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2017 Coastal Master Plan

Attachment E3: Nonstructural Model Results

Report: Final

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Prepared By: Coastal Protection and Restoration Authority

Coastal Protection and Restoration Authority

This document was prepared in support of the 2017 Coastal Master Plan being prepared by the Coastal Protection and Restoration Authority (CPRA). CPRA was established by the Louisiana Legislature in response to Hurricanes Katrina and Rita through Act 8 of the First Extraordinary Session of 2005. Act 8 of the First Extraordinary Session of 2005 expanded the membership, duties and responsibilities of CPRA and charged the new authority to develop and implement a comprehensive coastal protection plan, consisting of a master plan (revised every five years) and annual plans. CPRA's mandate is to develop, implement and enforce a comprehensive coastal protection and restoration master plan.

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Executive Summary

The Attachment E3: Nonstructural Model Results compiles the nonstructural project results for the 2017 Coastal Master Plan and the Flood Risk and Resilience Program. This attachment summarizes the mitigation measures recommended in the nonstructural project areas and highlights key datasets derived from the nonstructural technical analysis conducted using the Coastal Louisiana Risk Assessment (CLARA) Model and the Planning Tool. This information can be utilized by local parishes in the refinement of nonstructural projects through the Flood Risk and Resilience Program application process. In addition, the results may be informative to other state agencies, nongovernmental organizations, community advocates, and coastal stakeholders who are interested in developing coastal hazard mitigation plans, comprehensive plans, or other nonstructural mitigation projects. The Nonstructural Model Results include:

- Maps and list of all candidate nonstructural projects considered
- Maps and list of nonstructural projects recommended for the 2017 Coastal Master Plan
- Description of number and type of mitigation measures recommended for each nonstructural project area
- Description of recommended implementation phase and mitigation standards
- Additional nonstructural datasets available

Table of Contents

List of Figures

1.0 2017 Candidate Nonstructural Projects

The 2017 Coastal Master Plan analyzed 54 candidate nonstructural project areas. These nonstructural project areas include several nonstructural mitigation measures, which are defined according to flood depths and structure types. Each mitigation measure is based on the CPRA estimates of 100-year flood depths (or 1% annual flood event) plus two feet of freeboard for elevation projects. Mitigation measures are defined as:

- **Floodproofing** of non-residential structures. Recommended in areas where the mitigation standard is less than three feet.
- **Elevation** of residential structures. Recommended in areas where the mitigation standard is between 3-14 feet.
- **Voluntary Acquisition** for residential structures. Recommended in areas where the mitigation standard is greater than 14 feet.

The 100-year flood depths were defined by either year 10 or year 25 future conditions under the High environmental scenario depending on when the nonstructural project is selected for implementation. The development of the candidate nonstructural projects and mitigation standards is described in more detail below.

The 54 candidate nonstructural project areas were created using parish or municipal boundaries as well as existing and/or future structural risk reduction projects. Several sets of project variations (termed "variants"), or mitigation options, have been developed within each nonstructural project area. These project variants include nonstructural mitigation measure recommendations (i.e., floodproofing, elevation, and acquisition) based on different mitigation standards. Mitigation standards corresponded to different flood depth conditions as determined by a given time period (initial conditions, year 10, or year 25) and environmental scenario (Low, Medium, and High) that the nonstructural measures were designed to mitigate. For each project variant, the number and cost of floodproofing, elevation, and acquisition mitigation options were summarized in total and by structure type.

Figure 1 includes a map of the 54 project areas considered in the nonstructural analysis. For more information about all of the candidate nonstructural projects, details can be found on project factsheets for each of the 54 project areas in Attachment A8: Project Factsheets. Also, please see Appendix E: Flood Risk and Resilience Program Framework, section 3.2 "Nonstructural Project Formulation for the 2017 Coastal Master Plan," for more details about how the nonstructural projects were developed.

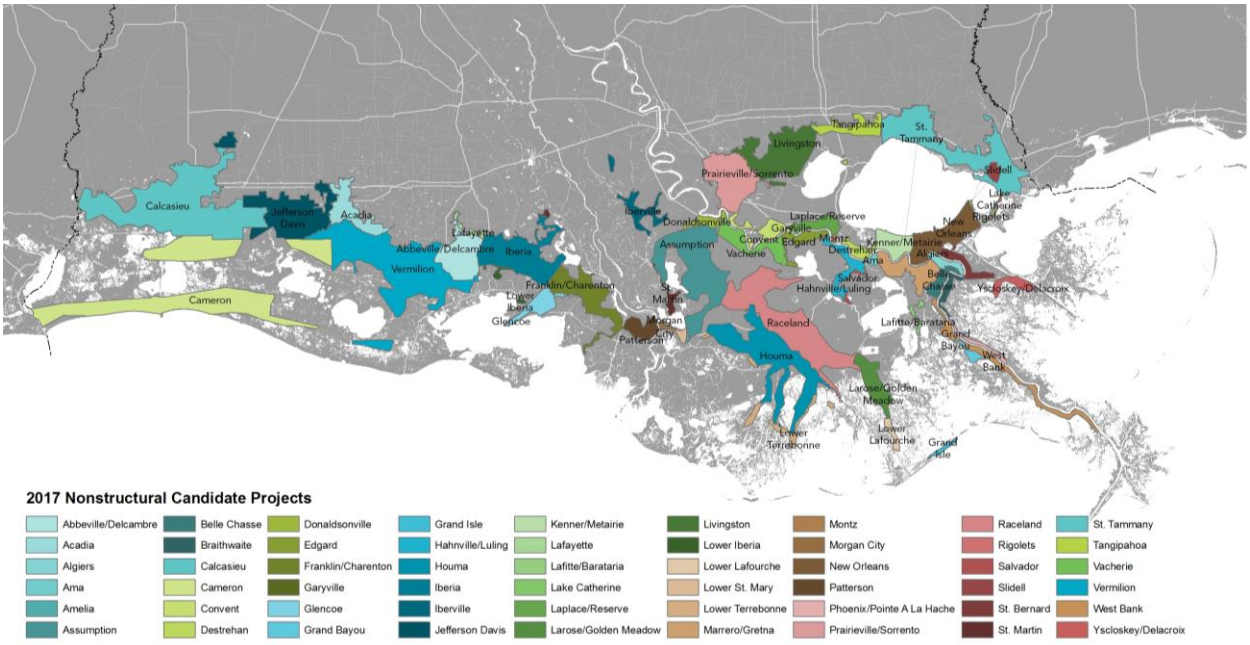

Figure 1: 2017 Candidate Nonstructural Projects Considered.

2.0 2017 Nonstructural Project Recommendations

For the 2017 Coastal Master Plan, CPRA conducted an analysis of 54 candidate nonstructural project areas. The results of this analysis refined the nonstructural project areas to 32 recommended nonstructural project areas.

To determine the 32 recommended nonstructural project areas, the master plan compared different nonstructural projects variants to each other as well as to structural risk reduction projects. The Planning Tool was first used to compare the benefits of individual risk reduction projects based on their ability to maximize near-term (year 25) and long-term (year 50) expected annual damage (EAD) reduction. The Planning Tool was then used to develop sets of risk reduction projects (termed alternatives) to implement in two time periods (years 1-30 and 31-50) that best achieve CPRA's risk reduction goals. This procedure ensured that the projects that provide the greatest immediate risk reduction (constrained by available funding) were selected in the first time period and those with reduced benefits in the next period. This approach took into account the significant uncertainty about how precisely the master plan will be implemented over the coming decades, and the importance of implementing projects now that will most efficiently put Louisiana on a trajectory of increased resilience.

After comparing nonstructural project variations to each other, two nonstructural variants were selected for each project area as defined by flood depths occurring at either year 10 or year 25 under the High environmental scenario. Nonstructural projects slated for the initial implementation period (years 1-30) are designed to reduce the economic damage due to 100-year flood depths occurring 10 years into the future, while nonstructural projects selected in the last implementation period (years 31-50) are designed to reduce economic damage due to flood depths occurring 25 years into the future. It should be noted that only one nonstructural variant can be selected for any given nonstructural project area. For instance, a nonstructural

project is designed to mitigate either year 10 flood depths if selected for the first time period, or year 25 flood depths if selected for the last time period.

Nonstructural and structural risk reduction projects were evaluated by how well the project could reduce a given area's EAD within a given budget. Effects on EAD were determined by the difference in EAD for a risk region for the "Future with Project" compared against the "Future without Project." Economic damages were generated by the CLARA model for initial conditions and years 10, 25, 50, and across all of the environmental and risk scenarios. Different nonstructural project variants were compared to each other as well as to the structural risk reduction projects to determine which projects provide the greatest risk reduction. In general, all risk reduction projects were evaluated based on the same risk metric (EAD). However, ten nonstructural projects were also identified as prerequisites to proposed structural projects that resulted in increased flood depths outside the levee system.

See Appendix E: Flood Risk and Resilience Program Framework, section 3.2 "Nonstructural Project Formulation for the 2017 Coastal Master Plan," for more details about how the nonstructural projects were evaluated and selected.

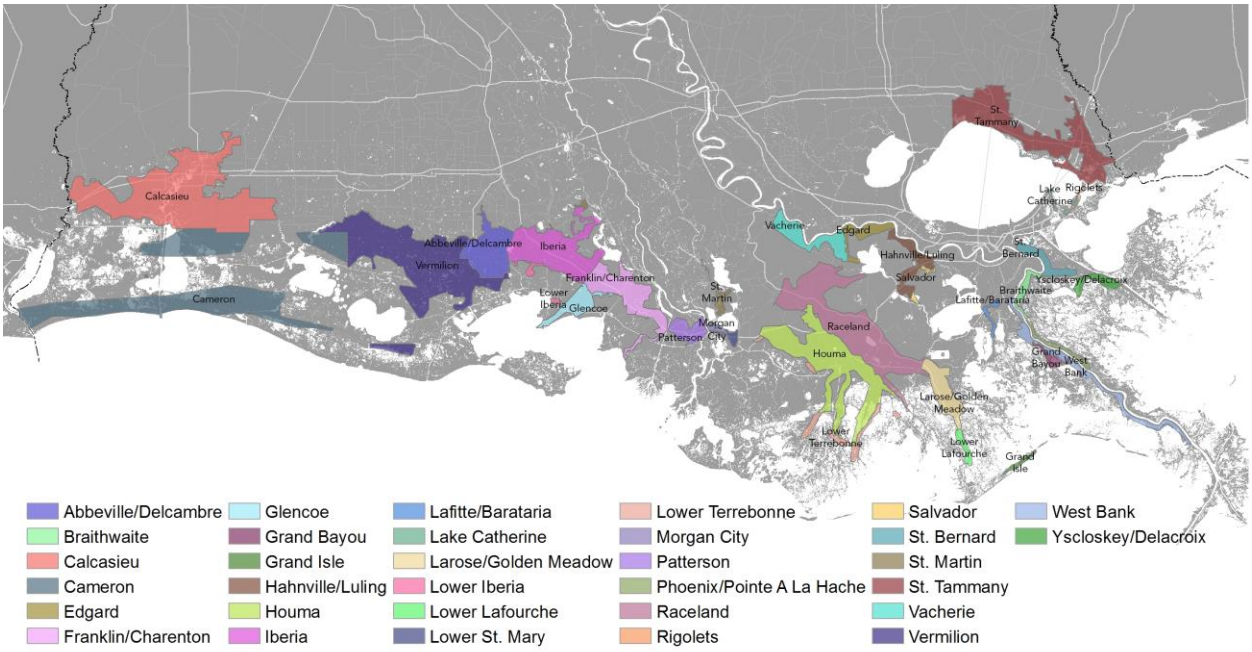

Figure 2: 2017 Nonstructural Project Recommendations.

The 2017 Coastal Master Plan includes a range of nonstructural projects that, when combined with the structural risk reduction projects, effectively reduce economic damages due to storm surge flood risk. These recommendations build upon and refine the nonstructural projects developed for the 2012 Coastal Master Plan by including new mitigation standards, and considering additional community characteristics, such as low to moderate income (LMI) households. In some coastal areas, only a low level of nonstructural mitigation is appropriate. In other cases, more extensive nonstructural mitigation is required to reduce risk in vulnerable communities. Additional nonstructural project refinement will occur in partnership with parishes through the Flood Risk and Resilience application process, which is outlined in the Attachment E4: Parish Applicant's Handbook.

Overall, 32 nonstructural projects are recommended to mitigate a total of 26,233 structures at a cost of $6 billion over the next 50 years. This includes 1,398 non-residential floodproofings, 22,432 residential elevations, and 2,403 residential voluntary acquisitions. The 32 recommended nonstructural projects vary in project area size, number and cost of mitigation measures, and other details.

Table 1 includes a summary of the 32 nonstructural project areas, number of proposed mitigation measures by type (floodproofing, elevation, and voluntary acquisition), estimated count of mitigated structures, and estimated project cost. It should be noted that these recommendations are intended to provide planning level estimates, and do not include recommendations for specific structures to be mitigated. During project implementation, nonstructural projects will be further revised by coastal parishes to determine the specific structures to be mitigated, total structure counts, and total costs based on available funding and the parish prioritization process. In addition, it should be noted that the Flood Risk and Resilience Program is a strictly voluntary program.

Table 1: 2017 Recommended Nonstructural Projects and Mitigation Measures.

32 Recommended Nonstructural Projects and Mitigation Measures by Type, Estimated Count, and Estimated Cost						
NS Project ID	**Name**	**Floodproofing**	**Elevation**	**Voluntary Acquisition**	**Total Count**	**Estimated Total Cost**
CAL.01N	Calcasieu	11	143	83	237	$69.8M
CAM.01N	Cameron	27	437	114	578	$127.0M
IBE.01N	Lower Iberia	0	6	0	6	$1.0M
IBE.02N	Iberia	94	1,398	0	1,492	$289.4M
JEF.01N	Grand Isle	1	519	23	543	$98.2M
JEF.02N	Lafitte/Barataria	9	1,237	2	1,248	$200.8M
LAF.01N	Lower Lafourche	0	9	0	9	$1.7M
LAF.02N	Larose/Golden Meadow	39	30	0	69	$32.6M
LAF.03N	Raceland	140	1,517	2	1,659	$363.5M
ORL.01N	Rigolets	0	7	14	21	$18.0M
ORL.02N	Lake Catherine	0	33	211	244	$135.6M
PLA.01N	West Bank	46	1,331	54	1,431	$264.7M
PLA.02N	Braithwaite	0	184	79	263	$56.2M

NS Project ID	Name	Floodproofing	Elevation	Voluntary Acquisition	Total Count	Estimated Total Cost
PLA.03N	Grand Bayou	0	11	1	12	$3.0M
PLA.05N	Phoenix/Pointe A La Hache	0	163	24	187	$38.3M
SJB.03N	Edgard	4	26	0	30	$7.8M
SMT.01N	St. Martin	3	58	0	61	$13.2M
STB.01N	Yscloskey/ Delacroix	0	0	124	124	$70.4M
STB.02N	St. Bernard	1	1	0	2	$2.4M
STC.01N	Hahnville/Luling	110	3,672	144	3,926	$829.5M
STC.05N	Salvador	0	12	0	12	$2.3M
STJ.02N	Vacherie	2	10	0	12	$3.9M
STM.01N	Morgan City	3	0	0	3	$4.2M
STM.02N	Glencoe	5	69	8	82	$15.8M
STM.03N	Patterson	2	9	0	11	$3.0M
STM.04N	Franklin/Charenton	52	290	0	342	$80.4M
STM.05N	Lower St. Mary	8	4	0	12	$7.2M
STT.01N	St. Tammany	375	4,605	889	5,869	$1,611.3M
TER.01N	Lower Terrebonne	1	261	120	382	$87.7M
TER.02N	Houma	312	5,307	477	6,096	$1,264.0M
VER.01N	Vermilion	40	448	20	508	$109.9M
VER.02N	Abbeville/ Delcambre	113	635	14	762	$190.6M
TOTAL		**1,398**	**22,432**	**2,403**	**26,233**	**$6.0B**

To also illustrate the various types of the nonstructural project recommendations, see Figures 3-6 for maps of the counts of total mitigation measures and counts by mitigation type.

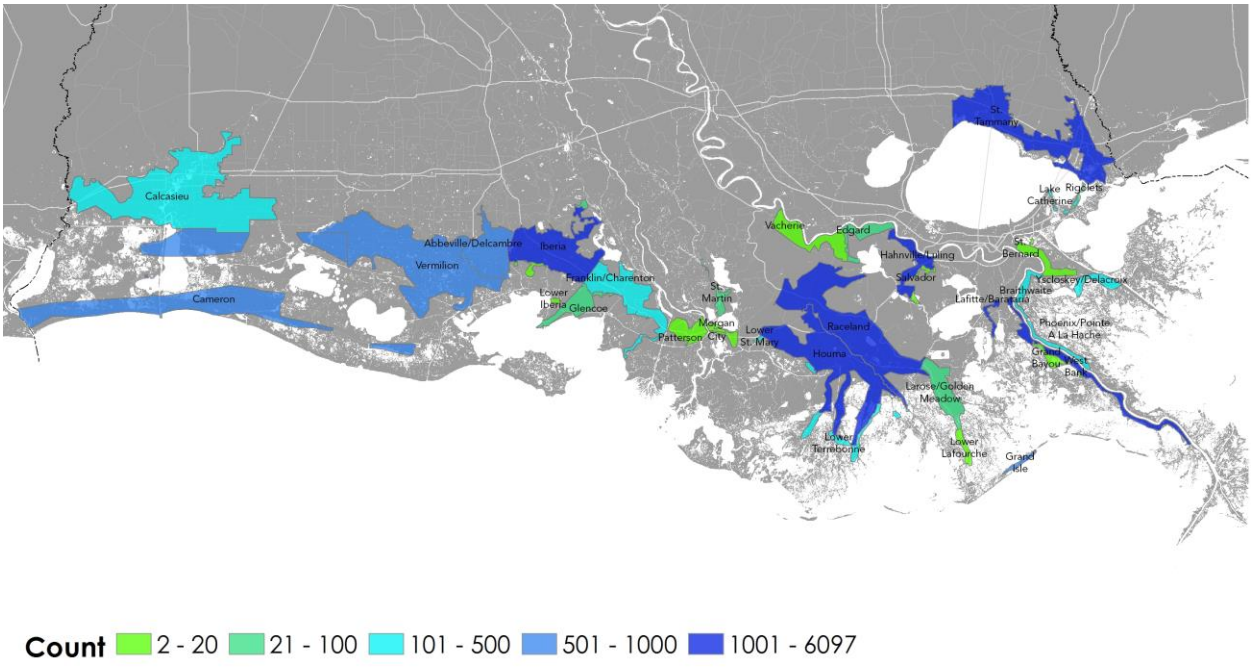

Figure 3: Range of Total of Structures to Be Mitigated.

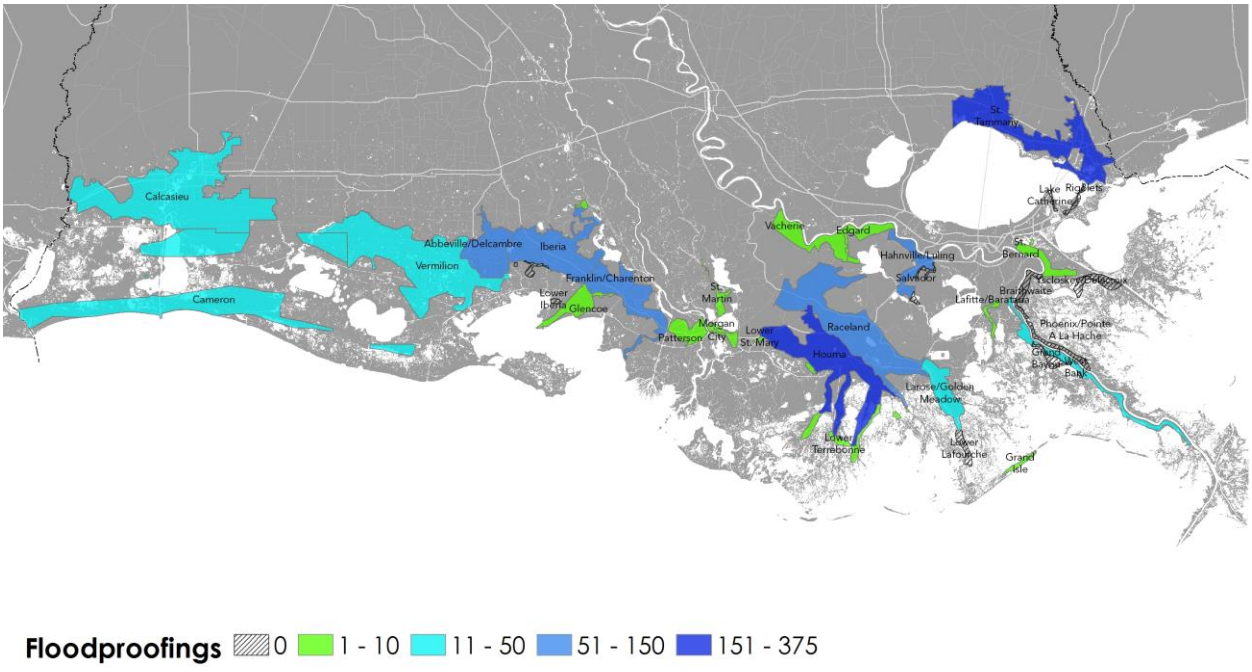

Figure 4: Range of Non-Residential Floodproofing Counts.

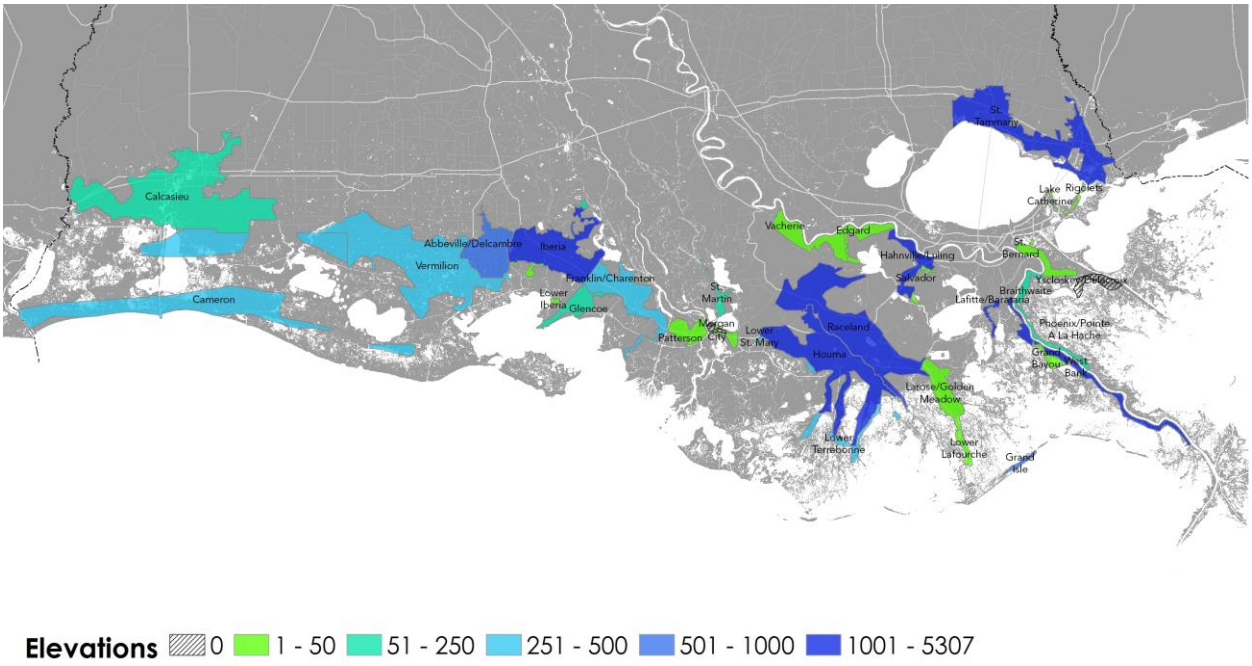

Figure 5: Range of Residential Elevation Counts.

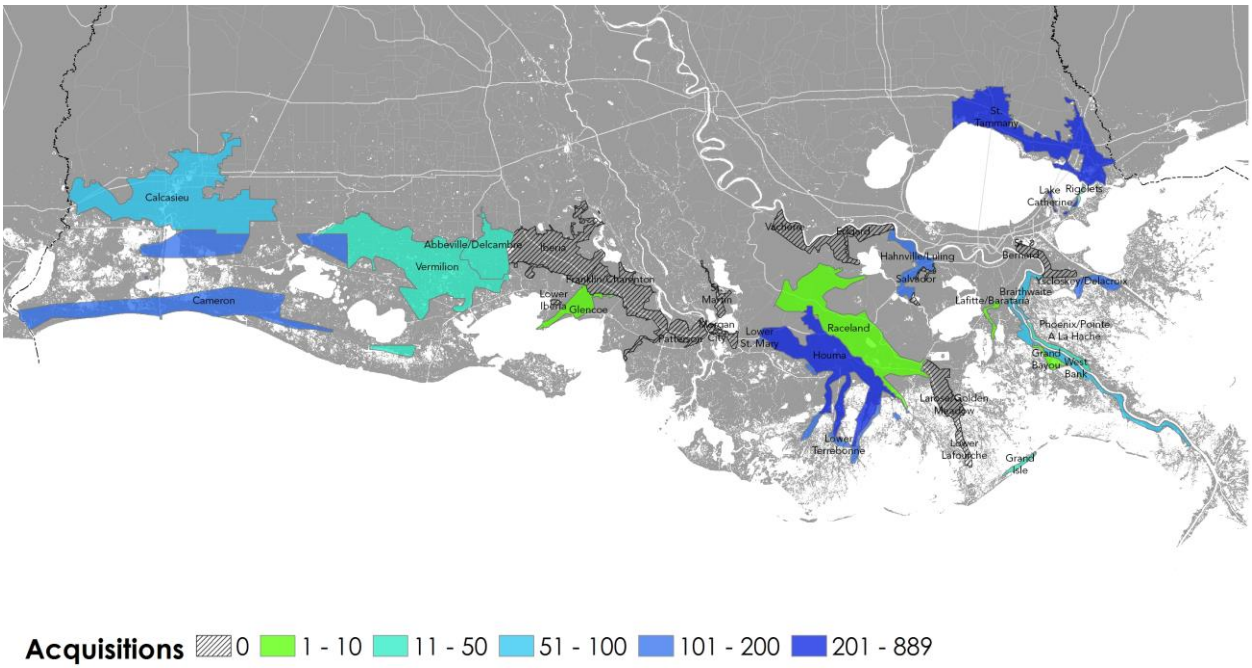

Figure 6: Range of Residential Voluntary Acquisition Counts.

3.0 Nonstructural Project Implementation Periods

The nonstructural projects cannot all be implemented at once due to funding and capacity constraints. Therefore, similarly to restoration and structural risk reduction projects, nonstructural projects are recommended for different implementation periods over the 50-year planning horizon. Both structural and nonstructural risk reduction projects are recommended for two implementation periods: years 1-30 and years 31-50. Nonstructural projects also vary by mitigation standard, which is based on the implementation period. For instance, projects selected for the first period include mitigation measures that are designed to mitigate 100-year flood depths occurring at year 10. Projects selected in the second period include mitigation measures designed to mitigate 100-year flood depths occurring at year 25. This mitigation standard promotes higher risk reduction and more flexibility than a static mitigation standard.

In general, nonstructural projects that reduce the most EAD were selected for the first time period (year 1-30). However, in certain instances the selection of a proposed structural project necessitated the selection of a nonstructural project. These were recommended if a selected candidate structural project increased flood depths outside the levee system, then the nonstructural project in that area would automatically be selected to mitigate the area of induced flooding. Ten nonstructural projects were identified as prerequisites for structural projects recommended in the master plan.

Table 2 shows recommended nonstructural projects by implementation period, whether or not they were a structural project prerequisite, and the corresponding mitigation standard. For more information on how the Planning Tool considers differences in structural and nonstructural project implementation, project benefits for risk reduction, alternative formulation, and the plan development process, see Appendix D: Planning Tool.

Table 2: 2017 Recommended Nonstructural Projects and Implementation Periods.

Nonstructural Projects by Implementation Period and Other Selection Details				
NS Project	**Name**	**Implementation Period**	**Structural Project Prerequisite**	**Mitigation Standard**
CAL.01N	Calcasieu	Year 1-30	no	Year 10
CAM.01N	Cameron	Year 1-30	no	Year 10
IBE.01N	Lower Iberia	Year 1-30	no	Year 10
IBE.02N	Iberia	Year 1-30	no	Year 10
JEF.01N	Grand Isle	Year 1-30	03a.HP.20 - Larose to Golden Meadow	Year 10
JEF.02N	Lafitte/Barataria	Year 1-30	002.HP.06 - Upper Barataria Risk Reduction	Year 10
LAF.01N	Lower Lafourche	Year 1-30	03a.HP.103 - Morganza to the Gulf and 03a.HP.20 - Larose to Golden Meadow	Year 10

NS Project ID	Name	Implementation Period	Structural Project Prerequisite	Mitigation Standard
LAF.02N	Larose/ Golden Meadow	Year 1-30	002.HP.06: Upper Barataria Risk Reduction and 03a.HP.103: Morganza to the Gulf	Year 10
LAF.03N	Raceland	Year 1-30	002.HP.06 - Upper Barataria Risk Reduction	Year 10
ORL.01N	Rigolets	Year 1-30	001.HP.08 - Lake Pontchartrain Barrier	Year 10
ORL.02N	Lake Catherine	Year 1-30	No	Year 10
PLA.01N	West Bank	Year 1-30	no	Year 10
PLA.02N	Braithwaite	Year 1-30	no	Year 10
PLA.03N	Grand Bayou	Year 1-30	no	Year 10
PLA.05N	Phoenix/Pointe A La Hache	Year 1-30	no	Year 10
SJB.03N	Edgard	Year 1-30	no	Year 10
SMT.01N	St. Martin	Year 1-30	no	Year 10
STB.01N	Yscloskey/Delacroix	Year 1-30	no	Year 10
STB.02N	St. Bernard	Year 1-30	001.HP.08 - Lake Pontchartrain Barrier	Year 10
STC.01N	Hahnville/Luling	Year 31-50	no	Year 25
STC.05N	Salvador	Year 1-30	002.HP.06 - Upper Barataria Risk Reduction	Year 10
STJ.02N	Vacherie	Year 31-50	no	Year 25
STM.01N	Morgan City	Year 31-50	no	Year 25
STM.02N	Glencoe	Year 31-50	no	Year 25
STM.03N	Patterson	Year 31-50	no	Year 25
STM.04N	Franklin/Charenton	Year 1-30	no	Year 10
STM.05N	Lower St. Mary	Year 1-30	no	Year 10
STT.01N	St. Tammany	Year 1-30	no	Year 10
TER.01N	Lower Terrebonne	Year 1-30	03a.HP.103 - Morganza to the Gulf	Year 10
TER.02N	Houma	Year 1-30	no	Year 10
VER.01N	Vermilion	Year 1-30	03b.HP.14 - Iberia/St. Mary Upland Levee	Year 10
VER.02N	Abbeville/Delcambre	Year 1-30	no	Year 10

Figure 7 illustrates the nonstructural projects by recommended implementation period, which includes the first time period (years 1-30) and second time period (years 31-50).

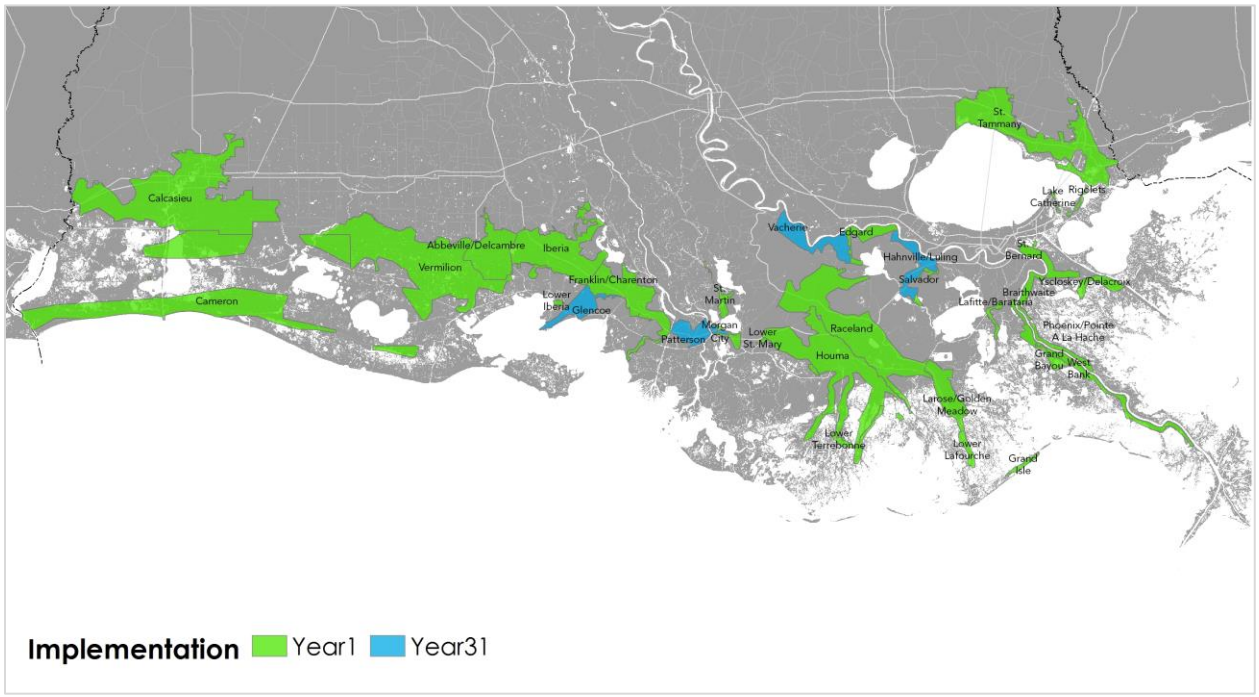

Figure 7: Nonstructural Project Implementation Periods.

4.0 Nonstructural Projects and Additional Details

During the nonstructural project development process, several types of data were collected to describe the projects and project benefits. This information was focused on better understanding how candidate nonstructural projects could potentially affect communities that were especially vulnerable to flood risk. For instance, additional data available by nonstructural project area includes:

- **Repetitive loss and severe repetitive loss properties-** total count of RL/SRL properties within the mitigated grid points in the nonstructural project area;
- **Low to moderate income households-** the average percentage of the low to moderate income households in the project area.

See Table 3 below for more details on these datasets for each nonstructural project. For more information about each of the nonstructural projects, details can be found in Appendix A: Project Definition.

Table 3: 2017 Recommended Nonstructural Projects and Additional Details.

Nonstructural Projects by Counts of Repetitive Loss/Severe Repetitive Loss Properties in Mitigated Areas and Average Percentage of Low to Moderate Income Households			
NS Project ID	**Name**	**RL/SRL Count**	**Avg. % LMI**
CAL.01N	Calcasieu	930	29%
CAM.01N	Cameron	1,225	35%
IBE.01N	Lower Iberia	15	35%
IBE.02N	Iberia	660	28%
JEF.01N	Grand Isle	465	39%
JEF.02N	Lafitte/Barataria	765	42%
LAF.01N	Lower Lafourche	50	59%
LAF.02N	Larose/Golden Meadow	0	50%
LAF.03N	Raceland	155	38%
ORL.01N	Rigolets	55	42%
ORL.02N	Lake Catherine	615	42%
PLA.01N	West Bank	95	47%
PLA.02N	Braithwaite	295	42%
PLA.03N	Grand Bayou	35	66%
PLA.05N	Phoenix/Pointe A La Hache	35	82%
SJB.03N	Edgard	30	43%
SMT.01N	St. Martin	0	26%
STB.01N	Yscloskey/Delacroix	170	85%
STB.02N	St. Bernard	0	17%
STC.01N	Hahnville/Luling	245	27%
STC.05N	Salvador	5	22%
STJ.02N	Vacherie	5	30%
STM.01N	Morgan City	0	0%
STM.02N	Glencoe	65	58%
STM.03N	Patterson	0	45%
STM.04N	Franklin/Charenton	90	48%
STM.05N	Lower St. Mary	0	56%
STT.01N	St. Tammany	4,400	25%
TER.01N	Lower Terrebonne	455	61%
TER.02N	Houma	6,265	48%
VER.01N	Vermilion	315	36%
VER.02N	Abbeville/Delcambre	965	40%

Figures 8 and 9 also provide examples of this data. The former illustrates the range of the number of repetitive loss/severe repetitive loss properties (only for mitigated grid points) by nonstructural project area, while the latter illustrates the range of the average percent of LMI households in each project area.

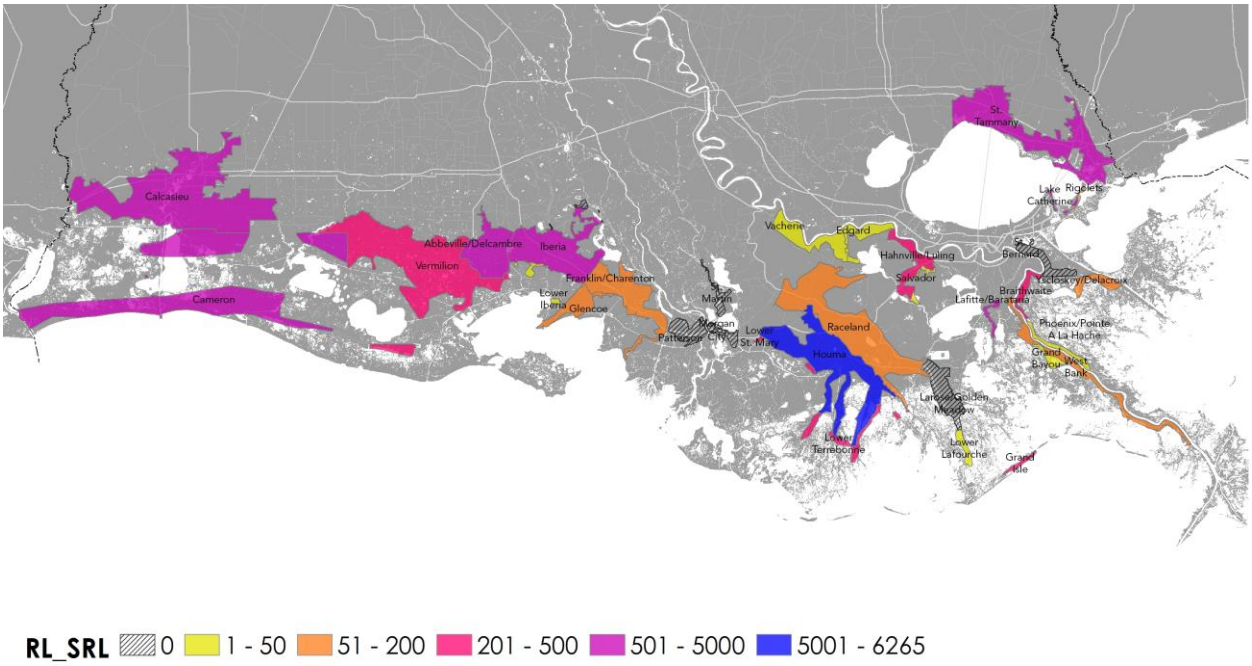

Figure 8: Repetitive Loss and Severe Repetitive Loss Properties.

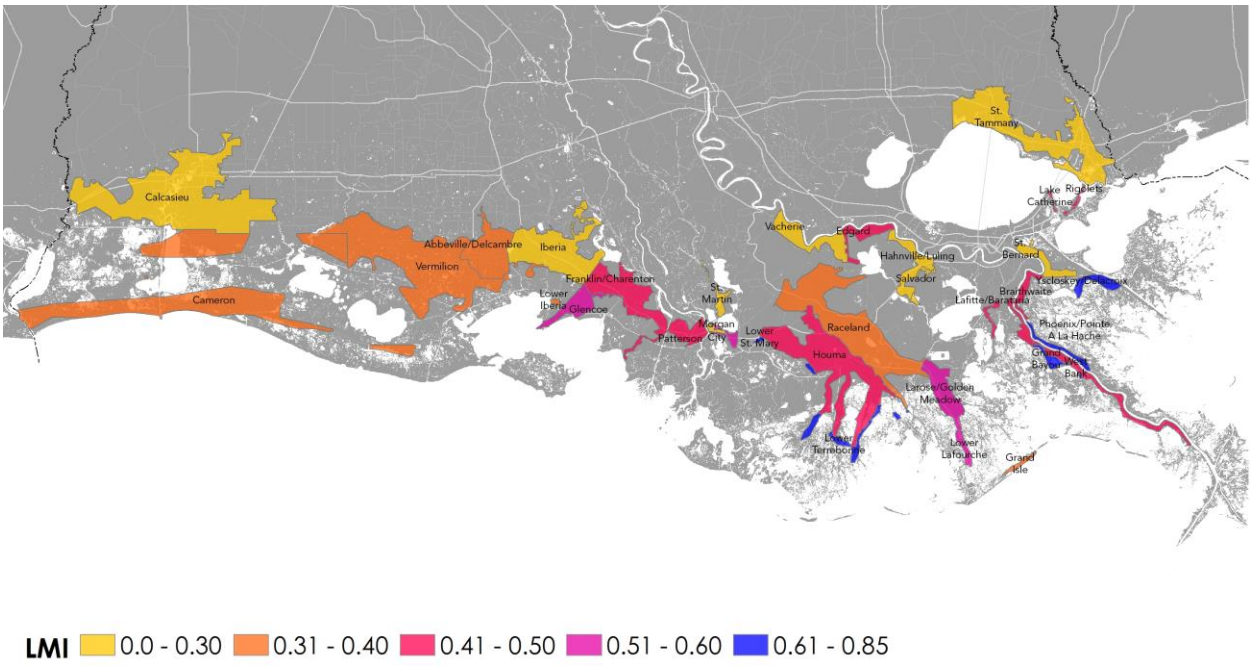

Figure 9: Percent LMI Households in Each Nonstructural Project Area.

5.0 Conclusion

The 2017 Coastal Master Plan's nonstructural project recommendations (along with structural risk reduction projects) provide a comprehensive approach to reduce the impacts of coastal flood risk over the next 50 years. The aim of the 2017 Coastal Master Plan is to provide a coast wide planning-level assessment to better focus the state's priorities for investment in order to meet the needs of coastal Louisiana's most vulnerable communities. These recommendations will be updated every five years with the next iteration of the master plan. It is also anticipated that the recommended nonstructural projects described above will be further refined through the Flood Risk and Resilience Program to accommodate other local community considerations and funding constraints. For more information on the Flood Risk and Resilience Program, please see Appendix E: Flood Risk and Resilience Program Framework.