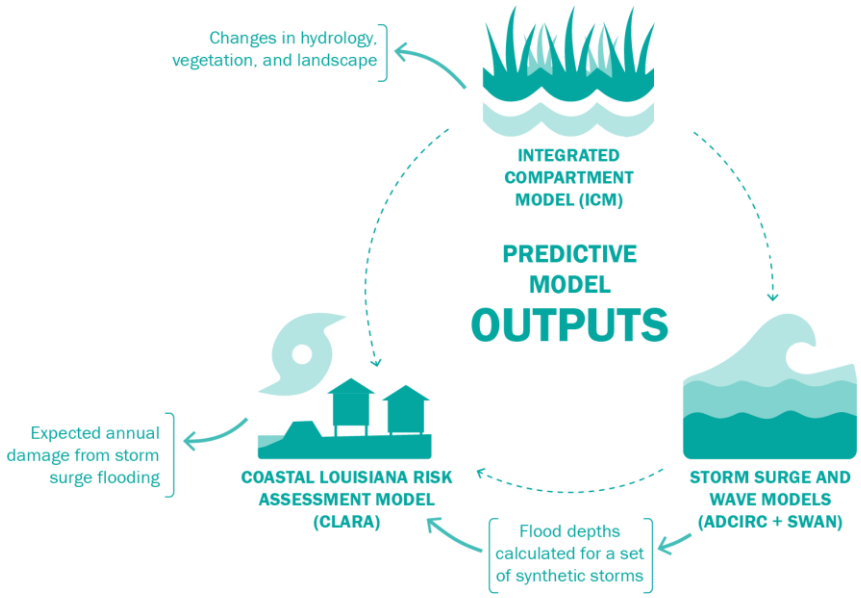
2029 COASTAL MASTER PLAN NEW PROJECT DEVELOPMENT: DEEP DIVE

Louisiana's coast is ever-changing, and the coastal master plan process evolves over time to reflect and address those changes. As we enter the new project development stage for the 2029 Coastal Master Plan (MP29), we are also updating our modeling tools to incorporate new data and produce new outputs for evaluation of candidate projects. Recognizing that the final plan can only be as good as the projects that get evaluated, information on relevant 2023 Coastal Master Plan (MP23) outputs and new results beyond those reported for MP23 are provided here to support development of new project ideas for MP29 that will effectively address overarching master plan goals and more specific regional priorities. The target audience for this "Deep Dive" information is already familiar with coastal processes and project types. Those who are new to this content can likely find all the information and model outputs they need by exploring the 2023 Coastal Master Plan Data Tools instead of this Deep Dive version.

BACKGROUND

The master plan uses a set of four main predictive models to consider landscape change, storm surge and waves, and flood-related damages to coastal Louisiana structures and assets and understand what the future holds under a range of environmental conditions and risk scenarios. The changing landscape of coastal Louisiana is represented using the Integrated Compartment Model (ICM), which predicts coastal hydrology, wetland morphology, vegetation dynamics, and the suitability of habitats to support an array of fish and wildlife. Storm surge and wave models (Advanced Circulation model [ADCIRC] + Simulating Waves Nearshore model [SWAN]) provide water level inputs to the risk assessment model. The Coastal Louisiana Risk Assessment (CLARA) model estimates flood depths and direct economic damages from hurricanes and other tropical events.



A detailed explanation of the models that support the master planning process and results from the MP23 analyses are included in MP23 **Appendix C:** Use of Predictive Models in the 2023 Coastal Master Plan.

Since the analyses CPRA conducted for the 2023 Coastal Master Plan, the tools are being updated to 1) incorporate new data and produce new outputs, and 2) to reflect changes that have occurred on the landscape and to structures and assets since 2018, the year represented in MP23 initial conditions.

The initial conditions data serve as the baseline for predicting changes to the landscape and storm surge-based risk into the future in master plan analyses, including for a Future Without Action (FWOA).

For MP23, the FWOA was modeled for multiple future scenarios with differing assumptions related to uncertain conditions (e.g., for sea level rise [SLR]). A lower and higher scenario (with lower and higher rates of SLR, for example) were used for analyses related to project selection. The MP23 FWOA landscape realizes significant land loss and increases to storm surge-based flood depths over the 50-year model prediction, particularly for the higher scenario.

The **MP23 Plan Data Viewer** is an interactive online tool that includes MP23 outputs for land change, vegetation type, flood depth, flood damage, etc. Land change and vegetation

data can be explored by decade, by environmental scenario, and with or without master plan projects. Flood depth and damage information can be explored in the same way, with the added layers of seeing how depth and damage change when the frequency of occurrence (annual exceedance probability) varies and how projected damage is quantified over time either in dollars or by structures.

More information on MP23 scenarios and their assumptions are explained in **MP23 Appendix B**: Scenario Development and Future Conditions.

CPRA does not have updated initial conditions data in time for MP29 New Project Development. All model outputs available through the 2023 Coastal Master Plan Data Tools and within this Deep Dive content are based on model runs that started with a 2018 landscape and included projects we reasonably assumed would be constructed within a few years of 2023. This means that dramatic changes to the coast that have occurred since 2018 are not reflected here. For example, the land and property losses that resulted from Hurricanes Laura, Delta, and Ida are not reflected in the available model outputs. It also means that projects that were reasonably expected to be constructed at the time of modeling for the 2023 plan are also included on the landscape even if these projects have not been constructed yet or have had a change in status.

Update as of April 2026: The original intent of providing the current version of the ICM (ICMv24) results was to: a) assess interim updates made to the ICM code base (ICMv24) and apply to the MP23 scenarios; b) provide outputs for the newly derived landscape metrics; and c) produce land area outputs, comparable to MP23 FWOA, but *without the mid-basin diversions*.

The ICMv24 runs were completed on time; however, as is typical, errors were identified during QA/QC of the model outputs. Some errors were easy to correct, but one set of errors would have required substantial rework without adding value to MP29 progress. More specifically, these errors related to how the land/water and vegetation surfaces were aligned. Addressing these errors would have required updating the model grid files. The ICM team was already working on updating the model grid files to represent the updated 2024 existing conditions landscape for the MP29 modeling and updating the model grid files differently for ICMv24 would have put CPRA's ability to begin MP29 model runs on time at risk.

CPRA considered pausing MP29 work to fulfill the public commitment we made to providing ICMv24 results to the public but ultimately decided that we were already on the path to addressing much of the public interest in ICMv24 results by providing MP29 ICM FWOA

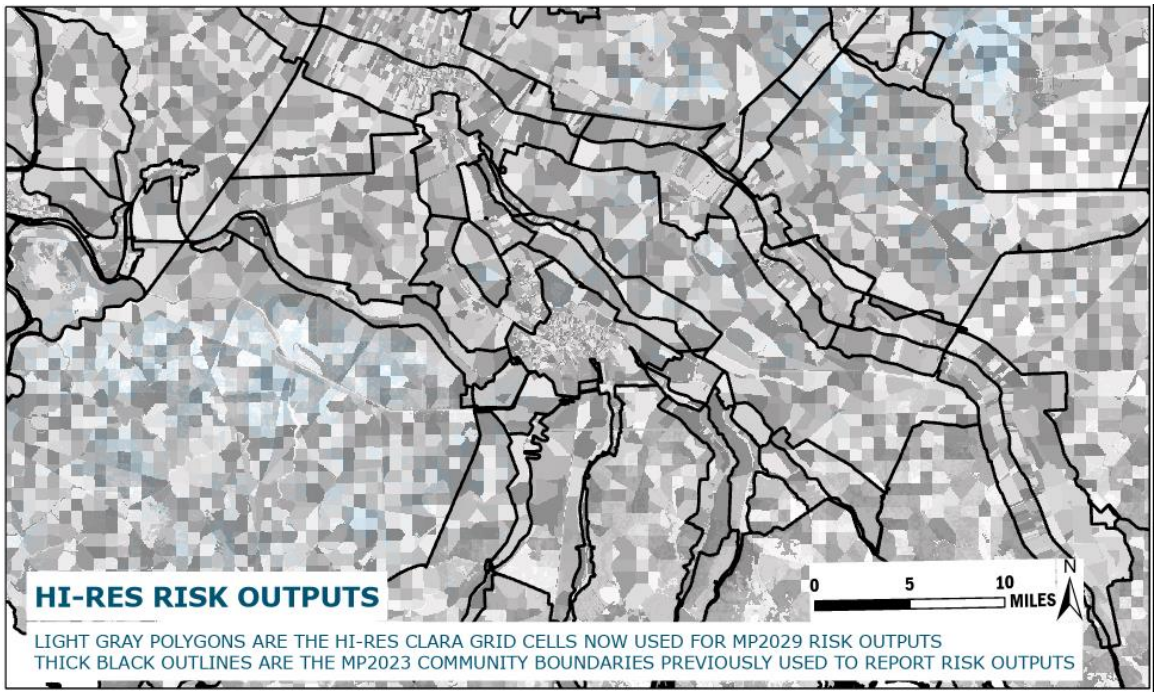
results in time to inform the second public solicitation for new project ideas. The decision to prioritize updating the model grid for MP29 FWOA meant not completing corrected ICMv24 FWOA runs or being able to disseminate their results as originally intended.

More information on new subsidence data and spatial interpolation rates is available in the report: **Development of a Continuous Prediction Surface of Subsidence Rates across the Louisiana Coast.**

Note that the final FWOA runs for MP29 will include an updated initial landscape based on 2024 conditions (including land loss from Hurricane Ida, etc.), newly defined scenarios that incorporate updated data into boundary conditions (including for SLR, etc.), and newly constructed projects, etc. Those updates were not ready in time to be included in ICMv24.

ICMv24 outputs available to support new project development for MP29 also include new metrics that were not calculated for MP23. Information is included here for three new land-related metrics that may be particularly helpful for new project development: land/water/plus, Wetland Value Assessments (WVA), and Habitat Diversity. Outputs for these and other new metrics currently being tested will be available for MP29.

Master plan risk models are also being updated to include new data for MP29 (e.g., structure inventory), but no new model runs are available at this time. Although new model runs are not available, the ability to view estimated annual structural damages at a higher resolution is. Within the 2023 Master Plan Data Viewer, flood depths are reported at the CLARA model grid level (approximately 1 grid cell per US Census block), but damages in dollars and structure equivalents are reported at the coarser community level. To support MP29 new project development, CPRA is providing the modeled FWOA structure damages at the higher resolution grid level. Note that all currently available FWOA risk outputs are based on MP23 assumptions related to initial conditions and include the two mid-basin sediment diversions. An example of the updated resolution is shown in the figure below.



Example estimated annual damages in structures (EASD) outputs and links to the new grid-level annual estimated structural damages maps are provided in a later section, below.

LAND AND RELATED METRICS

MP23 ICM

For more information on MP23 FWOA, see the **2023 Coastal Master Plan.** Chapter 6 (pages 94-157) of the final 2023 Coastal Master Plan is a summary of the regional approach for MP23. Additional discussions of FWOA results for each region are provided in **MP23 Appendix C2**: 50-Year FWOA Model Output, Regional Summaries – ICM. Regional Workgroups may be especially interested in the FWOA Wetland Morphology discussion for each region, keeping in mind when reading about Barataria and Breton that the mid-basin diversions were included in the MP23 FWOA landscape.

MP23 FWOA outputs available on the **Master Plan Data Access Portal (MP-DAP)** include land change and vegetation as well as additional ICM metrics not discussed here in detail (e.g., salinity, tidal range, suspended sediment, etc.). Note that new ICM metrics like "Land Type with Water Depth" are not available in the 2023 Master Plan Data Viewer or MP-DAP. MP23 ICM-HSI outputs are also not currently available through the MP-DAP.]

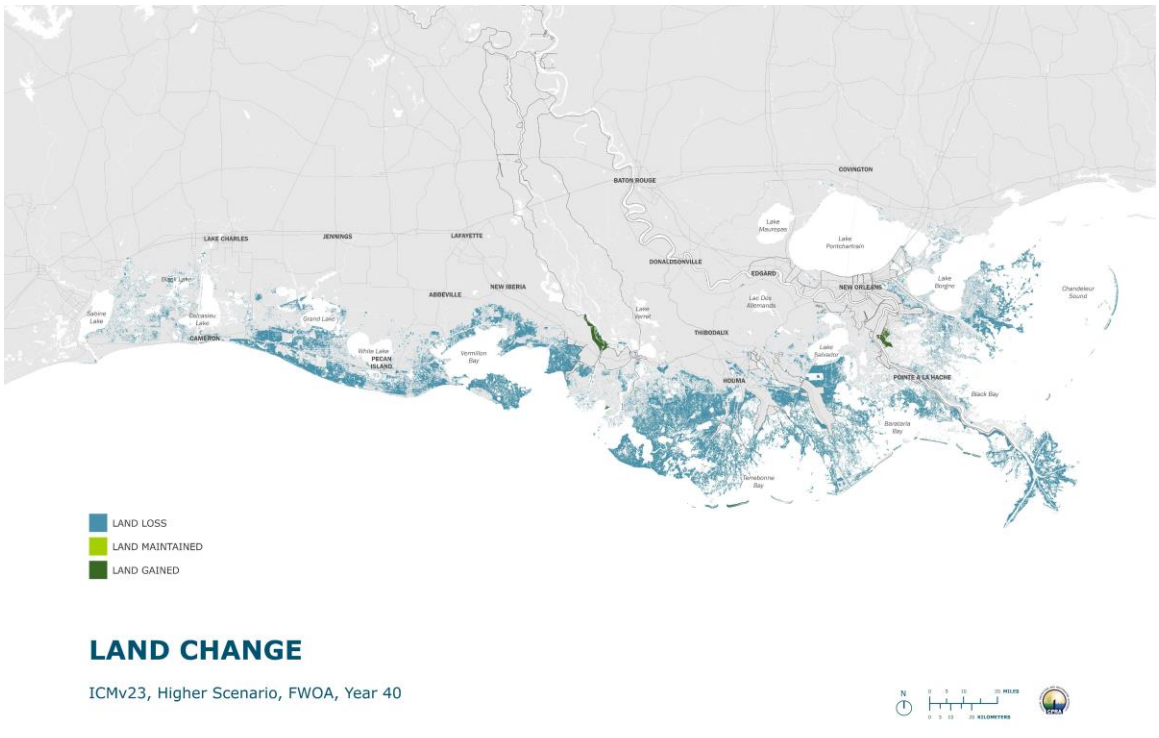
UPDATED FWOA

To support MP29 new project development, CPRA is providing FWOA projections in new ways. CPRA is providing interim versions of outputs for new metrics that are based on FWOA runs with the MP23 ICM (using MP23 initial conditions with mid-basin diversions and MP23 subsidence rates).

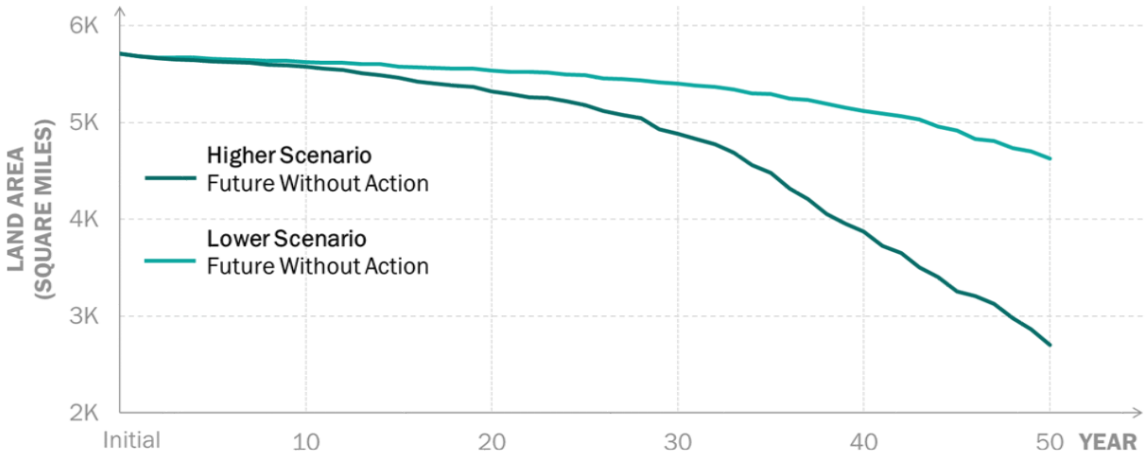
LAND AREA

The primary metric addressing the master plan goal of reducing land loss is land area benefit, specifically the difference in land area that restoration projects make, or the acres of land benefited by projects. Candidate projects are evaluated by how much land they create and maintain over 50 years relative to the FWOA landscape, and those results help determine which projects are included in the plan. Other factors that may be considered in evaluation of projects include cost-effectiveness, timing and duration of land change benefits, and robustness across future scenarios.

An example land change map for Year 40 under the MP23 higher scenario and coastwide land area curve and are provided below along with links to view additional figures for other years, spatial scales, or scenario.



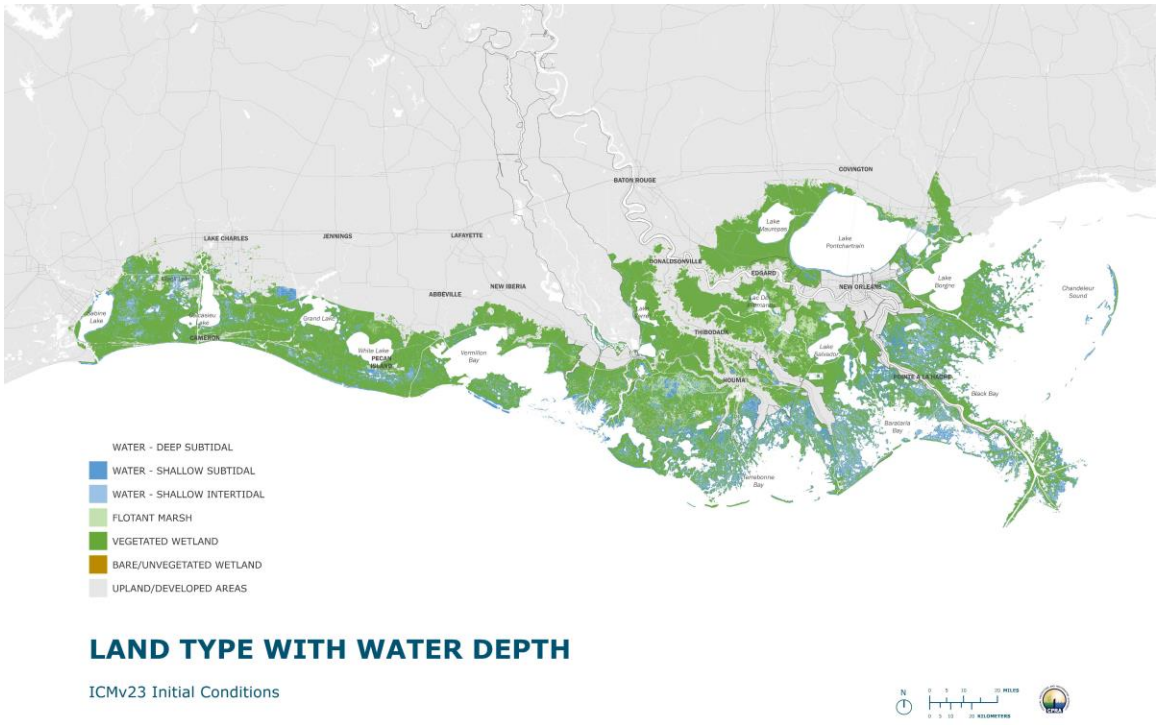
- ICMv23 Land Change, Lower Scenario, FWOA
- ICMv23 Land Change, Higher Scenario, FWOA



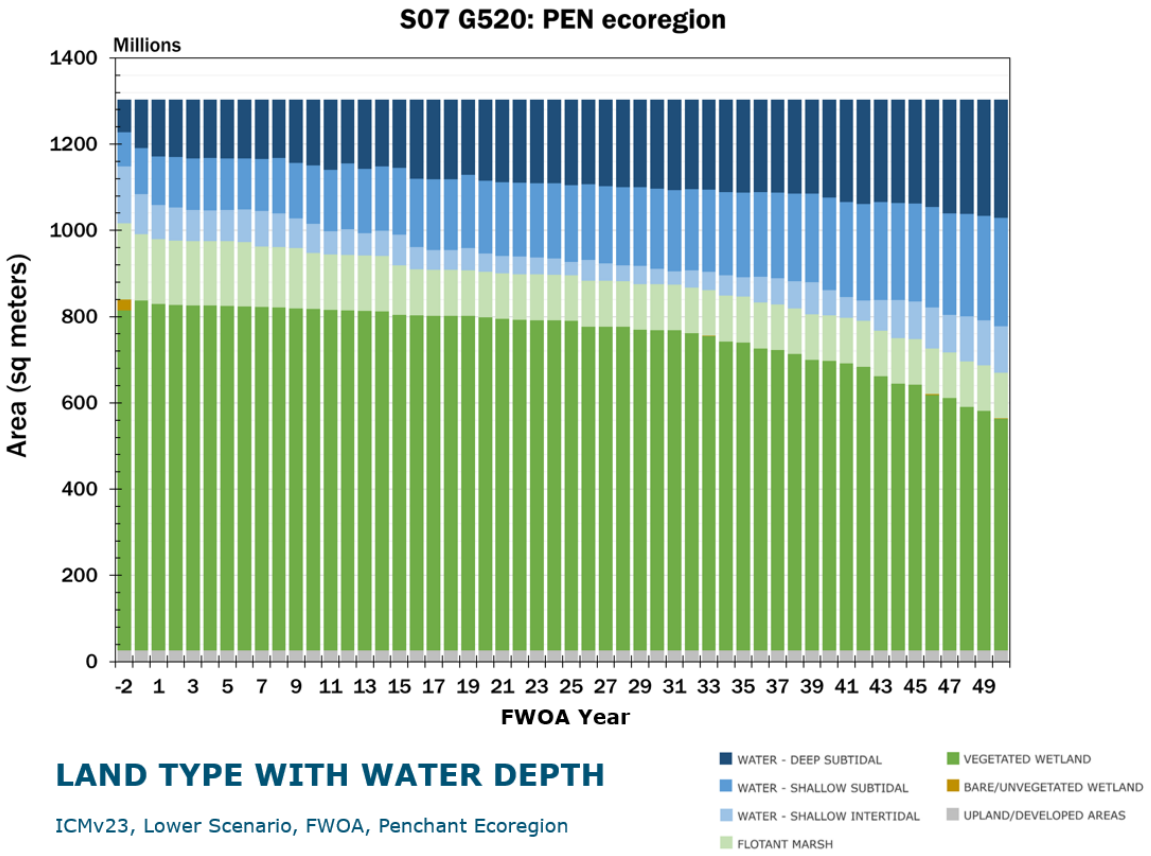
- ICMv23 Land Area Curves, FWOA

LAND TYPE AND WATER DEPTH

In addition to change in land area, it can be informative to look at how the types of land (e.g., vegetated wetland, flotant marsh, bareground/unvegetated wetland, and upland/developed) and water depths (e.g., shallow vs. deep water) projected by the ICM changes over time. Examples of outputs for land type and water depth are provided below along with links to view additional figures for different ecoregions, time, periods or scenario.



- ICMv23 Land Type with Water Depth, Lower Scenario, FWOA
- ICMv23 Land Type with Water Depth, Higher Scenario, FWOA



- Land Type with Water Depth Timeseries Graphs, Lower Scenario, FWOA
- Land Type with Water Depth Timeseries Graphs, Higher Scenario, FWOA

The MP23 FWOA landscape showed significant land loss over the 50-year model prediction. Under the lower scenario, 1,100 sq mi of land are lost in 50 years; an equivalent amount of loss occurs by Year 34 under the higher scenario, with up to 3,000 sq mi of land loss in 50 years under those more severe environmental conditions. Note that we do not expect dramatic differences compared to MP23 except in Barataria and Breton ecoregions and where there have been significant storm impacts.

VEGETATION

The ICM also models annual land cover, represented by the relative abundance of vegetation species for areas of vegetated wetlands and the amount of bareground. The model utilizes mean salinity during the growing season (May through August), the maximum 2-week salinity, mean water level, and variability of the water surface to determine how vegetation changes over time in response to changing environmental conditions. For most

species, mean salinity during the growing season and variability of the water surface are the main factors driving changes in vegetation. The coverages of individual species then determine habitat type (e.g., bottomland hardwood forest, fresh to saline marsh) so that changes in the distribution and abundance of those different habitat types can be tracked over time.

Although not a new metric, upcoming MP29 FWOA vegetation maps will be informative, especially for the Barataria and Breton Basins. Until the MP29 FWOA outputs are available, the best way to view ICMv23 vegetation maps is by using the 2023 Coastal Master Plan Data Tools.

Vegetation changes over time are tied to land change and hydrologic conditions that can be regionally or locally specific.

WETLAND VALUE ASSESSMENT

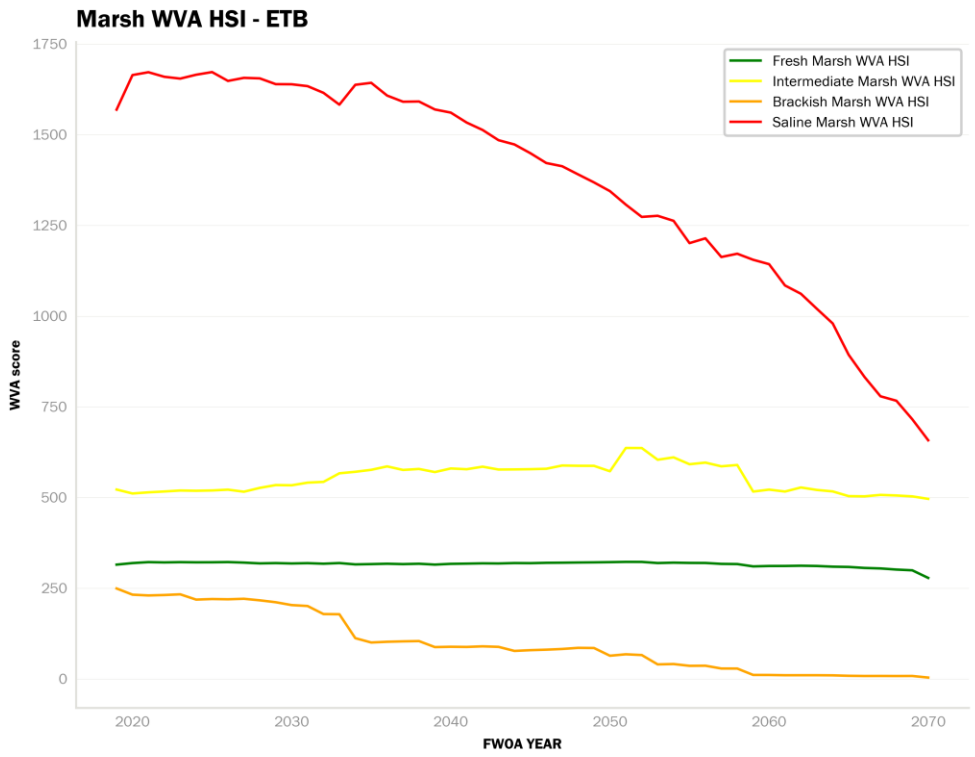
The ICM-Wetland Value Assessment (WVA) metric was developed based on methodology established through the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) program in order to support evaluation of wetland quality in addition to quantity in master plan analyses. Since the models are already familiar to many agency partners and data users, results can be interpreted more easily (and in the context of projects that have been constructed and monitored over time). In addition, calculation of WVA metrics allows for better assessment of certain master plan project types (e.g., forested wetland restoration, diversions, hydrologic restoration, ridge restoration) that are known to have a restorative value beyond increases to land area.

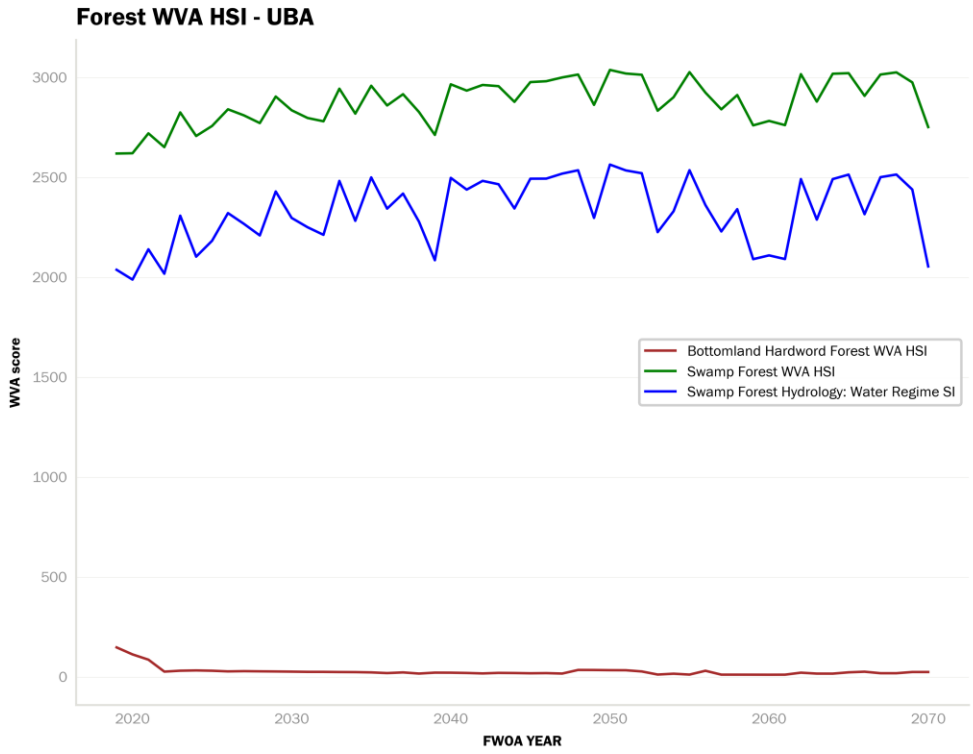
In the ICM-WVA framework, the models consist of variables (V), Suitability Indices (SI) calculated for each variable, and habitat suitability indices (HSIs) by habitat type. ICM-WVA currently includes the following habitat types: Bottomland Hardwood Forest, Swamp Forest, Fresh Marsh, Intermediate Marsh, Brackish Marsh, and Saline Marsh. Wetland value can also be assessed across all habitats by combining HSIs into Habitat Units (HUs). The ICM-WVA metrics are calculated from ICM output of vegetation types, land/water interface, and coastal hydrology. Variables from the CWPPRA WVA models that are not available as ICM output were held constant in the ICM-WVA. Note that if a region does not have any area of a specific habitat type (e.g., fresh marsh) then the tabulated HSI score for that habitat type will equal zero since that habitat type is not present.

WVA calculations can point to relatively better or worse conditions, but the absolute values of outputs are less meaningful, particularly for comparison of SI values across variables. However, certain variables calculated for use in the WVAs also have independent utility. For

example, the SI value for the water regime variable in the swamp WVA can help identify restoration projects that improve swamp quality, even if they do not result in increased land area. These values are calculated at the grid level so can be aggregated to any spatial scale of interest.

Examples of ICM-WVA output by ecoregion are provided below.



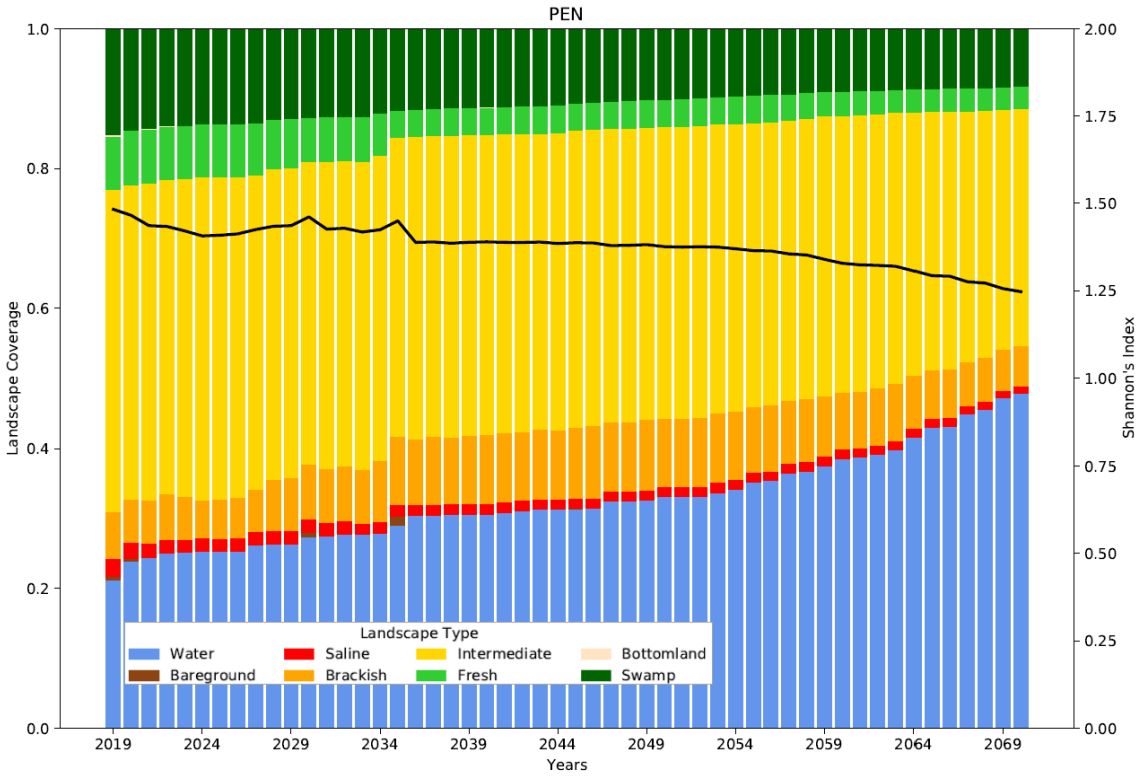


- ICMv23 Ecoregion Map and ICM-WVA Timeseries Graphs, FWOA, Lower Scenario

HABITAT DIVERSITY

The Habitat Diversity Index (HDI) metric, based on Shannon's Diversity Index, is another way to consider quality along with land area for coastal wetlands. In estuarine systems, a gradient of habitat types is essential to providing a mosaic of different habitats supporting unique plant and animal communities. As incorporated into the ICM, the ICM-HDI captures changes in habitat richness and the proportional abundance of different types of wetland habitat. Values can be calculated at scales from ICM-Hydro compartment to coastwide, and results are scale-dependent. Generally speaking, for example, larger areas may be expected to have greater species or habitat richness compared to smaller areas.

An example of ICM-HDI output is provided below for the Penchant ecoregion along with a link to view additional figures for outputs calculated for other ecoregions and both scenarios.



HABITAT DIVERSITY

ICMv23, Lower Scenario, FWOA, Penchant Ecoregion

- ICMv23 Ecoregion Map and ICM-HDI Timeseries Graphs, Lower Scenario, FWOA

RISK METRICS

MP23 RISK MODELS

Projected land loss in the MP23 FWOA impacts not only the landscape configuration and ecology but also results in changes to storm surge and waves and, thus, flood-related damages. The primary metrics used to evaluate risk reduction projects for coastal master plan analyses include estimated annual damages in dollars (EADD) and by number of structures (EASD).

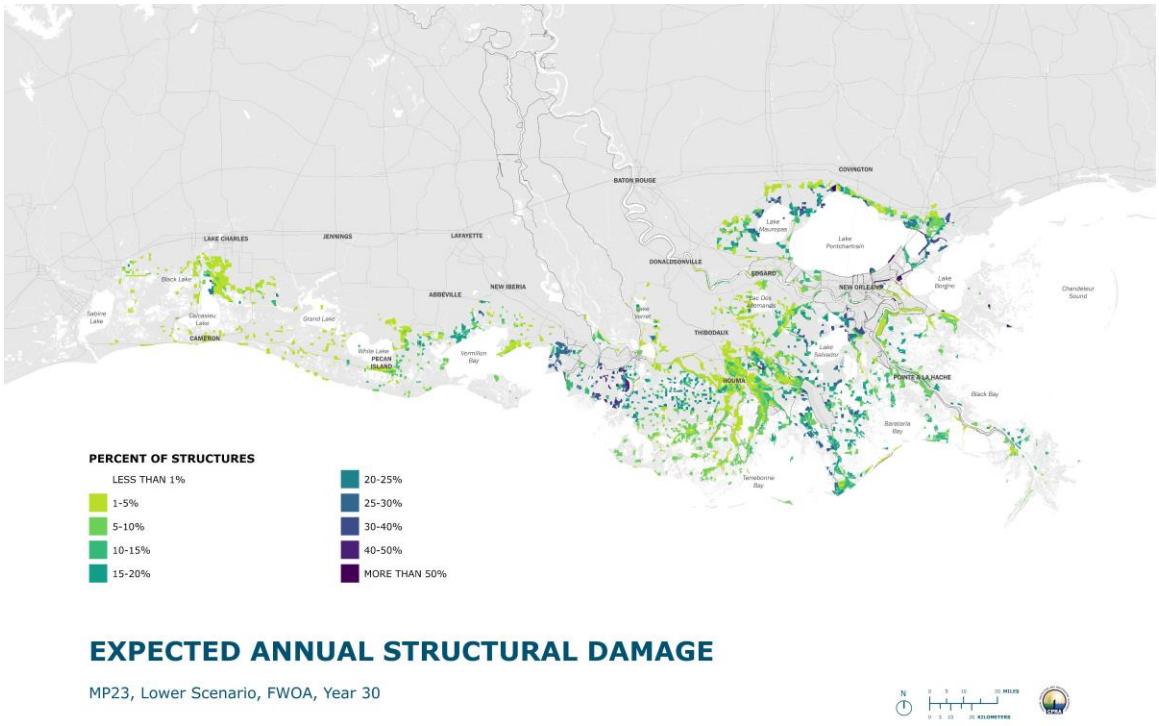
Results from MP23 indicated that under the lower scenario at Year 50 flood depths were projected to be highest east of the Mississippi River, around Vermilion Bay and West and East Cote Blanche bays, and along the coast in the Chenier Plain. For the higher scenario these areas show even greater flood depths and higher flooding in the Chenier Plain, in the

Terrebonne Basin, and around Lake Pontchartrain. MP23 projected that without additional project implementation, flood damages could increase by up to $24 billion annually, with 22,000 additional structures damaged due to significant increases in flood depths under the higher environmental scenario.

For more information on MP23 FWOA, see the **2023 Coastal Master Plan** and **MP23 Appendix C3**: 50-Year FWOA Model Output, Regional Summaries – Risk.

The **2023 Master Plan Data Viewer** includes MP23 flood depth (grid level) and damage (community level) information that can be explored by decade, by environmental scenario, with or without master plan projects, and by frequency of occurrence (annual exceedance probability). Grid level expected annual structural damage projections are available here.

An example map of EASD output by grid level is provided below for Year 30 under the MP23 lower scenario along with a link to view additional figures for outputs by decade for both scenarios.



- MP23 Grid Level EASD, Lower Scenario, FWOA
- MP23 Grid Level EASD, Higher Scenario, FWOA