APPENDIX G

BENEFIT MODEL

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G MODEL DOCUMENTATION INTRODUCTION

The Department of the Army Engineer Regulation (ER) 1105-2-100 requires that ecosystem restoration planning contribute to national ecosystem restoration (NER), which is measured in terms of increases in the net quantity and/or quality of desired ecosystem resources. The United States Army Corps of Engineers (USACE) uses NER benefits as the basis to compare alternatives and select plans for ecosystem restoration projects. The following report documents the methodology that was used to quantify ecological benefits and support plan evaluation, comparison, and selection for the Loxahatchee River Watershed Restoration Project. The LRWRP Planning Model underwent peer review per Engineering Circular (EC) 1105-2-412, 31 May 2011 (Assuring Quality of Planning Models) and was recommended for single-use on LRWRP by the National Ecosystem Restoration Planning Center of Expertise (ECO-PCX) on 27-JUL-2016. The HQUSACE Model Certification Panel approved the LRWRP Planning Model on 16-AUG-2016.

G.1 Overview of LRWRP Planning Model

The LRWRP planning model was specifically developed to evaluate project alternative benefits within the LRWRP project domain. The primary areas to be evaluated in the project domain include the Loxahatchee river watershed, the freshwater and tidal flood plains of Northwest Fork of the Loxahatchee River (NWFLR), the freshwater river itself, and the downstream oligohaline, mesohaline, and polyhaline zones. The planning model was developed by the Jacksonville District with support from multiple Federal, state, and local agencies including the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, National Marine Fisheries Service, South Florida Water Management District, Florida Fish and Wildlife Conservation Commission, Florida Department of Environmental Protection, Loxahatchee River District, Martin County, Palm Beach County, and City of West Palm Beach. Members of the project delivery team (PDT) include subject matter experts on Loxahatchee Watershed, River, and Estuary flora and fauna, with extensive experience working in south Florida and Everglades wetland systems in the fields of ecology, hydrology, engineering, and planning.

Performance measures were used to document the linkage between hydrologic output from models and ecosystem functions to evaluate the degree to which alternative plans met restoration objectives. Each of the performance measures were updated from the prior North Palm Beach County Part 1 project based on the availability of new tools, updated knowledge on the system from peer reviewed literature and technical reports, and RECOVER review comments. RECOVER is an interagency system-wide science team to support Comprehensive Everglades Restoration Plan (CERP) projects and is made up of Everglades scientists independent of the PDT. Each performance measure has a predictive target and process for how to measure predicted performance of alternatives. Targets were based on peer-reviewed relationships between hydrology and ecological species or communities, and technical synthesis reports of multiple data sources identifying restored conditions in the Loxahatchee River and Estuary. Performance measure scores were displayed as a function of restoration potential or achievement of the target. Habitat unit (HU) scores were produced by indexing the scores 0-1. The indexed scores were then multiplied by their proportion of the total index score for a given ecological zone (i.e., some performance measure outputs overlap in area) and then multiplied by the area to get the HUs. HUs were then evaluated for the Existing Condition Baseline (ECB), future without project (FWO) condition, and project alternatives, to identify the best performer for each zone and the whole Loxahatchee River watershed and estuarine system.

G.2 Description of Project Performance Measures

Three performance measures (PM) were developed to measure five restoration objectives (see **Table G-1**) for LRWRP within five ecological zones (see **Table G-2**):

1. **Flows to Manage Salinity and Floodplain Inundation PM 1** - Seasonal flows to manage salinity and floodplain hydroperiod in the NWFLR to benefit native flora and fauna.
2. **Watershed Hydrology PM 4** - Hydrologic regimes of major plant communities in the Loxahatchee watershed and adjacent wetlands based on inundation durations.
3. **Connectivity PM 9** - Measuring potential benefits of reconnecting natural areas specific to four criteria (1-Hydrologic flow; 2-Greenway; 3-Water Quality; and 4-Endangered and/or Rare Species).

Table G-1. LRWRP Project Objective linked to performance measures.

1. Restore wet and dry season flows to Northwest Fork of Loxahatchee River	√	Not Applicable	Not Applicable
2. Restore and/or maintain estuarine communities (oysters, fish, seagrass)	√	Not Applicable	Not Applicable
3. Increase natural area extent of wetlands	√	√	Not Applicable
5. Restore native plant and animal species abundance and diversity	√	√	√

Table G-2. Ecosystem Zones linked to performance measures.

Ecosystem Zones	PM 1	PM 4	PM 9
Watershed Wetlands – Freshwater Flora and Fauna	Not Applicable	√	√
Cypress Swamp-River Floodplain - Freshwater Flora and Fauna	√	Not Applicable	√
Tidal River Floodplain -	√	Not Applicable	Not Applicable
Oligohaline with *Vallisneria americana* and Fish Larvae	√	Not Applicable	Not Applicable

Mesohaline - Oysters	√	Not Applicable	Not Applicable
Polyhaline - Seagrass	√	Not Applicable	Not Applicable

G.3 Hydrologic Models Used

Several hydrologic modeling tools were used to provide the output used in PMs 1 and 4. GIS data were used to analyze PM 9. **Figure G-1** provides an overview of models used to measure performance measure output for the seven habitat zones. Some of the zones overlap and the benefits model process describes later on in the document how the results were combined to avoid double counting.

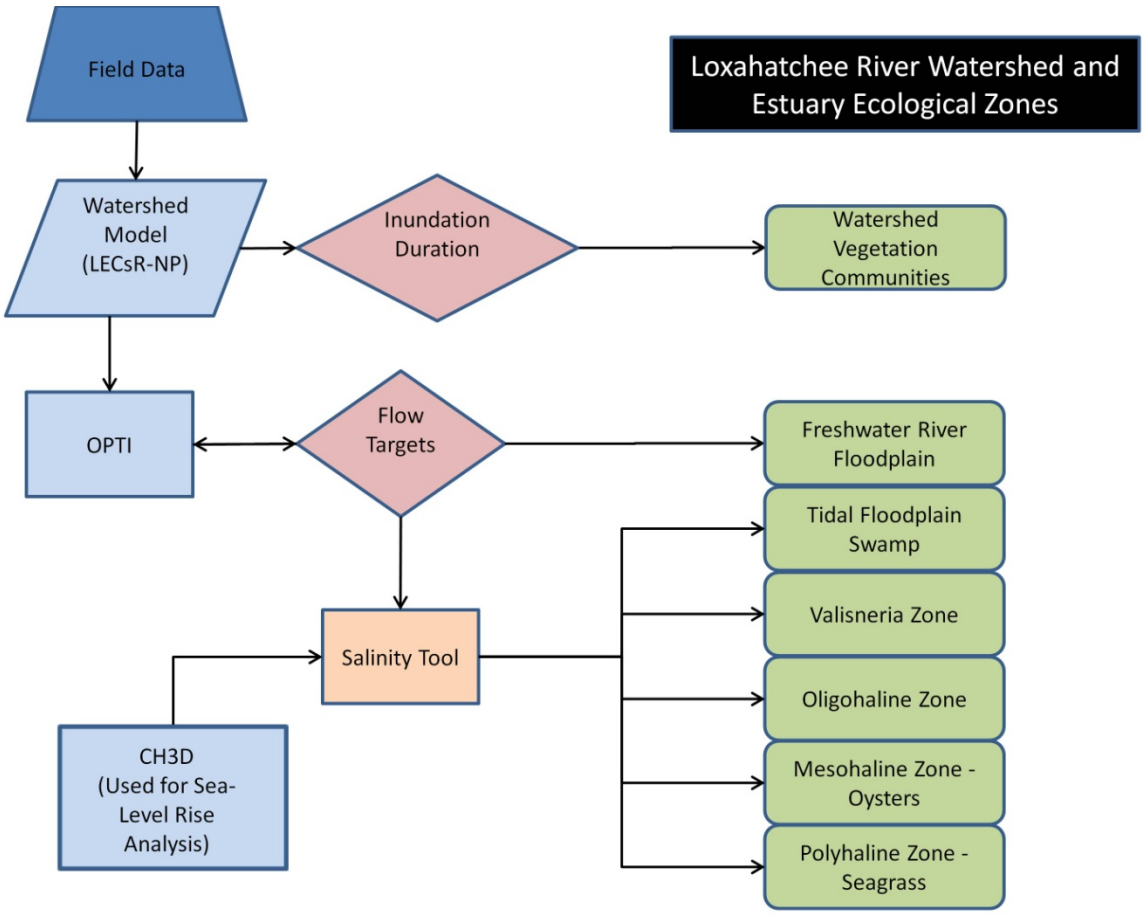

Figure G-1. Diagram of models used to measure performance in the Loxahatchee River, Watershed, and Estuary ecological zones.

G.3.1 Spatial Extent of Performance Measures.

The performance measures cover the Loxahatchee River Watershed depicted in **Figure G-2**. Performance measure 1 covers the riverine floodplain, river and downstream to the estuary (see **Figure G-2** [orange circle] and **Figure G-3**). Performance measure 4 covers the watershed vegetation communities. Performance measure 9 is mostly focused in the watershed leading into the river.

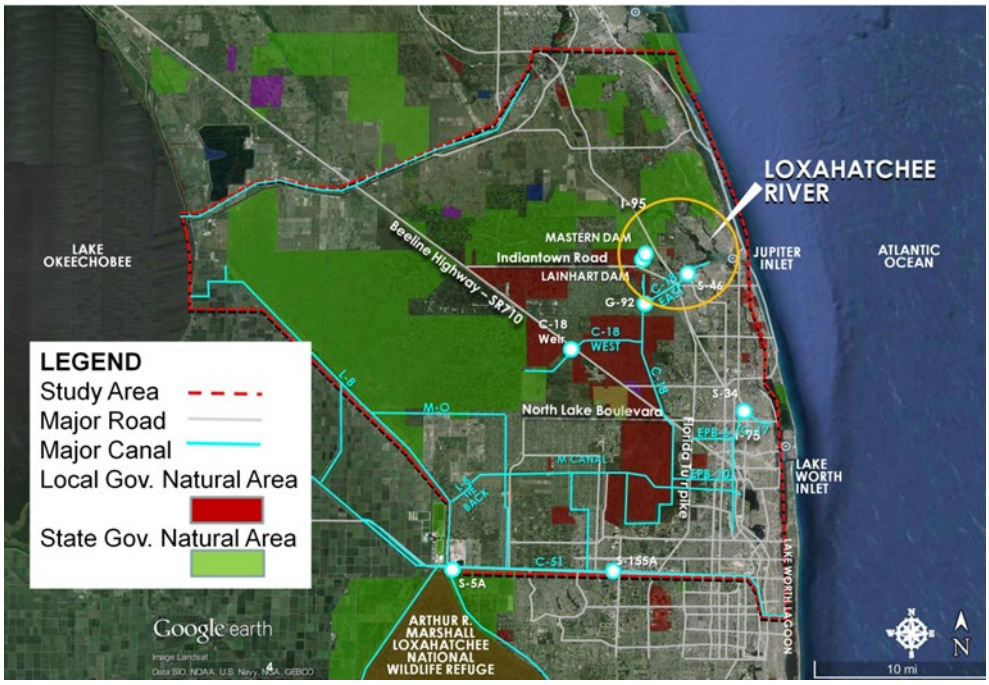

Figure G-2. Map of Loxahatchee River Watershed Project Area including river and estuary.

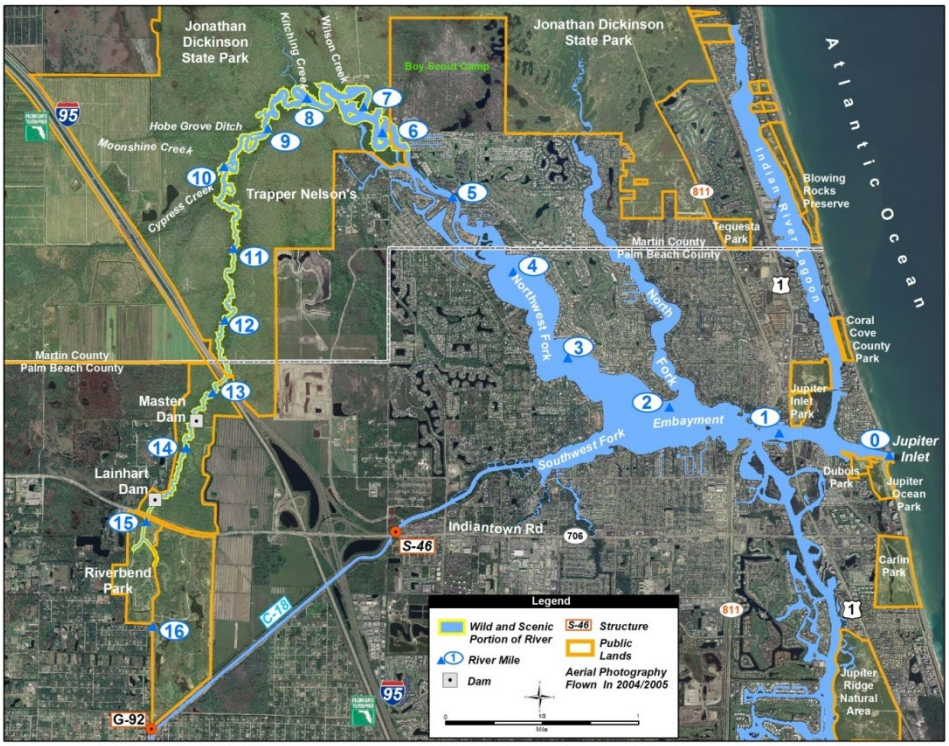

Figure G-3. Loxahatchee River close-up.

G.3.1.1 Performance Measures.

The following provides a brief description of the above performance measures including the performance measure target for each, and the applicable metrics for the target(s).

G.3.2 PM 1 – Flows to Manage Salinity and Floodplain Inundation

The purpose of LRWRP is to restore and sustain the overall quantity, quality, timing, and distribution of freshwaters to the federally designated "National Wild and Scenic" NWFLR for current and future generations. This performance measure concentrates on the restoration and preservation of key indicator species (Valued Ecosystem Components or VECs, USEPA 1987) from the farthest upstream freshwater section of the river to the outer estuary. Performance metrics representing characteristic regimes of hydrology or salinity at desired locations are identified for each of the VECs in order to evaluate alternative scenarios. The areas in the river and estuary designated in these targets have been determined based on mainly two factors, dynamic and static habitat. Dynamic habitat is then paired up with a location in the river or estuary where the static habitat is conducive to the health and survival of that VEC. For example, the preferred location for juvenile fish can be found where both the salinity is favorable and where there is floodplain and shoreline vegetation and SAV such as *Vallisneria* to provide refuge for small fish to hide from predators. Another example is the oyster which needs not only favorable salinity conditions but also hard bottom substrate for larvae (spat) to settle on.

In the Restoration Plan for the Northwest Fork of the Loxahatchee River (Restoration Plan) (SFWMD *et al*. 2006) and the addendum (SFWMD et al. 2012), the Northwest Fork ecosystem was partitioned into the following five habitat zones, each with its own specific valued ecosystem components (VECs) to evaluate the biological effects of each restoration flow alternative. For this study we added one more habitat zone and VEC, *Vallisneria americana*, which provides excellent structural habitat for small fish and invertebrates as well as food for such things as turtles and manatees. Under the recommended variable flow scenarios, which include both seasonal and short term (daily to monthly) variation, it was determined that the six desired habitat zones and their associated VECs would be established in the following areas of the river and have the associated salinity target ranges:

- Floodplain swamp and hydric hammock in the freshwater riverine floodplain – 0 practical salinity units (psu), 4 to 8 months inundation per year during the months of June–November (RM 16 to RM 9.5)
- Floodplain swamp in the tidal floodplain – < 2 psu (RM 9.5 to RM 8.1)
- *Vallisneria americana* – < 5 psu (RM 10.5 to RM 6.5)
- Fish larvae in the oligohaline zone – preferred salinity range of 2 to 8 psu (RM 10 to RM 5.5)
- Oysters in the mesohaline zone – preferred salinity range of 10 to 20 psu (RM 6.0 to RM 3.5)
- Seagrasses in the polyhaline zone – preferred salinity range of > 20 psu (RM 4.0 to RM 0.0)

The alternatives, which will include sets of management measures, will be compared against each other and the FWO by running the series of models outlined in **Figure G-1**. These models are linked together with the Northern Palm Beach County version of the Lower East Coast Sub-regional Model (LECSR-NP), providing output to the OPTI model, which optimizes operations of the alternative in order to best meet the flow and inundation targets. The optimized operation output flows are evaluated for the inundation duration targets for the freshwater floodplain and also fed into the salinity regression tool, which outputs salinity zones in ½-mile increments throughout the entire river and estuary from the top of the river to the inlet.

G.3.3 PM 4 – Watershed Vegetation Community Hydrology

One of the goals of the Loxahatchee River Watershed Restoration Project (LRWRP) is to achieve appropriate depth, duration and frequency targets in the Loxahatchee watershed wetlands (USACE and SFWMD 2014). The draft Loxahatchee Watershed Conceptual Ecological Model (2004) states that general hydrologic requirements need to be defined for each of the major plant communities identified within the indicator regions. As described by the Florida Natural Areas Inventory (FNAI 1990), fifteen of these distinct plant communities are found within Jonathan Dickinson State Park (Roberts et al. 2006) and the Loxahatchee River watershed. The nine most dominant plant communities are mesic and wet flatwoods, wet prairie, floodplain, strand and dome swamp, depression marsh, and mesic and hydric hammock.

The performance measure target is as follows: seasonal hydrologic regimes to be within five % (plus or minus) of desired values for major wetland plant communities at specified indicator regions (See **Figure G-4**). Desired values were based on literature data, model outputs for pre-development conditions, and/or existing conditions in unimpacted areas based on field assessment data collected through the wetland

rapid assessment procedure (WRAP, Miller and Gunsalus 1999). At minimum these literature based community hydrologic regimes will be used as targets for each major wetland plant community. However, they are subject to refinement based on comparison and validation of model outputs from Lower East Coast Sub-Regional Model (LECSR) to actual field conditions in unimpacted areas. Refinements would only be made if field conditions indicated the community was unimpacted and experiencing a different hydrologic regime than understood from published literature in **Table G-3**. (Sources: Drew and Schomer 1984; Duever et al 1984; Vince et al. 1989; Abrahamson and Harnett, 1990; Myers and Ewel 1990; Mitsch and Gosselink 1993; David 1996; FDEP 2003).

Table G-3. Annual average water depth and annual inundation for major wetland plant communities identified within the Loxahatchee watershed.

Plant Community Type	Annual Avg. Water Depth (inches)	Inundation Duration* (days/yr)	Target - Median Inundation Duration (days/yr)	Target Inundation Duration 36 Year Period of Record (POR)
Mesic Flatwood	Below ground	<30	15	540
Mesic (Oak) Hammock	Below ground	0-60	30	1080
Hydric Flatwood	0-6	30-60	45	1620
Hydric Hammock	0-6	30-60	45	1620
Depression Marsh	12-24	180-300	240	8640
Wet Prairie	6-16	60-180	120	4320
Strand Swamp	18-36	210-300	255	9180
Floodplain Swamp	12-30	120-240	180	6480
Dome Swamp	12-24	210-300	255	9180

Note: * Frequency of inundation duration days/yr coincides with wet weather patterns and existing groundwater conditions.

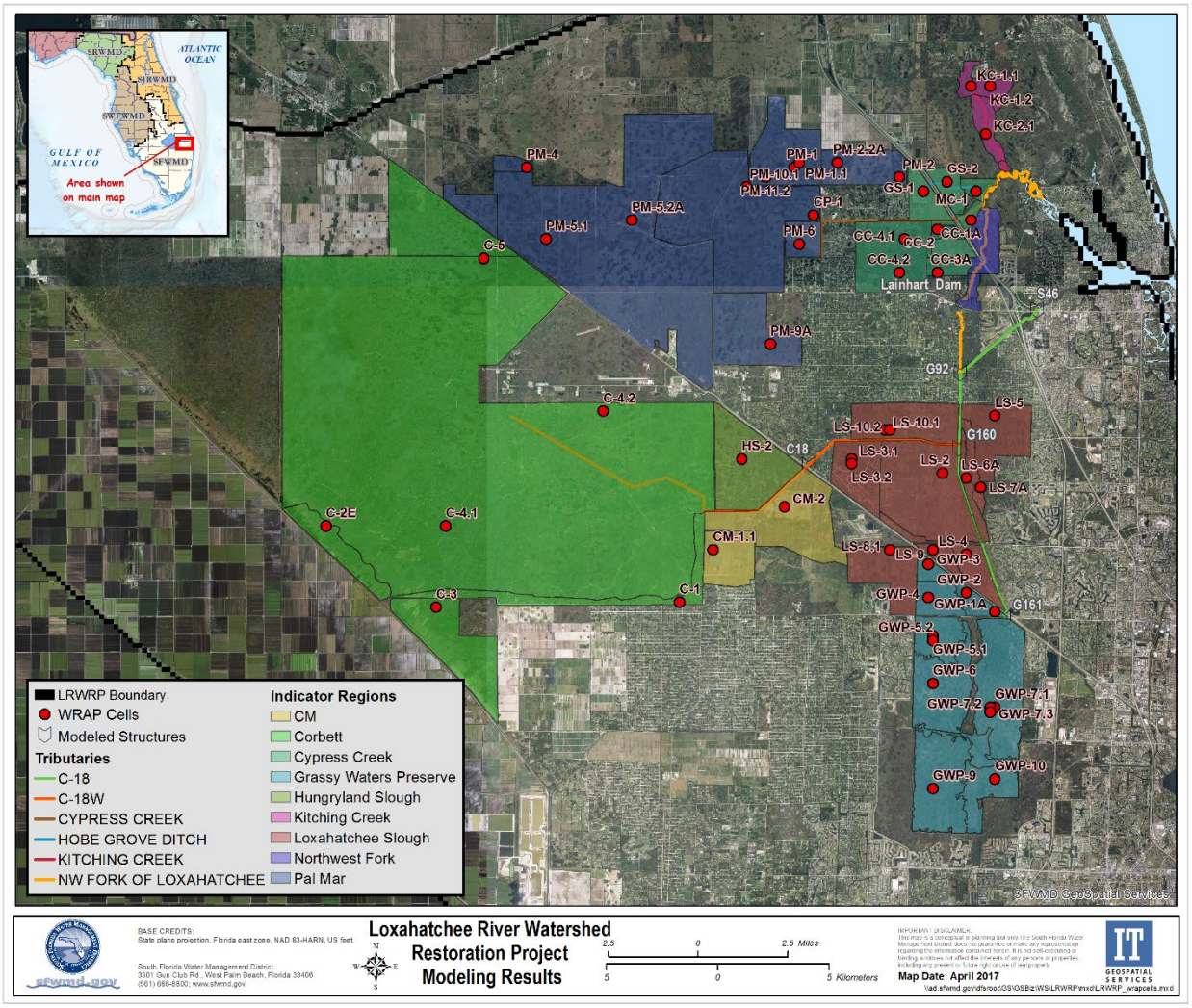

Figure G-4. Map of Indicator Regions.

G.3.4 PM 9 – Connectivity

Agricultural practices and urban development activities such as drainage systems, roadways, utility corridors, and housing have disrupted and impacted wetland communities by fragmenting the natural hydrologic landscape. Specifically, the continuity of pre-development surface water flow through wetland systems has been compromised, and the loss of continuity between and among greenway connections has resulted in the loss of wildlife habitat and functionality. Hydrologic connectivity is essential to the ecological integrity of the landscape, and reduction or alteration by anthropological processes can have major negative environmental effects (Pringle 2003).

Potential for hydrologic and spatial connectivity will be evaluated using the "Connectivity Matrix" (**Table G-4**) developed by the interagency team. The connectivity target is the highest % increase in connectivity

compared to the total maximum score achievable of 100% based on Hydrologic/Spatial Connectivity Matrix and Scoring Rubric (see **Table G-4**). CRITERION SCORING: **0**: No/Does not occur; **12.5:** Partially occurs; **25**: Yes/Definitely occurs. No specific targets were stated for CERP in the 1999 Comprehensive Plan or by RECOVER.

Table G-4. Hydrologic/Spatial Connectivity Matrix.

Hydrologic/Spatial Connectivity Matrix Target	Criterion Value based on Subteam Assessment (Example)	Maximum Score Possible
Downstream Hydrologic Linkage: Connection provides historic hydrologic linkage which contributes to the restoration of downstream areas and improved quantity, timing and distribution of water. Connections that are closer to the river (<10 miles) and are continuous based on GIS analysis will be scored higher than those further away.	12.5	**25**
Greenway Corridor: Connections cover majority area (>50%) of an existing or proposed greenway.	25	**25**
Water Quality: Connectivity promotes water quality improvements and protects water quality by allowing for only sheetflow across natural lands and natural flow ways.	12.5	**25**
Fish and Wildlife: Connectivity contributes to expanded native habitats and the support of wildlife populations by improving the following: 1) foraging range, 2) territory, or 3) migration path of listed or rare endemic species. Restoration actions address 2-3 of the criteria using maps of known species occurrences and potential habitats.	25	**25**
TOTAL SCORE	75	**100**

While a quantitative approach focused on counting the number of miles of levee, berms, canals, ditches removed could have been developed, it wouldn't necessarily be accurate with respect to more is better for connectivity. The team chose a qualitative approach focused on GIS analysis and best professional judgment to maximize the benefits of connectivity related to four ecologic, hydrologic and management criteria: Downstream Hydrologic Linkage; Greenway Corridor; Water Quality (RECOVER, 2007); and Fish and Wildlife (Smith, et al., 1996; Beier and Noss, 1998; Bond, 2003; Hoctor, et al., 2008). To avoid subjectivity, we standardized the approach to evaluate alternatives using a scoring rubric developed as a method of evaluating potential connectivity to meet ecosystem restoration objectives. Each alternative is evaluated to determine how well it meets each criterion by using a scoring rubric (**Table G-4**): not at all = 0; partially = 12.5; yes, completely = 25. There are four criteria resulting in a total possible score for any alternative of 100 with performance varying by 12.5 increments all the way to zero. The ECB is scored as a 0 from the standpoint of natural areas being disconnected with respect to hydrology and flow to the river, and natural areas allowing natural movement of physical and biological resources. The team assumes that connectivity will not get worse in publicly owned lands. The FWO condition will likely be slightly better given some restoration efforts that are likely to be implemented by partner agencies at the

state, county, and city levels. All alternatives are then compared to FWO alternative score to estimate increased connectivity from actions to plug canals and ditches, flow-ways to improve hydrologic connections, removal of levees/berms that are barriers to flow, and providing movement of water below roads and between natural areas.

G.4 Method: Calculation of Ecosystem Benefits

The calculation of ecosystem benefits (quantitative scoring) consisted of the following steps: 1) *Normalize Scores* - normalizing performance measures output to a common scale (0-1); 2) *Combine Scores and Calculate Habitat Units* - combine performance measures into aggregates scores for each habitat zone in the project area (i.e., watershed evaluation polygons, freshwater river floodplain, tidal river floodplain, *Vallisneria*, oligohaline, mesohaline, polyhaline) and multiply by acreages to get habitat units; and 3) *Compare Habitat Units* - Aggregate watershed habitat units and compare alternatives by habitat zones.

G.4.1 Step 1 – Normalize Performance Measure Scores to Common Scale

Performance measure scores were calculated for restoration alternatives and then scaled to 0-1 scale using the following processes for each performance measure.

G.4.1.1 Performance Measure 1 Normalization

The original approach to calculate ecosystem benefits for the river and estuary involved calculation of inundation frequencies (period of record annual averages in the freshwater floodplain (salinity < 0) using model output related to flow from the LECSR model. The frequency the floodplain was wet was compared to the target of 4-8 months in river mile 16.0 to 9.5. The salinity output from the CH3D salinity model tool would then be used to compare with target ranges for the other five VECs in the specified area of where they should occur in a restored condition. The output is normalized 0-1 using the following rubric (see **Table G-5**).

Table G-5. Scoring rubric to index PM 1 output for river and tidal floodplain, *Vallisneria*, oligohaline, mesohaline, and polyhaline zones.

Score	Riverine Floodplain	Tidal floodplain	*Vallisneria americana* (tapegrass)	Oligohaline Zone (Juvenile Fish)	Mesohaline Zone (Oysters)	Polyhaline Zone (Seagrass)
1	Inundation June-November for 4-8 months	Salinity target met in 80-100% of the specified area	Salinity target met in 80-100% of the specified area	Salinity target met in 80-100% of the specified area	Salinity target met in 80-100% of the specified area	Salinity target met in 80-100% of the specified area
0.75	Inundation June-February for 3-9 months	Salinity target met in 60-80% of the specified area	Salinity target met in 60-80% of the specified area	Salinity target met in 60-80% of the specified area	Salinity target met in 60-80% of the specified area	Salinity target met in 60-80% of the specified area

Score	Riverine Floodplain	Tidal floodplain	*Vallisneria americana* (tapegrass)	Oligohaline Zone (Juvenile Fish)	Mesohaline Zone (Oysters)	Polyhaline Zone (Seagrass)
0.50	Inundation of < 3months and/or 9-10 months	Salinity target met in 40-60% of the specified area	Salinity target met in 40-60% of the specified area	Salinity target met in 40-60% of the specified area	Salinity target met in 40-60% of the specified area	Salinity target met in 40-60% of the specified area
0.25	12 months of no inundation and/or 11-12 months of continual inundation	Salinity target met in 20-40% of the specified area	Salinity target met in 20-40% of the specified area	Salinity target met in 20-40% of the specified area	Salinity target met in 20-40% of the specified area	Salinity target met in 20-40% of the specified area
0.00	24 or more months of no inundation and/or constant inundation for >12 months	Salinity target met in <20% of the target area	Salinity target met in <20% of the target area	Salinity target met in <20% of the target area	Salinity target met in <20% of the target area	Salinity target met in <20% of the target area

However, the CH3D salinity model tool output was not sensitive to providing meaningful habitat units for the river and estuary. The tributary and groundwater flow did not represent meaningful differences among the future with and future without project flows going to the river/estuary down stream of Lainhart due to lack of calibration data, which fed into the CH3D salinity model tool. The salinity tool output is presented in Appendix C.2 to describe a representation of alternative effects on these several VECs, but the approach utilized in Table G-5 given small changes in tributary flow, didn't show much change between alternatives when combining salinity zones into habitat units. A different approach was used to provide more sensitive calculation of river and estuary benefits based on the original performance measure 1 using dry season flows across Lainhart dam and is further explained in section G.5.2

G.4.1.2 Performance Measure 4 Normalization

The ECB model derived score for hydrology was modified based on field assessment data derived from the WRAP field assessment scores (Miller and Gunsalus, 1999). The WRAP field assessment uses specific criteria to score hydrology criteria on a scale of 0-3 in 0.5 increments. The example indicator region LS-2 had a hydrology field score of 2. The field derived ECB score is then divided by 3 to calculate the normalized score 0-1 and multiplied by the target days for the dominant vegetation community to determine the number of days inundated over the period of record. For LS-2, the ECB score would be 2/3 or 0.67 multiplied by 8,640 target inundation days for 5,788 (number of days the model cell would need to be inundated to receive a field score of 2). The model (LECSR daily elevation data for each WRAP cell were then examined to find the corresponding elevation that resulted in the calculated number of inundation days (the calibration line) for all WRAP evaluation cells in each indicator region. For LS-2, a normalized

scored of 0.67 and 5,788 inundation days would correspond to an elevation of 16.51 in the model (calibration line). The ECB score for LS-2 = 0.34 based on the WRAP assessment score of 2 divided by 3 for a score of 0.67 multiplied by a scaling factor of 0.5. The calibration line for the WRAP evaluation cell and LIDAR ground elevation of each indicator region was then used to compare FWO and project alternative to calculate inundation days. The inundation days model output (X_m) is divided by the target inundation days (X_t) for the dominant vegetation community in the indicator region to get a score ranging from 0-1. PM 4 Score = X_m/X_t, see **Example 1**.

Example 1 - FWO: Indicator Region LS-2, depression marsh is dominant vegetation community. X_m = 5,581, X_t = 8,640, PM4 score = 0.65.

The score is then rescaled to reflect the non-linear nature on wetland functional unit value compared to an index score (See **Table G-6**).

Table G-6. PM 4 WRAP Score Re-Scaling Table.

WRAP Score	Re-Scale Factor
1.00 – 0.85	1.00
0.84 – 0.70	0.75
0.69 – 0.55	0.50
0.54 – 0.40	0.25
<0.39	0.10

The scaling of the WRAP scores differentiates between those systems functioning at a very high level (1.00–0.85) to those systems exhibiting heavy impacts and functioning at a low level (<0.40). In addition to differentiating between severely degraded wetlands compared to those which are minimally impacted, the weighting factor also addresses the linearity associated with scoring the WRAP components. The linearity is unintentional and a consequence of scaling the scoring from 0 to 1. The LRWRP eco-subteam that developed the PMs recognized that restoration is not linear. For example, a 0.25 change in scoring from 0.25 to 0.50 is different than a 0.25 change in scoring from a 0.50 to 0.75, not only from a functionality standpoint, but mathematically. A 0.25 increase from 0.25 to 0.50 is a 100% increase, while a 0.25 increase from 0.50 to 0.75 is a 50% increase. As a general guideline, wetlands with WRAP scores ranging from 0.85 to 1.0 are high quality, 0.84-0.70 are medium high, 0.69-0.55 are medium, 0.54-0.40 are low quality and ≤0.39 are poor quality wetlands. Therefore, the 0.50 to 0.75 increase is likely more ecologically significant from an improved function standpoint than a 0.25 to 0.50 increase.

Using the example above, the LS-2 indicator regions had a score of 0.65 and would then be multiplied by 0.50 to get a final score of 0.33 for the FWO.

G.4.1.3 Performance Measure 9 Normalization

GIS data is used to evaluate project alternatives degree of connectivity using the four criteria and the scoring rubric methodology in **Table G-7**.

Table G-7. Scoring Criterion Rubric.

Criterion	No/Does not Occur = 0	Partially Occurs = 12.5	Yes/Definitely Occurs = 25
1.0 - Hydrologic Linkage to River	Restoration actions do not allow any additional water to flow to the Loxahatchee River;	Restoration actions improve wetland storage near Loxahatchee River that allows for groundwater recharge that is greater than 10 miles away from the river; or promotes additional flows of water to the river.	Restoration actions improve wetland storage near Loxahatchee River that allows for groundwater recharge, and/or promotes additional flows of water to the river and are closer than 10 miles to the river.
2.0 - Greenway Corridor	Restoration actions do not support hydrological restoration or additional connections to existing or proposed greenway corridors.	Restoration actions support hydrological restoration and/or greenway land connections in a portion of existing or proposed greenway corridors.	Restoration actions support hydrological restoration and/or greenway land connections along a majority of an existing or proposed greenway corridor.
3.0 - Water Quality Improvements	Connectivity and restoration actions do not provide additional water quality improvements.	Connectivity and restoration actions improves water quality by partially allowing for sheetflow across natural lands, natural flow ways providing some treatment, but also utilizing the canal system.	Connectivity and restoration actions improves water quality by allowing for only sheetflow across natural lands and natural flow ways.
4.0 - Flora and Fauna	Restoration actions do not lead to wildlife connectivity.	Restoration actions address 1 of 3 questions regarding flora and fauna benefits from connectivity	Restoration actions address 2-3 of the 3 questions regarding flora and fauna benefits from connectivity.

A derived score from combining the criterion values is then divided by 100 to get an index value of 0-1. For example, an alternative that scores a 62.5, divided by 100, would get a normalized score of 0.625.

G.4.2 Step 2 – Combine Performance Measure Scores into Habitat Zone Scores and Calculate Habitat Units

Performance measure output scores for PM4 and PM9 were combined for the Loxahatchee River indicator region and then multiplied by the indicator region acreage to get habitat units. The PM1 output score is used for the other habitat zones Loxahatchee river watershed, the freshwater and tidal flood plains of Northwest Fork of the Loxahatchee River, the freshwater river and the downstream oligohaline, mesohaline, and polyhaline zones, and is not combined with any other PM output. The PM1 scores are multiplied by the areas of the zones they represent to generate habitat units. The process is described in more detail below.

G.4.2.1 Loxahatchee River Watershed

The watershed habitat zone scores are made up of scores from PM 4 and PM 9. Because hydrology is the dominant driver of change related to restoration and based on more empirical data, PM 4 represents 90% of the combined score for each indicator region and PM 9 represents 10 % of the score. The combined score for an indicator region *i* (PC_i) is the indicator region PM 4 score ($PM4_i$) x 0.9 plus the PM 9 score ($PM9_i$) x 0.1

Equation: $PC_{i=} PM4_i*0.9 + PM9_i \times 0.1$

For example, using LS-2 indicator region, the FWO PC_i score is based on PM4 score is 0.34 and the PM9 score is 0. The combined watershed performance score for the LS-2 (PCi) would be 0.31 = 0.34(0.9) + 0(0.1).

The combined watershed performance score for LS-2 is then multiplied by the indicator region area of 3,849 acres to calculate habitat units of 1,193 for the future without project condition.

Indicator region habitat unit scores are then combined to get the total habitat units for the watershed zone for the FWO and project alternatives. See **Table G-8** for FWO total habitat unit score for the Loxahatchee Watershed Zone.

Table G-8. Example watershed zone performance measure output and calculation of habitat units.

Indicator Region	Acres	Dominant Vegetation	Target Inundation	FWO Inundation	PM 4 Initial Score	PM 4 Function Scale Factor	PM 4 Function Scaled Score	PM 9 Score	PM 4 & 9 Combined	FWO HUs	Maximum HUs
C-1	1,642	DM	8,640	5,761	0.67	0.50	0.34	0.00	0.30	**495**	1,642
C-2E	1,226	DM	8,640	5,820	0.67	0.50	0.34	0.00	0.30	**370**	1,226
C-3	2,806	DS	9,180	3,035	0.33	0.10	0.03	0.00	0.03	**83**	2,806
C-4.1	54,871	DM	8,640	7,166	0.83	0.75	0.62	0.00	0.56	**30741**	54,871
C-5	3,170	DM	8,640	7,153	0.83	0.75	0.62	0.00	0.56	**1776**	3,170
CC-1	202	FS	1,800	591	0.33	0.10	0.03	0.00	0.03	**6**	202
CC-2	557	FS	1,800	135	0.08	0.10	0.01	0.00	0.01	**4**	557
CC-4.1	2,542	DM	2,400	1,353	0.56	0.50	0.28	0.00	0.25	**641**	2,542
GS-1	1,411	DM	2,400	403	0.17	0.10	0.02	0.00	0.02	**22**	1,411
GWP-10	1,107	DS	9,180	2,233	0.24	0.10	0.02	0.00	0.02	**24**	1,107
GWP-1A	42	DS	9,180	2,738	0.30	0.10	0.03	0.00	0.03	**1**	42
GWP-2	397	DS	9,180	4,237	0.46	0.25	0.12	0.00	0.10	**41**	397
GWP-3	308	DS	9,180	5,318	0.58	0.50	0.29	0.00	0.26	**80**	308
GWP-4	755	DS	9,180	8,497	0.93	1.00	0.93	0.00	0.84	**632**	755
GWP-5.1	977	DS	9,180	6,832	0.74	0.75	0.56	0.00	0.50	**488**	977
GWP-6	2,134	DS	9,180	5,836	0.64	0.50	0.32	0.00	0.29	**615**	2,134
GWP-7.1	2,992	DS	9,180	3,459	0.38	0.10	0.04	0.00	0.03	**102**	2,992
GWP-9	2,518	DS	9,180	4,953	0.54	0.25	0.14	0.00	0.12	**306**	2,518
LS-2	3,849	DM	8,640	5,581	0.65	0.50	0.33	0.00	0.29	**1126**	3,849
LS-3.1	1,451	DM	8,640	4,316	0.50	0.25	0.13	0.00	0.11	**163**	1,451
LS-4	772	DM	8,640	3,421	0.40	0.10	0.04	0.00	0.04	**28**	772
LS-5	1,782	DM	8,640	490	0.06	0.10	0.01	0.00	0.01	**10**	1,782
LS-6A	405	DM	8,640	2,819	0.33	0.10	0.03	0.00	0.03	**12**	405
LS-7A	426	SS	9,180	259	0.03	0.10	0.00	0.00	0.00	**1**	426

Indicator Region	Acres	Dominant Vegetation	Target Inundation	FWO Inundation	PM 4 Initial Score	PM 4 Function Scale Factor	PM 4 Function Scaled Score	PM 9 Score	PM 4 & 9 Combined	FWO HUs	Maximum HUs
MC-1	266	FS	1,800	293	0.16	0.10	0.02	0.00	0.01	**4**	266
PM-1	2,177	DM	2,400	1,230	0.51	0.25	0.13	0.00	0.11	**250**	2,177
PM-2	1,452	DM	2,400	754	0.31	0.10	0.03	0.00	0.03	**41**	1,452
PM-3	709	DM	2,400	1,952	0.81	0.75	0.61	0.00	0.55	**388**	709
PM-4	284	DM	2,400	1,999	0.83	0.75	0.62	0.00	0.56	**159**	284
PM-5.1	19,672	DM	2,400	1,994	0.83	0.75	0.62	0.00	0.56	**11021**	19,672
PM-6	636	DM	2,400	404	0.17	0.10	0.02	0.00	0.02	**10**	636
PM-7A	4,236	DM	2,400	1,567	0.65	0.50	0.33	0.00	0.29	**1239**	4,236
PM-8	671	DM	2,400	1,927	0.80	0.75	0.60	0.00	0.54	**362**	671
PM-9	637	DM	2,400	937	0.39	0.10	0.04	0.00	0.04	**22**	637
CG	2,700	DM	2,400	NA	0.17	0.10	0.02	0.00	0.02	**41**	2700
Totals	121,782	NA	NA	NA	NA	NA	NA	NA	NA	**51,304**	**121,782**

Loxahatchee River Freshwater Floodplain

The scores for the Loxahatchee Freshwater Floodplain are already normalized 0-1 using PM1 output. Scores are broken out by area as part of the PM 1 and need to be multiplied by the area to develop habitat units. See the following example for a hypothetical alternative.

The area of the river between RM 12.0 and 16.0 was inundated for 6 months during the preferred time frame of June – November giving that area a score of 1 and acreage size was 650 acres, but in the area between RM 9.5 and 12.0 the floodplain was only inundated for 3 months giving that portion of the river a score of 0.5 and acreage size was 300 acres. Therefore the habitat units for the Riverine Floodplain habitat zone 300 x 0.5 = 150 and 650 x 1.0 = 650, therefore 150 + 650 = 800 habitat units.

Loxahatchee River Tidal Floodplain, Vallisneria, Oligohaline, Mesohaline, and Polyhaline Zones

The Loxahatchee River Tidal Floodplain, Vallisneria, Oligohaline, Meshaline, and Polyhaline Zones scores and habitat units are all calculated in the same way. Model output scores are calculated and in some areas there is overlap of salinity ranges for the habitat zones. Where the overlap occurs between two habitat zones (e.g., oysters and SAV at river mile 4-3.5), the scores for both oysters and SAV are multiplied by 0.5. For example, salinity zone for oysters is met on annual average for the period of record ranging between 10 to 25 psu between river miles 6 to 4, and acreage of 250.

G.4.3 Step 3 - Compare Alternatives

Habitat units are used to compare project alternatives compared to the FWO for each habitat zone and for the total project area. The cost effectiveness and incremental cost analysis (CE/ICA) will identify the most cost effect alternative for each habitat zone, as well as the total project area. The results will be displayed in a table (see **Table G-9**) examining cost and habitat units over the FWO.

Table G-9. Example cost-effectiveness comparison table by habitat zone and total project area.

Project Alternative	Cost	Watershed	Freshwater Floodplain	Tidal Floodplain	Vallisneria	Oligohaline (Fish Larvae)	Mesohaline (Oysters)	Polyhaline (Seagrass)	Total Project Area
FWO	N/A	51,304	456	325	300	700	200	500	53,785
Alt. A	N/A	79000	600	400	450	1000	300	505	82,255
Alt. B	N/A	85000	750	480	500	1100	350	525	88,705
Alt. C	N/A	84000	850	600	500	1250	400	530	88,130
Alt. D	N/A	95000	950	650	500	1250	375	530	99,255
Alt. E	N/A	66000	950	625	500	1500	400	530	70,505

Ultimately, the best performance plan should be cost-effective for the most habitat zones to ensure restoration alternatives meet all project objectives.

G.5 Loxahatchee River Watershed Restoration Project Evaluation of Alternative Plan Benefits

Performance measures 4 (watershed plant community hydrology) and performance measure 9 (connectivity) were evaluated as described in the approved planning model and are presented below. Performance measure 1 output had to be modified to focus on the original performance measure output based on restoration flows to the northwest fork of the Loxahatchee River. The salinity modeling output was not reliable due to the fact that tributary flows did not show meaningful differences from the base conditions. This resulted in very few differences between alternatives compared to the base condition for the oligohaline and Vallisneria zones. This information is presented below when documenting river and estuarine benefits. The overall approach for evaluating river and estuarine benefits is consistent with the Loxahatchee River Restoration Plan.

G.5.1 Watershed Benefits

G.5.1.1 Performance Measure 4 Output

Alternative 13 performed the best due to the natural storage area in flow-way 2 with a PM 4 score of 0.49 (38,605 habitat units [HUs]). Alternative 5R followed with a close second having similar flow-way 1 and 3 features with a PM score of 0.48 (37,261 HUs). Alternative 2 followed with a PM score of 0.46 (36,138 Hus) habitat units with slightly more habitat units in flow-way 2 than alternative 5r due to seepage from the shallow L-8 Reservoir into Corbett Wildlife Management Area, but slightly less in flow-way 3 due to the lack of the mack dairy spreader canal in cypress creek. Alternative 10 performed the worst with a PM score of 0.39 (30, 335 Hus) mainly due to the smaller flow-way 3 features (**Table G-10**). Complete calculations for habitat units using PM4 are shown in **Table G-11**.

Table G-10. PM 4 scores for base conditions and project alternative and corresponding habitat units based on PM4 only.

Flowway	Area	ECB Habitat Units	FWO Habitat Units	ALT-2 Habitat Units	ALT-5R Habitat Units	ALT-10 Habitat Units	ALT-13 Habitat Units
FW1	9,654	5,487	5,477	6,999	7,009	6,988	6,970
FW2	43,373	14,615	14,220	14,435	14,169	14,092	15,582
FW3	25,312	8,532	8,532	14,705	16,083	9,255	16,083
Total	78,339	28,635	28,230	36,138	37,261	30,335	38,635
PM4 Score	N/A	0.37	0.36	0.46	0.48	0.39	0.49

Table G-11. Performance Measure 4 – Wetland Plant Community Hydrology Output – ECB and FWO.*

Indicator Region	WRAP Cell Name	Acres	Dominant Vegetation	Target Inundation	FW Designation	ECB WRAP Hydro score	WL Type Upper Range Ratio	ECB Inundation (est.)	2014 ECB (APR 2018)	PM 4 Initial Score	PM Functional Scaling Score	PM4 Score Scaled	ECB Habitat Units	2070FWO	2070 FWO (APR 2018)	PM 4 Initial Score	Revised PM4 Functional Scaling Score	PM4 Score Scaled	FWO Habitat Units
C-1	C-1	1,642	DM	9,840	FW2	2.00	1.25	6560	7296	0.74	0.75	0.56	913	6649	7296	0.74	0.75	0.56	913
C-2	C-2E	1,226	DM	9,840	FW2	2.00	1.25	13117	12879	1.31	0.73	0.96	1171	6633	12879	1.31	0.73	0.96	1171
C-3	C-3	2,806	DS	10,455	FW2	1.00	1.18	3485	2015	0.19	0.10	0.02	54	4117	2015	0.19	0.10	0.02	54
C-4	C-4.1	25,500	DM	9,840	FW2	2.50	1.25	8200	4805	0.49	0.25	0.12	3113	7198	4805	0.49	0.25	0.12	3113
C-4	C-4.2	–	–	–	–	–	–	8200	8397	0.00	0.10	0.00	0	7669	8397	0.00	0.10	0.00	0
C-5	C-5	3,170	DM	9,840	FW3	2.50	1.25	8200	6093	0.62	0.50	0.31	981	7912	6094	0.62	0.50	0.31	982
CC-1	CC-1A	202	FS	7,380	FW3	1.00	1.33	2460	108	0.01	0.10	0.00	0	1231	106	0.01	0.10	0.00	0
CC-2	CC-2	557	FS	7,380	FW3	0.50	1.33	1230	102	0.01	0.10	0.00	1	1956	102	0.01	0.10	0.00	1
CC-3	CC-3A	394	WP	4,920	FW3	2.50	1.50	4100	1213	0.25	0.10	0.02	10	353	1203	0.24	0.10	0.02	10
CC-4	CC-4.1	2,542	DM	9,840	FW3	1.50	1.25	4920	32	0.00	0.10	0.00	1	3461	32	0.00	0.10	0.00	1
CC-4	CC-4.2	–	–	–	FW3	–	–	4920	3241	0.00	0.10	0.00	0	5101	3241	0.00	0.10	0.00	0
CM-1	CM-1.1	1,381	DM	9,840	FW2	0.50	1.25	1640	3	0.00	0.10	0.00	0	1	3	0.00	0.10	0.00	0
CM-2	CM-2	3,191	DM	9,840	FW2	0.50	1.25	1640	11656	1.18	0.84	1.00	3191	3135	12802	1.30	0.74	0.96	3066
Pal-Mar	CP-1	642	DM	9,840	FW3	1.50	1.25	4920	1018	0.10	0.10	0.01	7	3541	1017	0.10	0.10	0.01	7
Pal-Mar	CP-2	642	DM	9,840	–	–	1.25	–	427	0.04	0.10	0.00	3	–	426	0.00	0.10	0.00	0
GS-1	GS-1	543	DM	9,840	FW3	0.50	1.25	1640	0	0.00	0.10	0.00	0	0	0	0.00	0.10	0.00	0
GS-2	GS-2	737	DM	9,840	FW3		1.25	1640	0	0.00	0.10	0.00	0	0	0	0.00	0.10	0.00	0
GWP-10	GWP-10	1,107	DS	10,455	–	3.00	1.18	10455	14436	1.38	0.62	0.85	943	12803	13813	1.32	0.67	0.89	986
GWP-1	GWP-1A	42	DS	10,455	FW1	1.50	1.18	5228	13305	1.27	0.73	0.92	39	5823	13161	1.26	0.74	0.93	39
GWP-2	GWP-2	397	DS	10,455	FW1	2.00	1.18	6970	7788	0.74	0.75	0.56	222	6762	8395	0.80	0.75	0.60	239
GWP-3	GWP-3	308	DS	10,455	FW2	2.00	1.18	6970	14227	1.36	0.64	0.86	266	9482	14595	1.40	0.60	0.84	260
GWP-4	GWP-4	755	DS	10,455	FW2	3.00	1.18	10455	12457	1.19	0.83	0.99	745	10288	13101	1.25	0.75	0.94	709
GWP-5	GWP-5.1	977	DS	10,455	–	2.50	1.18	8713	10244	0.98	1.00	0.98	957	9570	10033	0.96	1.00	0.96	938
GWP-5	GWP-5.2	–	–	–	–	–	–	–	9591	0.00	0.10	0.00	0	10454	9347	0.00	0.10	0.00	0
GWP-6	GWP-6	2,134	DS	10,455	–	3.00	1.18	10455	14762	1.41	0.59	0.83	1778	13383	14655	1.40	0.60	0.84	1791
GWP-7	GWP-7.1	2,992	DS	10,455	–	3.00	1.18	10455	13968	1.34	0.66	0.88	2635	11495	13726	1.31	0.68	0.90	2681

Indicator Region	WRAP Cell Name	Acres	Dominant Vegetation	Target Inundation	FW Designation	ECB WRAP Hydro score	WL Type Upper Range Ratio	ECB Inundation (est.)	2014 ECB (APR 2018)	PM 4 Initial Score	PM Functional Scaling Score	PM4 Score Scaled	ECB Habitat Units	2070FWO	2070 FWO (APR 2018)	PM 4 Initial Score	Revised PM4 Functional Scaling Score	PM4 Score Scaled	FWO Habitat Units
GWP-7	GWP-7.2	2,992	DS	10,455	–	–	1.18	10455	14182	1.36	0.64	0.87	2595	11551	13911	0.00	0.10	0.00	0
GWP-7	GWP-7.3	2,992	DS	10,455	–	–	1.18	10455	13077	1.25	0.75	0.94	2814	11632	12816	0.00	0.10	0.00	0
GWP-9	GWP-9	2,518	DS	10,455	–	3.00	1.18	10455	13738	1.31	0.68	0.90	2254	14566	13449	1.29	0.71	0.91	2303
HS-2	HS-2	2,867	DM	9,840	FW2	2.50	1.25	8200	11246	1.14	0.87	1.00	2867	2905	11305	1.15	0.87	1.00	2867
KC-1	KC-1.1	658	FS	7,380	FW3	1.50	1.33	3690	3817	0.52	0.25	0.13	85	0	3814	0.52	0.25	0.13	85
KC-1	KC-1.2	658	FS	7,380		1.50	1.33	3690	5068	0.69	0.50	0.34	226	0	5042	0.68	0.50	0.34	225
KC-2	KC-2.1	585	FS	7,380	FW3	2.00	1.33	4920	382	0.05	0.10	0.01	3	0	381	0.05	0.10	0.01	3
LS-10	LS-10.1	1,981	DM	9,840	FW1	–	1.25	–	6594	0.67	0.50	0.34	664	–	6616	0.67	0.50	0.34	666
LS-10	LS-10.2	1,981	DM	9,840	–	–	1.25	–	9060	0.92	1.00	0.92	1824	–	9077	0.00	0.10	0.00	0
LS-2	LS-2	3,849	DM	9,840	FW1	2.00	1.25	6560	8980	0.91	1.00	0.91	3513	5695	9330	0.95	1.00	0.95	3650
LS-3.1	LS-3.1	1,451	DM	9,840	FW2	1.50	1.25	4920	3288	0.33	0.10	0.03	48	4700	3230	0.33	0.10	0.03	48
LS-3.1	LS-3.2	1,451	DM	9,840	–	–	1.25	–	4574	0.46	0.25	0.12	169	5152	4538	0.00	0.10	0.00	0
LS-4	LS-4	772	DM	9,840	FW1	1.50	1.25	4920	8035	0.82	0.75	0.61	473	4231	8602	0.87	1.00	0.87	675
LS-5	LS-5	1,782	DM	9,840	FW1	1.50	1.25	4920	6090	0.62	0.50	0.31	551	4218	4133	0.42	0.25	0.11	187
LS-6	LS-6A	405	DM	9,840	FW1	2.00	1.25	6560	3205	0.33	0.10	0.03	13	6576	2735	0.28	0.10	0.03	11
LS-7	LS-7A	426	SS	10,455	FW1	2.00	1.18	6970	3074	0.29	0.10	0.03	13	6657	2473	0.24	0.10	0.02	10
LS-8	LS-8.1	1670	DM	9840	FW2	2	1.25	6560	12143	1.23	0.81	1.00	1670	6303	14222	1.45	0.60	0.86	1444
LS-9	LS-9	576	DM	9840	FW2	2	1.25	6560	10476	1.06	0.94	1.00	576	6736	11469	1.17	0.86	1.00	576
MC-1	MC-1	266	FS	7,380	FW3	0.50	1.33	1230	0	0.00	0.10	0.00	0	0	0	0.00	0.10	0.00	0
PM-1	PM-1	2,177	DM	9,840	–	1.50	1.25	4920	994	0.10	0.10	0.01	22	4618	994	0.00	0.10	0.00	0
PM-1	PM-1.1	2,177	DM	9,840	FW3	1.50	1.25	4920	1901	0.19	0.10	0.02	42	4644	1899	0.19	0.10	0.02	42
PM-10	PM-10.1	7,181	DM	9,840	FW3	2.50	1.25	8200	7378	0.75	0.75	0.56	4038	8710	7378	0.75	0.75	0.56	4038
PM-1	PM-11.2	2,181	DM	9,840	–	1.50	1.25	4920	446	0.05	0.10	0.00	10	5211	446	0.00	0.10	0.00	0
PM-2	PM-2	1,452	DM	9,840	FW3	1.00	1.25	3280	8210	0.83	0.75	0.63	909	3162	8211	0.83	0.75	0.63	909
PM-2	PM-2.2A	709	DM	9,840	FW3	2.50	1.25	3280	2798	0.28	0.10	0.03	20	3253	2796	0.28	0.10	0.03	20
PM-4	PM-4	284	DM	9,840	FW3	2.50	1.25	8200	9176	0.93	1.00	0.93	265	7801	9176	0.93	1.00	0.93	265
PM-5	PM-5.1	19,672	DM	9,840	–	2.50	1.25	8200	344	0.03	0.10	0.00	69	8438	344	0.00	0.10	0.00	0
PM-5	PM-5.2A	–	DM	9,840	–	2.50	1.25	8200	7745	0.79	0.75	0.59	0	8505	7744	0.00	0.10	0.00	0
PM-6	PM-6	636	DM	9,840	FW3	2.00	1.25	6560	1713	0.17	0.10	0.02	11	1803	1713	0.17	0.10	0.02	11
PM-9	PM-9A	2577	DM	9,840	FW3	2.00	1.25	6560	14677	1.49	0.56	0.84	2160	6619	14677	1.49	0.56	0.84	2160

Table G-12. Performance Measure 4 – Wetland Plant Community Hydrology Output – Alt 2, Alt 5R.

Indicator Region	WRAP Cell Name	Acres	Dominant Vegetation	Target Inundation	ALT 2 (APR 2018)	PM 4 Initial Score	PM Functional Scaling Score	PM4 Score Scaled	Alt 2 Habitat units	Alt 5R (APR 2018)	PM 4 Initial Score	PM Functional Scaling Score	PM4 Score Scaled	Alt 5r Habitat Units
C-1	C-1	1,642	DM	9,840	8029	0.82	0.75	0.61	1005	8074	0.82	0.75	0.62	1010
C-2	C-2E	1,226	DM	9,840	12880	1.31	0.73	0.95	1171	12880	1.31	0.73	0.95	1171
C-3	C-3	2,806	DS	10,455	5180	0.50	0.25	0.12	348	2014	0.19	0.10	0.02	54
C-4	C-4.1	25,500	DM	9,840	4803	0.49	0.25	0.12	3112	4803	0.49	0.25	0.12	3112
C-4	C-4.2	–	–	–	8403	0.00	0.10	0.00	0	8397	0.00	0.10	0.00	0
C-5	C-5	3,170	DM	9,840	6094	0.62	0.50	0.31	982	6093	0.62	0.50	0.31	981
CC-1	CC-1A	202	FS	7,380	308	0.04	0.10	0.00	1	308	0.04	0.10	0.00	1
CC-2	CC-2	557	FS	7,380	8829	1.20	0.84	1.00	557	8835	1.20	0.84	1.00	557
CC-3	CC-3A	394	WP	4,920	1608	0.33	0.10	0.03	13	1609	0.33	0.10	0.03	13
CC-4	CC-4.1	2,542	DM	9,840	3374	0.34	0.10	0.03	87	3374	0.34	0.10	0.03	87
CC-4	CC-4.2	–	–	–	3775	0.00	0.10	0.00	0	3775	0.00	0.10	0.00	0
CM-1	CM-1.1	1,381	DM	9,840	12867	1.31	0.73	0.96	0	13271	1.35	0.69	0.93	0
CM-2	CM-2	3,191	DM	9,840	13354	1.36	0.68	0.92	2939	13252	1.35	0.69	0.93	2962
Pal-Mar	CP-1	642	DM	9,840	1926	0.20	0.10	0.02	13	1926	0.20	0.10	0.02	13
Pal-Mar	CP-2	642	DM	9,840	729	0.00	0.10	0.00	–	732	0.00	0.10	0.00	0
GS-1	GS-1	543	DM	9,840	12288	1.25	0.80	1.00	543	12288	1.25	0.80	1.00	543
GS-2	GS-2	737	DM	9,840	6623	0.67	0.50	0.34	248	6623	0.67	0.50	0.34	248
GWP-10	GWP-10	1,107	DS	10,455	13816	1.32	0.67	0.89	986	14609	1.40	0.60	0.84	932
GWP-1	GWP-1A	42	DS	10,455	13942	1.33	0.66	0.88	37	13928	1.33	0.66	0.88	37
GWP-2	GWP-2	397	DS	10,455	13472	1.29	0.71	0.91	362	13483	1.29	0.71	0.91	362
GWP-3	GWP-3	308	DS	10,455	14798	1.42	0.59	0.83	256	14799	1.42	0.59	0.83	256
GWP-4	GWP-4	755	DS	10,455	13462	1.29	0.71	0.91	690	13468	1.29	0.71	0.91	690
GWP-5	GWP-5.1	977	DS	10,455	9930	0.95	1.00	0.95	928	10036	0.96	1.00	0.96	938
GWP-5	GWP-5.2	–	–	–	9179	0.00	0.10	0.00	0	9360	0.00	0.10	0.00	0
GWP-6	GWP-6	2,134	DS	10,455	14653	1.40	0.60	0.84	1791	14765	1.41	0.59	0.83	1778

Indicator Region	WRAP Cell Name	Acres	Dominant Vegetation	Target Inundation	ALT 2 (APR 2018)	PM 4 Initial Score	PM Functional Scaling Score	PM4 Score Scaled	Alt 2 Habitat units	Alt 5R (APR 2018)	PM 4 Initial Score	PM Functional Scaling Score	PM4 Score Scaled	Alt 5r Habitat Units
GWP-7	GWP-7.1	2,992	DS	10,455	13737	1.31	0.68	0.90	2679	14046	1.34	0.65	0.88	2620
GWP-7	GWP-7.2	2,992	DS	10,455	13917	0.00	0.10	0.00	0	14256	0.00	0.10	0.00	0
GWP-7	GWP-7.3	2,992	DS	10,455	12783	0.00	0.10	0.00	0	13255	0.00	0.10	0.00	0
GWP-9	GWP-9	2,518	DS	10,455	13447	1.29	0.71	0.91	2303	13930	1.33	0.66	0.88	2223
HS-2	HS-2	2,867	DM	9,840	10505	1.07	0.94	1.00	2867	10481	1.07	0.94	1.00	2867
KC-1	KC-1.1	658	FS	7,380	4681	0.63	0.50	0.32	209	4681	0.63	0.50	0.32	209
KC-1	KC-1.2	658	FS	7,380	7624	1.03	0.97	1.00	658	7621	1.03	0.97	1.00	658
KC-2	KC-2.1	585	FS	7,380	1069	0.14	0.10	0.01	8	1069	0.14	0.10	0.01	8
LS-10	LS-10.1	1,981	DM	9,840	6930	0.70	0.75	0.53	1046	6963	0.71	0.75	0.53	1051
LS-10	LS-10.2	1,981	DM	9,840	9529	0.00	0.10	0.00	–	9541	0.00	0.10	0.00	0
LS-2	LS-2	3,849	DM	9,840	10715	1.09	0.92	1.00	3849	10789	1.10	0.91	1.00	3849
LS-3.1	LS-3.1	1,451	DM	9,840	3381	0.34	0.10	0.03	50	3411	0.35	0.10	0.03	50
LS-3.1	LS-3.2	1,451	DM	9,840	4690	0.00	0.10	0.00	0	4720	0.00	0.10	0.00	0
LS-4	LS-4	772	DM	9,840	13106	1.33	0.70	0.94	725	13166	1.34	0.70	0.93	721
LS-5	LS-5	1,782	DM	9,840	4425	0.45	0.25	0.11	200	4463	0.45	0.25	0.11	202
LS-6	LS-6A	405	DM	9,840	10708	1.09	0.92	1.00	405	11140	1.13	0.88	1.00	405
LS-7	LS-7A	426	SS	10,455	9176	0.88	1.00	0.88	374	9356	0.89	1.00	0.89	381
LS-8	LS-8.1	1670	DM	9840	14317	1.45	0.59	0.86	1435	14319	1.46	0.59	0.86	1435
LS-9	LS-9	576	DM	9840	12576	1.28	0.77	0.98	563	12596	1.28	0.76	0.98	562
MC-1	MC-1	266	FS	7,380	0	0.00	0.10	0.00	0	0	0.00	0.10	0.00	0
PM-1	PM-1	2,177	DM	9,840	3679	0.00	0.10	0.00	0	3680	0.00	0.10	0.00	0
PM-1	PM-1.1	2,177	DM	9,840	5876	0.60	0.50	0.30	650	5876	0.60	0.50	0.30	650
PM-10	PM-10.1	7,181	DM	9,840	10679	1.09	0.92	1.00	7181	10679	1.09	0.92	1.00	7181
PM-1	PM-11.2	2,181	DM	9,840	6022	0.00	0.10	0.00	0	6022	0.00	0.10	0.00	0
PM-2	PM-2	1,452	DM	9,840	13083	1.33	0.71	0.94	1365	13087	1.33	0.71	0.94	1365
PM-2	PM-2.2A	709	DM	9,840	7595	0.77	0.75	0.58	410	7593	0.77	0.75	0.58	410
PM-4	PM-4	284	DM	9,840	9176	0.93	1.00	0.93	265	9176	0.93	1.00	0.93	265
PM-5	PM-5.1	19,672	DM	9,840	341	0.00	0.10	0.00	0	341	0.00	0.10	0.00	0

PM-5	**PM-5.2A**	–	DM	9,840	7653	0.00	0.10	0.00	0	7653	0.00	0.10	0.00	0
PM-6	**PM-6**	636	DM	9,840	2015	0.20	0.10	0.02	13	2017	0.20	0.10	0.02	13
PM-9	**PM-9A**	2577	DM	9,840	14675	1.49	0.56	0.84	2160	14676	1.49	0.56	0.84	2160

Table G-13. Performance Measure 4 – Wetland Plant Community Hydrology Output – ALT 10, Alt 13.

Indicator Region	WRAP Cell Name	Acres	Dominant Vegetation	Target Inundation	Alt 10	ALT 10 (APR 2018)	PM 4 Initial Score	PM Functional Scaling Score	PM4 Score Scaled	Alt 10 habitat units	Alt 13	ALT 13 (APR 2018)	PM 4 Initial Score	PM Functional Scaling Score	PM4 Score Scaled	Alt 13 Habitat Units
C-1	C-1	1,642	DM	9,840	1461	7543	0.77	0.75	0.57	944	6420	7734	0.79	0.75	0.59	968
C-2	C-2E	1,226	DM	9,840	6590	12879	1.31	0.73	0.96	1171	6607	12879	1.31	0.73	0.96	1171
C-3	C-3	2,806	DS	10,455	4079	2013	0.19	0.10	0.02	54	4135	4619	0.44	0.25	0.11	310
C-4	C-4.1	25,500	DM	9,840	7201	4803	0.49	0.25	0.12	3112	7195	4803	0.49	0.25	0.12	3112
C-4	C-4.2	–	–	–	7667	8393	0.00	0.10	0.00	0	7668	8395	0.00	0.10	0.00	0
C-5	C-5	3,170	DM	9,840	7913	6094	0.62	0.50	0.31	982	7908	6094	0.62	0.50	0.31	982
CC-1	CC-1A	202	FS	7,380	1525	172	0.02	0.10	0.00	0	2513	493	0.07	0.10	0.01	1
CC-2	CC-2	557	FS	7,380	10578	4207	0.57	0.50	0.29	159	14505	9560	1.30	0.77	1.00	557
CC-3	CC-3A	394	WP	4,920	454	1461	0.30	0.10	0.03	12	1395	2914	0.59	0.50	0.30	117
CC-4	CC-4.1	2,542	DM	9,840	13027	2528	0.26	0.10	0.03	65	14650	7052	0.72	0.75	0.54	1366
CC-4	CC-4.2	–	–	–	5546	3706	0.00	0.10	0.00	0	7569	7607	0.00	0.10	0.00	0
CM-1	CM-1.1	1,381	DM	9,840	13868	9890	1.01	0.99	1.00	0	14974	13823	1.40	0.63	0.89	1229
CM-2	CM-2	3,191	DM	9,840	2964	13328	1.35	0.68	0.92	2945	4920	14778	1.50	0.55	0.83	2656
Pal-Mar	CP-1	642	DM	9,840	10444	1027	0.10	0.10	0.01	7	12407	1958	0.20	0.10	0.02	13
Pall-Mar	CP-2	642	DM	9,840	–	391	0.00	0.10	0.00	0	–	763	0.00	0.10	0.00	0
GS-1	GS-1	543	DM	9,840	0	0	0.00	0.10	0.00	0	14966	12292	1.25	0.80	1.00	543
GS-2	GS-2	737	DM	9,840	0	0	0.00	0.10	0.00	0	0	6624	0.67	0.50	0.34	248
GWP-10	GWP-10	1,107	DS	10,455	11524	13217	1.26	0.74	0.93	1030	13116	13820	1.32	0.67	0.89	985
GWP-1	GWP-1A	42	DS	10,455	6435	13627	1.30	0.69	0.90	38	6056	14013	1.34	0.65	0.88	37
GWP-2	GWP-2	397	DS	10,455	8222	13534	1.29	0.70	0.91	361	8320	13761	1.32	0.68	0.89	355
GWP-3	GWP-3	308	DS	10,455	9473	14793	1.41	0.59	0.83	256	10068	14927	1.43	0.58	0.82	254
GWP-4	GWP-4	755	DS	10,455	9603	13343	1.28	0.72	0.92	696	10311	14095	1.35	0.65	0.87	659
GWP-5	GWP-5.1	977	DS	10,455	8787	8472	0.81	0.75	0.61	594	9657	9986	0.96	1.00	0.96	933
GWP-5	GWP-5.2	–	–	–	9214	7431	0.00	0.10	0.00	0	10520	9209	0.00	0.10	0.00	0
GWP-6	GWP-6	2,134	DS	10,455	11795	13571	1.30	0.70	0.91	1934	13443	14658	1.40	0.60	0.84	1791
GWP-7	GWP-7.1	2,992	DS	10,455	9201	11848	1.13	0.88	1.00	2992	11540	13743	1.31	0.68	0.90	2678
GWP-7	GWP-7.2	2,992	DS	10,455	9265	12509	0.00	0.10	0.00	0	11656	13921	0.00	0.10	0.00	0
GWP-7	GWP-7.3	2,992	DS	10,455	9357	8617	0.00	0.10	0.00	0	11820	12790	0.00	0.10	0.00	0
GWP-9	GWP-9	2,518	DS	10,455	14055	10536	1.01	0.99	1.00	2518	14647	13457	1.29	0.71	0.91	2302
HS-2	HS-2	2,867	DM	9,840	2563	10801	1.00	1.00	1.00	2867	2215	10361	1.00	1.00	1.00	2867
KC-1	KC-1.1	658	FS	7,380	0	4683	0.63	0.50	0.32	209	0	4681	0.63	0.50	0.32	209
KC-1	KC-1.2	658	FS	7,380	0	7617	1.00	1.00	1.00	658	0	7618	1.00	1.00	1.00	658
KC-2	KC-2.1	585	FS	7,380	0	788	0.11	0.10	0.01	6	0	1070	0.14	0.10	0.01	8

Indicator Region	WRAP Cell Name	Acres	Dominant Vegetation	Target Inundation	Alt 10	ALT 10 (APR 2018)	PM 4 Initial Score	PM Functional Scaling Score	PM4 Score Scaled	Alt 10 habitat units	Alt 13	ALT 13 (APR 2018)	PM 4 Initial Score	PM Functional Scaling Score	PM4 Score Scaled	Alt 13 Habitat Units
LS-10	LS-10.1	1,981	DM	9,840	–	6932	0.70	0.75	0.53	1047	–	6902	0.70	0.75	0.53	1042
LS-10	LS-10.2	1,981	DM	9,840	–	9604	0.00	0.10	0.00	0	–	9466	0.00	0.10	0.00	0
LS-2	LS-2	3,849	DM	9,840	10420	11079	1.13	0.89	1.00	3849	10695	11106	1.13	0.89	1.00	3849
LS-3.1	LS-3.1	1,451	DM	9,840	5397	3463	0.35	0.10	0.04	51	6130	5844	0.59	0.50	0.30	431
LS-3.1	LS-3.2	1,451	DM	9,840	5729	4742	0.00	0.10	0.00	0	6312	8880	0.00	0.10	0.00	0
LS-4	LS-4	772	DM	9,840	10240	13714	1.39	0.64	0.90	692	10503	13409	1.36	0.67	0.92	708
LS-5	LS-5	1,782	DM	9,840	4863	4491	0.46	0.25	0.11	203	5291	4436	0.45	0.25	0.11	201
LS-6	LS-6A	405	DM	9,840	12565	12644	1.28	0.76	0.97	394	12423	10277	1.04	0.96	1.00	405
LS-7	LS-7A	426	SS	10,455	11574	9908	0.95	1.00	0.95	404	11484	9150	0.88	1.00	0.88	373
LS-8	LS-8.1	1670	DM	9840	6883	14305	1.45	0.59	0.86	1436	7375	14738	1.50	0.56	0.83	1394
LS-9	LS-9	576	DM	9840	8219	12645	1.29	0.76	0.97	560	8433	13299	1.35	0.68	0.92	533
MC-1	MC-1	266	FS	7,380	0	0	0.00	0.10	0.00	0	0	0	0.00	0.10	0.00	0
PM-1	PM-1	2,177	DM	9,840	4723	996	0.00	0.10	0.00	0	13220	3673	0.00	0.10	0.00	0
PM-1	PM-1.1	2,177	DM	9,840	4743	1911	0.19	0.10	0.02	42	13144	5835	0.59	0.50	0.30	645
PM-10	PM-10.1	7,181	DM	9,840	8686	7377	0.75	0.75	0.56	4038	14975	10678	1.09	0.92	1.00	7181
PM-1	PM-11.2	2,181	DM	9,840	5238	449	0.00	0.10	0.00	0	14975	6023	0.00	0.10	0.00	0
PM-2	PM-2	1,452	DM	9,840	4670	8676	0.88	1.00	0.88	1280	14383	13087	1.33	0.71	0.94	1365
PM-2	PM-2.2A	709	DM	9,840	3403	2825	0.29	0.10	0.03	20	7854	7581	0.77	0.75	0.58	410
PM-4	PM-4	284	DM	9,840	7801	9176	0.93	1.00	0.93	265	7798	9176	0.93	1.00	0.93	265
PM-5	PM-5.1	19,672	DM	9,840	8437	344	0.00	0.10	0.00	0	8438	341	0.00	0.10	0.00	0
PM-5	PM-5.2A	–	DM	9,840	8502	7745	0.00	0.10	0.00	0	8501	7653	0.00	0.10	0.00	0
PM-6	PM-6	636	DM	9,840	14975	1654	0.17	0.10	0.02	11	14975	2085	0.21	0.10	0.02	13
PM-9	PM-9A	2577	DM	9,840	6584	14676	1.49	0.56	0.84	2160	6554	14676	1.49	0.56	0.84	2160

*NOTES- Table color coding represents

Yellow	areas where we had to make adjustments to model output or topo	Orange/peach	consistent lack of results	Red	Data not used for habitat units calculation
Blue	scores have improved from 2005 to present due to local restoration efforts	Dark gray	extra model cell for indicator region to check on different hydrology questions. Not part of habitat units calculations	Dark Green	Model Output in inundation duration days used to ultimately calculate habitat units for the watershed

Please note that the Grassy Waters Preserve (GWP) main area performance was not factored into the habitat units for PM 4, because ultimately the stages in GWP are regulated by the City of West Palm Beach. The LRWRP does not incorporate changes in authority or responsibility for regulating water levels in GWP. The project coordinates flows to and from GWP in coordination with the City of West Palm Beach to provide additional flow for restoration of the Loxahatchee River.

G.5.1.2 Performance Measure 9 – Connectivity Output

Four criteria were used to score alternatives based on hydrology, water quality, greenway, and fish and wildlife criteria as explained in PM 9 documentation sheet. Alternative 13 scored the highest (0.83) because of increased hydrological, water quality, and fish and wildlife connectivity in flow-way 2 due to the natural storage area connecting with several other indicator regions (Avenir, Loxahatchee Slough west, and northern Grassy Water Preserve areas) that are not connected in any other alternative. Alternative 10 scored the worst (0.46) due to less connectivity from a hydrological and fish and wildlife perspective in flow-way 3 and has fewer natural area flow-ways than all the other alternatives in flow-way 1 from a water quality perspective. Alternative 2 and 5R had similar scores of 0.67 and 0.63 due to similar features except for the Mack Dairy spreader canal which has a lower water quality score due to use of canal to natural area hydrologic connection. **Table G-14** provides a more detailed breakdown of scores by criteria and flow-way, followed by **Table G-15** that summarizes scores, and **Table G-16** that provides the habitat units based only on **PM 9**.

Table G-14. PM 9 connectivity output for alternatives.

Criteria and Flow-way	Alt 2 Score	Alt 5R Score	Alt 10 Score	Alt 13 Score	Alt 2 Description	Alt 5R Description	Alt 10 Description	Alt 13 Description
Hydrology 3	25	25	12.5	25	Complete	Complete	Partial - does not fully meet the wetland storage near Lox. River compared to other alternatives	Complete
Hydrology 2	0	0	0	12.5	0	0	0	Partial provides wetland storage and connectivity to provide flows to river.
Hydrology 1	12.5	12.5	12.5	12.5	Partial provides wetland storage and	Partial provides wetland storage and	Partial provides wetland storage and	Partial provides wetland storage and

Criteria and Flow-way	Alt 2 Score	Alt 5R Score	Alt 10 Score	Alt 13 Score	Alt 2 Description	Alt 5R Description	Alt 10 Description	Alt 13 Description
					connectivity to provide flows to river.	connectivity to provide flows to river.	connectivity to provide flows to river.	connectivity to provide flows to river.
Hydrology	12.5	12.5	8.3	16.7	NA	NA	NA	NA
Greenway3	25	25	12.5	25	Restoration actions support hydrological restoration along a majority of an existing or proposed greenway corridor	Restoration actions support hydrological restoration along a majority of an existing or proposed greenway corridor	Restoration actions support hydrological restoration in a portion of existing or proposed greenway corridors.	Restoration actions support hydrological restoration along a majority of an existing or proposed greenway corridor
Greenway2	0	0	0	25	Restoration actions do not support hydrological restoration or additional connections existing or proposed greenway corridors.	Restoration actions do not support hydrological restoration or additional connections existing or proposed greenway corridors.	Restoration actions do not support hydrological restoration or additional connections existing or proposed greenway corridors.	Restoration actions support hydrological restoration along a majority of an existing or proposed greenway corridor
Greenway1	25	25	25	25	Restoration actions support hydrological restoration along a majority of an existing or proposed greenway corridor	Restoration actions support hydrological restoration along a majority of an existing or proposed greenway corridor	Restoration actions support hydrological restoration along a majority of an existing or proposed greenway corridor	Restoration actions support hydrological restoration along a majority of an existing or proposed greenway corridor
Greenway	16.7	16.7	12.5	25.0	NA	NA	NA	NA

Criteria and Flow-way	Alt 2 Score	Alt 5R Score	Alt 10 Score	Alt 13 Score	Alt 2 Description	Alt 5R Description	Alt 10 Description	Alt 13 Description
Water Quality 3	25	12.5	12.5	12.5	Connectivity and restoration actions improves water quality by allowing for only sheetflow across natural lands and natural flow ways.	Connectivity and restoration actions improves water quality by allowing for only sheetflow across natural lands and natural flow ways.	Connectivity and restoration actions improves water quality by partially allowing for sheetflow across natural lands, natural flow ways providing some treatment, but also utilizing the canal system. Focused on pump stations, spreader canal.	Connectivity and restoration actions improves water quality by partially allowing for sheetflow across natural lands, natural flow ways providing some treatment, but also utilizing the canal system. Incorporates additional spreader canal
Water Quality 2	12.5	12.5	12.5	25	Connectivity and restoration actions improves water quality by partially allowing for sheetflow across natural lands, natural flow ways providing some treatment, but also utilizing the canal system. Focused on pump stations, spreader canal.	Connectivity and restoration actions improves water quality by partially allowing for sheetflow across natural lands, natural flow ways providing some treatment, but also utilizing the canal system. Focused on pump stations, spreader canal.	Connectivity and restoration actions improves water quality by partially allowing for sheetflow across natural lands, natural flow ways providing some treatment, but also utilizing the canal system. Focused on pump stations, spreader canal.	Connectivity and restoration actions improves water quality by allowing for only sheetflow across natural lands and natural flow ways.
Water Quality 1	25	25	12.5	25	Connectivity and restoration actions improves water quality by allowing for only sheetflow across natural lands and natural flow ways.	Connectivity and restoration actions improves water quality by allowing for only sheetflow across natural lands and natural flow ways.	Connectivity and restoration actions improves water quality by partially allowing for sheetflow across natural lands, natural flow ways providing some treatment, but	Connectivity and restoration actions improves water quality by allowing for only sheetflow across natural lands and natural flow ways.

Criteria and Flow-way	Alt 2 Score	Alt 5R Score	Alt 10 Score	Alt 13 Score	Alt 2 Description	Alt 5R Description	Alt 10 Description	Alt 13 Description
							also utilizing the canal system. Force main.	
Water Quality	20.8	16.7	12.5	20.8	NA	NA	NA	NA
Fish and Wildlife 3	25	25	12.5	25	Restoration actions address 2-3 of the 3 questions regarding flora and fauna benefits from connectivity. Foraging, shelter, diversity	Restoration actions address 2-3 of the 3 questions regarding flora and fauna benefits from connectivity. Foraging, shelter, diversity	Restoration actions address 1 of 3 questions regarding flora and fauna benefits from connectivity. Foraging	Restoration actions address 2-3 of the 3 questions regarding flora and fauna benefits from connectivity. Foraging, shelter, diversity
Fish and Wildlife 2	12.5	12.5	12.5	25	Restoration actions address 1 of 3 questions regarding flora and fauna benefits from connectivity. Foraging	Restoration actions address 1 of 3 questions regarding flora and fauna benefits from connectivity. Foraging	Restoration actions address 1 of 3 questions regarding flora and fauna benefits from connectivity. Foraging	Restoration actions address 2-3 of the 3 questions regarding flora and fauna benefits from connectivity. Foraging, shelter, diversity
Fish and Wildlife 1	12.5	12.5	12.5	12.5	Restoration actions address 1 of 3 questions regarding flora and fauna benefits from connectivity. Foraging	Restoration actions address 1 of 3 questions regarding flora and fauna benefits from connectivity. Foraging	Restoration actions address 1 of 3 questions regarding flora and fauna benefits from connectivity. Foraging	Restoration actions address 1 of 3 questions regarding flora and fauna benefits from connectivity. Foraging
Fish and Wildlife	16.7	16.7	12.5	20.8	NA	NA	NA	NA

Table G-15. Summary of PM9 Connectivity Scores.

Criteria	Alt 2	Alt 5R	Alt 10	Alt 13
Hydrology	12.5	12.5	8.3	16.7
Greenway	16.7	16.7	12.5	25.0
Water Quality	20.8	16.7	12.5	20.8
F&W	16.7	16.7	11.1	20.8
PM 9 Score	67	63	44	83

Table G-16. Alternative Plan Habitat Units based on Connectivity.

Alternative	Alt 2	Alt 5R	Alt 10	Alt 13
Total PM 9 Acres	52,226	48,962	35,905	65,283

G.5.1.3 Summary of Habitat Unit Output by Alternative Restoration Plan for the Watershed

Performance measure output was combined based on the planning model formulas where PM 4 represents 90% of the watershed score and PM 9 represents 10%. **Table G-17** provides a summary of the final watershed habitat units plus lift over the future without project. Alternative 13 scores the highest with 41,300 habitat units, followed by alternative 5R with 38,401, alternative 2 with 37, 747 habitat units, and alternative 10 a distant fourth with 30,892 habitat units.

Table G-17. Total Watershed habitat units for each Loxahatchee River Watershed Restoration Project alternative.

Alternatives Performance							
	Flow-way	**2014B**	**2070B**	**ALT 2**	**ALT 5R**	**ALT 10**	**ALT 13**
PM4-WRAP (worth 90%)	FW1	5,487	5,477	6,999	7,009	6,988	6,970
	FW2	14,615	14,220	14,435	14,169	14,092	15,582
	FW3	8,532	8,532	14,705	16,083	9,255	16,083
	Subtotal	28,635	28,230	36,138	37,261	30,335	38,635

Alternatives Performance							
	Flow-way	**2014B**	**2070B**	**ALT 2**	**ALT 5R**	**ALT 10**	**ALT 13**
PM9 - Connectivity (worth 10%)	*Subtotal*	0	0	52,226	48,962	35,905	65,283
Watershed Habitat Units	**Total**	**25,771**	**25,407**	**37,747**	**38,431**	**30,892**	**41,300**
	LIFT VS 2070B	364	-	12,340	13,024	5,485	15,893
	% improvement	NA	NA	49%	51%	22%	63%

NOTE: Connectivity scores for 2014B and 2070B are zero since connectivity is assumed to be the increment above the base condition.
NOTE: Connectivity scores are not calculated by flow-way so only the total is shown.

G.5.2 Performance Measure 1 – River and Estuarine Performance

The performance measure (PM) 1 documentation sheet cites the restoration plan for the Northwest Fork of the Loxahatchee River to reference flow targets and how they correspond to desired salinity zones for five estuarine habitat zones (Tidal River, Vallisneria [Freshwater submerged aquatic vegetation], oligohaline [larval and juvenile fish], mesohaline [Oysters], and Polyhaline [Seagrass]. The original approach was to use the salinity model to provide salinity output related to downstream locations to measure performance. Unfortunately, the LECSR model output of tributary flows was not sensitive enough to detect changes between alternatives and base conditions due to small geographic scale of tributaries and narrowness of Northwest fork (see **Figure G-5**). The existing conditions appeared to be meeting targets for downstream for the Tidal and *Vallisneria* zones (see **Table G-18** and **Table G-19**). However, actual monitoring data indicates this is not the case for existing flows.

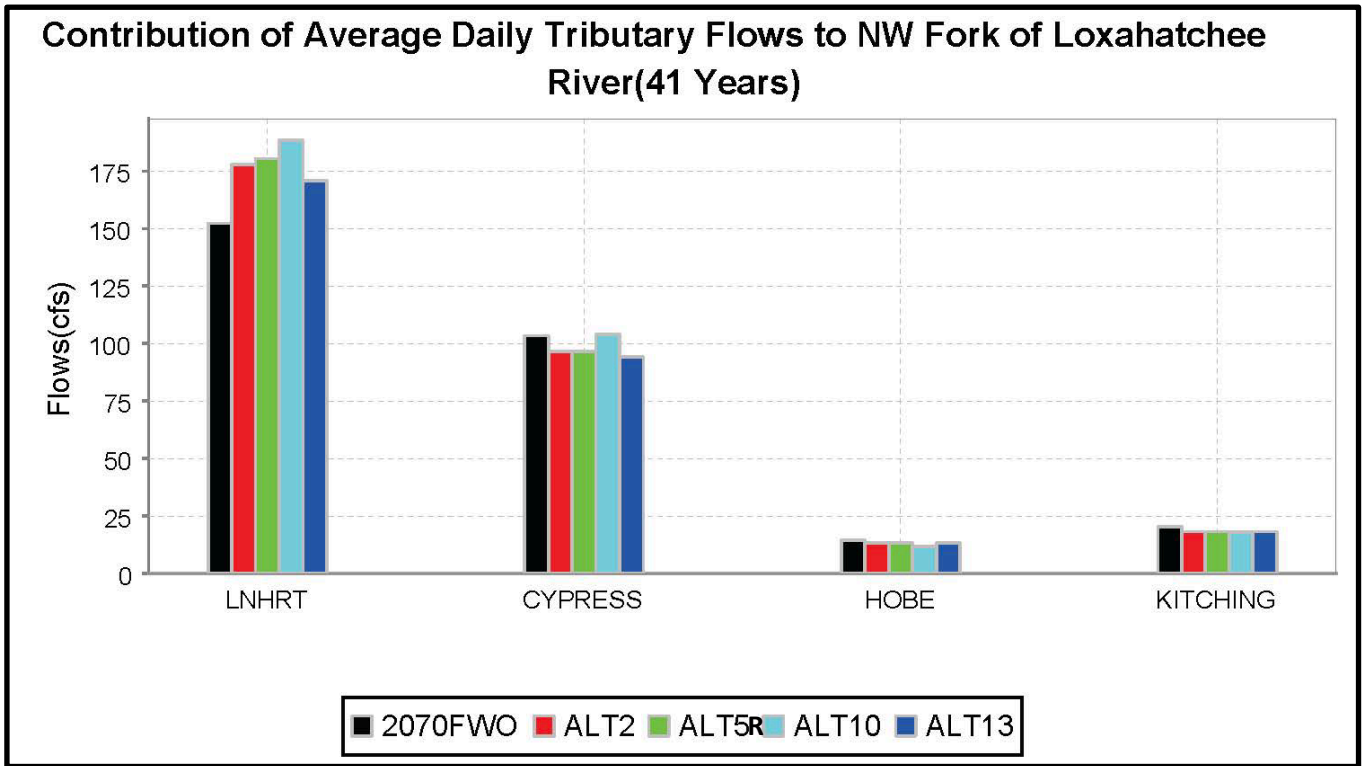

Figure G-5. Average daily flows from tributaries similarity with base conditions

Table G-18. Habitat units (in acre) computed using salinity tool during the wet seasons.

Scenario	Polyhaline	Mesohaline	Oligohaline	*Vallisneria*	*Tidal*	Total
2014B	624.22	139.75	36.18	74.79	17.69	788.63
2070FWO	619.32	137.27	36.05	74.79	17.69	782.50
ALT 2	619.21	145.20	36.35	74.79	17.69	792.23
ALT 5R	615.79	146.57	35.84	74.79	17.69	789.30
ALT 10	613.31	149.29	35.51	74.79	17.69	789.47

Scenario	Polyhaline	Mesohaline	Oligohaline	*Vallisneria*	*Tidal*	Total
ALT 13	619.70	144.55	36.65	74.79	17.69	791.29

Table G-19. Habitat units (in acres) computed using salinity tool during the dry seasons

Scenario	Polyhaline	Mesohaline	Oligohaline	*Vallisneria*	*Tidal*	Total
2014B	726.55	101.91	32.96	69.24	17.69	828.98
2070FWO	726.55	100.95	31.71	69.08	17.69	826.89
ALT 2	721.94	127.80	38.81	73.28	17.69	864.12
ALT 5R	720.96	128.36	38.55	74.23	17.69	866.35
ALT 10	719.87	128.49	41.79	74.61	17.69	865.96
ALT 13	723.65	118.31	36.51	71.34	17.69	850.15

The PDT recommended using the Lainhart Flows as an indicator of each habitat zone downstream based on the dry season performance measure criteria in the Restoration Plan of mean monthly flow of 69cfs or greater. A sliding scale scoring table was developed based on this criteria (see **Table G-20**). Habitat units were calculated for each alternative and base conditions based on 30-day monthly rolling averages for the model period of record with the maximum habitat units for these 6 habitat zones being 2067 habitat units (See **Table G-21**). Alternative 10 which provides the most storage overall scored a 0.95, followed by alternative 5R scoring a 0.91 and having the largest amount of storage closest to the river. Alternative 2 followed right behind with a score of 0.87, where the additional shallow L-8 storage and smaller C-18 west storage did not perform as well in meeting river targets. Alternative 13 performed the worst in meeting river targets with a 0.8 score likely due to much of the shallow L-8 storage not making its way to the river.

Table G-20. Dry season criteria sliding scale.

Daily Lainhart Flow	Daily Score
>= 69 cfs	1.0
>55 and <69 cfs	0.75
>45 and <= 55 cfs	0.50
>= 35 to <= 45 cfs	0.25
<35	0.00

Table G-21. Dry season performance and HUs.

Scenario	30Day Rolling Avg. Flow > 68cfs	Acreage of River, Floodplain and Estuary	Habitat Units Per Alternative	Habitat Unit Lift as compared to FWO
2070FWO	0.65	2067	1344	NA
2014B	0.65	2067	1344	NA
ALT 13	0.80	2067	1654	310
ALT 2	0.87	2067	1798	454
ALT 5R	0.91	2067	1881	537

Scenario	30Day Rolling Avg. Flow > 68cfs	Acreage of River, Floodplain and Estuary	Habitat Units Per Alternative	Habitat Unit Lift as compared to FWO
LT 10	0.95	2067	1964	620

G.5.3 Loxahatchee River Watershed Restoration Project (LRWRP) Annualization of Benefits

G.5.3.1 Loxahatchee Watershed:

The ecological response time for the Loxahatchee river watershed was estimated based on the ability of LRWRP to improve conditions for aquatic and herbaceous, shrubby and forested vegetation communities, periphyton, piscivorous fish, aquatic prey organisms in the diverse headwater's watershed. The watershed includes major plant communities consisting of mesic and wet flatwoods, mesic and hydric hammocks, wet prairies, depression and slough marsh, and floodplain, strand, and dome swamps. The expected ecological response time is estimated to be 75-100 years until full impact would be realized with a large percentage of benefits accruing earlier once the desirable hydrological conditions have been restored. Vegetation changes and wetland function will begin 2 years into hydrologic restoration with the rate of response to full wetland restoration decreasing over time, as vegetation succession moves forward. **Table G-22** provides the timing estimate for benefit accrual.

Table G-22. Watershed benefits accrual.

0-2 Years	2-5 Years	5-10 Years	10-30 Years	30-50 Years	50-75 Years	75-100 Years
50%	60%	70%	75%	80%	95%	100%

G.5.3.2 Loxahatchee River Northwest Fork and Estuary:

An ecological response time for the river, floodplain, and estuary was estimated based on the ability of the alternatives to improve the various communities as compared to the future without (FWO). In the future if there is no CERP project, there is likely to be a continued degradation of the ecosystem due to climate change and potentially future land-use changes that restrict flows to the river. Because estimating this rate of degradation is difficult with the available tools, the future without was determined to be similar to the existing conditions. The LRWRP river and estuary covers several different zones and habitat types. Increased volumes and improved timing of flows into the North West Fork of the Loxahatchee River will have a positive impact on the vegetation within the river floodplain (**Table G-23**). It will also directly impact the river channel, especially with respect to improving conditions to support the growth of *Vallisneria americana,* a freshwater submerged aquatic vegetation community that provides habitat for many small larval and juvenile fish and invertebrate species in the riverine oligohaline zone. In the mesohaline zone oyster habitat may slightly shift to a more downstream location where historically oysters were more abundant. This could allow for some expansion of oyster beds in areas with the proper substrate for spat settlement. Seagrasses within polyhaline areas should remain healthy and abundant (**Table G-24**).

Table G-23. Floodplain benefits accrual (483 acres).

0-2 Years	2-5 Years	5-10 Years	10-30 Years	30-50 Years	50-75 Years	75-100 Years
0%	30%	50%	60%	75%	80%	100%

Table G-24. River and estuary benefits accrual (1583 acres).

0-2 Years	2-5 Years	5-20 Years	20-50 Years
20%	75%	100%	100%