.

Habitat Units were calculated in **Table 8** below as follows:

Existing $\text{Eco-Value}_{FLUCCS2110} \times \text{Acres}_{FLUCCS2110} = HU_1$ *e.g.,* 0.2 x 2521.61 = 504.32 HUs

and then summed as $HU_1 + HU_2 + \ldots HU_9 = HU_{total}$ *e.g.,* 504.32 +33.49 + … 17.01 = 633.21 HUs

Table 8. Summation of the Existing Habitat Units for the Lake Okeechobee West site.

			Lake Okeechobee West		
FLUCCS	**Description**	**Existing Eco-Value**	**Acres**	**Percent of Area**	**Existing HUs**
2110	Improved Pastures	0.2	2521.61	0.901	504.32
2120	Unimproved Pastures	0.4	83.74	0.030	33.49
3200	Shrub and Brushland	0.4	9.24	0.003	3.70
4200	Upland Hardwood Forest	0.4	8.88	0.003	3.55
5120	Channelized waterways, canals	0.5	3.51	0.001	1.75
5300	Reservoirs	0.5	5.51	0.002	2.76
6172	Mixed Wetland Hardwoods - Mixed Shrubs	0.5	3.58	0.001	1.79
6410	Freshwater Marshes	0.5	129.67	0.046	64.83
6430	Wet Prairies	0.5	34.02	0.012	17.01
Grand Total			2799.76	1.00	633.21

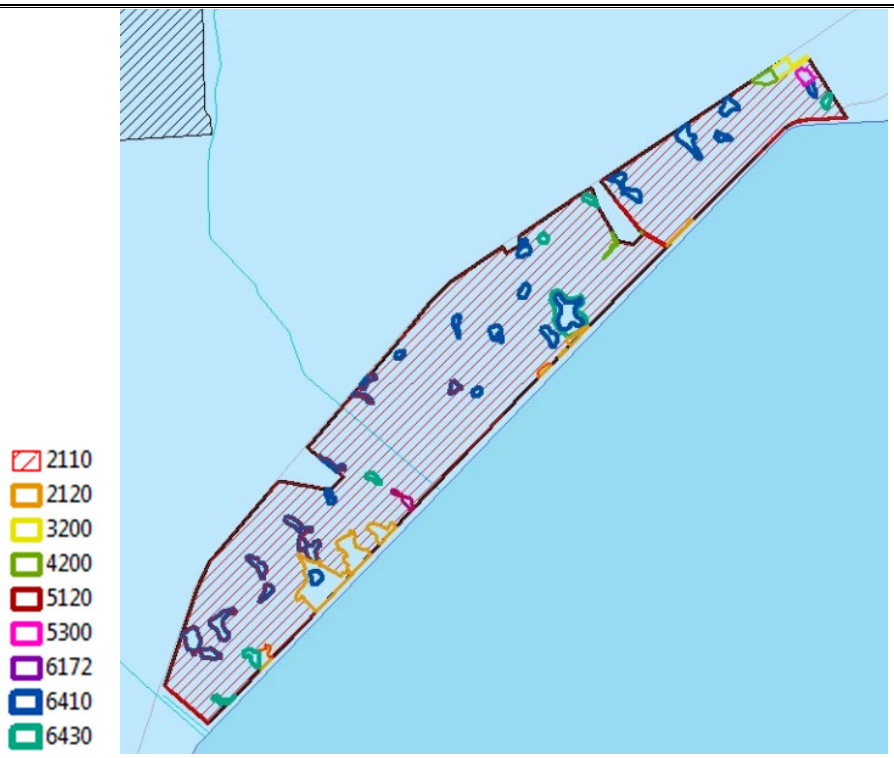

Figure 7. Land cover (FLUCCS) codes for the Lake Okeechobee West Site.

For the estimated total restored HUs under with-project conditions, all EVs are assumed to be restored to 1.0. These would primarily be wetland HUs but could include some small amount of upland HUs. The total HUs would then equal the total acres of the site (2799.76 HUs). Therefore, the HUs created by the LOWRP within the Lake Okeechobee West wetland site would be 2799.76 – 633.21 = 2,166.55 HUs.

Add HU Tables for other wetland sites here

Without Project Calculations of Habitat Units

To estimate HUs under without-project conditions, the team made assumptions about how the wetland and upland land covers would change over time. Because CERP projects have a 50-year life span, the possible land use change scenarios were estimated as: 1) no change within the site; 2) the site is restored by another entity such as the Wetland Reserve Easement Program; or 3) the ecological value of the site is reduced. The LOWRP area is generally rural, however given the proximity of Lake Okeechobee as a water resource and the relatively good transportation and utility infrastructure, combined with the recent increase in population immigration into Florida and the possibility that as sea levels rise, the coastal populations of humans will move inland, it was assumed that it is more likely that these wetland sites would be degraded over time (*i.e.,* converted to more developed conditions). Sites farther from human population centers (*e.g.,* Fish Slough) are probably less likely to undergo habitat degradation, but it is not possible to accurately predict the relative degree. **Table 9** and **Table 10** show the anticipated conversions in ecological quantity and quality without the project within the study area. The discussion of the assumptions follows the tables.

Table 9. Landscape change predictions over time for habitat quantity.

Without Project Condition	
Resource Type	**Changes in Quantity from Baseline to 2078**
Functioning Wetlands	Wetlands <0.5 acres are converted to Drained Wetlands; Wetlands >0.5 acres do not change size
Drained Wetlands	Acreage increases slightly due to above
Native Uplands	Conversion of 50% to Non-native Uplands
Non-native Uplands	Increases in quantity due to above 50% conversion
Open/Deep Water	No change in quantity

Table 10. Landscape change predictions over time for habitat quality.

Without Project Condition	
Resource Type	**Changes in Quality from Baseline to 2078**
Functioning Wetlands	Ecological Value for wetlands < 0.5 ac drops to 0.19; for wetlands > 0.5 ac that are surrounded by native or natural uplands, the quality is reduced by 25% due to conversion of native uplands.
Drained Wetlands	No change in quality
Native Uplands	Ecological Value for 50% of the acreage drops to 0.19
Non-native Uplands	No change in quality
Open/Deep Water	No change in quality

Given the changes in land use patterns that have occurred and continue to take place in the project study area, it was predicted that Existing Condition HUs for functioning wetlands would decrease over time. LOWRP project authorization is anticipated to occur in 2028; therefore, the project's life span lasts until 2078. One assumption was that no project benefits were assumed to have accrued by 2028. Therefore, the 2028 "with project" and "without project" HUs are the same. Benefits would not begin to accrue until 2028 plus one day (with project).

The EVs were updated to reflect the projected losses of wetland, upland, and open water habitats likely to occur from 2028 to 2078 without the project. Wetlands were separated into functional or drained classes; and uplands into native and non-native classes as follows:

a. Functional Wetlands were defined and those represented by FLUCCS 6000 Series.
b. Drained or Non-functioning Wetland habitats were defined as areas with historic hydric soils that currently do not exhibit wetland function (although they should have some upland function). These areas are comprised of lands classified by FLUCCS Level 4 Codes in the 2000 (Agriculture), 3000 (Rangeland), 4000 (Upland Forest), or 7000 (Barren Land) Series. In general, many of these EVs are low; therefore, the resulting HUs are also low.
c. Uplands were broadly defined as areas underlain by non-hydric soils that retain some degree of upland ecological functionality [all FLUCCS Level 4 Codes except 5000 (Open Water) and 6000 (Wetlands) Series]. Native and Natural Uplands were defined as areas underlain by non-hydric soils that retain a high degree of upland ecological functionality. Specifically, these were unimproved or woodland pasture (FLUCCS 2120 and 2130), rangeland (FLUCCS 3000 Series), rural lands in transition (FLUCCS 7410), and upland forests (FLUCCS 4000 Series) with the exception of those land uses infested with exotic plants.
d. Non-native Uplands were FLUCCS Codes 4119, 4220, 4240, 4350, 4400 and 4410. In addition, these included all FLUCCS Codes on non-hydric soils in the 1000, 2000, 7000 (except FLUCCS 7410), and 8000 Series.
e. Open or Deep-Water habitats included FLUCCS Series 5000 (Open Water) and 8160 (Canals). Within our restoration sites these areas included more natural systems like the partially disconnected Kissimmee River oxbows, large ponds, canals, or channelized streams.

Implicit in the above definitions was the need for soil data to separate out uplands from drained wetlands because the some non-native upland FLUCCS codes could occur on both hydric and non-hydric soils. The 2010 U.S. Department of Agriculture spatial data were used for this analysis.

Changes in Quantity

Future wetland losses across the study area were predicted based on current State and Federal regulations. For example, the SFWMD does not require an Environmental Resource Permit for wetlands less than 0.50 acres in size; therefore, mitigation is not a requirement. Similarly, for wetland losses of 0.10 acre or less, the Corps' district engineer determines on a case-by-case basis if compensatory mitigation is required (to ensure that the activity does not result in adverse effects on the aquatic environment). Due to the potential lack of protection by law, it was assumed that all isolated wetlands less than 0.50 acres in size would be converted to other land uses by 2078 and would no longer provide functioning wetland HUs in 2078 without the project. However, it is possible that such areas would provide some low quality upland-type HUs. Within all the potential wetland restoration sites, there are very few remaining wetlands less than 0.5 acre; therefore, we expect this loss to be very low.

For wetlands larger than 0.5 acres, no losses in quantity were projected through 2078. The rationale for this is that State and Federal regulations in effect now would protect the spatial extent of those wetlands (either in-place or through mitigation).

For native and natural uplands, it was assumed 50 percent would be converted by 2078 to more intensive land uses. The rationale for this was that the rate of development in Florida is now again increasing (after the housing market crash of 2007 to 2012), and whereas one would expect that all the native uplands on private lands would be converted to intensive land uses by 2078, there are some county restrictions (*e.g.,* in Martin and St. Lucie Counties) that protect certain percentages of native uplands on private lands from development. We anticipate that the remaining counties in the study area would adopt similar regulations or that some land owners will take it upon themselves to protect these ecologically valuable areas as they become rarer in south Florida. This conversion of native or natural uplands results in a 50 percent increase in the quantity of non-native uplands by 2078 (without the project).

Open or deep-water habitats were not anticipated to change in quantity by 2078 without project. The spatial extent of these areas within any of the potential restoration sites was very low with the exception of the New Kissimmee River site (8.4 percent), and the Paradise Run site (3.7 percent).

Changes in Quality

The predicted loss of wetlands less than 0.5 acres in size resulted in a drop in their existing conditions EV to 0.19. The value of 0.19 was used because it was not possible to accurately predict these individual wetlands' future value on a case by case basis, and this new value equals the arithmetic mean of all intensive land use EVs (*i.e.,* the mean of all EVs for FLUCCS 1000 and 2000 Series in the watershed with the exception of FLUCCS Codes 2120 and 2130 – unimproved and woodland pastures, respectively).

For wetlands greater than 0.5 acres in size, the predicted change in quality over time without the project was dictated by changes in the surrounding uplands. As mentioned previously, it was assumed that there would be a 50 percent loss in native upland quantity due to conversion to intensive land uses by 2078 (without the project). Any wetland greater than 0.5 acres that was also surrounded by at least half native uplands, had their EV reduced by 25 percent (*e.g.,* a 2028 wetland with a value of 0.7 was reduced to a value of 0.52 in 2078 without the project). In the event that value reduction would result in a new EV less than 0.19, then the new EV would be set at 0.19.

For changes to native upland quality, it was assumed that 50 percent of the uplands that are currently classified as unimproved or woodland pasture (FLUCCS Codes 2120 and 2130), rangeland (FLUCCS 3000 Series), upland forests (FLUCCS 4000 Series), or rural lands in transition (FLUCCS Code 7410) would be converted into more intensive residential, agricultural, or commercial land uses (FLUCCS 1000, 2000, or 8000 Series) by 2078. As mentioned previously, it was difficult to predict to which of the more intensive land uses that these native uplands would be converted (the more intensive land uses have low ecological values ranging from 0.01 to 0.20). Therefore, the average EV for all intensive land uses (*i.e.,* 0.19) was used for future without project native upland HU losses.

For drained wetlands and non-native uplands, no changes in quality under future without project conditions were assumed because the values were already low. For open or deep-water habitats, changes in quality were also not anticipated by 2078

without the project, but these ecological values are moderate.

Using the Lake Okeechobee West site as an example, these are the calculations for the predicted future without project HUs.

Functioning Wetlands less than 0.5 acres = 0 acres or 0 existing condition HUs
Functioning Wetlands greater than 0.5 acres = 167.27 acres or 83.64 existing condition HUs
Drained Wetlands on FLUCCS 2110 = 1194.18 acres or 238.84 existing condition HUs
Drained Wetlands on FLUCCS 2120 and 3200 = 58.10 acres or 34.24 existing condition HUs
Native Uplands = 8.88 acres or 3.55 existing condition HUs
Non-native Uplands (on non-hydric soils) = 1362.31 acres or 268.43 existing condition HUs
Open/Deep Water = 9.02 acres or 4.51 existing condition HUs

Since there are no existing wetlands less than 0.5 acres, there was no loss in those HUs. For functioning wetlands, quality loss was based on adverse impacts over time to surrounding native uplands. Since there were no native uplands adjacent to any wetlands, there was no change in those HUs either. Similarly, the drained wetlands do not change in quality or quantity, but those HUs (238.84 and 34.24) were subtracted from the total HUs for FLUCCS Codes 2110 2120, and 3200 (541.51) resulting in 268.43 HUs for existing non-native uplands. This value is used in a subsequent calculation.

Native uplands are converted to non-native uplands by 50 percent of their spatial extent. As their quantity drops, those acres become non-native quality (i.e., ecological value dropped from 0.4 to 0.19). Therefore:

8.88 acres Upland Hardwood Forest x 50% = 4.44 acres; and
4.44 acres (unaffected) x 0.4 = 1.78 HUs (native uplands); and
4.44 acres (reduced) x 0.19 = 0.84 HUs (added to the non-native upland HUs).

So, the total future without Native Upland HUs = 1.78 (or 50 percent reduction from the 3.55 existing condition HUs). For 2078 non-native uplands, the spatial extent increases slightly due to the above conversion but the 2028 EVs do not change. Therefore, the future without non-native uplands HUs are 0.84 + 268.43 = 269.27 HUs.

For open or deep-water there are no changes and therefore no loss of HUs without the project. Therefore, the total HU without the project in 2017 is:

Functioning Wetlands less than 0.5 acres =	0.00	HUs
Functioning Wetlands greater than 0.5 acres =	83.64	HUs
Drained Wetlands on FLUCCS 2110 =	238.84	HUs
Drained Wetlands on FLUCCS 2120 and 3200 =	34.24	HUs
Native Uplands =	1.78	HUs
Non-native Uplands (on non-hydric soils) =	269.27	HUs
Open/Deep Water =	4.51	HUs
TOTAL FWO =	**632.28**	**HUs**

The existing conditions HUs for the Lake Okeechobee West site was 633.21 HUs, therefore the loss in HUs without the project (0.93) was very small. Over 90 percent of this site is improved pasture (EV=0.20; **Table 11**). Had this site been in better ecological quality, the loss of future without project HUs would have been greater.

Table 11. Existing Condition Ecological Value for each land use within the wetland restoration sites.

FLUCCS	Description	Existing Eco-Value
2110	Improved Pastures	0.20
2120	Unimproved Pastures	0.40
6410	Freshwater Marshes	0.50
2156	Field Crops - Sugar Cane	0.01
3100	Herbaceous Rangeland	0.20
6430	Wet Prairies	0.50
4271	Oak - Cabbage Palm Forest	0.40
6440	Emergent Aquatic Vegetation	0.70
6172	Mixed Wetland Hardwoods - Mixed Shrubs	0.50
4340	Hardwood Conifer Mixed	0.40
6300	Wetland Forested Mixed	0.50
7430	Spoil Areas	0.10
4110	Pine Flatwoods	0.40
6170	Mixed Wetland Hardwoods	0.50
6180	Cabbage Palm Savannah	0.40
5120	Channelized waterways, canals	0.50
6110	Bay Swamps	0.50
5110	Streams and Waterways	0.50
5600	Slough Waters	0.70
6411	Freshwater Marshes - Sawgrass	0.50
4200	Upland Hardwood Forest	0.40
4280	Cabbage Palm	0.40
5300	Reservoirs	0.50
6250	Wet Pinelands Hydric Pine	0.50
4220	Brazilian Pepper	0.10
3200	Shrub and Brushland	0.40
4270	Live Oak	0.40
6216	Cypress - Mixed Hardwoods	0.50
8115	Grass Airports	0.10
6240	Cypress - Pine - Cabbage Palm	0.50
3210	Palmetto Prairies	0.40
2430	Ornamentals	0.10
7400	Disturbed Land	0.10
1230	Mixed Units (Fixed and mobile home units) 2-5	0.01
3300	Mixed Rangeland	0.40
2510	Horse Farms	0.20

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Contact

Steve Schubert - U.S. Fish and Wildlife Service

Gretchen Ehlinger - U.S. Army Corps of Engineers

Andy Rodusky - South Florida Water Management District

Brent Bachelder - Florida Fish and Wildlife Conservation Commission

Shannan Bogdanov - Florida Department of Environmental Protection