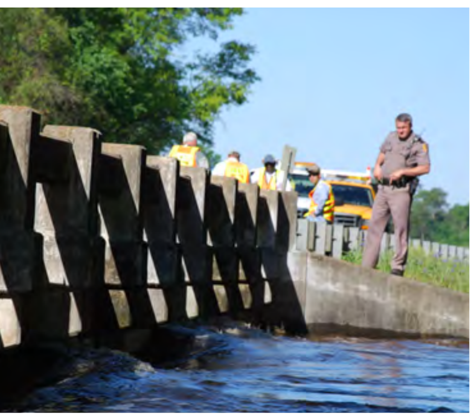
Florida Statewide Regional Evacuation Study Program



Depth Analysis Atlas

Lafayette County

Volume 9-3
Book 3 of 4

Florida Division of Emergency Management

North Central Florida Regional Planning Council

North Central Florida Region

Includes Hurricane Evacuation Study

Statewide Regional Evacuation Study Program

NORTH CENTRAL FLORIDA SURGE DEPTH ATLAS

Volume 9-3
Book 3
Lafayette County

This Book is part of Volume IX of the ***Statewide Regional Evacuation Study*** (SRES) Program and one of four county books in the North Central Florida Surge Depth Atlas Series. Book 1 covers Dixie County; Book 2 covers Gilchrist County; Book 3 covers Lafayette County, and Book 4 covers Taylor County. The Atlas maps identify those areas subject to potential Surge Depth flooding from the five categories of hurricane on the Saffir Simpson Hurricane Wind Scale as determined by NOAA's numerical storm surge model, SLOSH.

The Surge Depth Atlas, published in 2010, is the foundation of the hazards analysis for Surge Depth and a key component of the SRES. The Technical Data Report (Volume I) builds upon this analysis and includes the revised evacuation zones and population estimates, results of the evacuation behavioral data, shelter analysis and evacuation transportation analyses. The Study, which provides vital information to state and local emergency management, forms the basis for county evacuation plans. The final documents with summary information will be published and made available on the Internet (www.ncfrpc.org).

The Atlas was produced by the North Central Florida Regional Planning Council with funding by the Florida Legislature and the Federal Emergency Management Agency through the Florida Division of Emergency Management.

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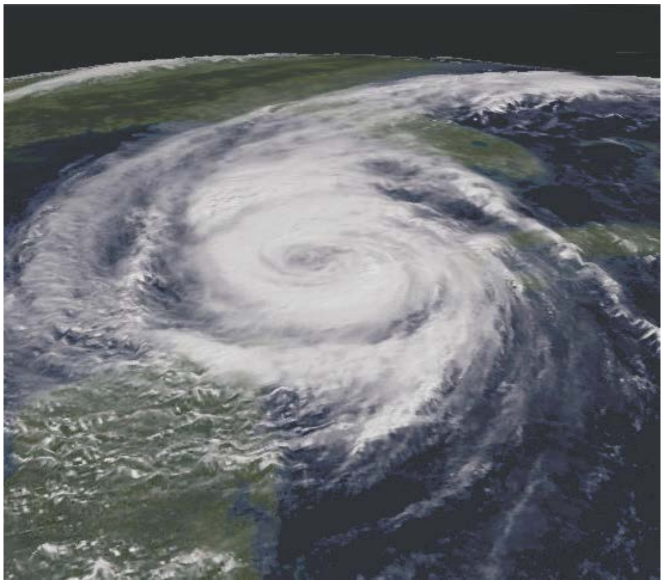

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CREDITS & ACKNOWLEDGEMENTS

Funding was authorized by the Florida Legislature through House Bill 7121, as a result of the 2004 and 2005 hurricane seasons. Provisions of this bill require the Division of Emergency Management to update all Regional Evacuation Studies in the State and inexorably tied the Evacuation Studies and Growth Management. As a result, this study addresses both Emergency Management and Growth Management data needs. Funds were also provided by the Federal Emergency Management Agency (FEMA) with all money administered through the Florida Division of Emergency Management (FDEM), 2555 Shumard Oak Blvd., Tallahassee, 32399. Web site: www.floridadisaster.org. Local match was provided by the counties listed below.

The Council acknowledges and extends its appreciation to the following agencies and people for their cooperation and assistance in the development of this Atlas:

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INTRODUCTION

A comprehensive emergency management program requires attention to four (4) key inter-related components: preparedness, response, recovery and mitigation. Preparing and avoiding or reducing potential loss of life and property damage - **preparedness and mitigation** - requires accurate and precise hazard and vulnerability analyses. These analyses are the foundation for evacuation and disaster response planning, as well as the development of local mitigation strategies designed to reduce the community's overall risk to disasters. This Atlas series provides information to state, county and local emergency management officials and planners for use in hurricane preparedness and coastal management in the North Central Florida Region including Alachua, Bradford, Columbia, Dixie, Gilchrist, Hamilton, Lafayette, Madison, Suwannee, Taylor and Union counties (Figure 1). It was part of a statewide effort to enhance our ability to respond to a hurricane threat, facilitate the evacuation of vulnerable residents to a point of relative safety and mitigate our vulnerability in the future. The ***Statewide Regional Evacuation Study Program*** provides a consistent, coordinated and improved approach to addressing the state and regional vulnerability to the hurricane threat.

The specific purpose of this Atlas is to provide maps which depict storm surge flood depth from hurricanes of five different intensities in the North Central Florida area. The Atlas was prepared by the North Central Florida Regional Planning Council as part of the *Statewide Regional Evacuation Study Program.* The Study is a cooperative effort of the Florida Division of Emergency Management, Florida Regional Planning Councils and the county emergency management agencies.

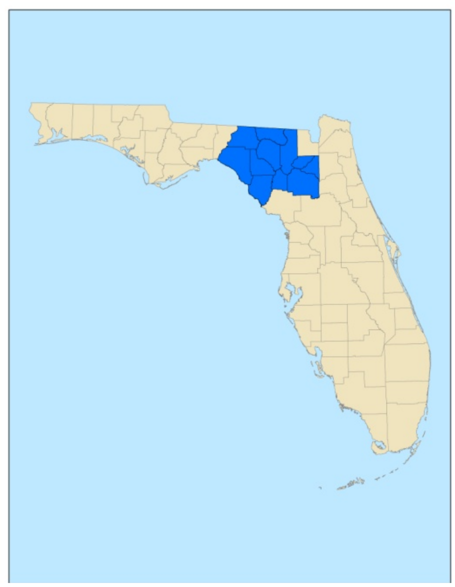
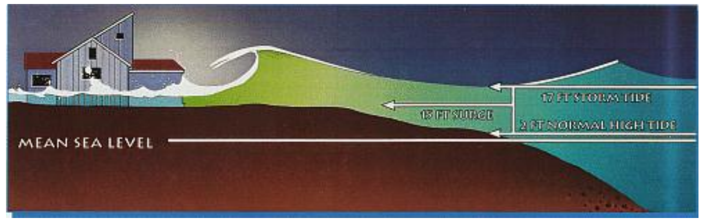


Figure 1: North Central Florida Region

THE SLOSH MODEL



The principal tool utilized in this study for analyzing the expected hazards from potential hurricanes affecting the study area is the Sea, Lake and Overland Surges from Hurricane (**SLOSH**) numerical storm surge prediction model. The SLOSH computerized model predicts the Storm Tide heights that result from hypothetical hurricanes with selected various combinations of pressure, size, forward speed, track and winds. Originally developed for use by the National Hurricane Center (NHC) as a tool to give geographically specific warnings of expected surge heights during the approach of hurricanes, the SLOSH model is utilized in regional studies for several key hazard and vulnerability analyses.

The SLOSH modeling system consists of the model source code and the model basin or grid. SLOSH model grids must be developed for each specific geographic coastal area individually incorporating the unique local bay and river configuration, water depths, bridges, roads and other physical features. In addition to open coastline heights, one of the most valuable outputs of the SLOSH model for evacuation planning is its predictions of surge heights over land into inland areas.

The first SLOSH model basin was completed in 1979 and represented the first application of SLOSH storm surge dynamics to a major coastal area of the United States. The model was developed by the Techniques Development Lab of the National Oceanic and Atmospheric Administration (NOAA) under the direction of the late Dr. Chester P. Jelesnianski. In December 1998 the National Hurricane Center updated the SLOSH model for the Cedar Key basin.

Hypothetical Storm Simulations

Surge height depends strongly on the specifics of a given storm including, forward speed, angle of approach, intensity or maximum wind speed, storm size, storm shape, and landfall location. The SLOSH model was used to develop data for various combinations of hurricane strength, wind speed, and direction of movement. Storm strength was modeled using the central pressure (defined as the difference between the ambient sea level pressure and the minimum value in the storm's center), the storm eye size and the radius of maximum winds using the five categories of hurricane intensity as depicted in the Saffir-Simpson Hurricane Wind Scale (see Table 1).

Table 1: Saffir-Simpson Hurricane Wind Scale

Category	Wind Speeds	Potential Damage
Category 1	(Sustained winds 74-95 mph)	*Very dangerous winds will produce some damage*
Category 2	(Sustained winds 96-110 mph)	*Extremely dangerous winds will cause extensive damage*
Category 3	(Sustained winds 111-130 mph)	*Devastating damage will occur*
Category 4	(Sustained winds 131-155 mph)	*Catastrophic damage will occur*
Category 5	(Sustained winds of 156 mph and above)	*Catastrophic damage will occur*

The modeling for each tropical storm/hurricane category was conducted using the mid-range pressure difference ($\triangle$p, millibars) for that category. The model also simulates the storm filling (weakening upon landfall) and radius of maximum winds (RMW) increase.

Nine storm track headings W, WNW, NW, NNW, N, NNE, NE, ENE, E) were selected as being representative of storm behavior in the North Central Florida region, based on observations by forecasters at the National Hurricane Center. And for each set of tracks in a specific direction storms were run at forward speeds of 5, 10, 15 and 25 mph. And, for each direction, at each speed, storms were run at two different sizes (20 statute mile radius of maximum winds and 35 statute miles radius of maximum winds.) Finally, each scenario was run at both mean tide and high tide. Both tide levels are now referenced to North American Vertical Datum of 1988 (NAVD88) as opposed to the National Geodetic Vertical Datum of 1929 (NGVD29) used in the previous study.

A total of 16,242 runs (compared to less than a thousand in 1990) were made consisting of the different parameters shown in Table 2.

Table 2: Cedar Key Basin Hypothetical Storm Parameters

Directions, speeds, (Saffir/Simpson) intensities, number of tracks and the number of runs.

Direction	Speeds (mph)	Size (Radius of Maximum winds)	Intensity	Tides	Tracks	Runs
W	5,15,25 - mph	20 statute miles; 35 statute miles	1 through 5	Mean / High	23	1380
WNW	5,15,25 - mph	20 statute miles; 35 statute miles	1 through 5	Mean / High	31	1860
NW	5,15,25 - mph	20 statute miles; 35 statute miles	1 through 5	Mean / High	22	1320
NNW	5,15,25 - mph	20 statute miles; 35 statute miles	1 through 5	Mean / High	22	1320
N	5,15,25 - mph	20 statute miles; 35 statute miles	1 through 5	Mean / High	24	1584
NNE	5,15,25 - mph	20 statute miles; 35 statute miles	1 through 5	Mean / High	30	1980
NE	5,15,25 - mph	20 statute miles; 35 statute miles	1 through 5	Mean / High	36	2376
ENE	5,15,25 - mph	20 statute miles; 35 statute miles	1 through 5	Mean / High	36	2376
E	5,15,25 - mph	20 statute miles; 35 statute miles	1 through 5	Mean / High	31	2046
TOTAL						16,242

The Grid for the North Central Florida SLOSH Model

Figure 2 illustrates the area covered by the grid for the Cedar Key SLOSH Model. To determine the surge values the SLOSH model uses a telescoping elliptical grid as its unit of analysis with 157 arc lengths (1< I> 157) and 169 radials (1< J> 169). Use of the grid configuration allows for individual calculations per grid square which is beneficial in two ways: (1) provides increased resolution of the storm surge at the coastline and inside the harbors, bays and rivers, while decreasing the resolution in the deep water where detail is not as important; and (2) allows economy in computation.

The grid size for the Cedar Key model varies from approximately 0.1 square miles or 63 acres closest to the pole (I = 1) to the grids on the outer edges (Gulf of Mexico) where each grid is approximately 5 square miles.

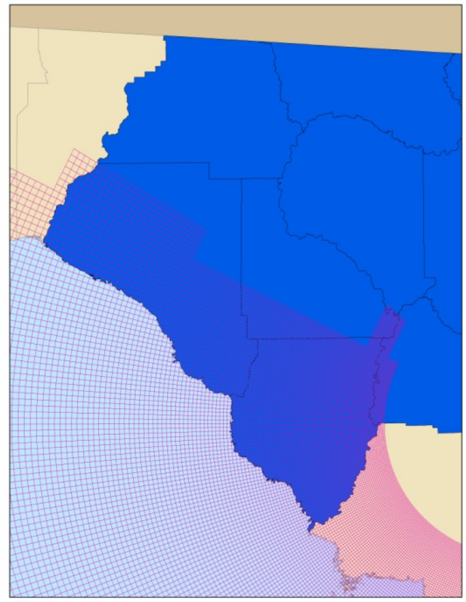


Figure 2: North Central Florida Region and the Cedar Key SLOSH Basin

Storm Scenario Determinations

As indicated, the SLOSH model is the basis for the "hazard analysis" portion of coastal hurricane evacuation plans. Thousands of hypothetical hurricanes are simulated with various Saffir-Simpson Wind categories, forward speeds, landfall directions, and landfall locations. An envelope of high water containing the maximum value a grid cell attains is generated at the end of each model run. These envelopes are combined by the NHC into various composites which depict the possible flooding. One useful composite is the MEOW (Maximum Envelopes of Water) which incorporates all the envelopes for a particular category, speed, and landfall direction. Once surge heights have been determined for the appropriate grids, the maximum surge heights are plotted by storm track and tropical storm/hurricane category. These plots of maximum surge heights for a given storm category and track are referred to as MEOWs. The MEOWs or Reference Hurricanes can be used in evacuation decision making when and if sufficient forecast information is available to project storm track or type of storm (different landfalling, paralleling, or exiting storms).

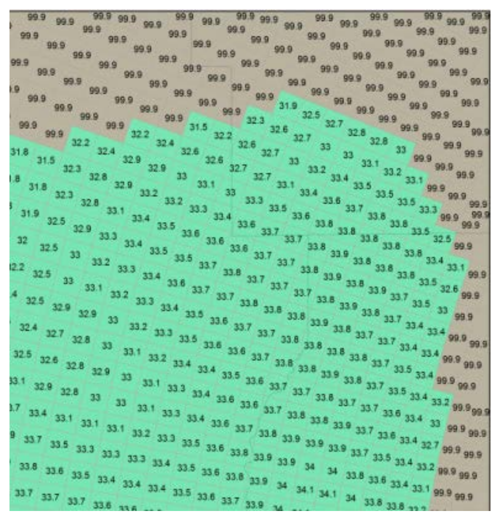


Figure 3: Cedar Key SLOSH Basin with Surge Values

The MEOWs provide information to the emergency managers in evacuation decision making. However, in order to determine a scenario which may confront the county in a hurricane threat 24-48 hours before a storm is expected, a further compositing of the MEOWs into Maximums of the Maximums (MOMs) is usually required.

The MOM (Maximum of the MEOWs) combines all the MEOWs of a particular category. The MOMs represent the maximum surge expected to occur at any given location, regardless of the specific storm track/direction of the hurricane. The only variable is the intensity of the hurricane represented by category strength (Category 1-5).

All SLOSH runs of the hypothetical hurricanes were based on an initial water height of 3.5 feet Mean Sea Level (MSL) Ocean or 2.0 feet MSL for the rivers and the resulting calculations of storm surge represent condition at time of high tide. All elevations are now referenced to the NAVD88 datum.

These surge heights were provided within the SLOSH grid system as illustrated on Figure 3. The range of maximum surge heights (low to high) for each scenario is provided for each category of storm (MOM) on Table 3. **It should be noted again that these surge heights represent the maximum surge height recorded in the county from the storm tide analysis including inland and riverine areas where the surge can be magnified dependent upon storm parameters.**

Table 3: Potential Storm Tide Height (s) by County**
(In Feet above NAVD88)

*Storm Strength	Dixie	Taylor	Gilchrist	Lafayette
Category 1	Up to 10.6	Up to 11.1	Up to 5.7	Up to 5.4
Category 2	Up to 17.4	Up to 19.5	Up to 14.9	Up to 8.5
Category 3	Up to 23.6	Up to 27.7	Up to 21.7	Up to 19.3
Category 4	Up to 29.3	Up to 33.5	Up to 26.5	Up to 28.1
Category 5	Up to 34.2	Up to 38.5	Up to 31.8	Up to 33.8

** Based on the category of storm on the Saffir-Simpson Hurricane Wind Scale*
*** Surge heights represent the maximum values from SLOSH MOMs*

CREATION OF THE SURGE DEPTH ZONES

The maps in this atlas depict SLOSH-modeled Surge Depth and extent of flood inundation for hurricanes of five different intensities. As indicate above, the Surge Depth was modeled using the Maximum of Maximums (MOMs) representing the potential flooding from the five categories of storm intensity of the Saffir/Simpson Hurricane Wind Scale.

Determining Surge Depth Height and Flooding Depth

SLOSH and SLOSH-related products reference Surge heights relative to the model vertical datum, NAVD88. In order to determine the inundation depth of surge flooding at a particular location the ground elevation (relative to NAVD88) at that location must be subtracted from the potential surge height.[1]

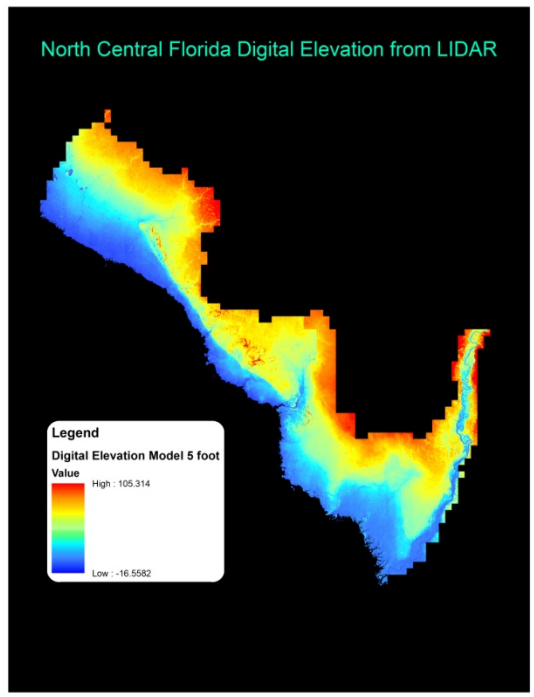


Figure 4: Digital Elevation from LIDAR

Surge elevation, or water height, is the output of the SLOSH model. At each SLOSH grid point, the maximum surge height is computed at that point.

Within the SLOSH model an average elevation is assumed within each grid square. Height of water above terrain was not calculated using the SLOSH average grid elevation because terrain height may vary significantly within a SLOSH grid square. For example, the altitude of a 1-mile grid square may be assigned a value of 1.8 meters (6 feet), but this value represents an average of land heights that may include values ranging from 0.9 to 2.7 meters (3 to 9 feet). In this case, a surge value of 2.5 meters (8 feet) in this square would imply a 0.7 meters (2 feet) average depth of water over the grid's terrain. However, in reality within the grid area portion of the grid would be "dry" and other parts could experience as much as 1.5 meters (5 feet) of inundation. Therefore, in order to determine the surge inundation limits, the depth of surge flooding above terrain at a specific site in the grid square is the result of subtracting the terrain height determined by remote sensing from the model-generated surge height in that grid square. [2]

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1 It is important to note that one must use a consistent vertical datum when post-processing SLOSH storm surge values

2 Note: This represents the regional post-processing procedure. When users view SLOSH output within the SLOSH Display Program, the system uses average grid cell height when subtracting land.

Surge Depth Post-Processing

The Atlas was created using a Toolset wrapped into ESRI's ArcGIS mapping application, ArcMap. The surge depth tool was developed for the Statewide Regional Evacuation Study Program by the Tampa Bay Regional Planning Council, who had to create this tool to fulfill local emergency manager needs for decision-making. This tool enables all regions within the state of Florida to process the SLOSH and elevation data with a consistent methodology for depth output.

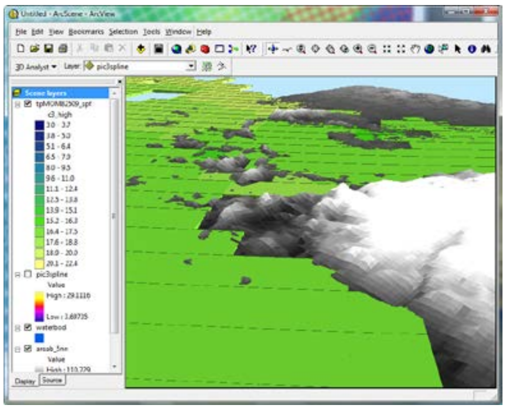


Figure 5: SLOSH Standard Output

The tool basically performs the operation of translating the lower resolution SLOSH grid data into a smooth surface resembling actual Surge Depth and terrain; processing it with the high resolution elevation data derived from LIDAR. The image on the left represents how the data would look as it appears directly from SLOSH Model output.

Processing all the data in the raster realm, the tool is able to digest large amounts of data and output detailed representations of surge inundation.

The program first interpolates the SLOSH height values for each category into a raster surface using spline interpolation. This type of interpolation is best for smooth surfaces, such as water and slow changing terrain. The result is a raster surface representing the surge height for a category that can be processed against the raster Digital Elevation Model from the LIDAR. The "dry" values (represented as 99.9 in the SLOSH Model) are replaced by an average of the inundated grids surrounding current processed grid. An algorithm performs this action utilizing the range of values in the current category of storm being processed.

Using this methodology, once the elevation is subtracted from the projected surge height, the surge depth limits are determined per category. The output of the tool is a polygon file holding all the depth classification strata for a particular storm category. The output differs from the inundation tool output because each map holds information for only one category.

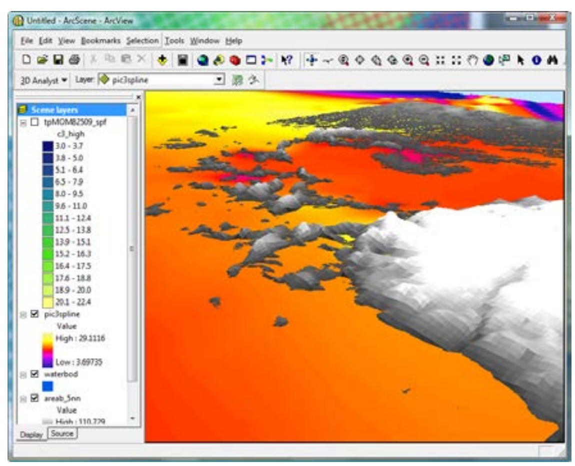
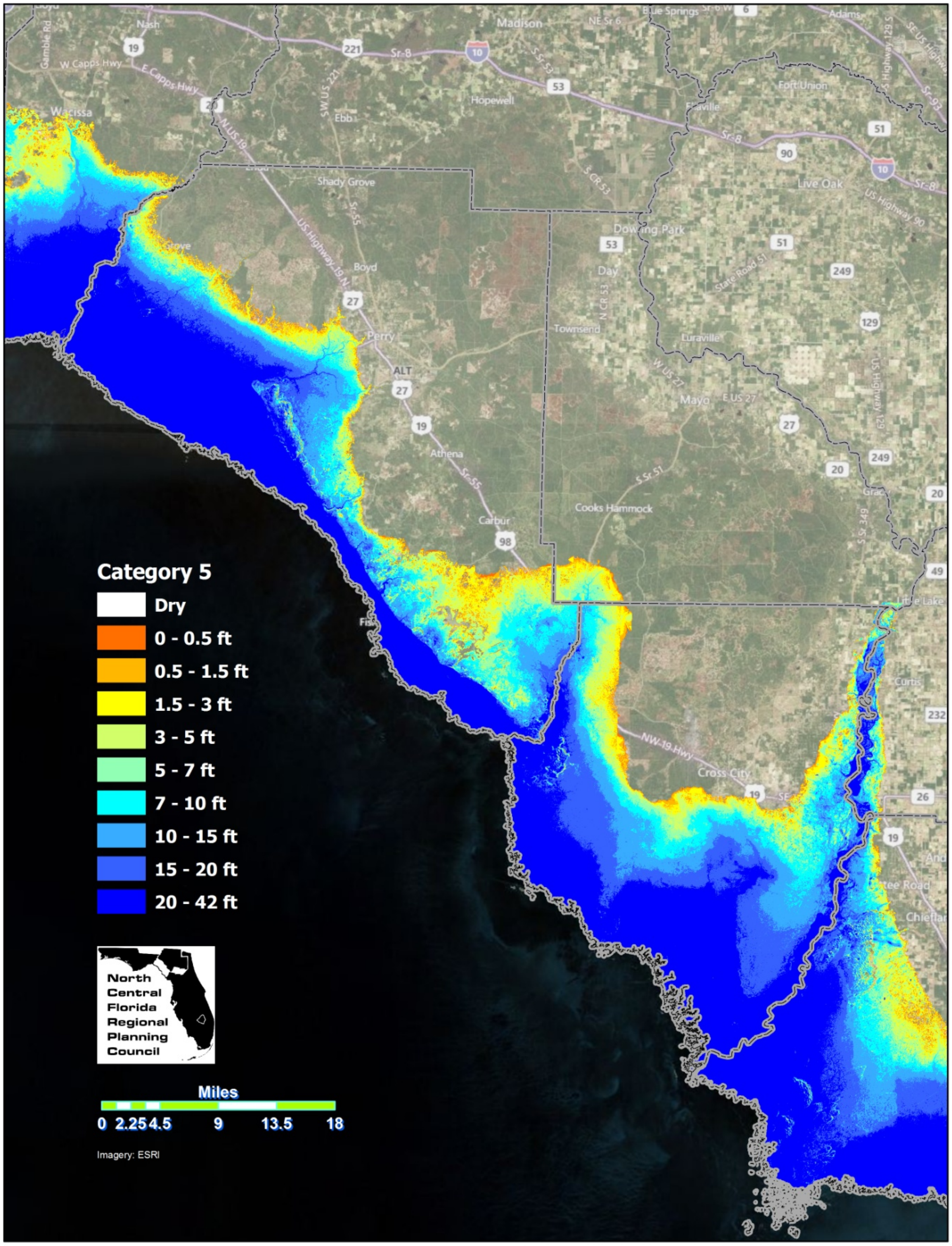


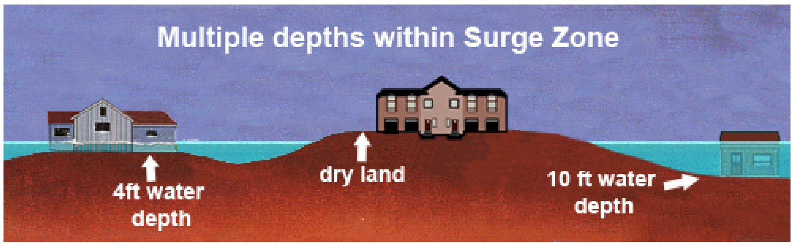
Figure 6: SLOSH Display Post-Processing

Figure 7: Category 5 Depth Analysis



VARIATIONS TO CONSIDER

Variations do exist between modeled versus actual measured Surge Depth values, and are typical of current technology in coastal storm surge modeling. In interpreting the data, emergency planners should recognize the uncertainties characteristic of mathematical models and severe weather systems such as hurricanes. The Surge Depth values developed for this study and presented in the ***Surge Depth Atlas*** should be used as guideline information for planning purposes.



Surge Depth & Wave Height

Regarding interpretation of the data, it is important to understand that the configuration and depth (bathymetry) of the Gulf of Mexico bottom will have a bearing on surge and wave heights. A narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water in close proximity to the shoreline, tends to produce a lower surge but a higher and more powerful wave. Those regions, like the North Central Florida Region, which have a gently sloping shelf and shallower normal water depths, can expect a higher surge but smaller waves. The reason this occurs is because a surge in deeper water can be dispersed down and out away from the hurricane. However, once that surge reaches a shallow gently sloping shelf it can no longer be dispersed away from the hurricane, consequently water piles up as it is driven ashore by the wind stresses of the hurricane. Wave height is NOT calculated by the SLOSH model and is not reflected within the Surge Depth delineations.

Forward Speed

Under actual storm conditions it may be expected that a hurricane moving at a slower speed could have higher coastal Surge Depths than those depicted from model results. At the same time, a fast moving hurricane would have less time to move storm surge water up river courses to more inland areas.

Astronomical Tides

Surge heights were provided by NOAA at high tide. The tide level is referenced to North American Vertical Datum of 1988. The Surge Depth limits reflect high tide in the region.

Accuracy

As part of the Statewide Regional Evacuation Study, all coastal areas as well as areas surrounding Lake Okeechobee were mapped using remote-sensing laser terrain mapping (LIDAR[3]) providing the most comprehensive, accurate and precise topographic data for this analysis. As a general rule, the vertical accuracy of the laser mapping is within a 15 centimeter tolerance. However, it should be noted that the accuracy of these elevations is limited to the precision and tolerance in which the horizontal accuracy for any given point is recorded. Other factors such as artifact removal algorithms (that remove buildings and trees) can affect the recorded elevation in a particular location. For the purposes of this study, the horizontal accuracy of the hardcopy atlas product cannot be assumed to be greater than that of a standard USGS 7 minute quadrangle map, or a scale of 1:24,000.

POINTS OF REFERENCE

Emergency management planners selected reference points which include key facilities or locations critical for emergency operations. The table below includes the map identification number, descriptions of the selected points and the elevation of the site. The elevation is based on the digital elevation data provided by the LIDAR. It should be noted that if the site is large, elevations may vary significantly. The table also provides the Surge Depth value from the SLOSH value and the depth of inundation (surge height value minus the ground elevation) at the site.

3 Light Imaging Detection and Ranging

Table 4: Selected Points of Reference

Map ID	Map Plate	County	Elevation	CAT 1 Surge	CAT 2 Surge	CAT 3 Surge	CAT 4 Surge	CAT 5 Surge	CAT 1 Depth	CAT 2 Depth	CAT 3 Depth	CAT 4 Depth	CAT 5 Depth
1	13	Dixie	24.18	Dry	Dry	2.23	7.74	12.58	Dry	Dry	21.95	16.44	11.60
2	13	Dixie	25.65	Dry	Dry	Dry	4.69	9.56	Dry	Dry	Dry	20.96	16.09
3	54	Dixie	8.04	2.19	8.61	14.58	20.21	25.11	5.85	0.57	6.54	12.17	17.07
4	54	Dixie	9.80	Dry	6.65	12.55	18.41	23.25	Dry	3.15	2.75	8.61	13.45
5	30	Dixie	3.37	5.63	12.03	17.93	23.43	28.13	2.27	8.66	14.56	20.06	24.77
6	69	Dixie	17.66	Dry	Dry	5.35	11.37	16.14	Dry	Dry	12.32	6.30	1.52
7	56	Dixie	14.86	Dry	Dry	7.60	13.56	18.25	Dry	Dry	7.26	1.30	3.40
8	56	Dixie	15.05	Dry	Dry	7.48	13.46	18.18	Dry	Dry	7.56	1.58	3.13
9	44	Dixie	18.81	Dry	Dry	3.41	9.36	14.16	Dry	Dry	15.41	9.45	4.66
10	21	Dixie	5.07	3.82	10.62	16.36	21.13	26.44	1.25	5.55	11.29	16.07	21.37
11	32	Dixie	9.77	Dry	6.06	11.74	16.73	21.88	Dry	3.71	1.96	6.96	12.11
12	14	Dixie	4.66	3.97	11.29	16.64	21.94	27.10	0.69	6.63	11.97	17.27	22.44
13	2	Dixie	4.43	3.97	10.24	15.65	20.66	25.26	0.46	5.80	11.21	16.22	20.82
14	7	Dixie	5.13	3.71	10.11	15.75	20.95	25.59	1.42	4.98	10.62	15.82	20.47
15	37	Dixie	22.20	Dry	Dry	Dry	5.92	10.64	Dry	Dry	Dry	16.28	11.56
16	15	Dixie	13.44	Dry	1.38	7.96	13.39	18.38	Dry	12.06	5.48	0.05	4.94
17	51	Dixie	17.74	Dry	Dry	5.20	9.96	13.77	Dry	Dry	12.54	7.78	3.97
18	76	Dixie	30.31	Dry	Dry	Dry	Dry	0.93	Dry	Dry	Dry	Dry	29.38
19	10	Dixie	5.82	2.68	8.77	14.57	19.37	24.06	3.15	2.95	8.75	13.54	18.24
20	10	Dixie	5.44	3.10	9.20	15.03	19.84	24.55	2.34	3.76	9.59	14.40	19.11
21	10	Dixie	5.65	2.99	9.10	14.99	19.84	24.54	2.66	3.45	9.34	14.19	18.89
22	20	Dixie	8.09	0.72	7.14	13.08	17.96	22.72	7.37	0.96	4.99	9.87	14.63
23	5	Dixie	6.73	1.97	8.40	13.89	18.69	23.79	4.76	1.67	7.17	11.97	17.06
24	2	Dixie	3.97	4.40	10.67	16.09	21.11	25.65	0.43	6.70	12.12	17.14	21.68

Table 4: Selected Points of Reference (Continued)

Map ID	Map Plate	County	Elevation	CAT 1 Surge	CAT 2 Surge	CAT 3 Surge	CAT 4 Surge	CAT 5 Surge	CAT 1 Depth	CAT 2 Depth	CAT 3 Depth	CAT 4 Depth	CAT 5 Depth
25	3	Dixie	5.54	2.99	9.34	14.83	19.93	24.53	2.55	3.80	9.30	14.40	19.00
26	3	Dixie	7.35	1.27	7.78	13.49	18.67	23.19	6.08	0.42	6.13	11.32	15.83
27	8	Dixie	11.29	Dry	3.47	9.68	14.88	19.58	Dry	7.82	1.62	3.59	8.28
28	27	Dixie	18.40	Dry	Dry	3.78	9.44	14.33	Dry	Dry	14.62	8.96	4.06
29	51	Dixie	8.17	Dry	5.62	13.97	18.28	23.35	Dry	2.54	5.80	10.12	15.18
30	65	Dixie	10.23	Dry	3.92	11.67	16.41	21.46	Dry	6.31	1.44	6.18	11.23
31	2	Dixie	5.54	10.07	11.60	17.63	23.20	28.09	4.53	6.06	12.09	17.66	22.56
32	8	Gilchrist	28.15	Dry	Dry	Dry	Dry	3.57	Dry	Dry	Dry	Dry	24.58
33	8	Gilchrist	27.71	Dry	Dry	Dry	Dry	0.89	Dry	Dry	Dry	Dry	26.82
34	7	Gilchrist	23.03	Dry	Dry	Dry	3.00	8.59	Dry	Dry	Dry	20.03	14.44
35	7	Gilchrist	20.95	Dry	Dry	Dry	5.34	10.77	Dry	Dry	Dry	15.60	10.18
36	15	Gilchrist	10.15	Dry	Dry	8.91	15.33	20.97	Dry	Dry	1.24	5.18	10.82
37	23	Gilchrist	7.90	Dry	Dry	11.31	17.44	23.12	Dry	Dry	3.41	9.55	15.22
38	24	Gilchrist	15.20	Dry	Dry	4.22	10.61	16.08	Dry	Dry	10.97	4.59	0.88
39	24	Gilchrist	22.29	Dry	Dry	Dry	3.51	8.90	Dry	Dry	Dry	18.78	13.38
40	2	Lafayette	28.59	Dry	Dry	Dry	Dry	4.95	Dry	Dry	Dry	Dry	23.64
41	2	Lafayette	30.72	Dry	Dry	Dry	Dry	4.33	Dry	Dry	Dry	Dry	26.39
42	117	Taylor	24.72	Dry	Dry	Dry	4.17	7.26	Dry	Dry	Dry	20.55	17.46
43	100	Taylor	0.10	10.30	18.68	25.81	30.46	35.61	10.20	18.58	25.71	30.36	35.50
44	101	Taylor	6.07	3.61	11.91	19.44	24.52	29.28	2.45	5.85	13.38	18.45	23.21
45	71	Taylor	0.17	10.09	17.90	24.96	30.89	35.95	9.93	17.73	24.79	30.73	35.78
46	71	Taylor	4.35	6.21	14.26	21.41	27.26	32.35	1.86	9.91	17.06	22.91	28.00
47	87	Taylor	9.90	0.87	9.11	16.51	22.23	27.23	9.03	0.79	6.61	12.33	17.33
48	88	Taylor	16.39	Dry	2.81	10.95	16.45	20.67	Dry	13.59	5.44	0.05	4.28

Table 4: Selected Points of Reference (Continued)

Map ID	Map Plate	County	Elevation	CAT 1 Surge	CAT 2 Surge	CAT 3 Surge	CAT 4 Surge	CAT 5 Surge	CAT 1 Depth	CAT 2 Depth	CAT 3 Depth	CAT 4 Depth	CAT 5 Depth
49	104	Taylor	21.95	Dry	Dry	5.47	10.31	14.73	Dry	Dry	16.48	11.64	7.22
50	73	Taylor	4.07	6.79	15.00	22.35	28.48	33.31	2.72	10.93	18.28	24.41	29.24
51	105	Taylor	23.84	Dry	Dry	3.20	8.78	12.81	Dry	Dry	20.64	15.06	11.03
52	60	Taylor	5.96	5.12	13.32	20.48	26.53	31.66	0.84	7.36	14.52	20.57	25.70
53	76	Taylor	22.24	Dry	Dry	4.44	10.61	15.70	Dry	Dry	17.81	11.63	6.54
54	77	Taylor	24.11	Dry	Dry	2.45	8.71	13.16	Dry	Dry	21.66	15.39	10.94
55	108	Taylor	32.40	Dry	Dry	Dry	Dry	0.63	Dry	Dry	Dry	Dry	31.76
56	79	Taylor	32.40	Dry	Dry	Dry	Dry	3.85	Dry	Dry	Dry	Dry	28.55
57	50	Taylor	31.28	Dry	Dry	Dry	0.51	6.30	Dry	Dry	Dry	30.77	24.98
58	30	Taylor	24.67	Dry	Dry	Dry	6.24	11.81	Dry	Dry	Dry	18.43	12.86
59	27	Taylor	30.96	Dry	Dry	Dry	Dry	3.84	Dry	Dry	Dry	Dry	27.12
60	19	Taylor	25.22	Dry	Dry	Dry	2.81	8.33	Dry	Dry	Dry	22.41	16.88
61	10	Taylor	23.02	Dry	Dry	0.41	5.86	10.76	Dry	Dry	22.61	17.16	12.27
62	4	Taylor	5.34	4.67	11.69	17.81	23.31	28.10	0.67	6.35	12.47	17.97	22.76
63	12	Taylor	19.12	Dry	Dry	4.34	9.66	14.40	Dry	Dry	14.79	9.47	4.72
64	20	Taylor	22.98	Dry	Dry	0.37	5.89	10.61	Dry	Dry	22.61	17.09	12.37
65	38	Taylor	5.39	5.31	13.05	19.98	25.51	30.81	0.08	7.66	14.59	20.12	25.42
66	38	Taylor	4.53	6.16	13.57	20.53	26.07	31.23	1.62	9.04	16.00	21.54	26.70
67	39	Taylor	2.88	7.91	15.23	22.12	27.71	32.80	5.03	12.35	19.24	24.83	29.92
68	29	Taylor	3.95	6.83	13.95	20.75	26.23	31.40	2.87	10.00	16.79	22.28	27.45
69	21	Taylor	3.99	6.22	13.61	20.20	25.81	31.00	2.22	9.61	16.21	21.82	27.01
70	22	Taylor	4.30	5.88	13.35	19.99	25.59	30.74	1.57	9.04	15.69	21.29	26.44
71	22	Taylor	3.56	6.73	14.13	20.74	26.34	31.50	3.18	10.57	17.18	22.78	27.94
72	22	Taylor	5.25	4.88	12.17	18.68	24.37	29.49	0.38	6.92	13.42	19.12	24.24

Table 4: Selected Points of Reference (Continued)

Map ID	Map Plate	County	Elevation	CAT 1 Surge	CAT 2 Surge	CAT 3 Surge	CAT 4 Surge	CAT 5 Surge	CAT 1 Depth	CAT 2 Depth	CAT 3 Depth	CAT 4 Depth	CAT 5 Depth
73	22	Taylor	6.77	3.47	10.81	17.40	23.01	28.20	3.29	4.05	10.64	16.24	21.43
74	14	Taylor	5.60	4.45	11.66	18.05	23.75	28.93	1.15	6.06	12.45	18.15	23.33
75	22	Taylor	4.11	6.04	13.25	19.73	25.43	30.61	1.93	9.14	15.62	21.31	26.50
76	22	Taylor	5.01	5.11	12.29	18.65	24.38	29.58	0.10	7.28	13.64	19.37	24.57
77	29	Taylor	21.32	Dry	Dry	3.65	9.22	14.36	Dry	Dry	17.66	12.10	6.96
78	15	Taylor	5.50	4.63	11.61	17.92	23.62	28.83	0.88	6.11	12.41	18.12	23.32
79	10	Taylor	8.06	2.04	9.17	15.34	20.91	25.70	6.02	1.11	7.28	12.85	17.64

SURGE DEPTH ATLAS

The surge depth ranges (MOM surge heights minus the ground elevations) are provided as GIS shape files and graphically displayed on maps in the *Hurricane Surge Depth Atlas for the North Central Florida Region*. The *Atlas* was prepared by the North Central Florida Regional Planning Council under contract to the State of Florida, Division of Emergency Management, as part of this study effort. The maps prepared for the *Atlas* consist of base maps (1:24,000) including topographic, hydrographic and highway files (updated using 2009 county and state highway data). Detailed shoreline and Surge Depth ranges for each category of storm were determined using the region's geographic information system (GIS).

The purpose of the maps contained in this Atlas is to reflect a "worst probable" scenario of the hurricane Surge Depth possibilities and to provide a basis for the hurricane evacuation zone decision-making and facility vulnerability analyses. While the Surge Depth delineations include the addition of an astronomical mean high tide and tidal anomaly, it should be noted that the data reflects only stillwater saltwater flooding. **Local processes such as waves, rainfall and flooding from overflowing rivers, are usually included in observations of surge height, but are not surge and are not calculated by the SLOSH model. It is incumbent upon local emergency management officials and planners to estimate the degree and extent of freshwater flooding as well as to determine the magnitude of the waves that will accompany the surge.**

NOTES ON SURGE DEPTH RANGES

Historically, the SLOSH storm surge analysis had focused on "average" storm parameters (size and forward speed), although the intensity and angle of approach was modeled to include direct strikes and catastrophic intensity. In the 2010 Regional Evacuation Study Update, 12,000 hypothetical hurricanes were included in the SLOSH suite of storms modeled varying forward speeds and the radii of maximum winds to include the large storm events and different forward speeds. This allowed for the development of a truer picture of the storm surge vulnerability in the region. The five categories of hurricane reflect a "worst probable" Surge extent for hurricanes holding the wind speed constant (consistent with the Saffir Simpson Hurricane Wind Scale) while varying storm parameters include size, forward speed, and angle of approach.

This has led to some confusion regarding evacuation decision-making since hurricane evacuations are based primarily on storm surge vulnerability. The National Oceanic and Atmospheric Administration (NOAA) is working to enhance the analysis and prediction of storm surge. Direct estimates of inundation are being communicated in the NHC's Public Advisories and in the Weather Forecast Office's (WFO) Hurricane Local Statements. NHC's probabilistic storm surge product, which provides the likelihood of a specific range of storm surge values, became operational in 2009, and the NWS Meteorological Development Laboratory is providing experimental, probabilistic storm surge products for 2010. In addition, coastal weather forecast offices will provide experimental Tropical Cyclone Impacts Graphics in 2010; these include a qualitative graphic on the expected storm surge impacts. Finally, the NWS is exploring the possibility of issuing explicit Storm Surge Warnings which could be implemented in the next couple of years. In all of these efforts, the NWS is working to provide specific and quantitative information to support decision-making at the local level[1]. NOAA continues to emphasize that the hurricane forecasts are not 100% accurate and dependent upon many factors.

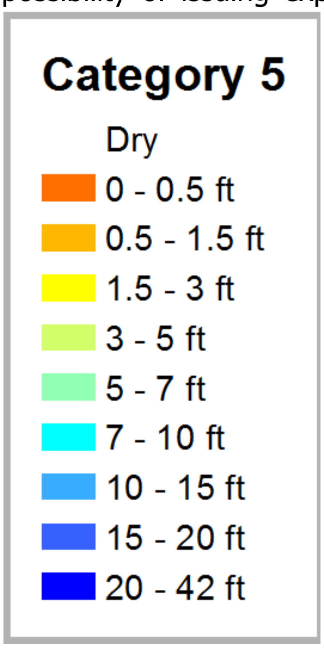
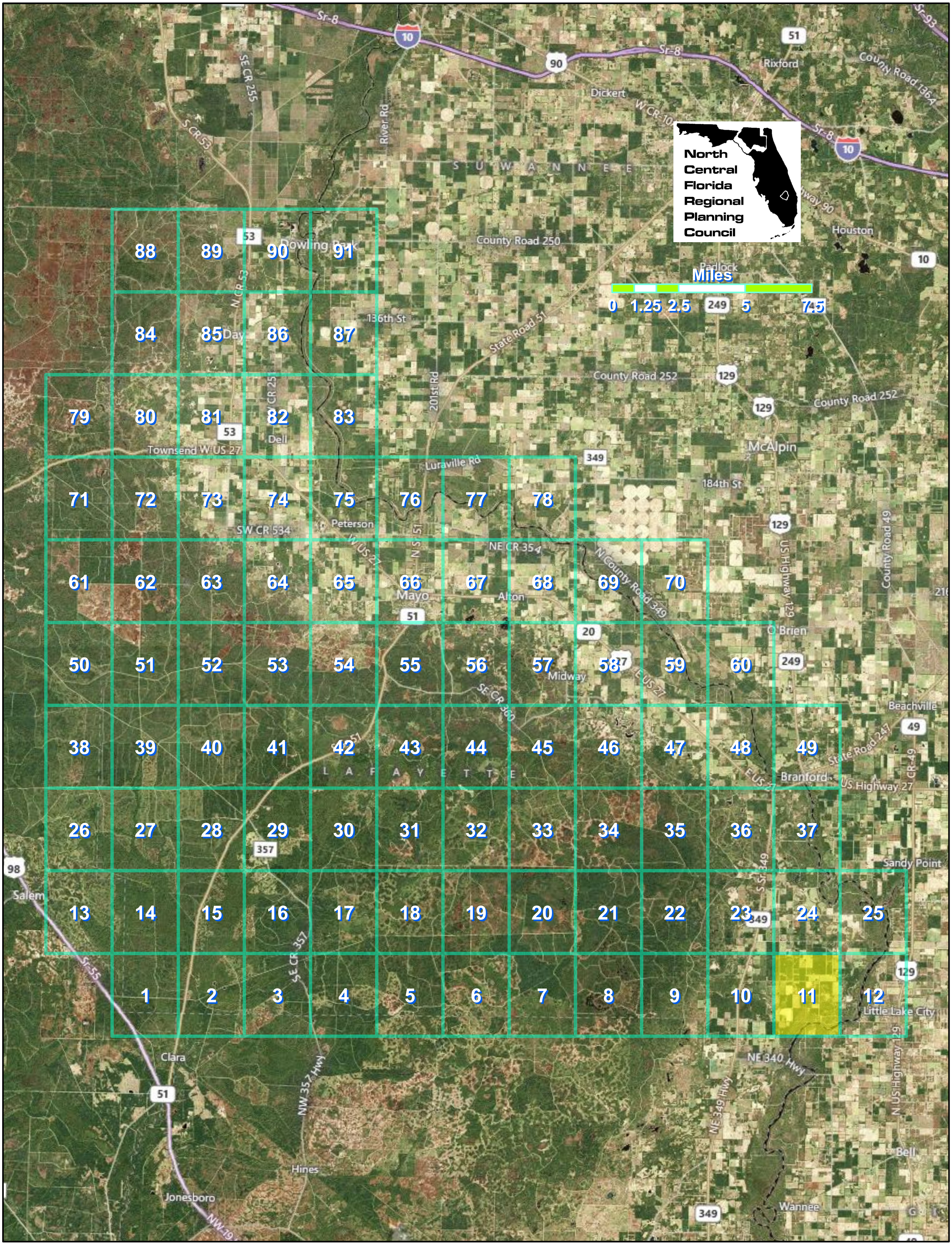


Figure 8: Lafayette County Surge Depth Ranges

To the left are the Surge Depth ranges identified for Lafayette County under the five (5) categories of hurricane on the Saffir Simpson Hurricane Wind Scale. It is important to recognize the following:

- The surge depth values are based on the highest surge height elevation above a standard datum (NAVD88) predicted by the model in the entire county and will only be appropriate for selected areas.
- Typically the highest surge depth values are NOT the surge depths predicted at the coast. The highest surge depth values are typically experienced inside bays and up rivers and inlets (water above ground).
- Surge Depth ranges by category of storm are presented on Table 3 on page 10 of this document.
- For surge heights at specific locations, please refer to Table 4 on page 16 which provides the expected storm surge depth at points of reference with the actual inundation (water depth) at that site.

[1] http://www.nhc.noaa.gov/sshws_statement.shtml



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N County Road 349
SE CR 360
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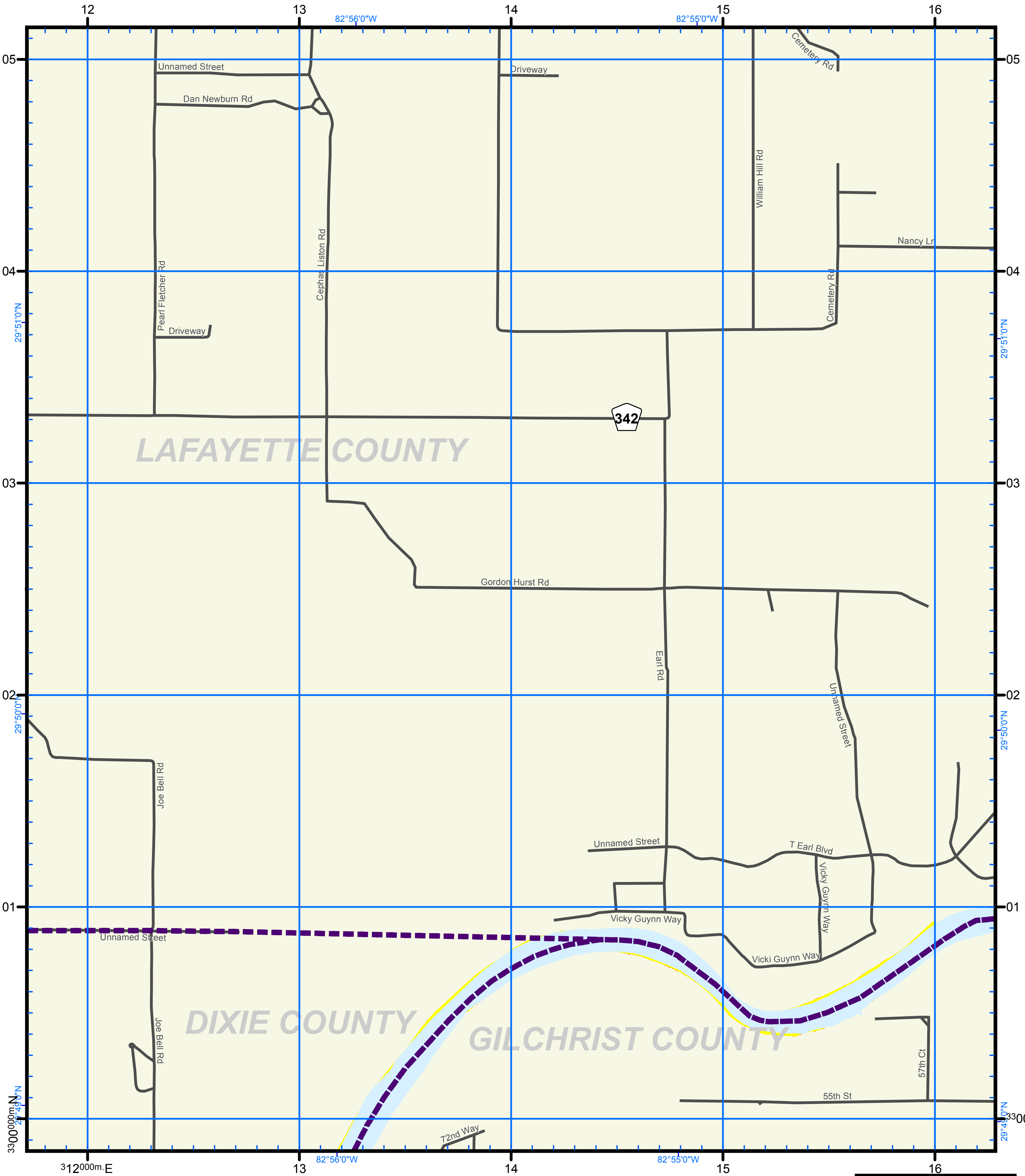

US National Grid
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Grid Zone Designation
17R

Datum = NAD 1983, 1,000-m USNG

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Notes:
1. Surge limits are based on still water storm tide height elevation above NAVD88 at high tide with no wave setup.
2. Total Storm Tide limits were derived from Maximum of Maximums surge heights over LIDAR based digital elevation.
3. The Points of Reference are locations determined to be relevant to emergency management officials.

ATLAS LEGEND
- Points of Reference
- Evacuation Routes
- City Limits
- NHD Lakes

Category 1
- Dry
- 0 - 0.5 ft
- 0.5 - 1.5 ft
- 1.5 - 3 ft
- 3 - 5 ft
- 5 - 7 ft
- 7 - 10 ft
- 10 - 15 ft
- 15 - 20 ft
- 20 - 42 ft

Storm Tide Depth

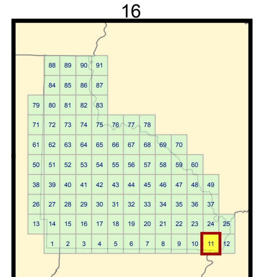
Lafayette County, 2012

Scale 1:24,000

Feet
0 2,000

Map Plate **11**

Page 1 of 1



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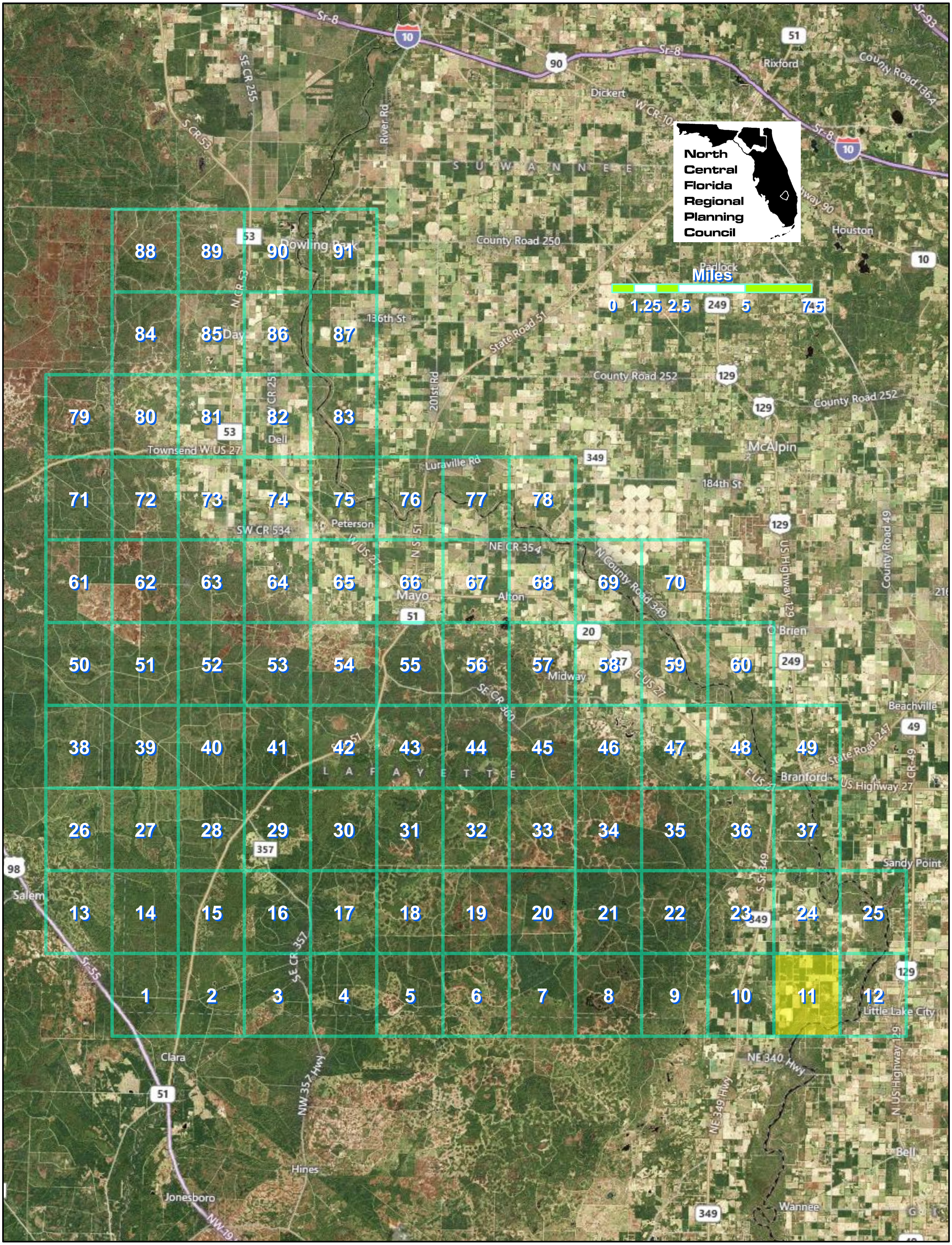
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Midway
Peterson
Dell
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McAlpin
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Rixford
Padlock
Beachville
Sandy Point
Little Lake City
Salem
Clara
Hines
Jonesboro
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Wannee
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County Road 252
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NE CR 354
N County Road 349
SE CR 360
NE 340 Hwy
NW 357 Hwy
US Highway 27
State Road 247
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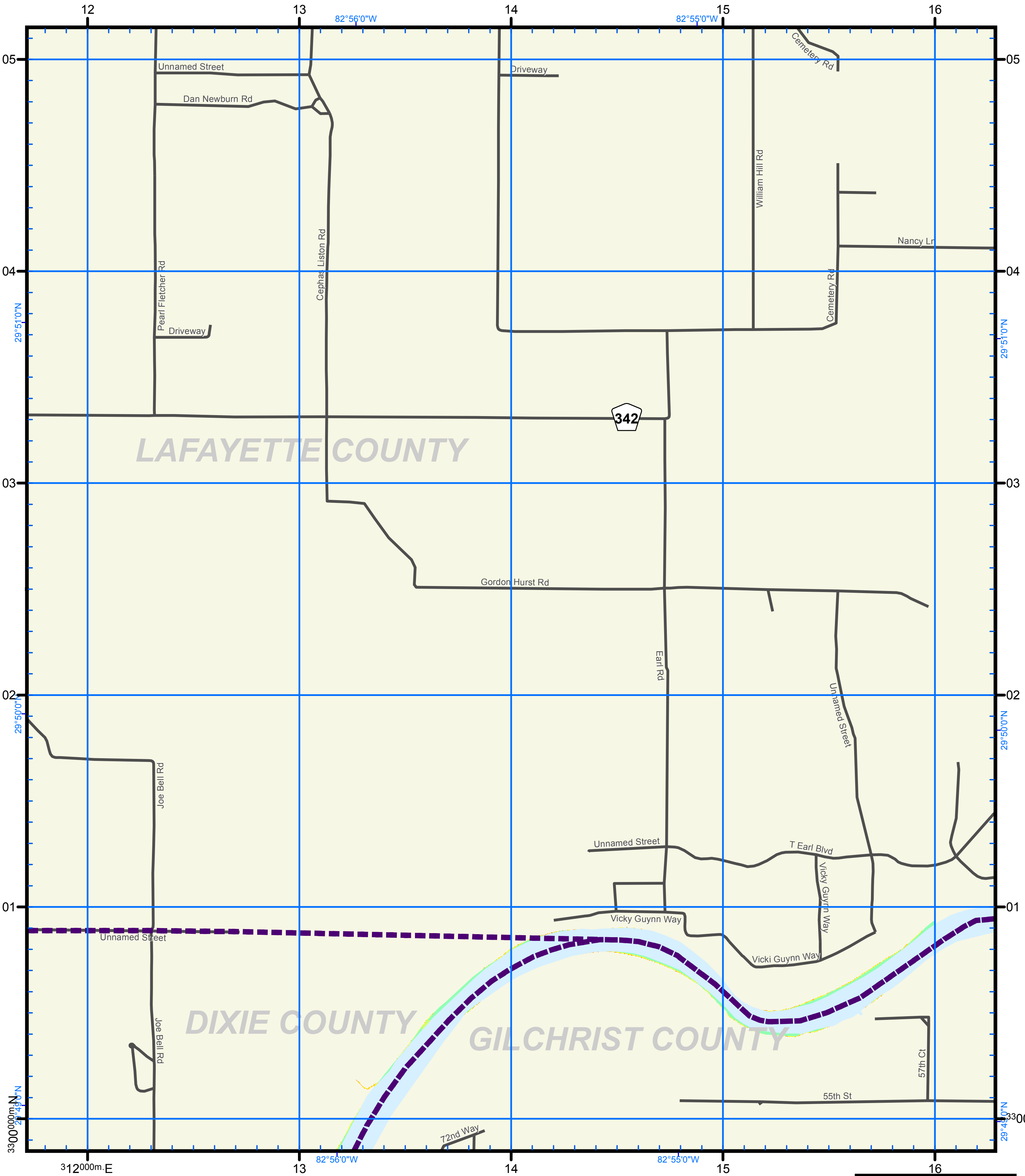
US Highway 129
N US Highway 129
136th St
184th St
201st Rd
River Rd
County Road 136A



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Datum = NAD 1983, 1,000-m USNG

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Notes:
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ATLAS LEGEND
- Points of Reference
- Evacuation Routes
- City Limits
- NHD Lakes

Category 2
- Dry
- 0 - 0.5 ft
- 0.5 - 1.5 ft
- 1.5 - 3 ft
- 3 - 5 ft
- 5 - 7 ft
- 7 - 10 ft
- 10 - 15 ft
- 15 - 20 ft
- 20 - 42 ft

Storm Tide Depth

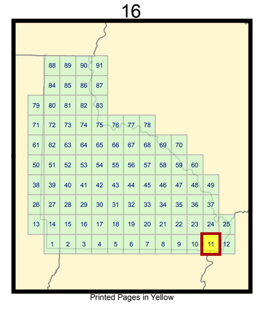
Lafayette County, 2012

Scale 1:24,000

Feet
0 2,000

Map Plate **11**

Page 1 of 1



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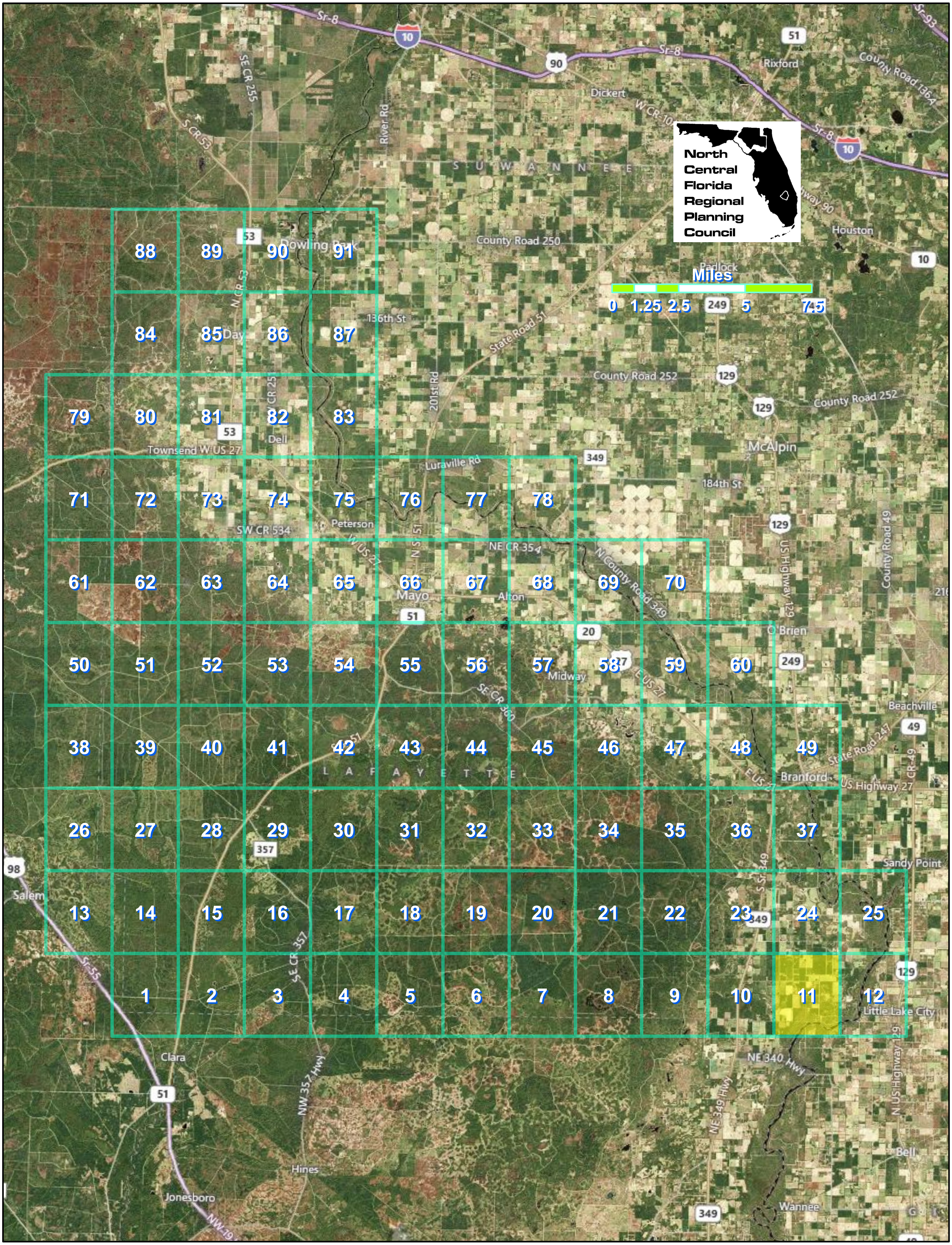
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River Rd
201st Rd
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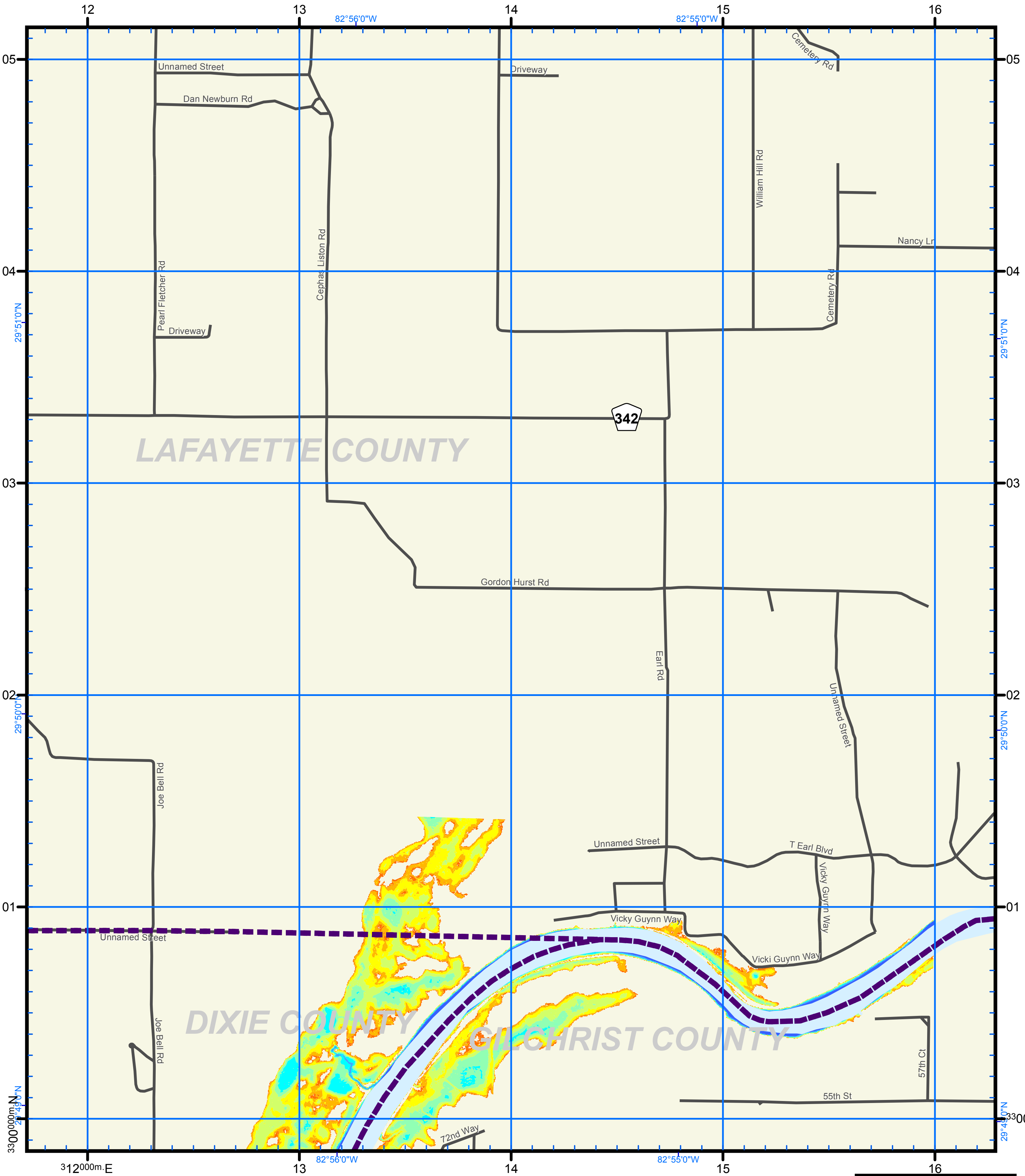

US National Grid
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ATLAS LEGEND

- Points of Reference
- Evacuation Routes
- City Limits
- NHD Lakes

Category 3

- Dry
- 0 - 0.5 ft
- 0.5 - 1.5 ft
- 1.5 - 3 ft
- 3 - 5 ft
- 5 - 7 ft
- 7 - 10 ft
- 10 - 15 ft
- 15 - 20 ft
- 20 - 42 ft

Storm Tide Depth

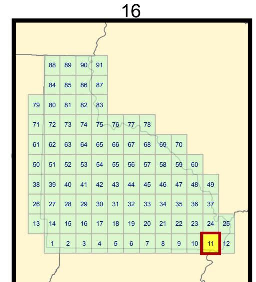
Lafayette County, 2012

Scale 1:24,000

Feet
0 2,000

Map Plate **11**

Page 1 of 1



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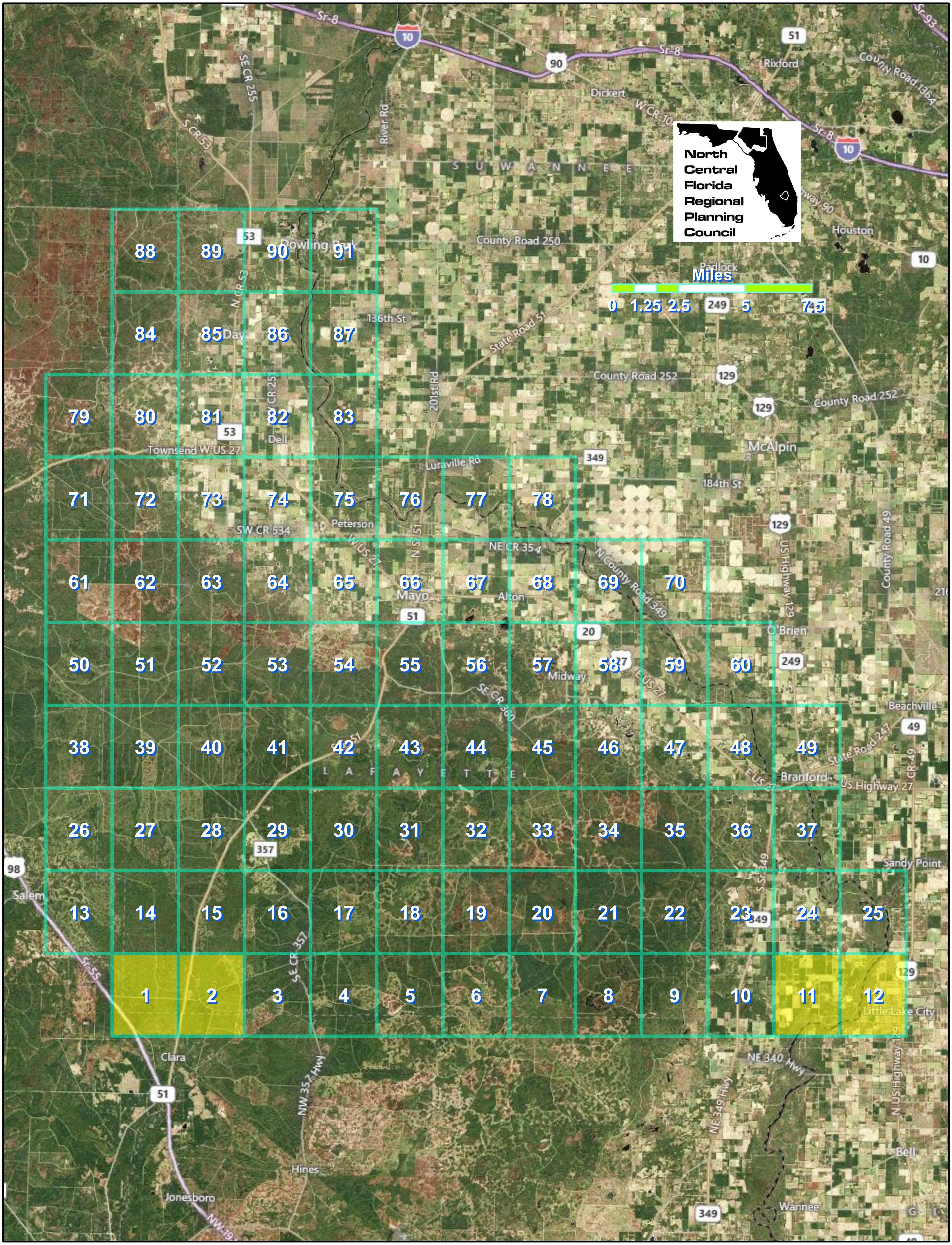

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Peterson
Alton
Midway
O'Brien
Branford
McAlpin
Dickert
Rixford
Houston
Padlock
Beachville
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Little Lake City
Salem
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201st Rd
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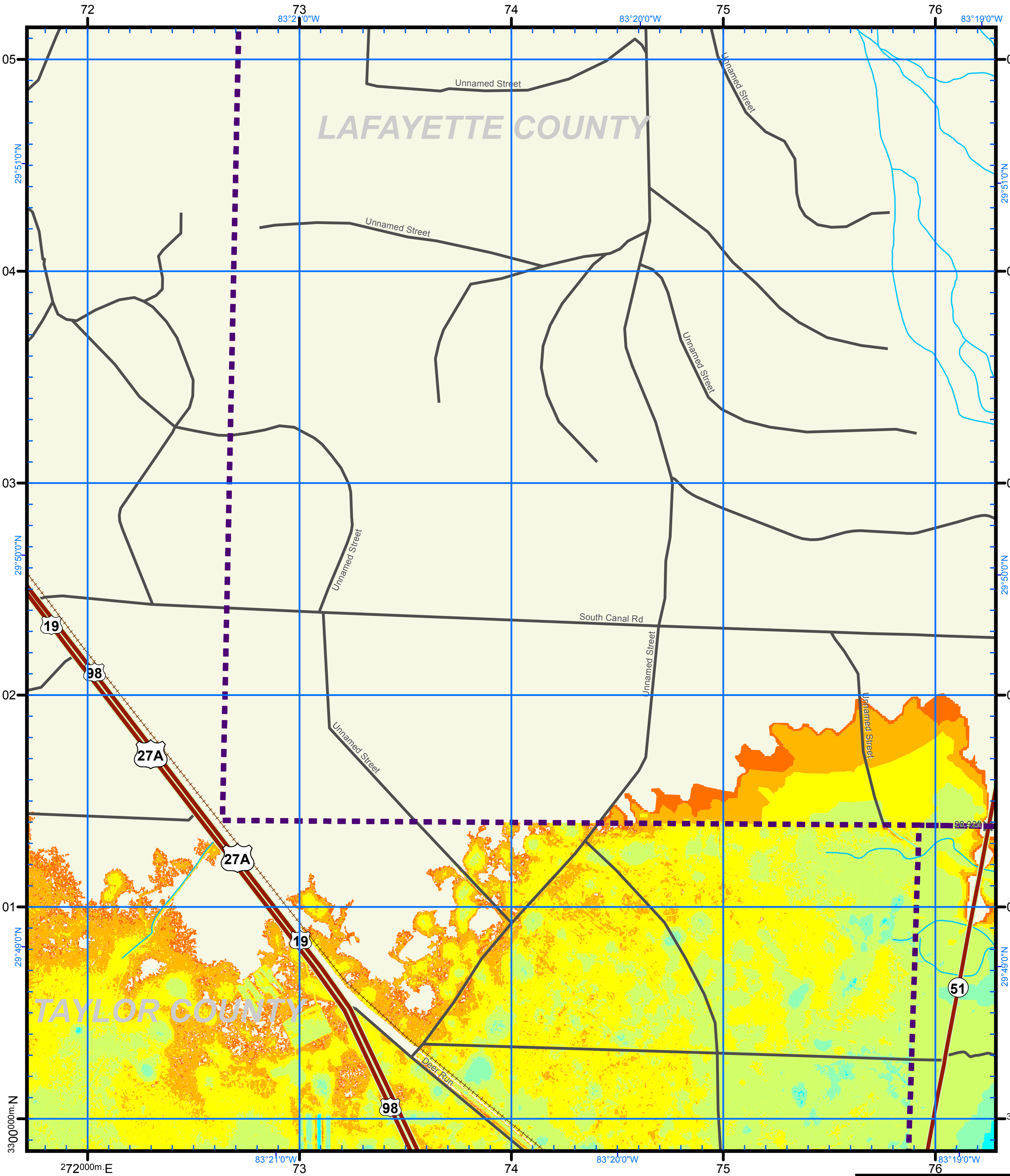

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ATLAS LEGEND
- Points of Reference
- Evacuation Routes
- City Limits
- NHD Lakes

Category 4
- Dry
- 0 - 0.5 ft
- 0.5 - 1.5 ft
- 1.5 - 3 ft
- 3 - 5 ft
- 5 - 7 ft
- 7 - 10 ft
- 10 - 15 ft
- 15 - 20 ft
- 20 - 42 ft

Storm Tide Depth

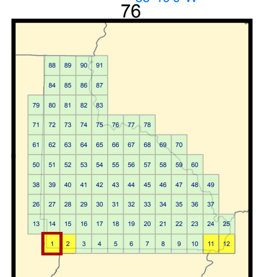
Lafayette County, 2012

Scale 1:24,000

Feet
0 2,000

Map Plate **1**

Page 1 of 4



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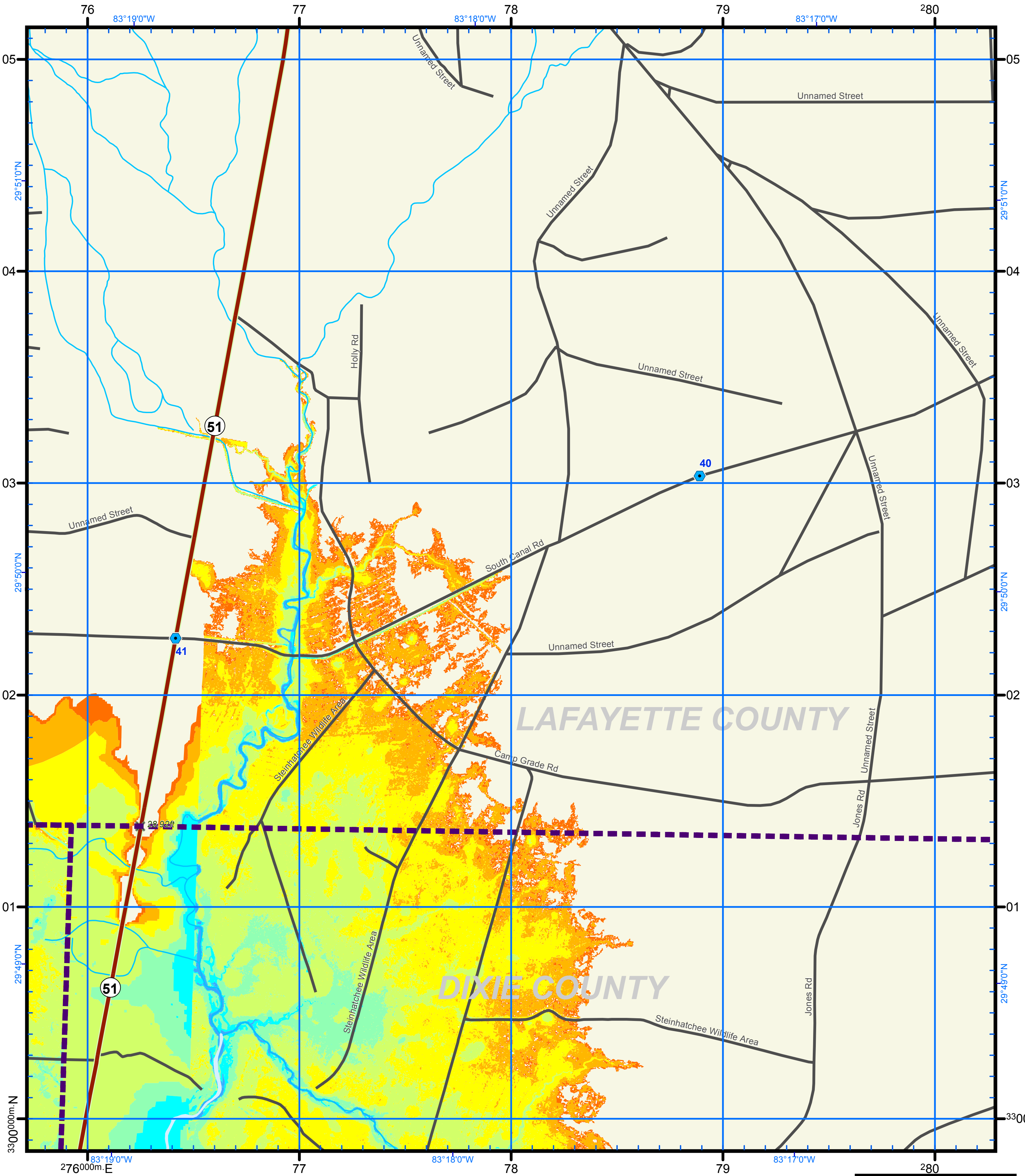

US National Grid
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ATLAS LEGEND
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- Evacuation Routes
- City Limits
- NHD Lakes

Category 4
- Dry
- 0 - 0.5 ft
- 0.5 - 1.5 ft
- 1.5 - 3 ft
- 3 - 5 ft
- 5 - 7 ft
- 7 - 10 ft
- 10 - 15 ft
- 15 - 20 ft
- 20 - 42 ft

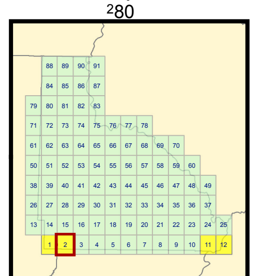
Storm Tide Depth

Lafayette County, 2012

Scale 1:24,000

Feet
0 2,000

Map Plate **2**



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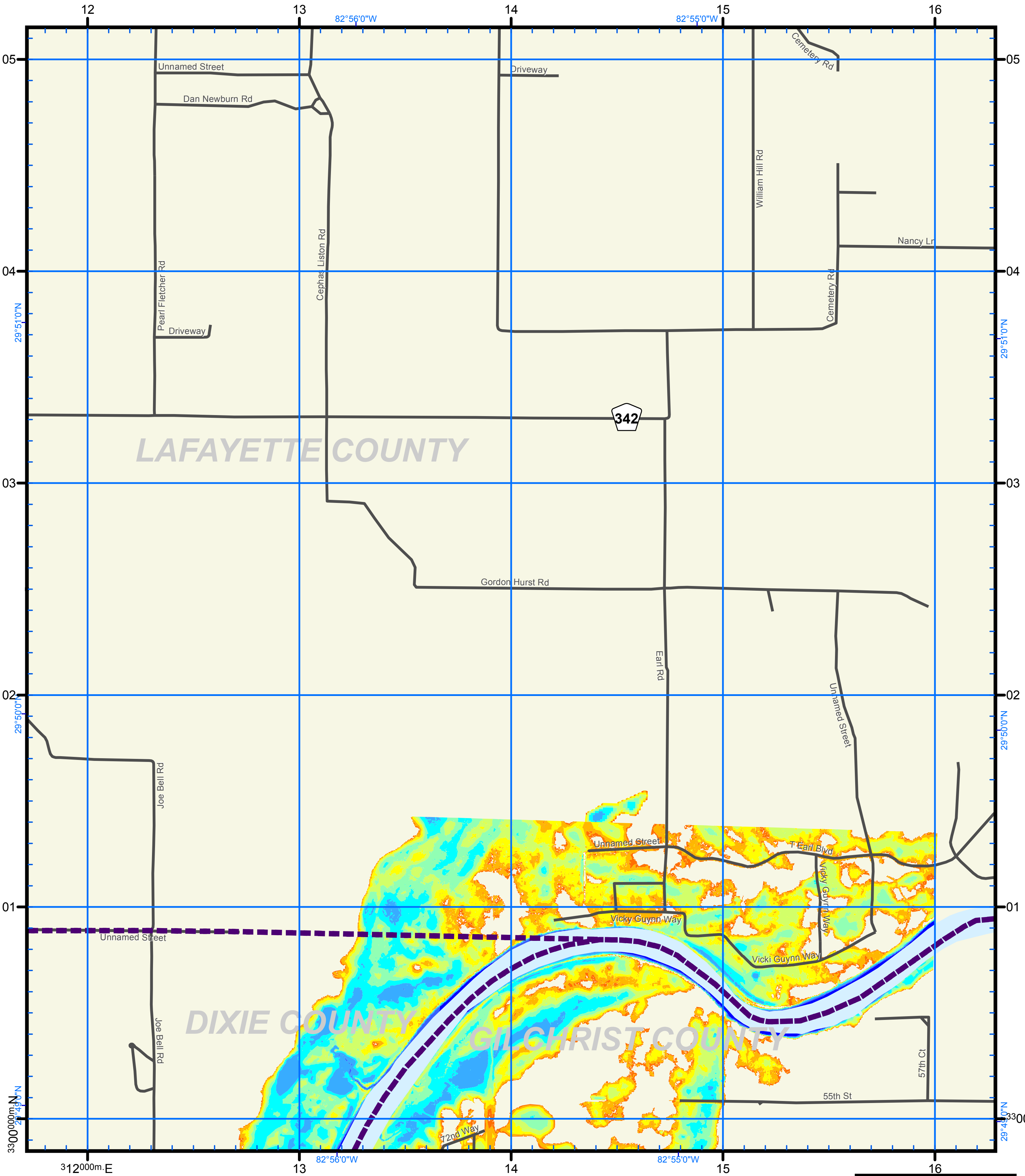

US National Grid
100,000-m Square ID
LP
Grid Zone Designation
17R

Datum = NAD 1983, 1,000-m USNG

GN

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ATLAS LEGEND
- Points of Reference
- Evacuation Routes
- City Limits
- NHD Lakes

Category 4
- Dry
- 0 - 0.5 ft
- 0.5 - 1.5 ft
- 1.5 - 3 ft
- 3 - 5 ft
- 5 - 7 ft
- 7 - 10 ft
- 10 - 15 ft
- 15 - 20 ft
- 20 - 42 ft

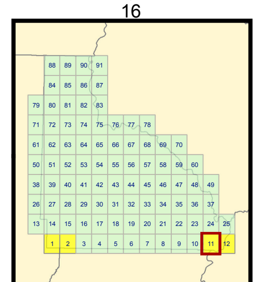
Storm Tide Depth

Lafayette County, 2012

Scale 1:24,000

Feet
0 2,000

Map Plate **11**



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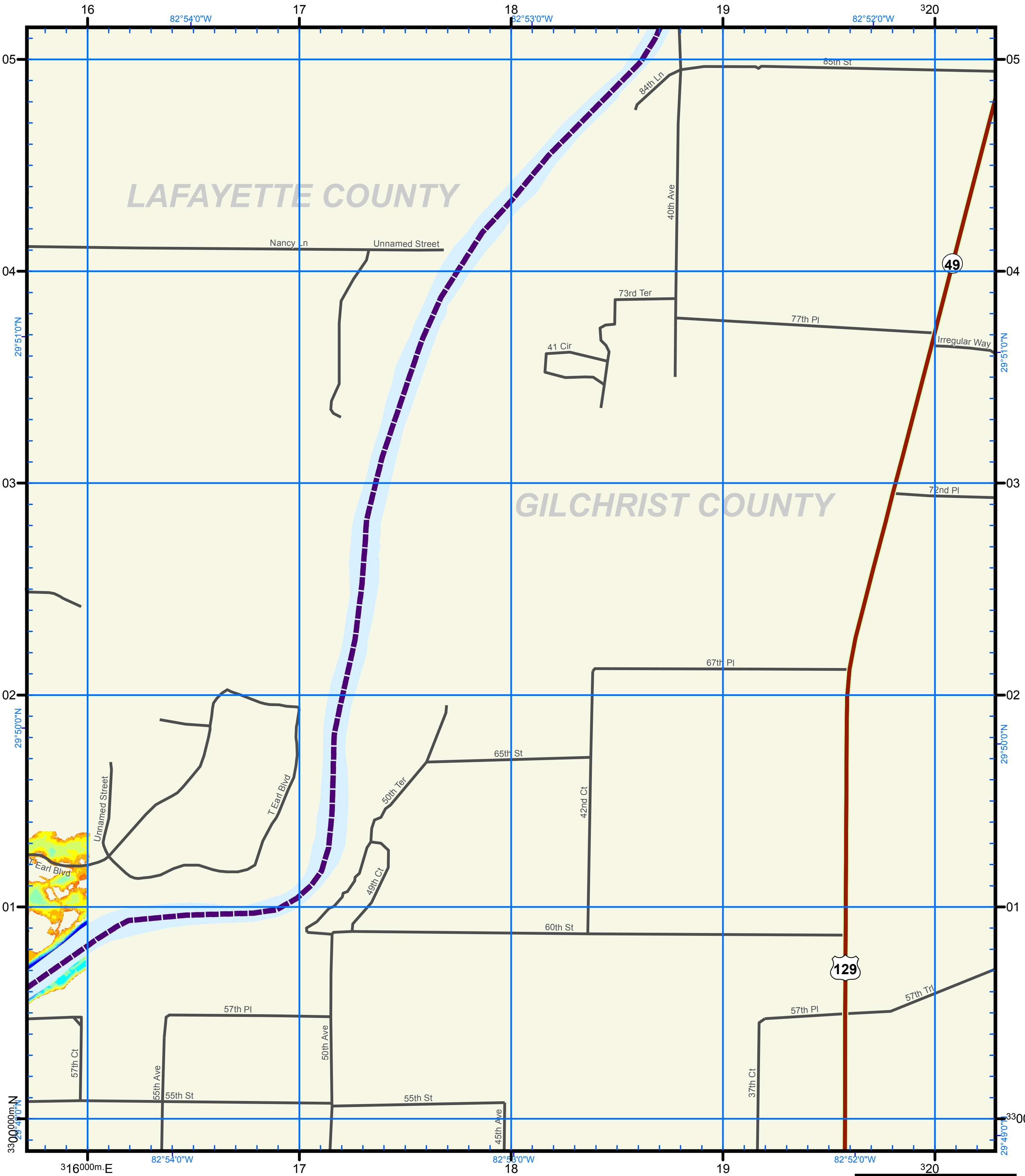

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ATLAS LEGEND

- Points of Reference
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- City Limits
- NHD Lakes

Category 4

- Dry
- 0 - 0.5 ft
- 0.5 - 1.5 ft
- 1.5 - 3 ft
- 3 - 5 ft
- 5 - 7 ft
- 7 - 10 ft
- 10 - 15 ft
- 15 - 20 ft
- 20 - 42 ft

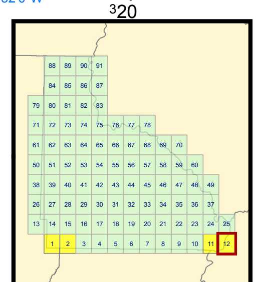
Storm Tide Depth

Lafayette County, 2012

Scale 1:24,000

Feet 0 2,000

Map Plate **12**



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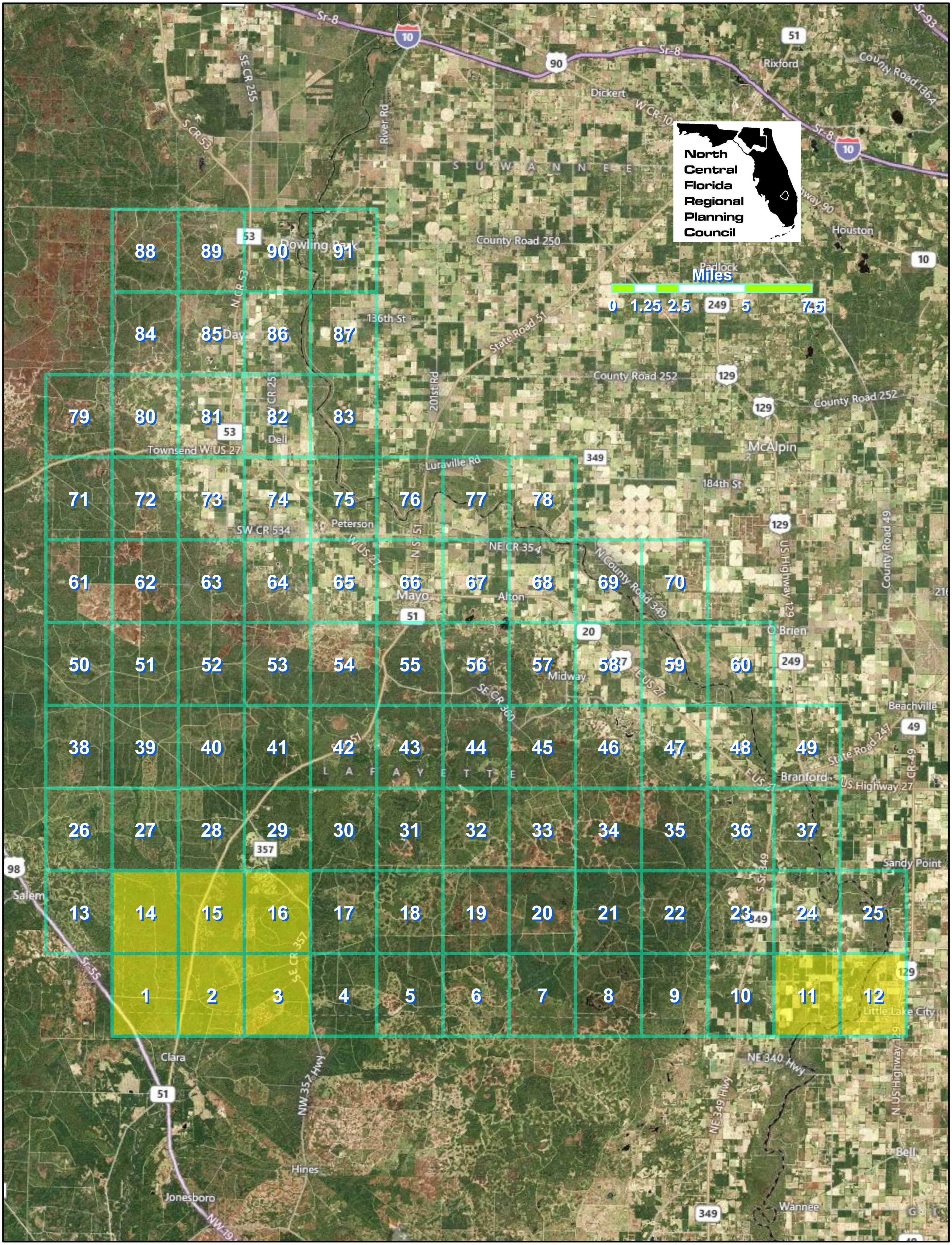

North Central Florida Regional Planning Council
Miles
0 1.25 2.5 5 7.5
S U W A N N E E
L A F A Y E T T E
Mayo
Dowling Park
Dell
Peterson
Alton
Midway
O Brien
Branford
McAlpin
Dickert
Rixford
Houston
Padlock
Beachville
Sandy Point
Little Lake City
Salem
Clara
Hines
Jonesboro
Wannee
Bell
County Road 250
County Road 252
State Road 51
Townsend W US 27
SW CR 534
NE CR 354
N County Road 349
SE CR 360
E US 27
US Highway 27
US Highway 129
County Road 49
NE 340 Hwy
NE 349 Hwy
NW 357 Hwy
SE CR 357
SE CR 255
S CR 53
N CR 53
136th St
184th St
201st Rd
Luraville Rd
River Rd
Sr-8
Sr-55
County Road 1364
State Road 247
N US Highway 129
1 2 3 4 5 6 7 8 9 10 11 12
13 14 15 16 17 18 19 20 21 22 23 24 25
26 27 28 29 30 31 32 33 34 35 36 37
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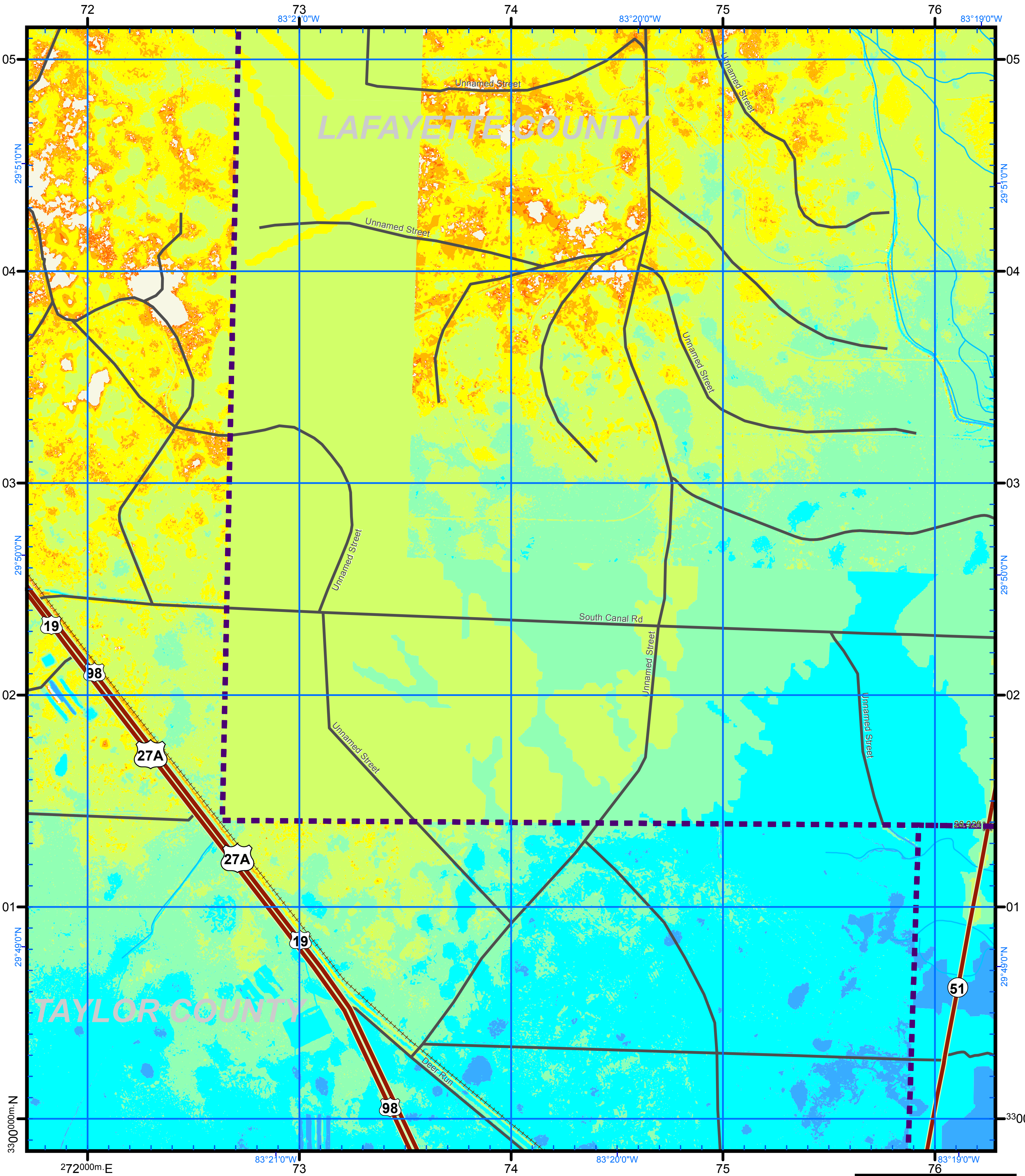

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ATLAS LEGEND
- Points of Reference
- Evacuation Routes
- City Limits
- NHD Lakes

Category 5
- Dry
- 0 - 0.5 ft
- 0.5 - 1.5 ft
- 1.5 - 3 ft
- 3 - 5 ft
- 5 - 7 ft
- 7 - 10 ft
- 10 - 15 ft
- 15 - 20 ft
- 20 - 42 ft

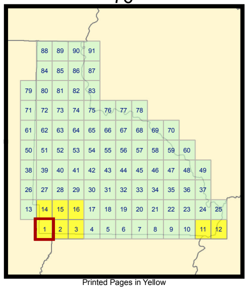
Storm Tide Depth
Lafayette County, 2012

Scale 1:24,000

Feet
0 2,000

Map Plate **1**

Page 1 of 8



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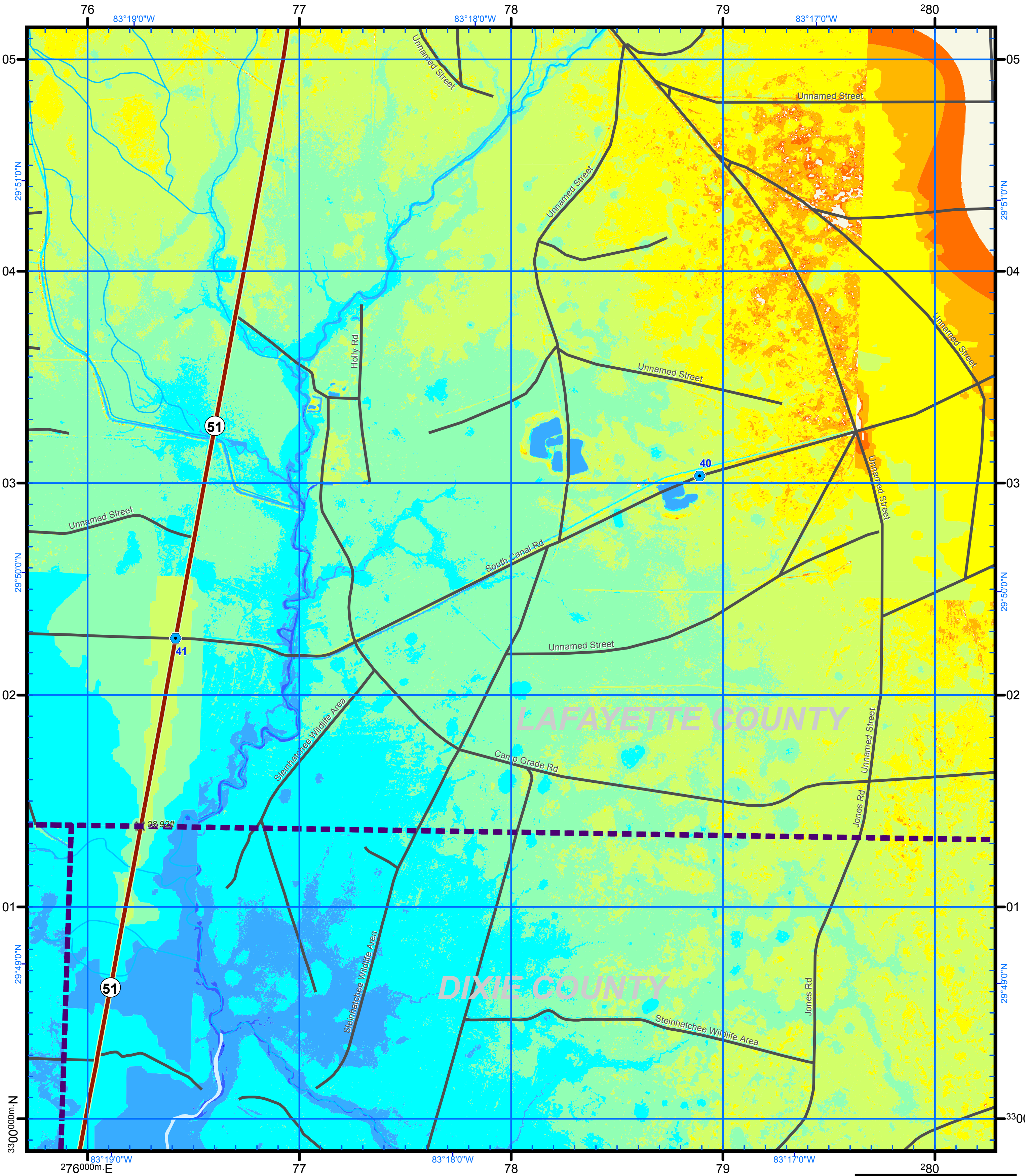

US National Grid
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Grid Zone Designation
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- Evacuation Routes
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- NHD Lakes

Category 5
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- 15 - 20 ft
- 20 - 42 ft

Storm Tide Depth

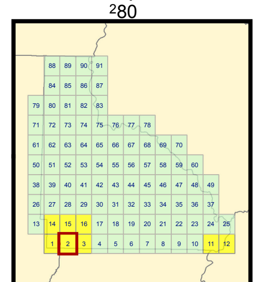
Lafayette County, 2012

Scale 1:24,000

Feet
0 2,000

Map Plate **2**

Page 2 of 8



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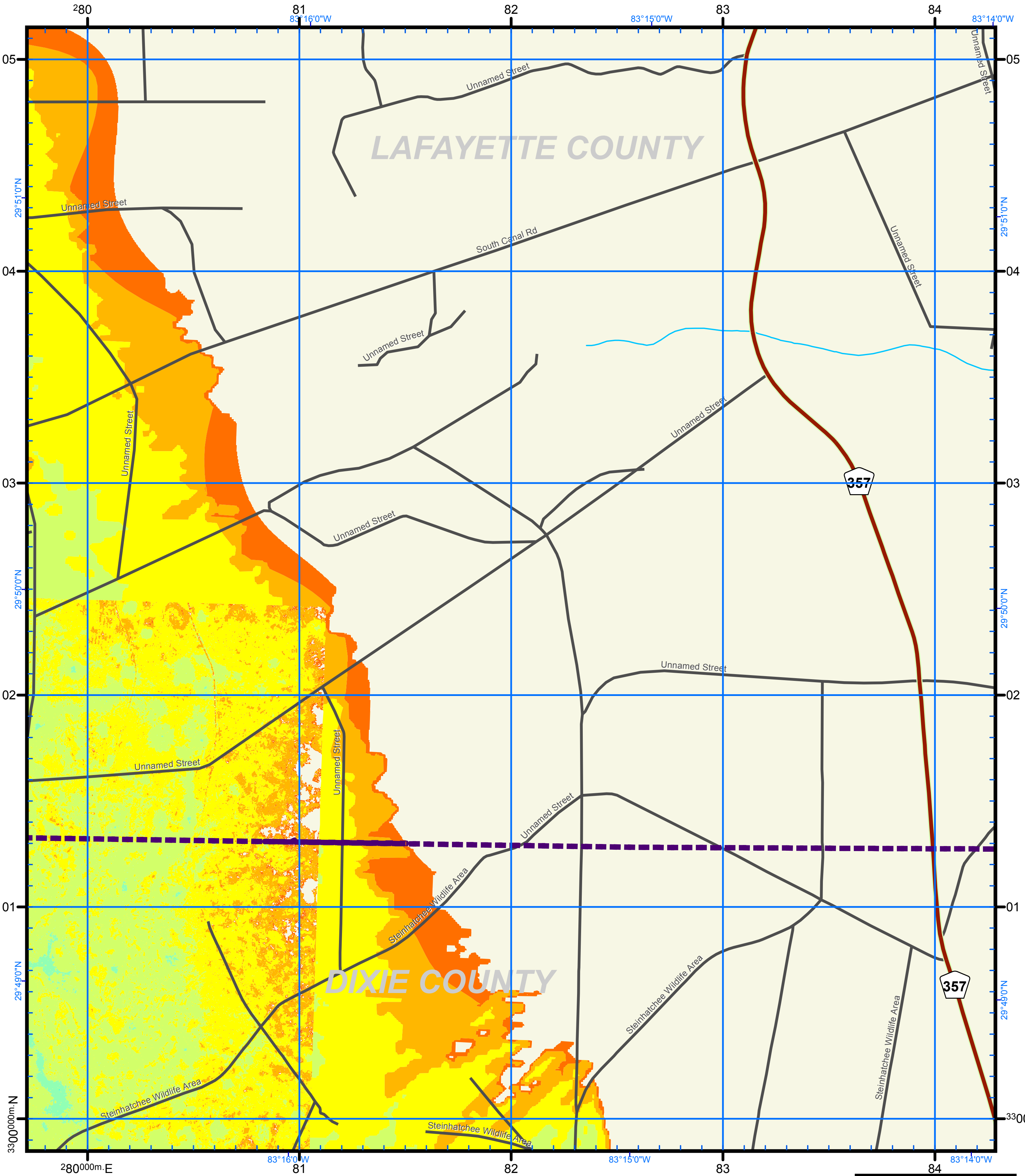

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ATLAS LEGEND

- Points of Reference
- Evacuation Routes
- City Limits
- NHD Lakes

Category 5

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- 15 - 20 ft
- 20 - 42 ft

Storm Tide Depth

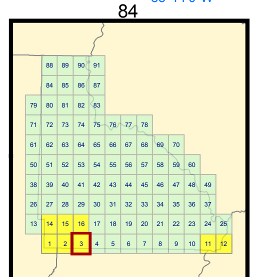
Lafayette County, 2012

Scale 1:24,000

Feet

0 2,000

Map Plate **3**



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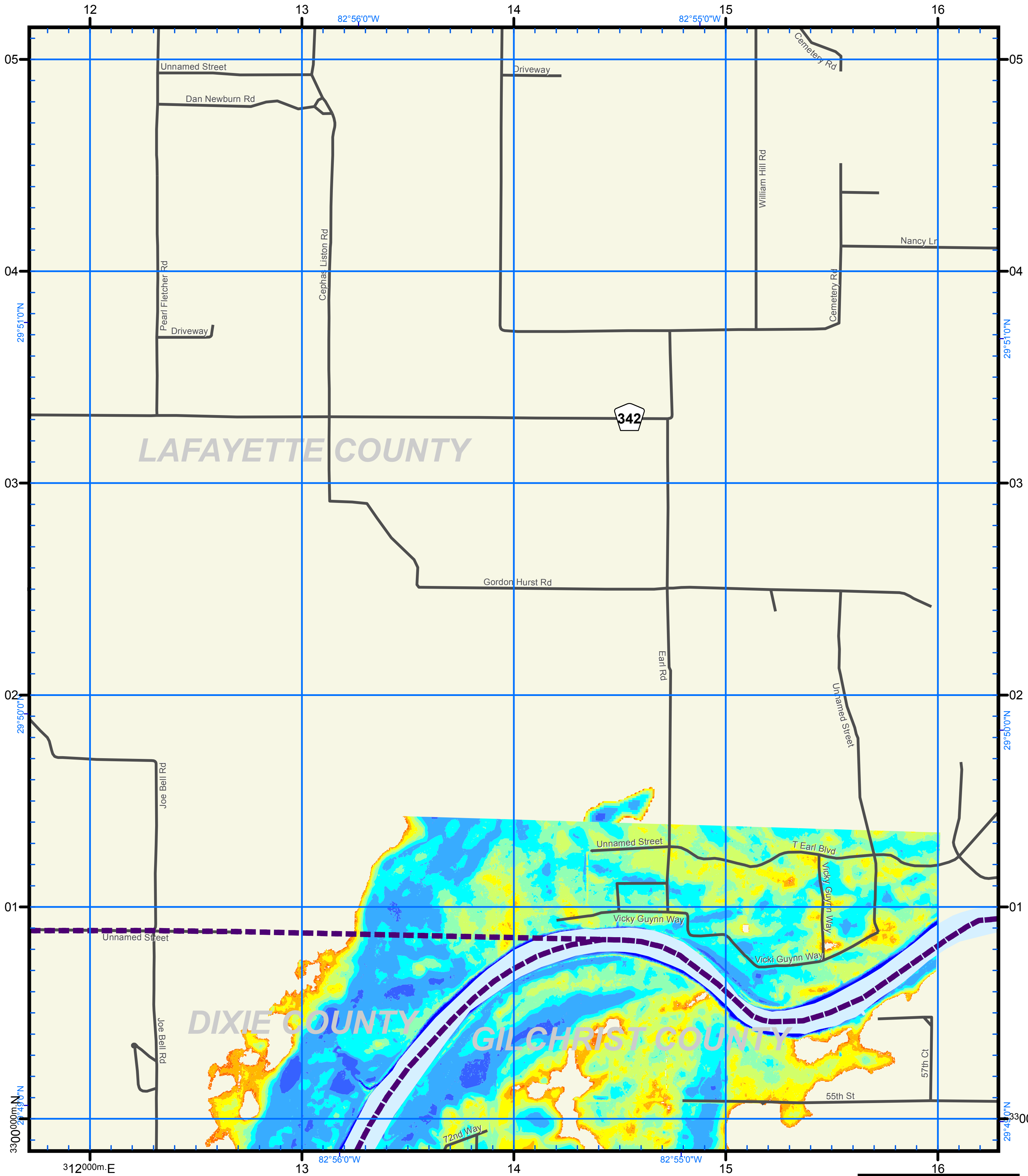

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ATLAS LEGEND

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- Evacuation Routes
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- NHD Lakes

Category 5

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- 20 - 42 ft

Storm Tide Depth

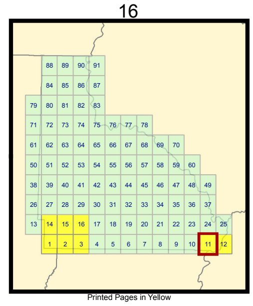
Lafayette County, 2012

Scale 1:24,000

Feet
0 2,000

Map Plate **11**

Page 4 of 8



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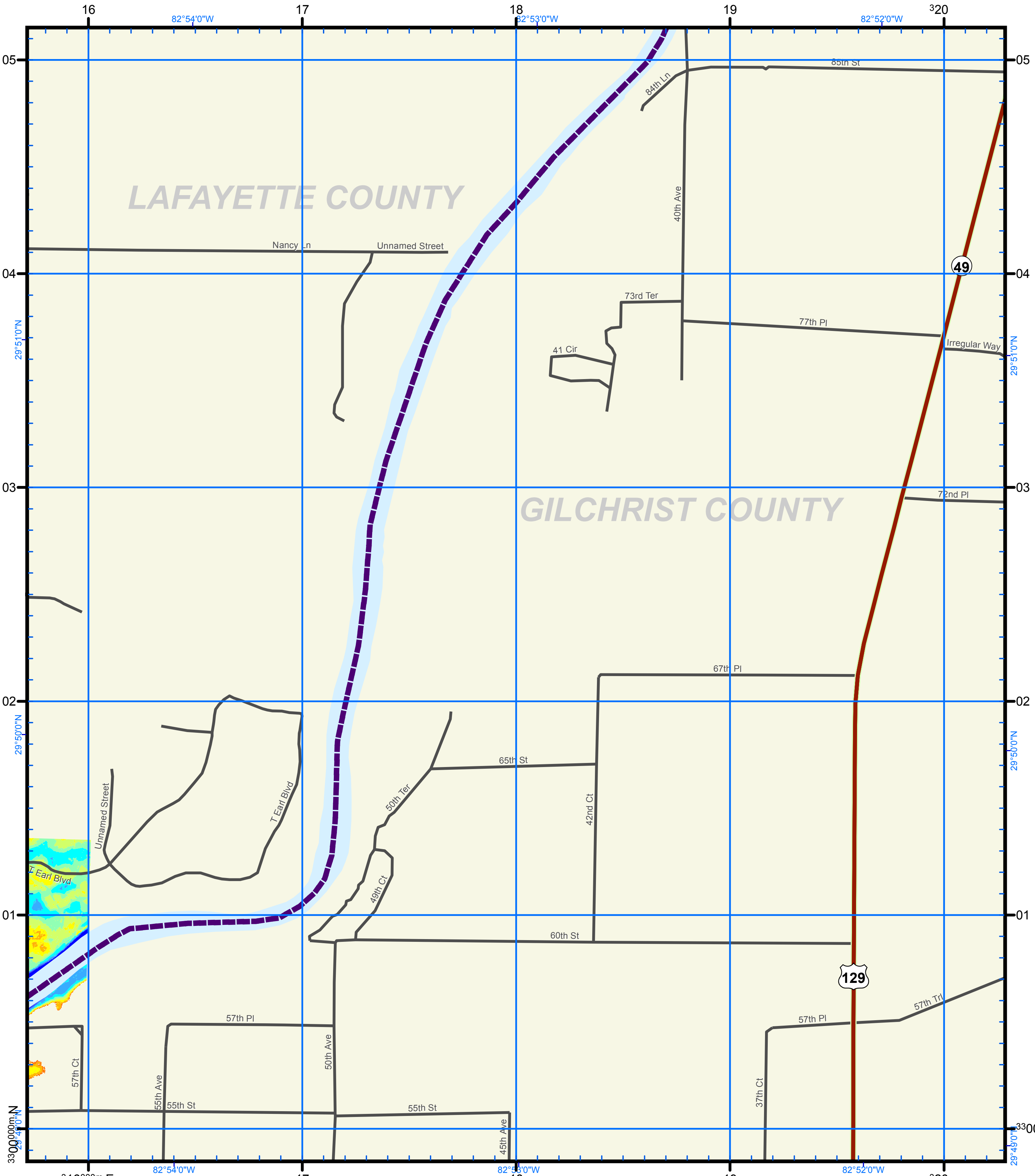

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- NHD Lakes

Category 5
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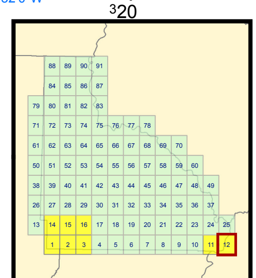
Storm Tide Depth
Lafayette County, 2012

Scale 1:24,000

Feet
0 2,000

Map Plate **12**

Page 5 of 8



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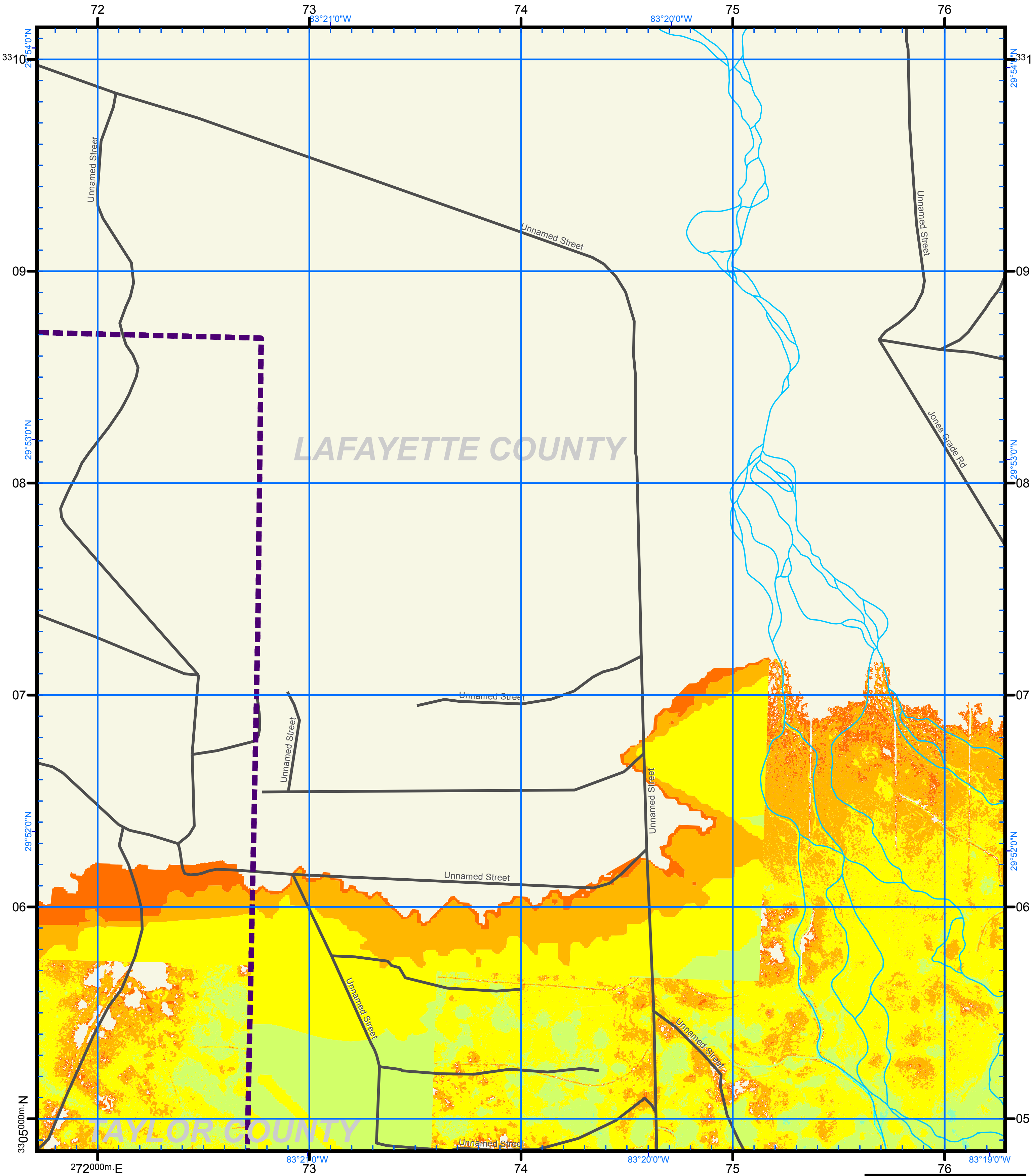

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ATLAS LEGEND

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- Evacuation Routes
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- NHD Lakes

Category 5

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- 10 - 15 ft
- 15 - 20 ft
- 20 - 42 ft

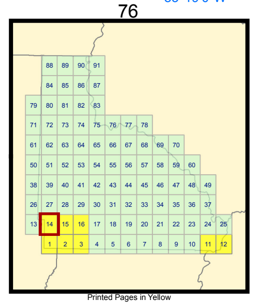
Storm Tide Depth

Lafayette County, 2012

Scale 1:24,000

Feet
0 2,000

Map Plate **14**



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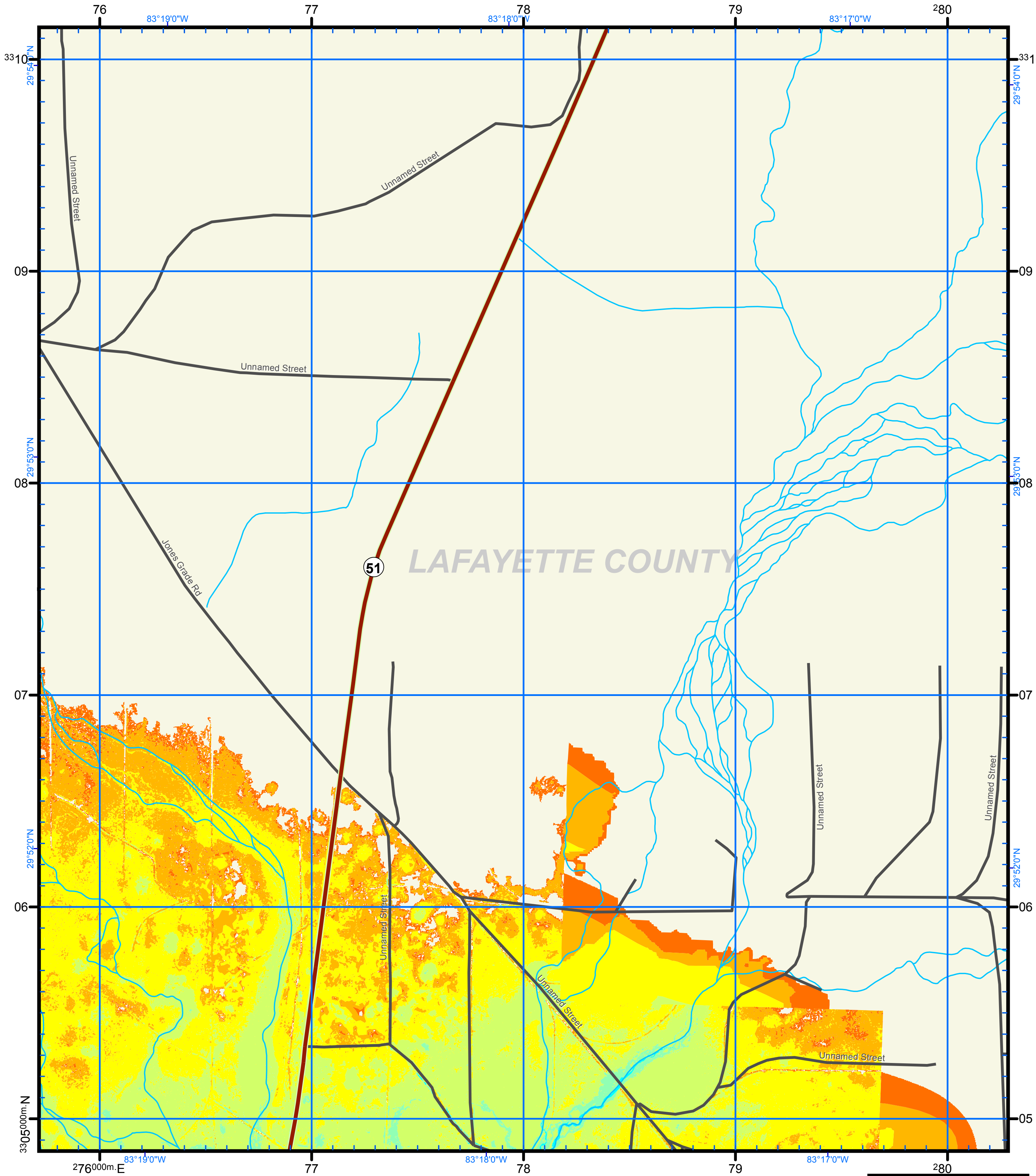

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ATLAS LEGEND
- **Points of Reference**
- **Evacuation Routes**
- **City Limits**
- **NHD Lakes**

Category 5
- Dry
- 0 - 0.5 ft
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- 20 - 42 ft

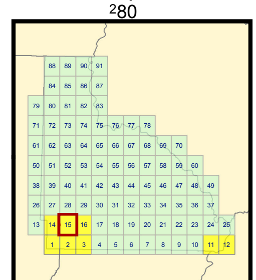
Storm Tide Depth

Lafayette County, 2012

Scale 1:24,000

Feet
0 2,000

Map Plate **15**



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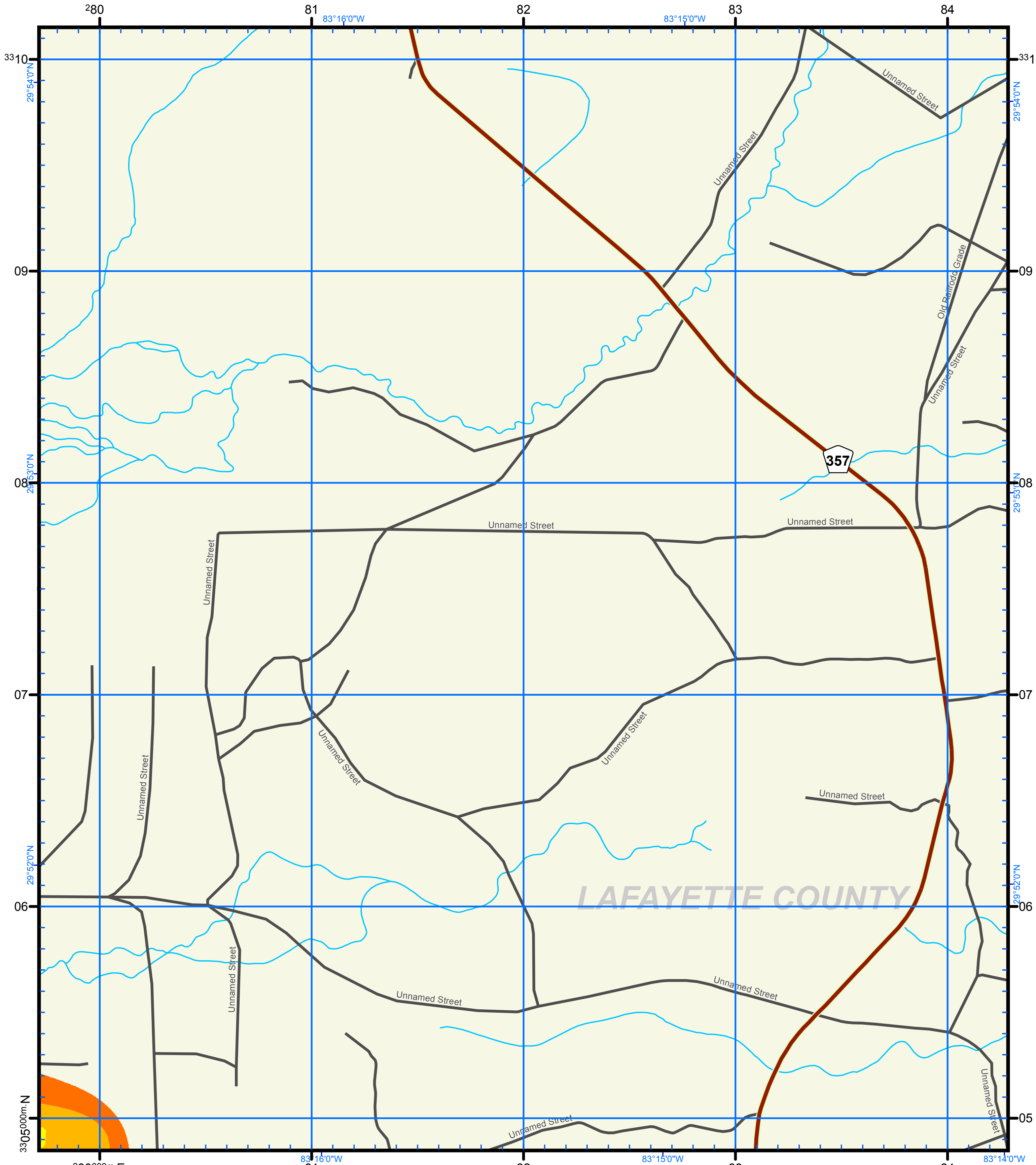

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Storm Tide Depth

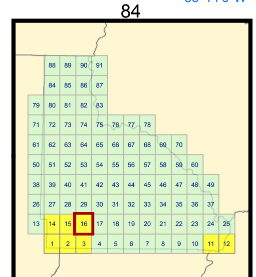
Lafayette County, 2012

Scale 1:24,000

Feet
0 2,000

Map Plate **16**

Page 8 of 8



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Funding was provided by the Florida Legislature with funding from the Federal Emergency Management Agency (FEMA) through the Florida Division of Emergency Management. Local match was provided by the North Central Florida Regional Planning Council and Dixie, Gilchrist, Lafayette and Taylor Counties.

Florida Division of Emergency Management
Bryan Koon, Director
2555 Shumard Oak Boulevard, Tallahassee, Florida 32399
Web site: www.floridadisaster.org

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Michael DePalma, Associate Planner and Geographic Information Systems
Statewide Program Manager: Jeffrey Alexander, Northeast Florida Regional Council