FORERUNNER

Using 2D Hydraulic Models to Manage Flood Risk in New Development

January 31, 2024

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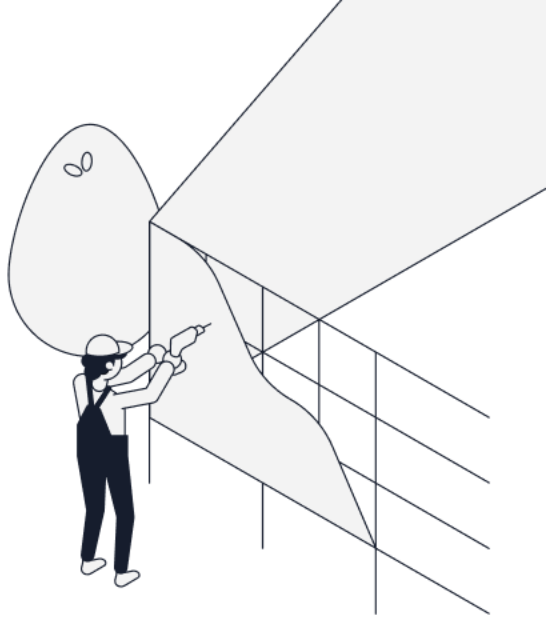
WELCOME

Housekeeping

- This presentation is being recorded
- The recording and presentation will be shared via email and posted on our blog
- Use the Q+A or the Chat to ask questions
- CFMs: Complete the post-attendance survey to receive your CEC. The CEC Certificate will be sent via email to you (and the list will be sent to ASFPM) next week



Agenda

1 **Introduction**

2 **Using 2D Hydraulic Models to Manage Flood Risk in New Development**

3 **Q+A**

GOV. PARTNERS

We work with over 80 of the most at-risk communities throughout the U.S.

FDEM
Florida

Coral Gables
Florida

Pasco County
Florida

Clearwater
Florida

Jefferson Parish
Louisiana

Aventura
Florida

Miramar
Florida

Pompano Beach
Florida

Middletown
New Jersey

Manasquan
New Jersey

Belmar
New Jersey

Long Branch
New Jersey

Bay Head
New Jersey

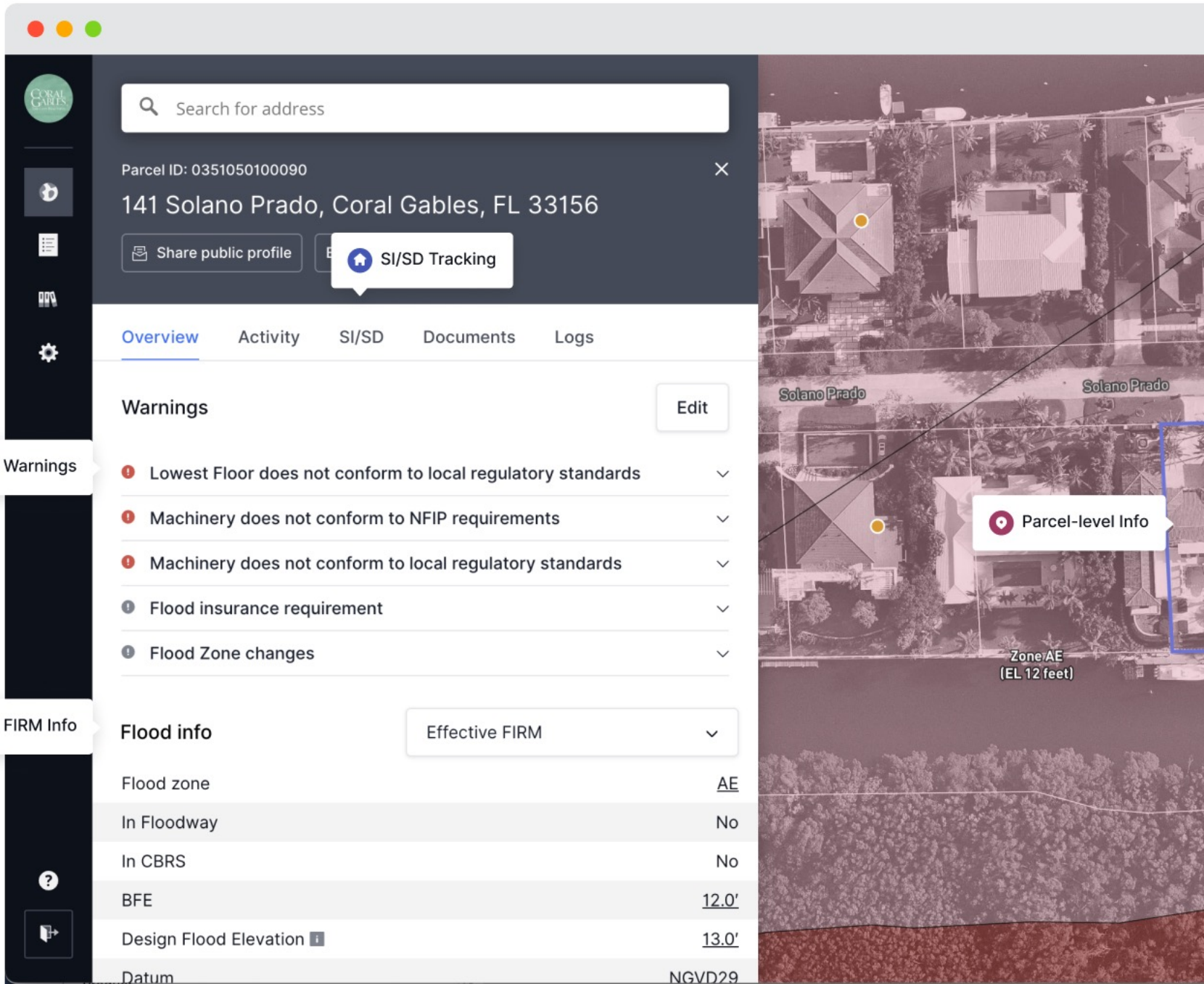
Longport
New Jersey

Parkland
Florida

Harris County
Texas

PRODUCT

Our geospatial dashboard drives per-property insight.



Agenda

1 Introduction

2 **Using 2D Hydraulic Models to Manage Flood Risk in New Development**

3 Q+A

Stokka Brown
MS, PE, CFM
Principal, Water Resources
Engineering Practice Lead
at CSRS

The City of Central's Offsite Drainage Assessment Program:

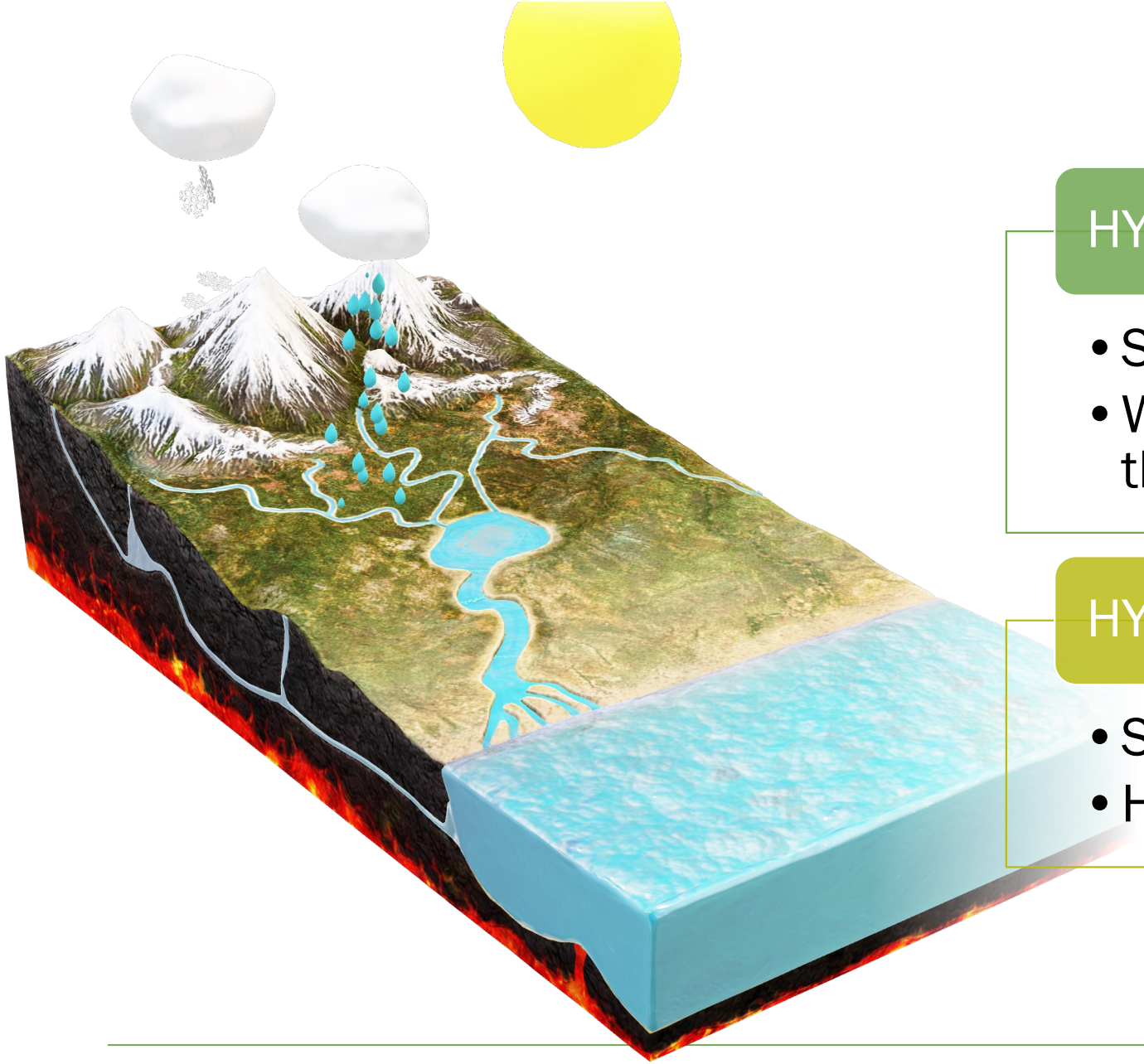
A Comprehensive Drainage Impact Analysis of Proposed Land Development Utilizing High-Resolution, 2D Hydraulic Models

PRESENTED BY:
Stokka Brown, MS, PE, CFM

CSRS | BUILDING STRONGER, SMARTER COMMUNITIES TOGETHER.

CSRS Stormwater Solutions

Our communities are growing more susceptible to flooding every day. The combination of increasing rainfall and extreme weather events, aging infrastructure, and inadequate development regulations has led to nuisance and disastrous flooding in areas that have never experienced it until recently. Fortunately, CSRS provides a suite of services to help clients build resilient communities: stormwater solutions. With implementation and future risk in mind, we perform assessments to understand risks within communities and develop unique solutions for your stormwater needs.



HYDROLOGY

- Study of rainfall runoff over land
- Where does & how much does the rainfall accumulate?

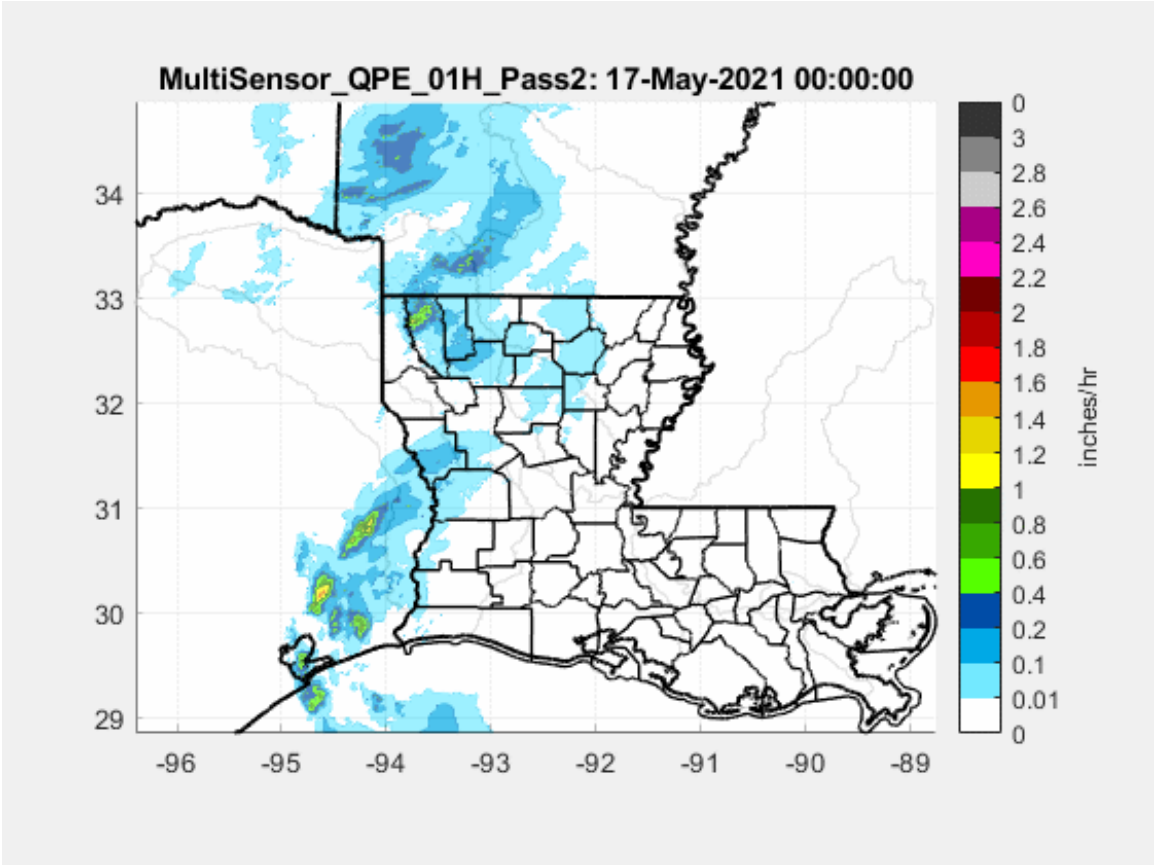
HYDRAULICS

- Study of water flow in a channel
- How high does the water get?

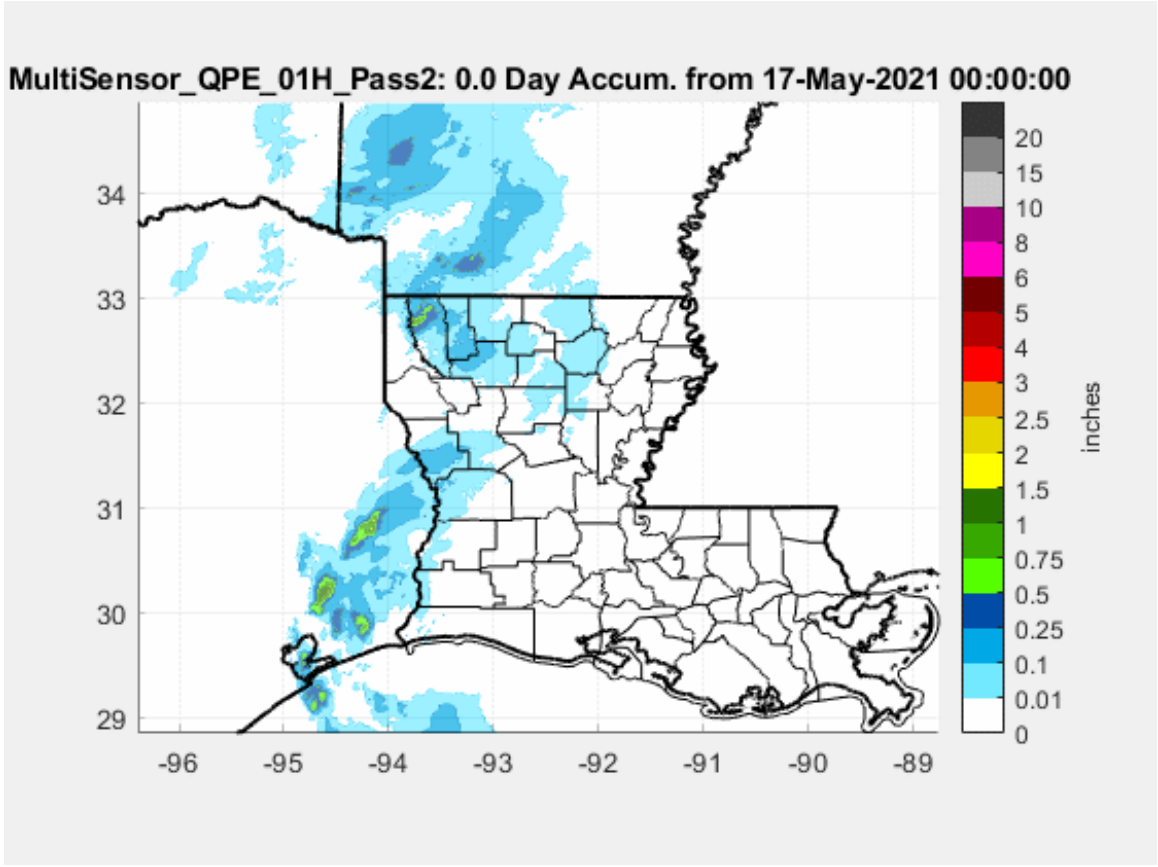
Advances in Technology: Meteorology & Hydrology

May 2021 Rain Event

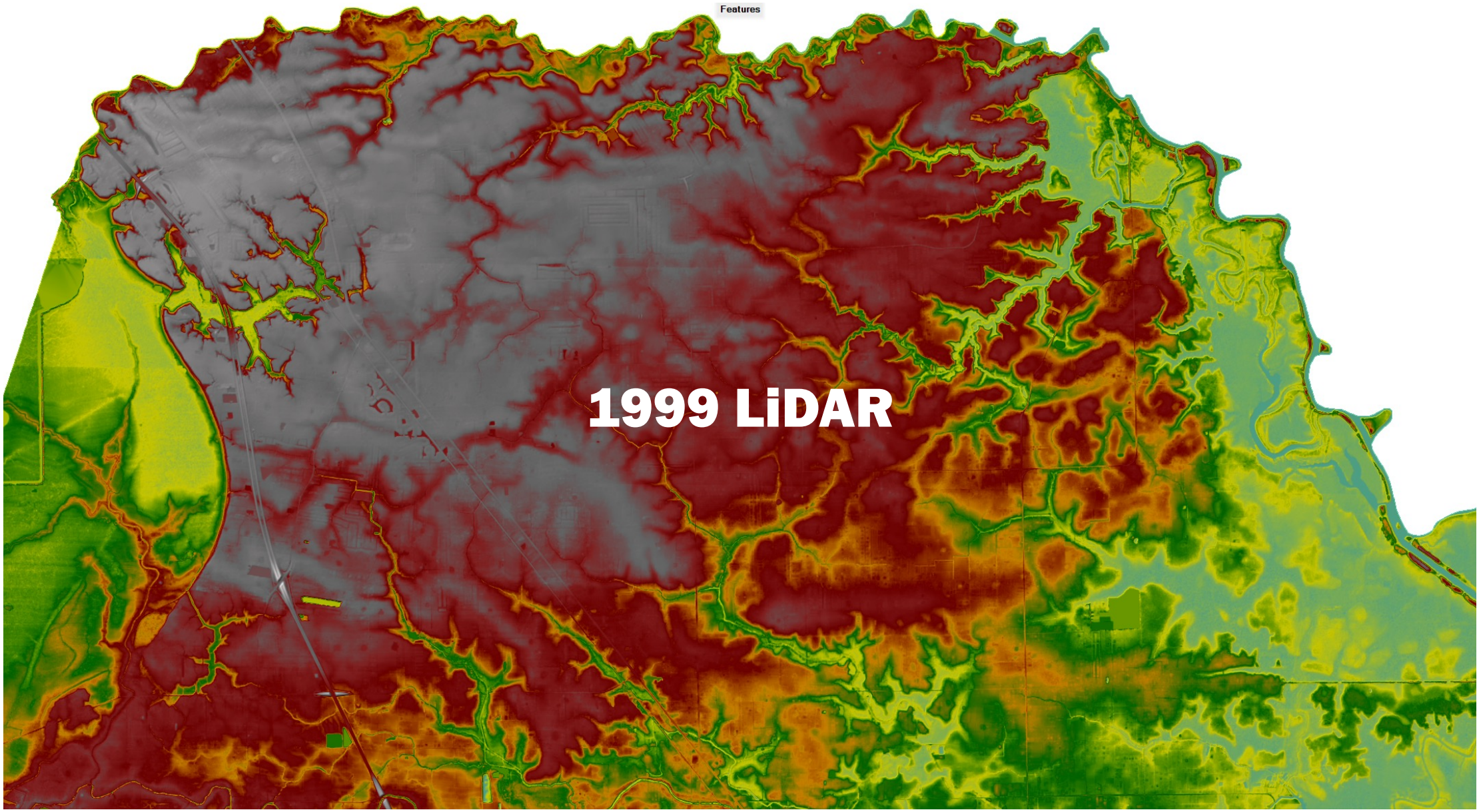
RATE

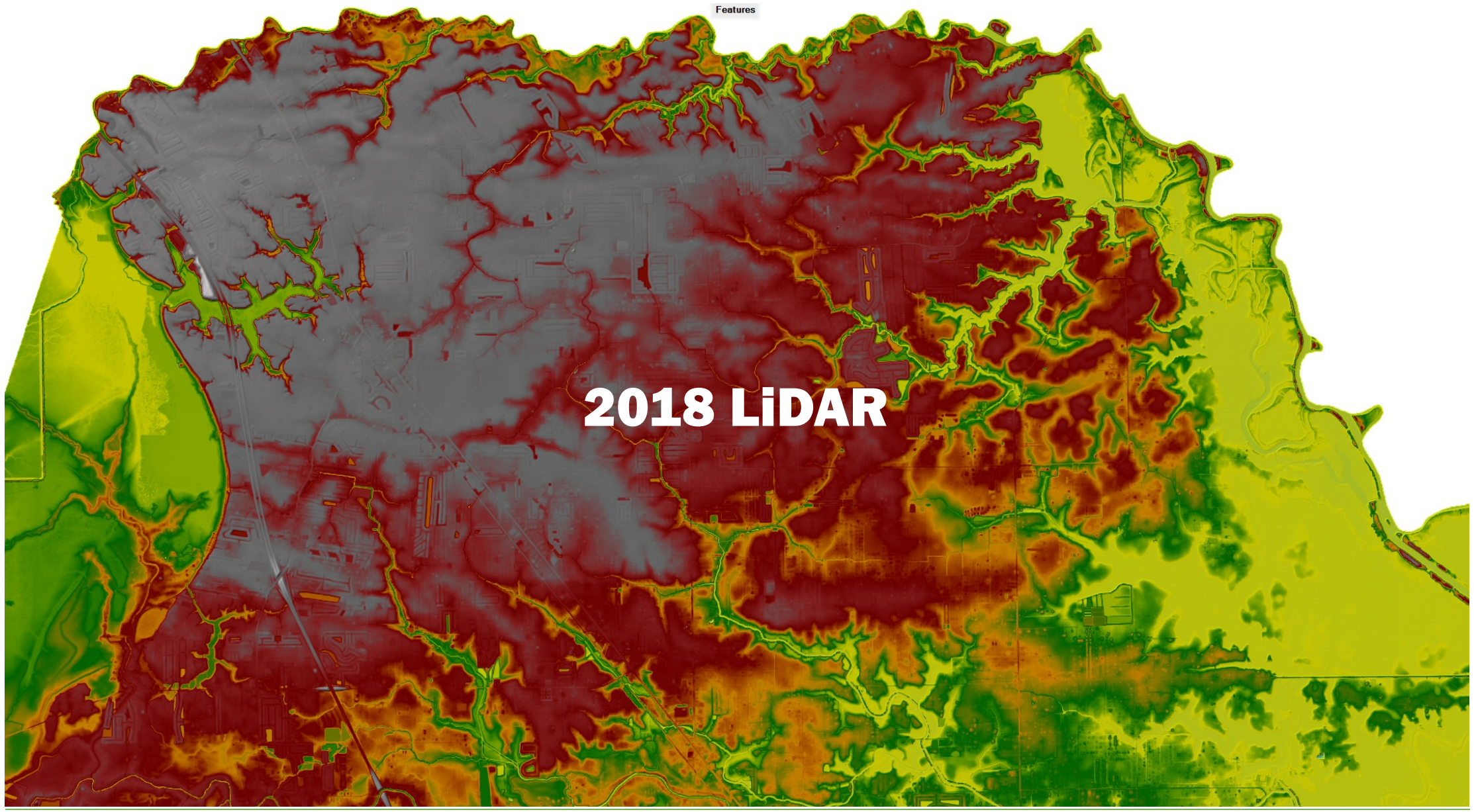


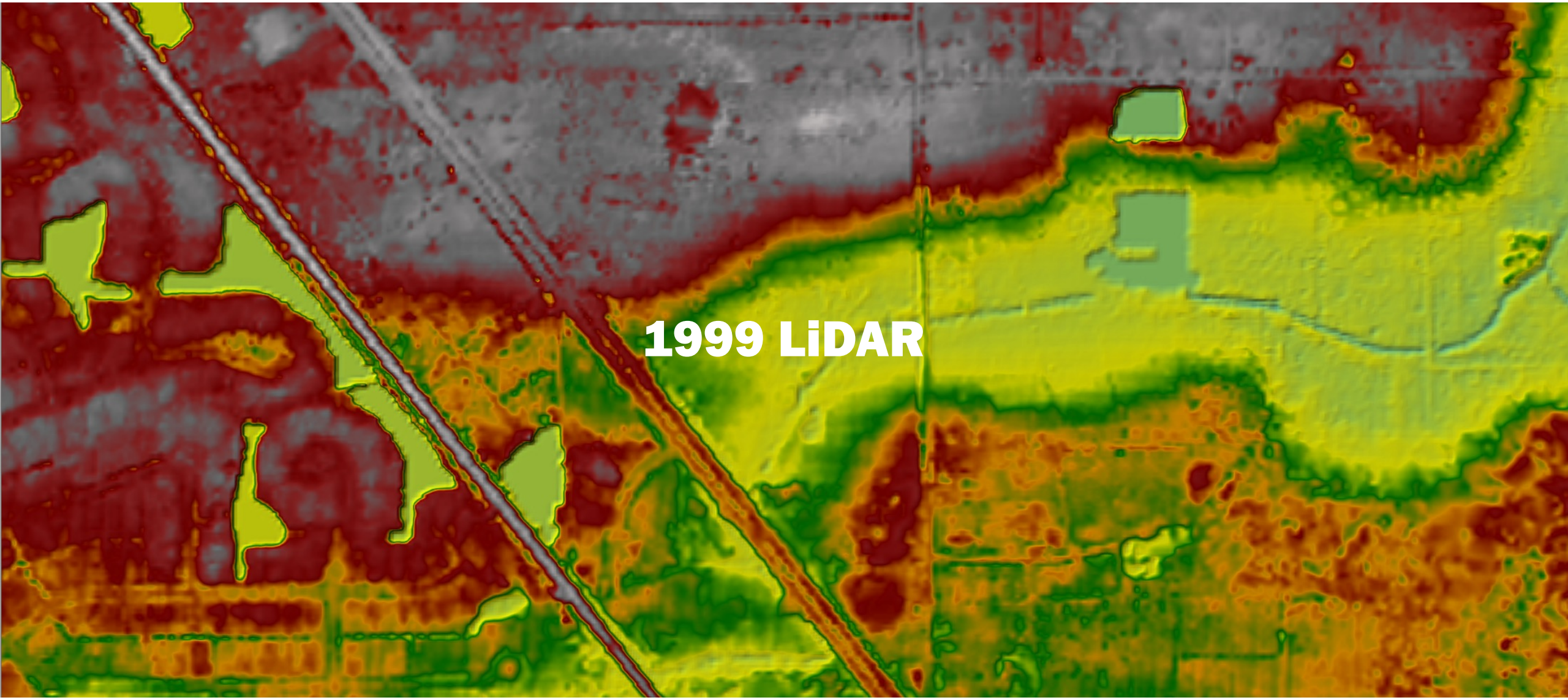
ACCUMULATION

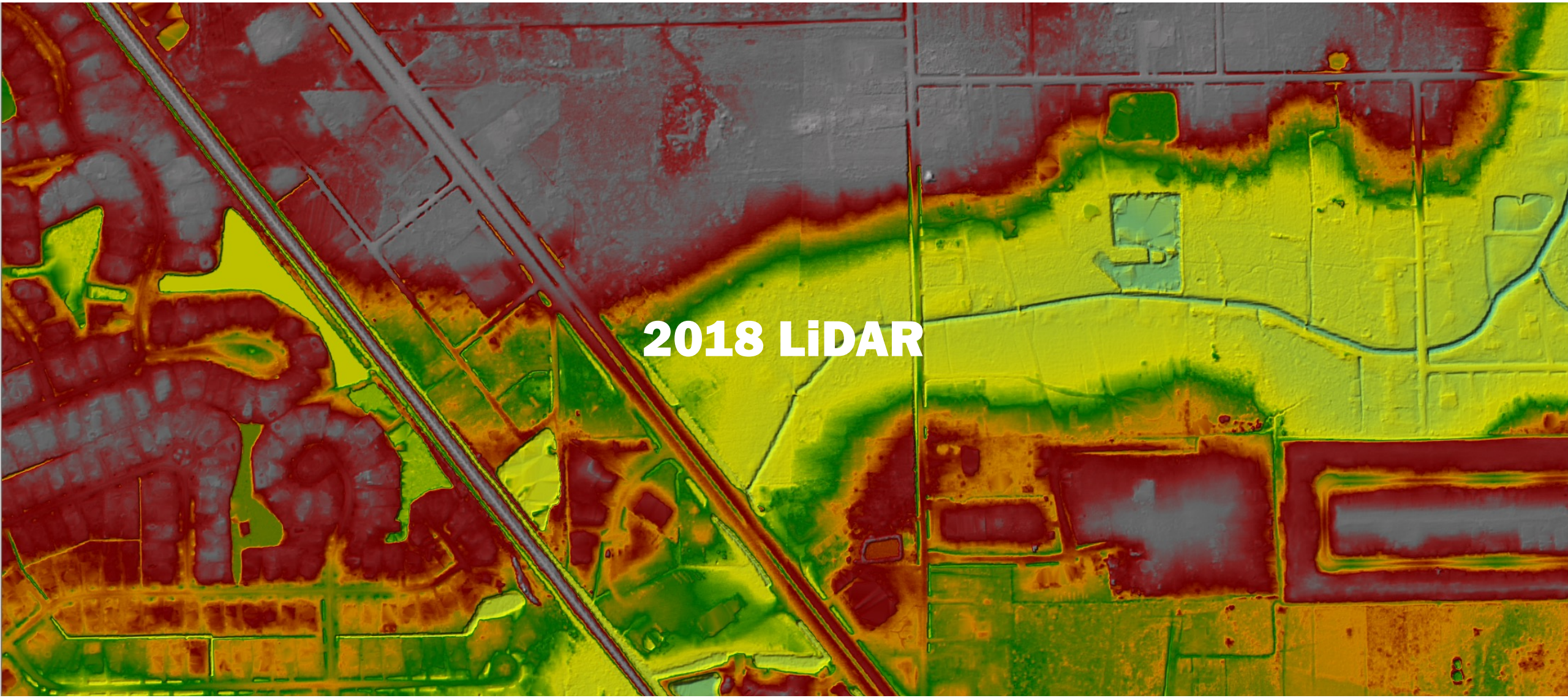


Advances in Technology: LiDAR

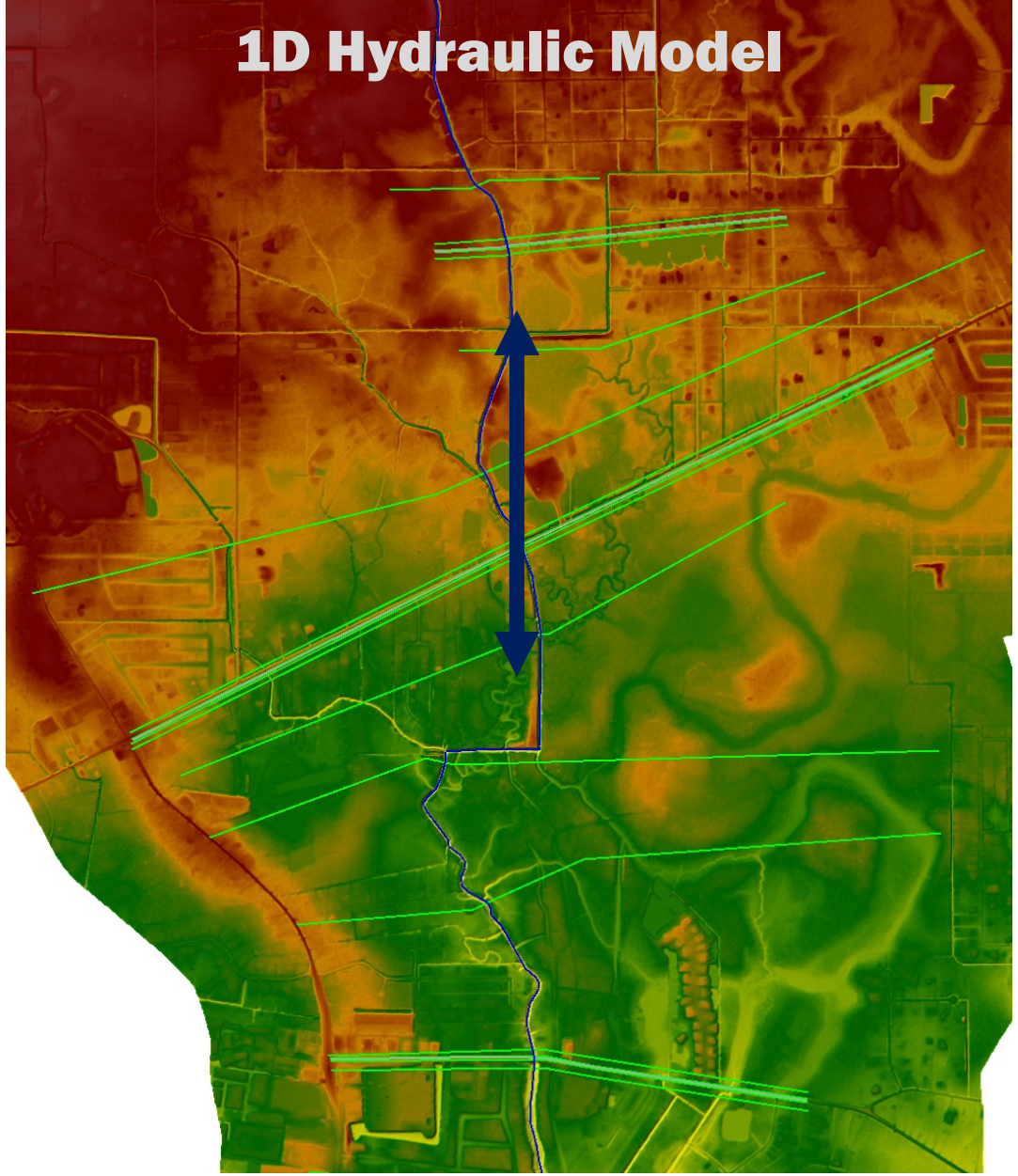

Features
1999 LiDAR

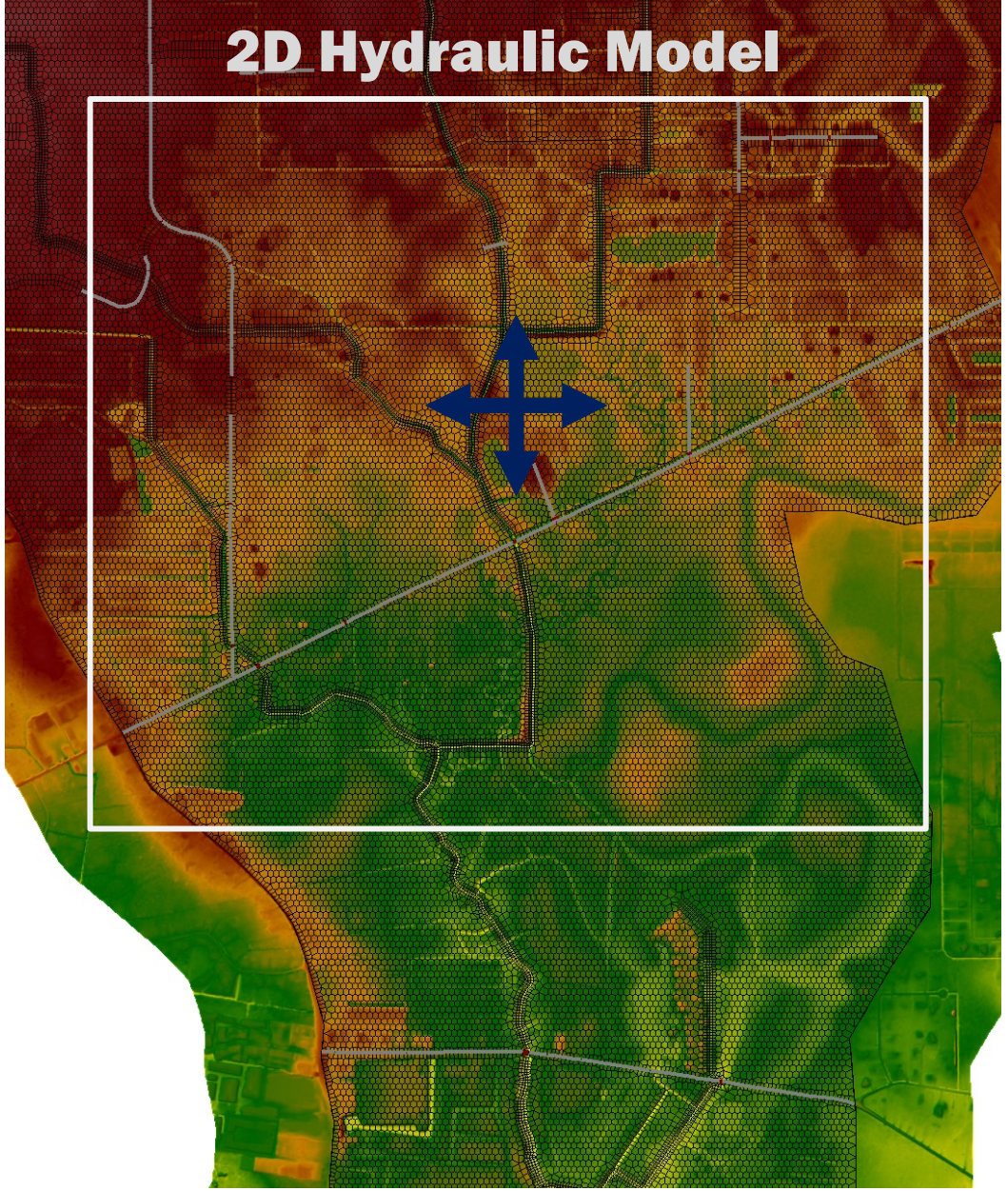

Features
2018 LiDAR


1999 LiDAR

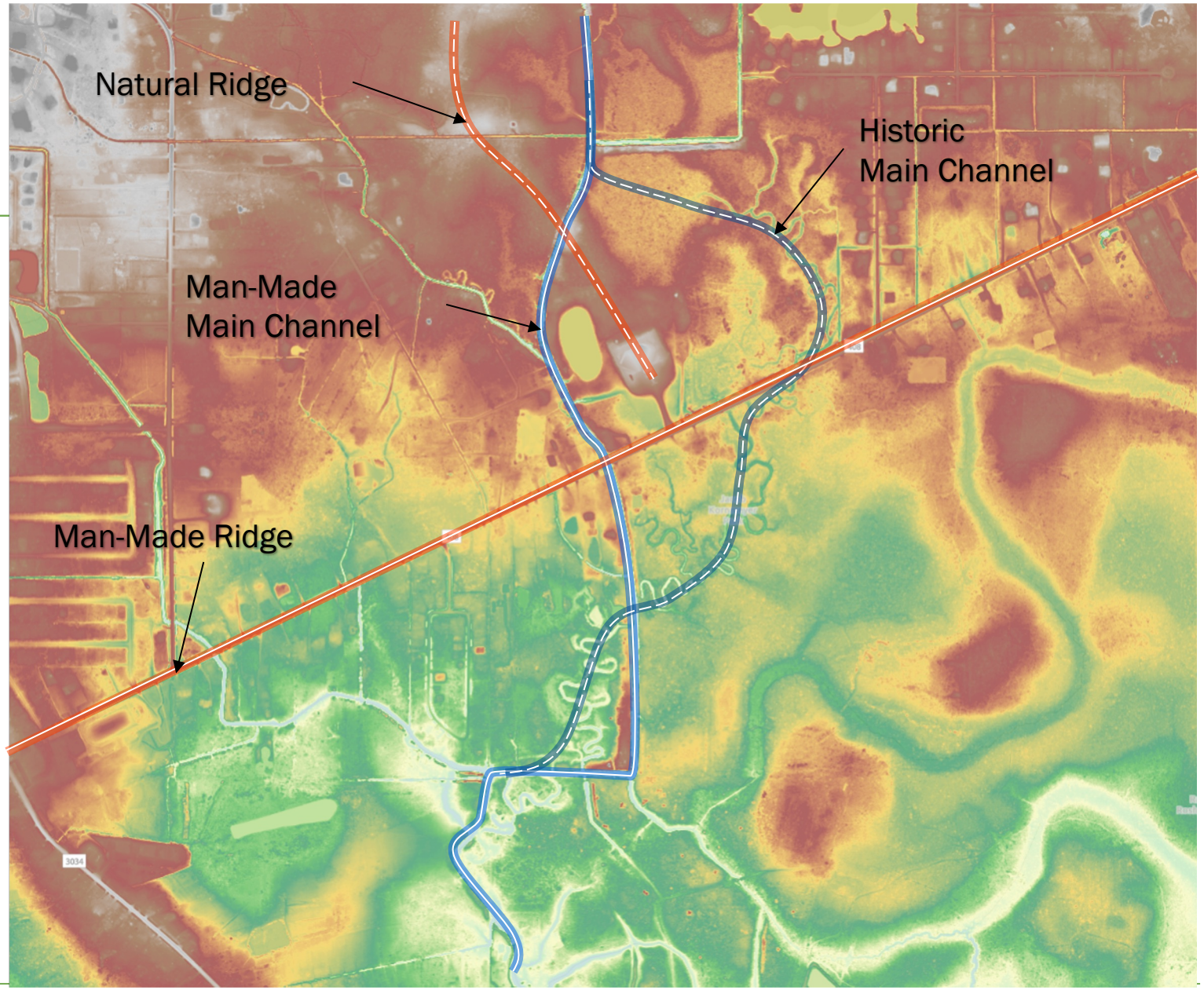

2018 LiDAR

Advances in Technology: Hydraulics

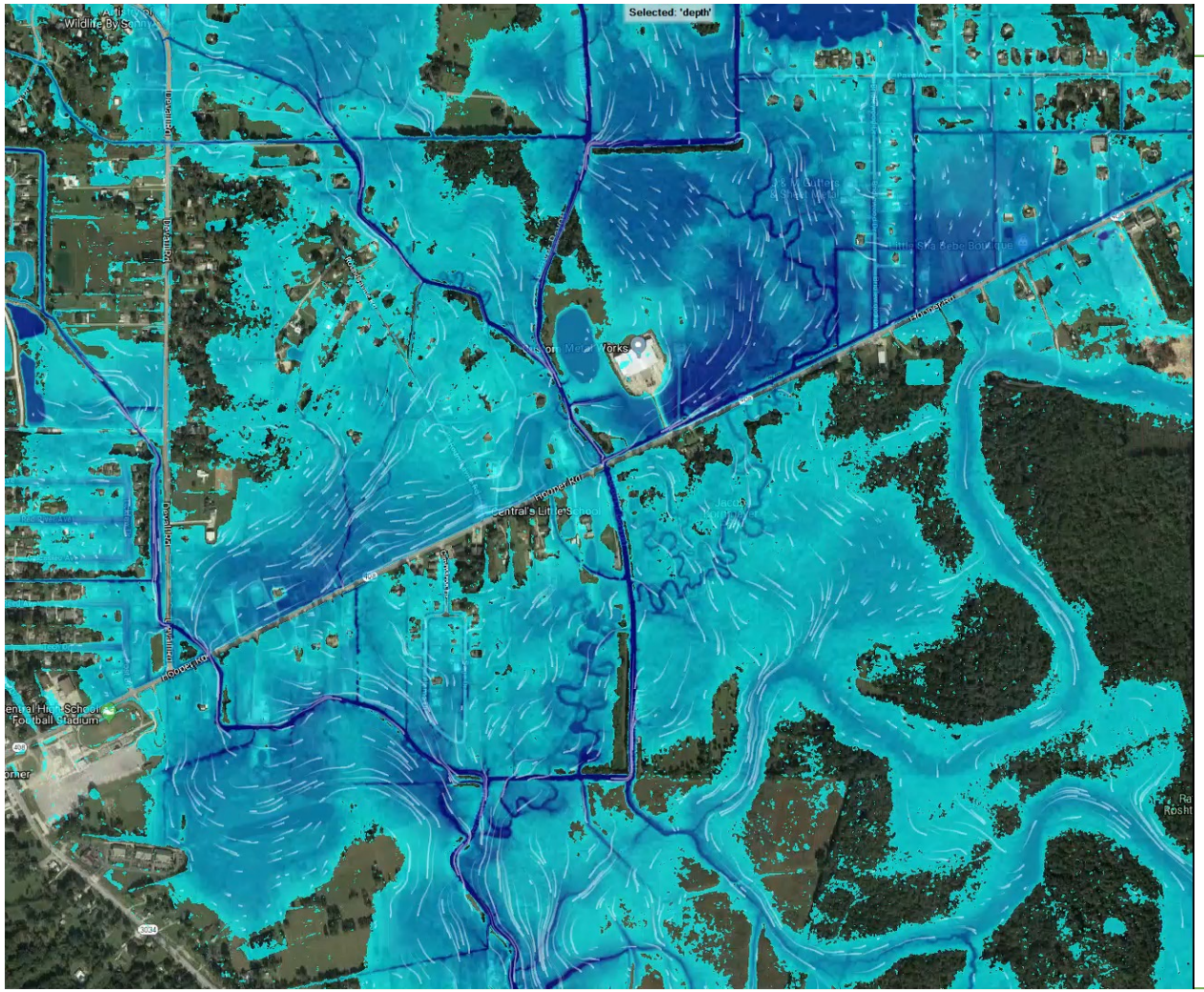

1D Hydraulic Model


2D Hydraulic Model

Beaver Bayou at Hooper Road **Terrain Analysis**



Beaver Bayou at Hooper Road **Existing Conditions**
25-Year Return Interval Peak Flow



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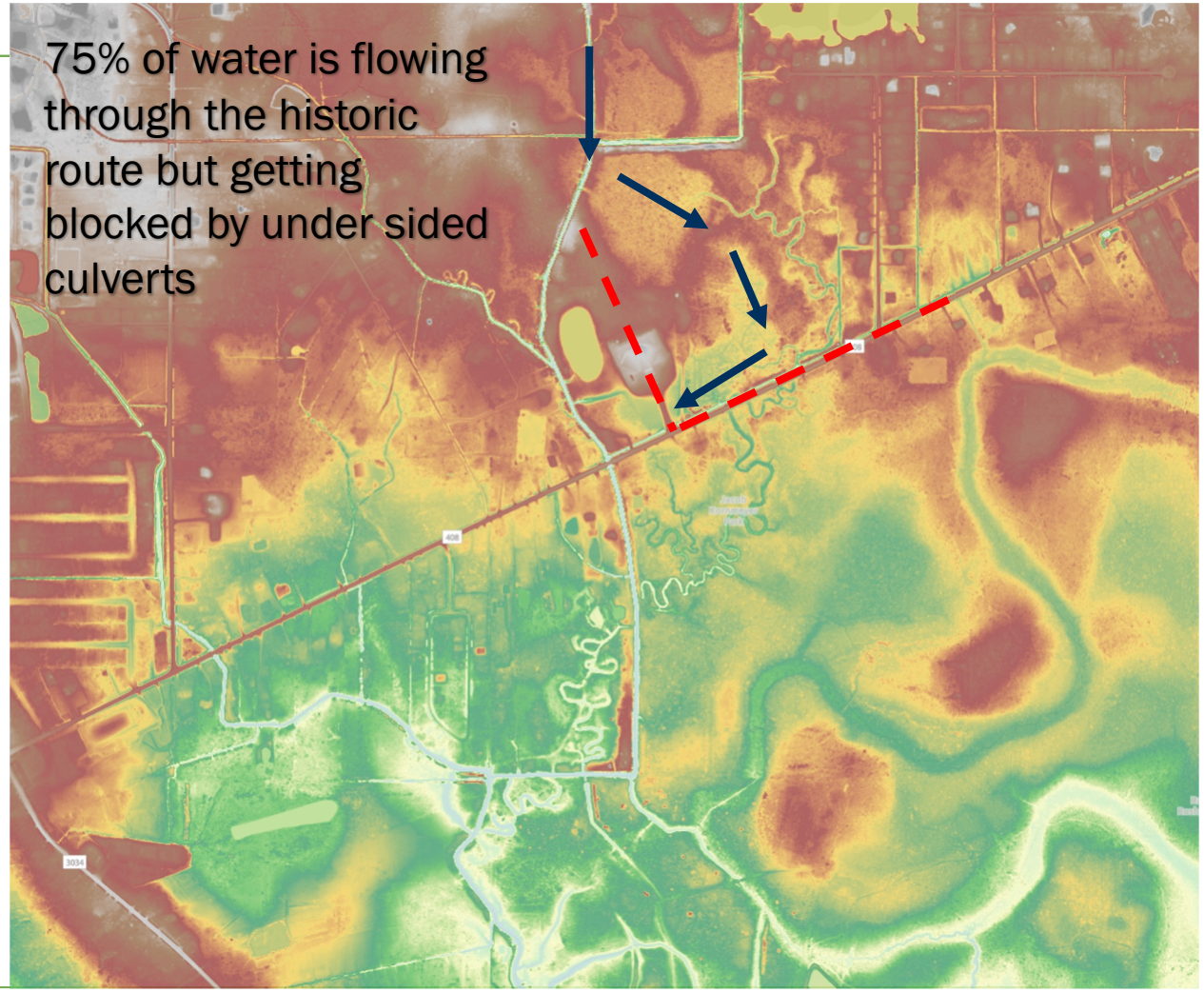

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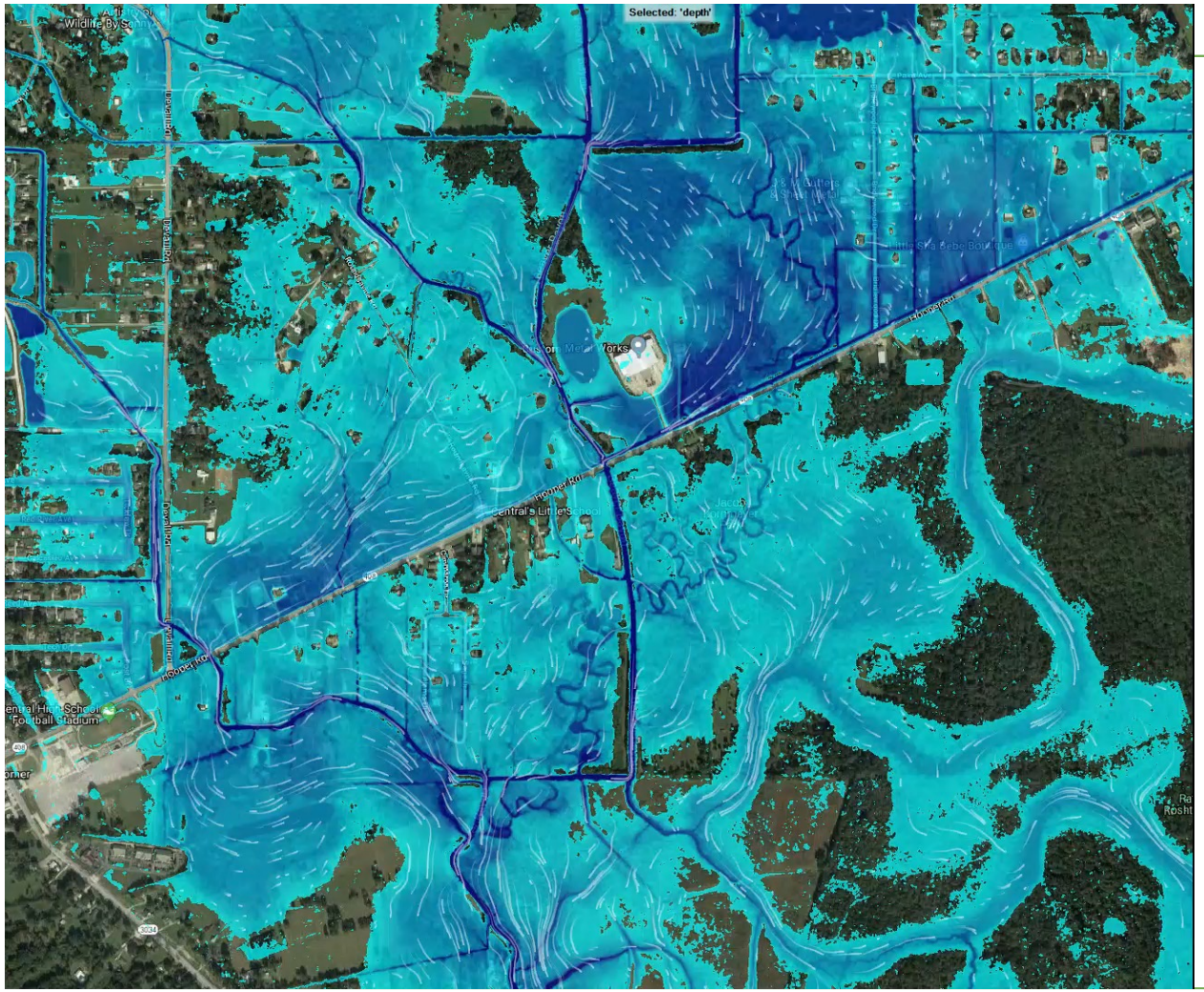
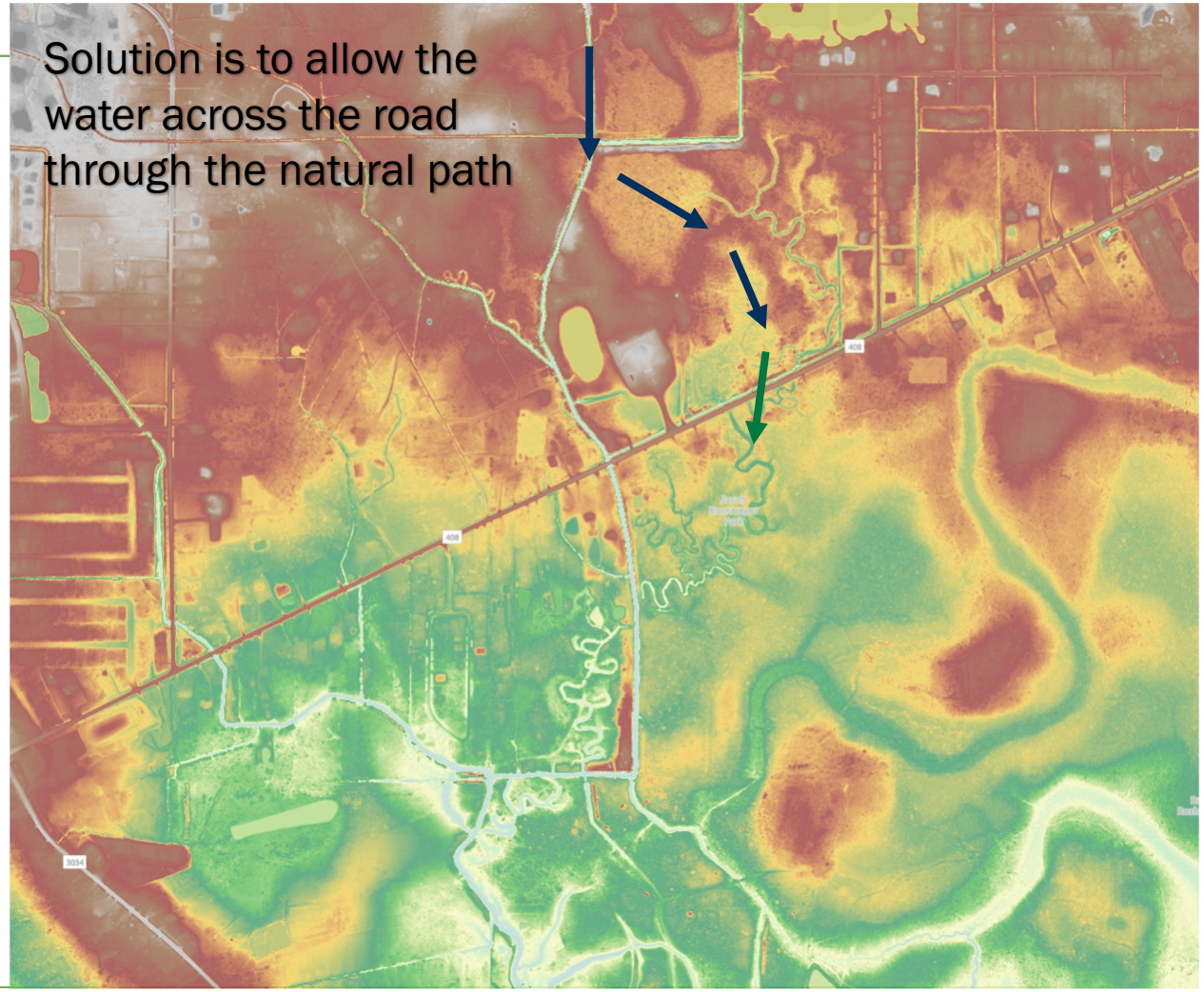


Beaver Bayou at Hooper Road **Proposed Solution**



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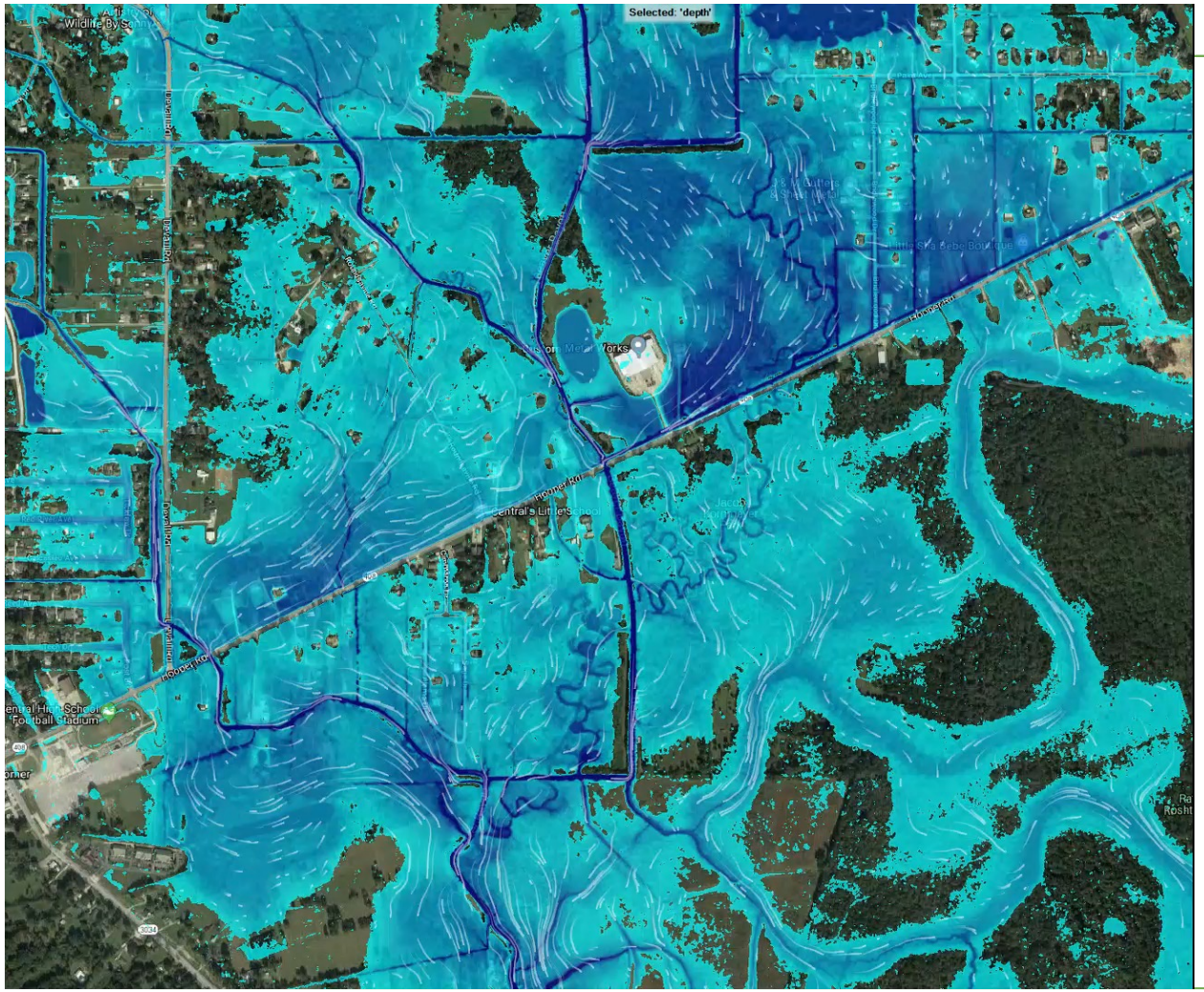
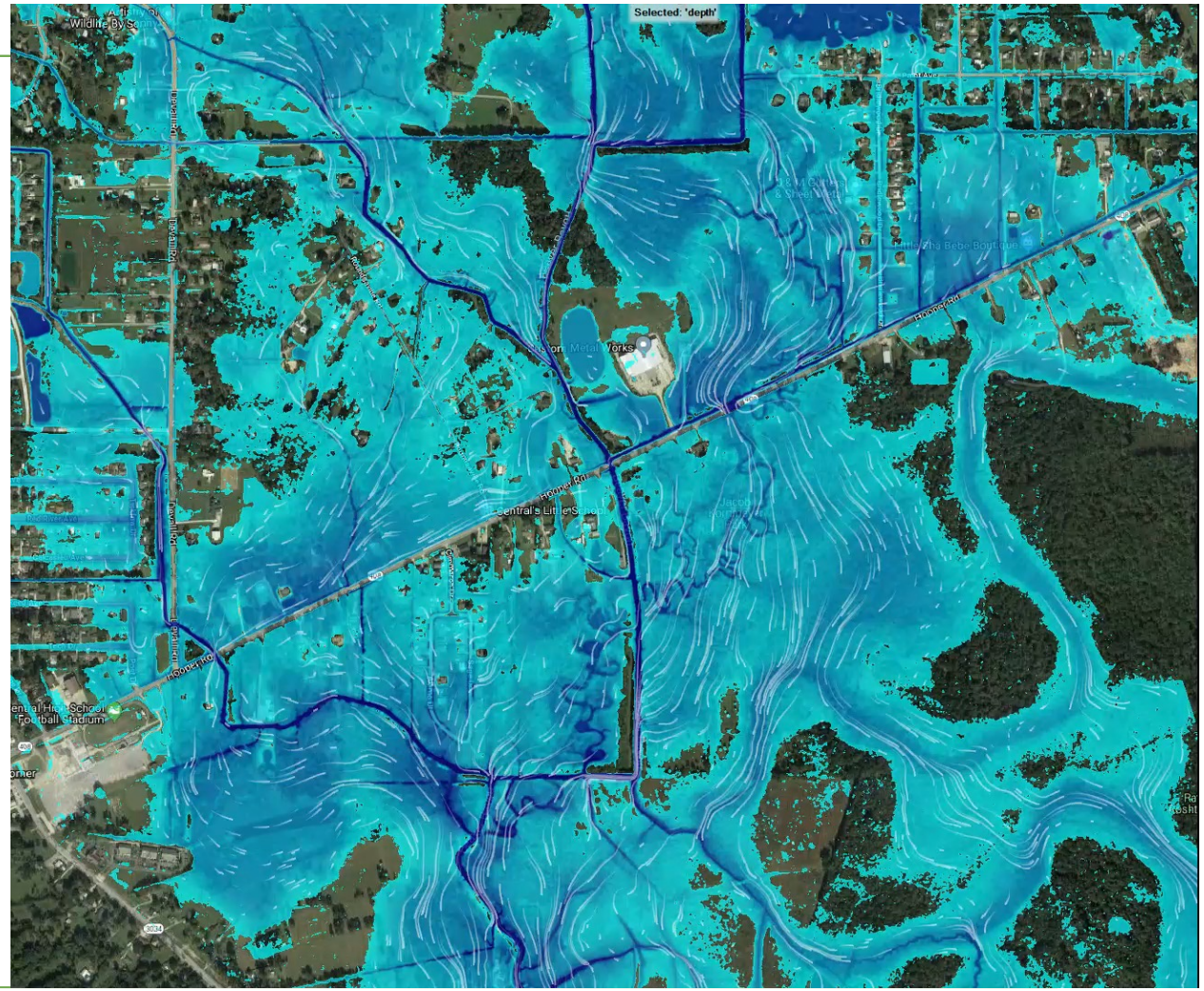


Beaver Bayou at Hooper Road **with Bridge**
25-Year Return Interval Peak Flow



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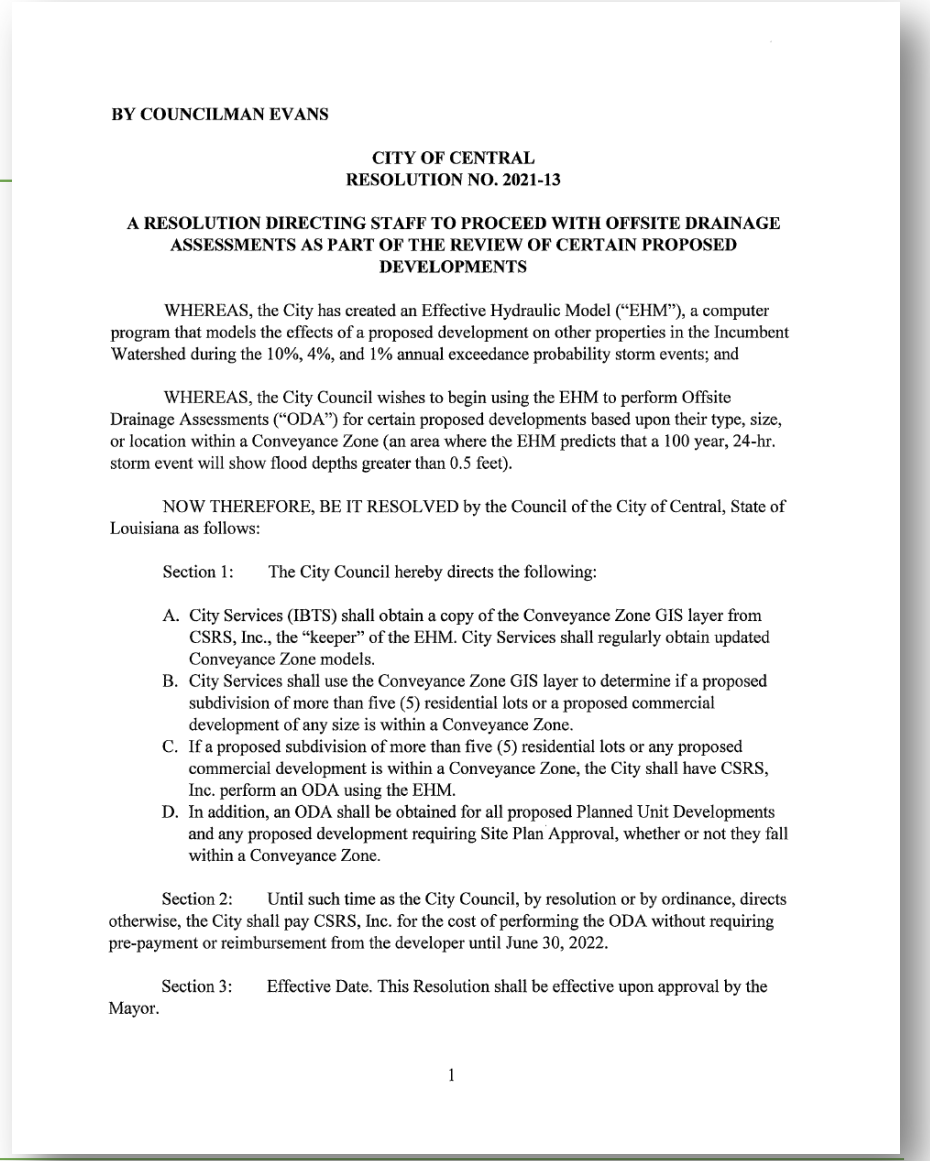
Offsite Drainage Assessment

History of City of Central ODA

April 2021 - Council passes resolution requiring ODA for

- Proposed subdivisions of more than 5 residential lots and all proposed commercial development within a Conveyance Zone
- Any proposed Planned Unit Development and proposed development requiring Site Plan approval.

Demonstrate no increase (<0.0 ft) in peak water surface elevations in the 10%, 4%, and 1% AEP Storm Events



BY COUNCILMAN EVANS

CITY OF CENTRAL
RESOLUTION NO. 2021-13

A RESOLUTION DIRECTING STAFF TO PROCEED WITH OFFSITE DRAINAGE ASSESSMENTS AS PART OF THE REVIEW OF CERTAIN PROPOSED DEVELOPMENTS

WHEREAS, the City has created an Effective Hydraulic Model ("EHM"), a computer program that models the effects of a proposed development on other properties in the Incumbent Watershed during the 10%, 4%, and 1% annual exceedance probability storm events; and

WHEREAS, the City Council wishes to begin using the EHM to perform Offsite Drainage Assessments ("ODA") for certain proposed developments based upon their type, size, or location within a Conveyance Zone (an area where the EHM predicts that a 100 year, 24-hr. storm event will show flood depths greater than 0.5 feet).

NOW THEREFORE, BE IT RESOLVED by the Council of the City of Central, State of Louisiana as follows:

Section 1: The City Council hereby directs the following:

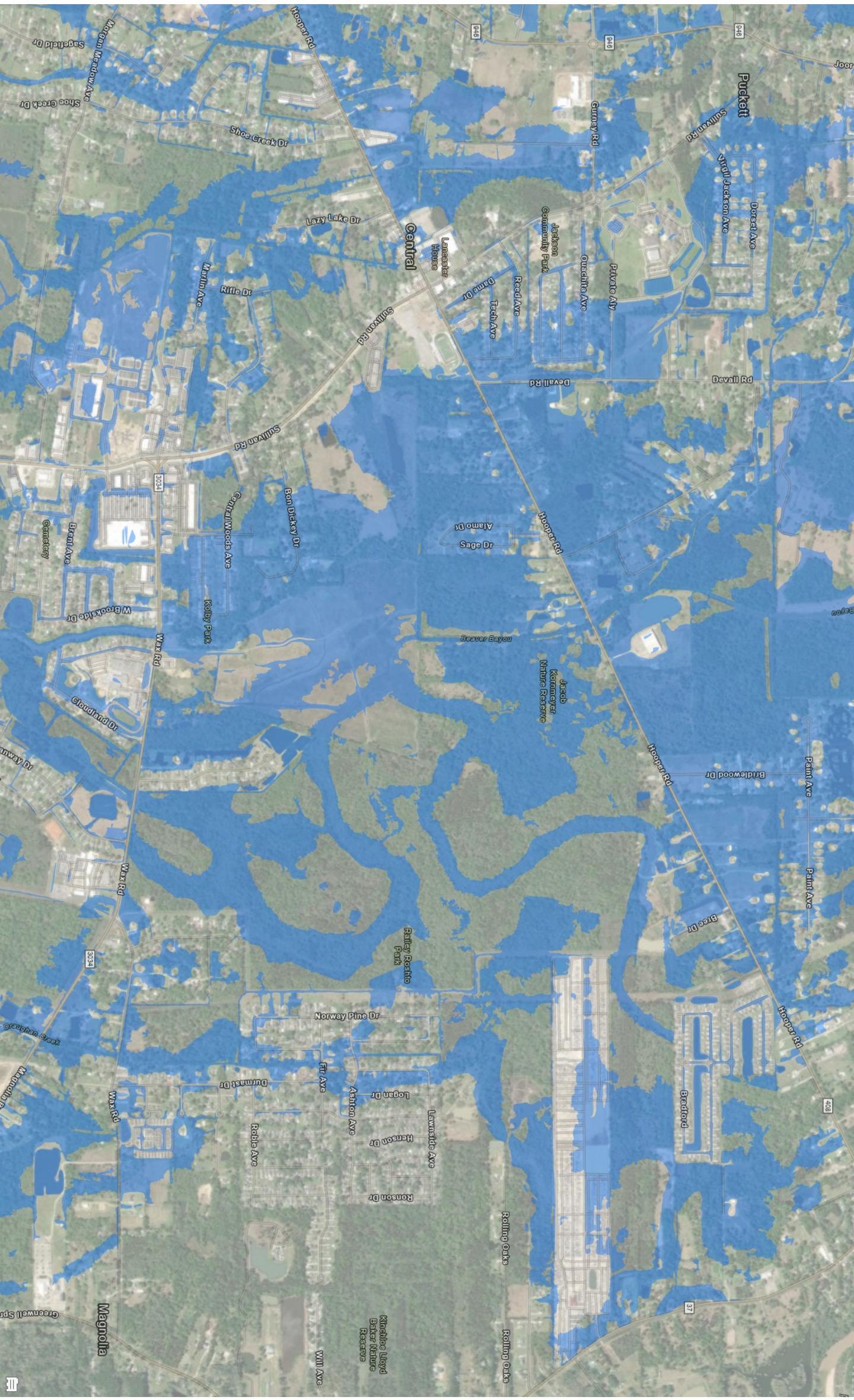
A. City Services (IBTS) shall obtain a copy of the Conveyance Zone GIS layer from CSRS, Inc., the "keeper" of the EHM. City Services shall regularly obtain updated Conveyance Zone models.
B. City Services shall use the Conveyance Zone GIS layer to determine if a proposed subdivision of more than five (5) residential lots or a proposed commercial development of any size is within a Conveyance Zone.
C. If a proposed subdivision of more than five (5) residential lots or any proposed commercial development is within a Conveyance Zone, the City shall have CSRS, Inc. perform an ODA using the EHM.
D. In addition, an ODA shall be obtained for all proposed Planned Unit Developments and any proposed development requiring Site Plan Approval, whether or not they fall within a Conveyance Zone.

Section 2: Until such time as the City Council, by resolution or by ordinance, directs otherwise, the City shall pay CSRS, Inc. for the cost of performing the ODA without requiring pre-payment or reimbursement from the developer until June 30, 2022.

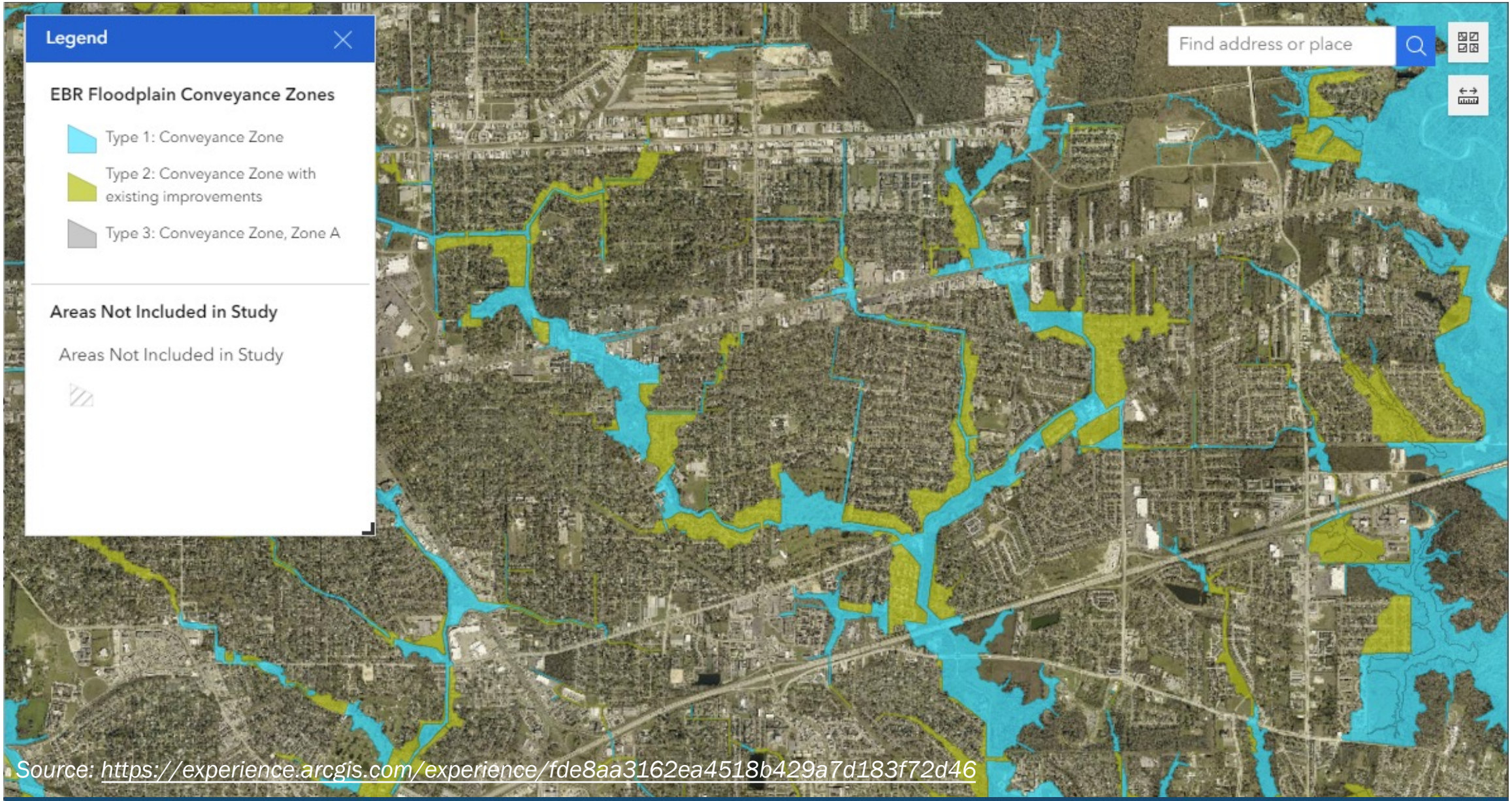
Section 3: Effective Date. This Resolution shall be effective upon approval by the Mayor.

1

City of Central Conveyance Zones



EBR Stormwater Master Plan



Forerunner Webinar – City of Central ODA Program

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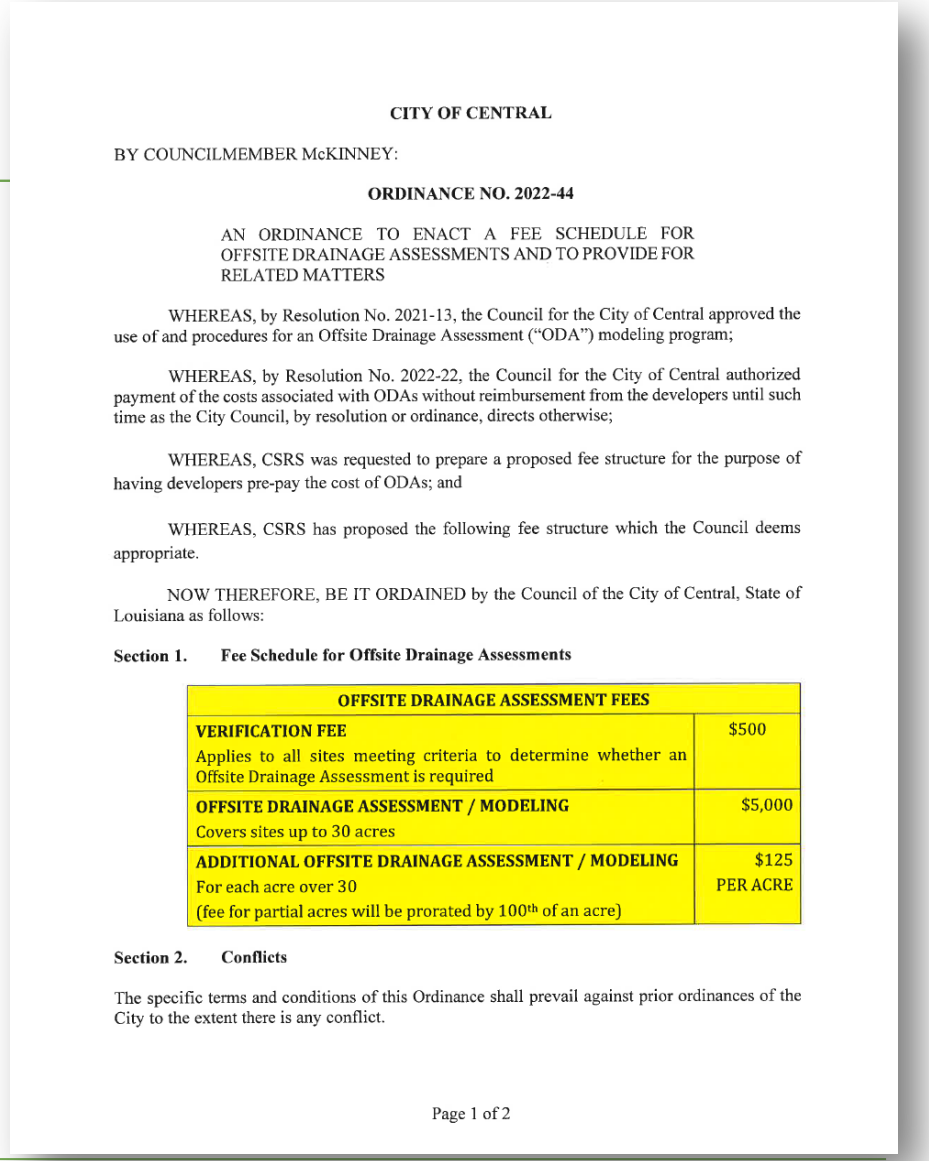
History of City of Central ODA

December 2022 - Council passes ordinance adopting a fee schedule for Offsite Drainage Assessments

Verification Fee Applies to all sites meeting criteria to determine whether an ODA is required	$500
ODA / Modeling Covers up to 30 acres	$5000
Additional ODA / Modeling For each acre over 30	$125/acre



CITY OF CENTRAL

BY COUNCILMEMBER McKINNEY:

ORDINANCE NO. 2022-44

AN ORDINANCE TO ENACT A FEE SCHEDULE FOR OFFSITE DRAINAGE ASSESSMENTS AND TO PROVIDE FOR RELATED MATTERS

WHEREAS, by Resolution No. 2021-13, the Council for the City of Central approved the use of and procedures for an Offsite Drainage Assessment ("ODA") modeling program;

WHEREAS, by Resolution No. 2022-22, the Council for the City of Central authorized payment of the costs associated with ODAs without reimbursement from the developers until such time as the City Council, by resolution or ordinance, directs otherwise;

WHEREAS, CSRS was requested to prepare a proposed fee structure for the purpose of having developers pre-pay the cost of ODAs; and

WHEREAS, CSRS has proposed the following fee structure which the Council deems appropriate.

NOW THEREFORE, BE IT ORDAINED by the Council of the City of Central, State of Louisiana as follows:

Section 1. Fee Schedule for Offsite Drainage Assessments

OFFSITE DRAINAGE ASSESSMENT FEES	
VERIFICATION FEE Applies to all sites meeting criteria to determine whether an Offsite Drainage Assessment is required	$500
OFFSITE DRAINAGE ASSESSMENT / MODELING Covers sites up to 30 acres	$5,000
ADDITIONAL OFFSITE DRAINAGE ASSESSMENT / MODELING For each acre over 30 (fee for partial acres will be prorated by 100th of an acre)	$125 PER ACRE

Section 2. Conflicts

The specific terms and conditions of this Ordinance shall prevail against prior ordinances of the City to the extent there is any conflict.

Page 1 of 2

History of City of Central ODA

As of January 2024, CSRS has performed 8 ODAs

ODA Project	Type	# of Reviews	Passed
1	Commercial	1	Yes
2	Residential	1	Yes
3	Residential	4	Yes
4	Residential	3	Yes
5	Commercial	6	Abandoned
6	Commercial	1	Yes
7	Residential	2	Pending
8	Commercial	1	Yes

ODA Process – Information from Applicant

Existing Conditions:

- Survey of drainage features

Proposed Conditions:

- Earthwork Plan
  - Drawing/Plans clearly identifying horizontal and vertical extents of:
    - Fill area
    - Ponds
    - Roadways
    - Culvert placements
    - Drainage ways
    - Drainage reroutes
- Drainage Structure
  - Size, type, length, invert elevation, cover topping elevation and entrance/exit geometry

ODA Process – Staff Procedure

Updated Effective Hydraulic Model

- Update the EHM to include on- and offsite information provided by applicant following Phase I ODA
- Run the 10%, 4%, and 1% 24-hour duration AEP storms

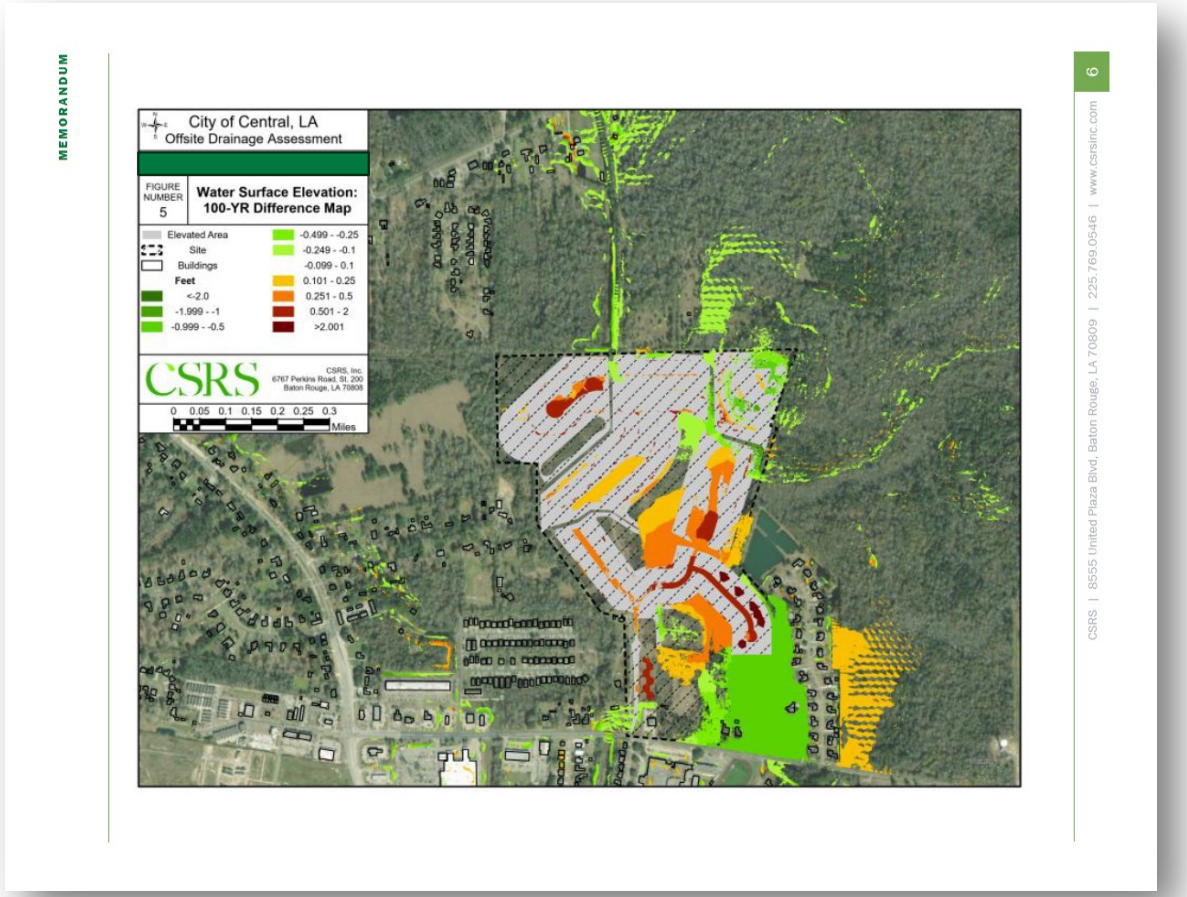
Post-Development Hydraulic Model

- Create a Post-Development Hydraulic Model starting with the Updated EHM and adding the proposed conditions received from the applicant.
- Run the 10%, 4%, and 1% 24-hour duration AEP storms

Impact Assessment

- Create a map of the difference in maximum water surface elevations between the Post-Development and Effective model runs for each storm
- Provide comments regarding the impacts of the development activity

ODA Process – Memorandum


MEMORANDUM

City of Central, LA
Offsite Drainage Assessment

FIGURE NUMBER 5

Water Surface Elevation: 100-YR Difference Map

Elevated Area
Site
Buildings
Feet
<-2.0
-1.999 - -1
-0.999 - -0.5
-0.499 - -0.25
-0.249 - -0.1
-0.099 - 0.1
0.101 - 0.25
0.251 - 0.5
0.501 - 2
>2.001

CSRS
CSRS, Inc.
6767 Perkins Road, St. 200
Baton Rouge, LA 70808

0 0.05 0.1 0.15 0.2 0.25 0.3
Miles

6

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MEMORANDUM

City of Central Offsite Drainage Assessment

[redacted]

To:
City of Central

From:
CSRS

Stokka Brown, MS, PE, CFM
Principal & Water Resources Practice Area Leader

8555 United Plaza Blvd, Baton Rouge, LA 70809
(225) 769-0546
stokka.brown@csrsinc.com

Date:
8/25/2022

This Memorandum assesses the potential offsite drainage impacts specific to the proposed development, The Preserve at Woodland Grove, submitted to the Planning Commission.

Information Received from Applicant

The applicant provided a proposed AutoCAD elevation surface.

Updated Effective Hydraulic Model (EHM)

The applicant did not provide existing elevation data; therefore, no adjustments to the EHM were made. The Updated EHM's terrain is shown in *Figure 1*. The Updated EHM was run for the 10%, 4%, and 1% annual exceedance probability (AEP), 24-hour storm events.

Post-Development Hydraulic Model

The proposed development consists of 130 lots and five retention ponds. The retention ponds collect runoff from the proposed development via the proposed subsurface drainage system. Ultimately, most of the runoff produced by the proposed development will be collected by the ponds and released via swales downstream of the site. The proposed terrain can be seen in *Figure 2*. The Post-Development Hydraulic Model was run for the 10%, 4%, and 1% AEP, 24-hour storm events.

Offsite Drainage Assessment Results

The peak water surface elevations from each storm event were extracted from the Updated EHM and Post-Development Hydraulic Models and compared to one another as shown in *Figures 3, 4, and 5*.

The comparisons reveal the following impact on peak water surface elevations beyond the development site for all storm events:

- Increases of 0.1 to 0.3 feet along the northern site boundary for the 10-yr and 25-yr events
- Increases of 0.1 to 0.3 feet along the eastern site boundary for the 10-yr and 25-yr events
- Increase of 0.1 feet north of Wax Road and east of Magnolia Blossom Avenue for the 100-yr event
- Decreases of 0.1 to 0.2 feet along the northwest site boundary for all events
- Decreases of 0.5 to 1.3 feet along the southeast site boundary for all events
- Decreases of 0.1 to 0.2 feet within Beaver Bayou downstream of the site

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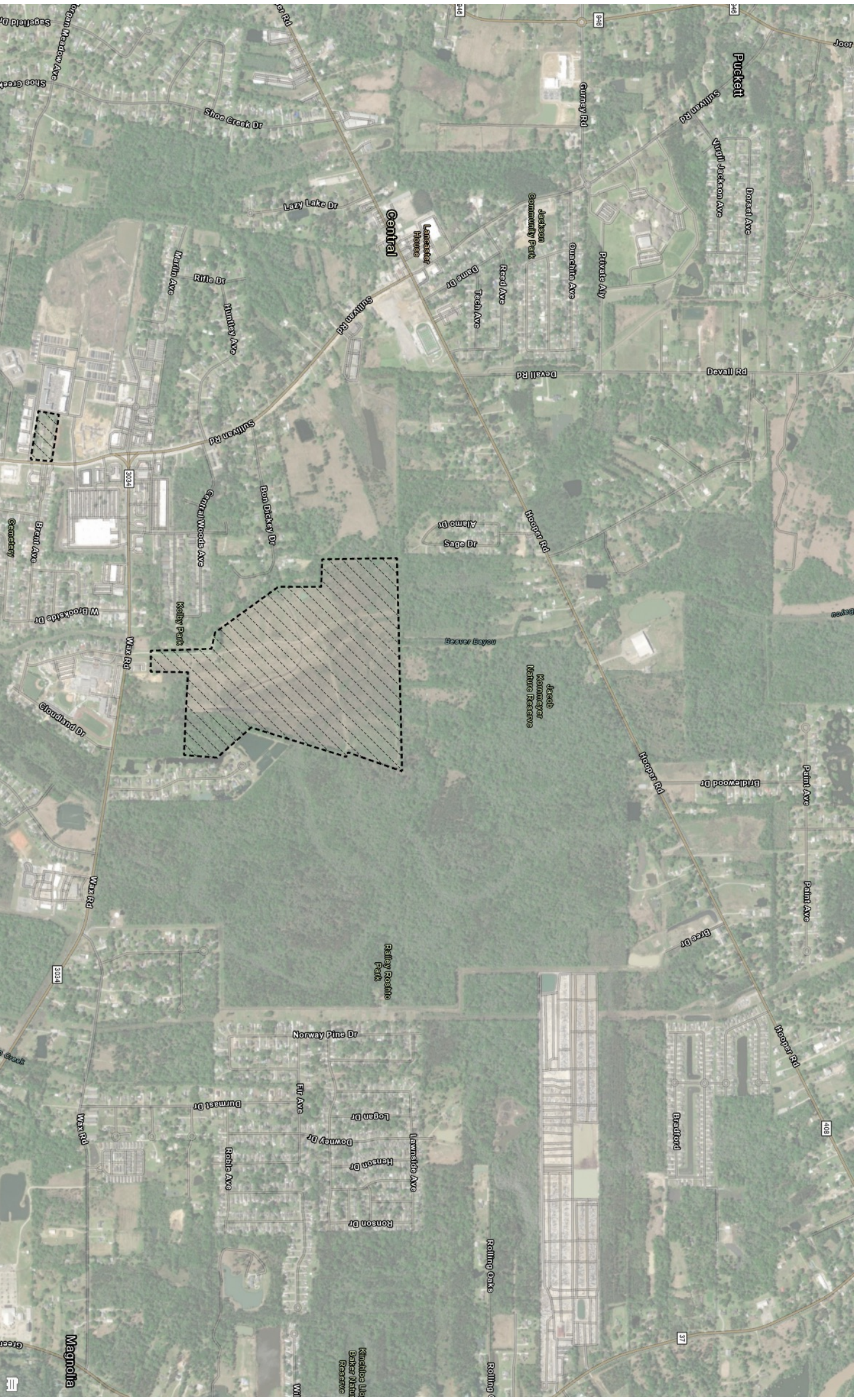
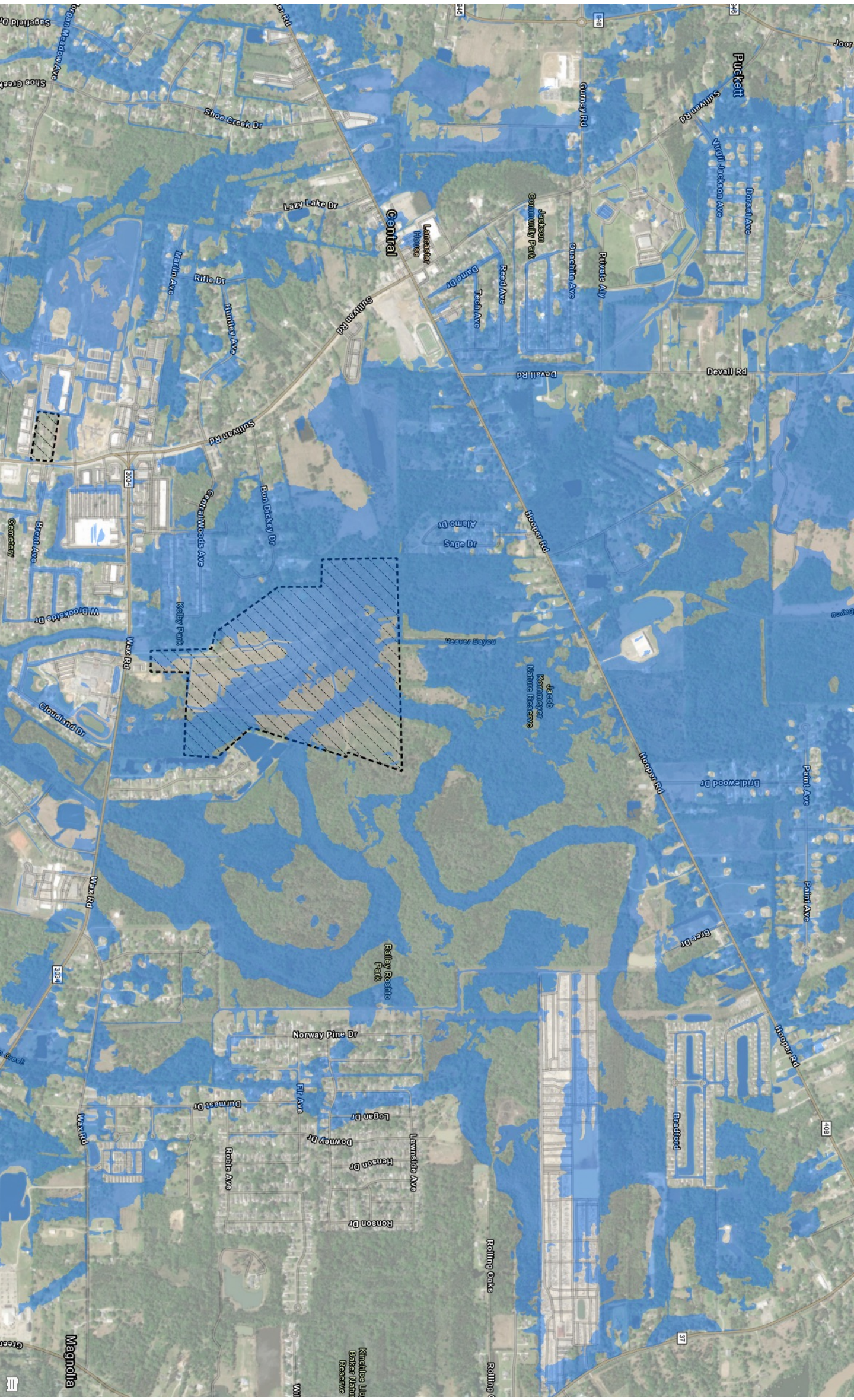
Example ODA

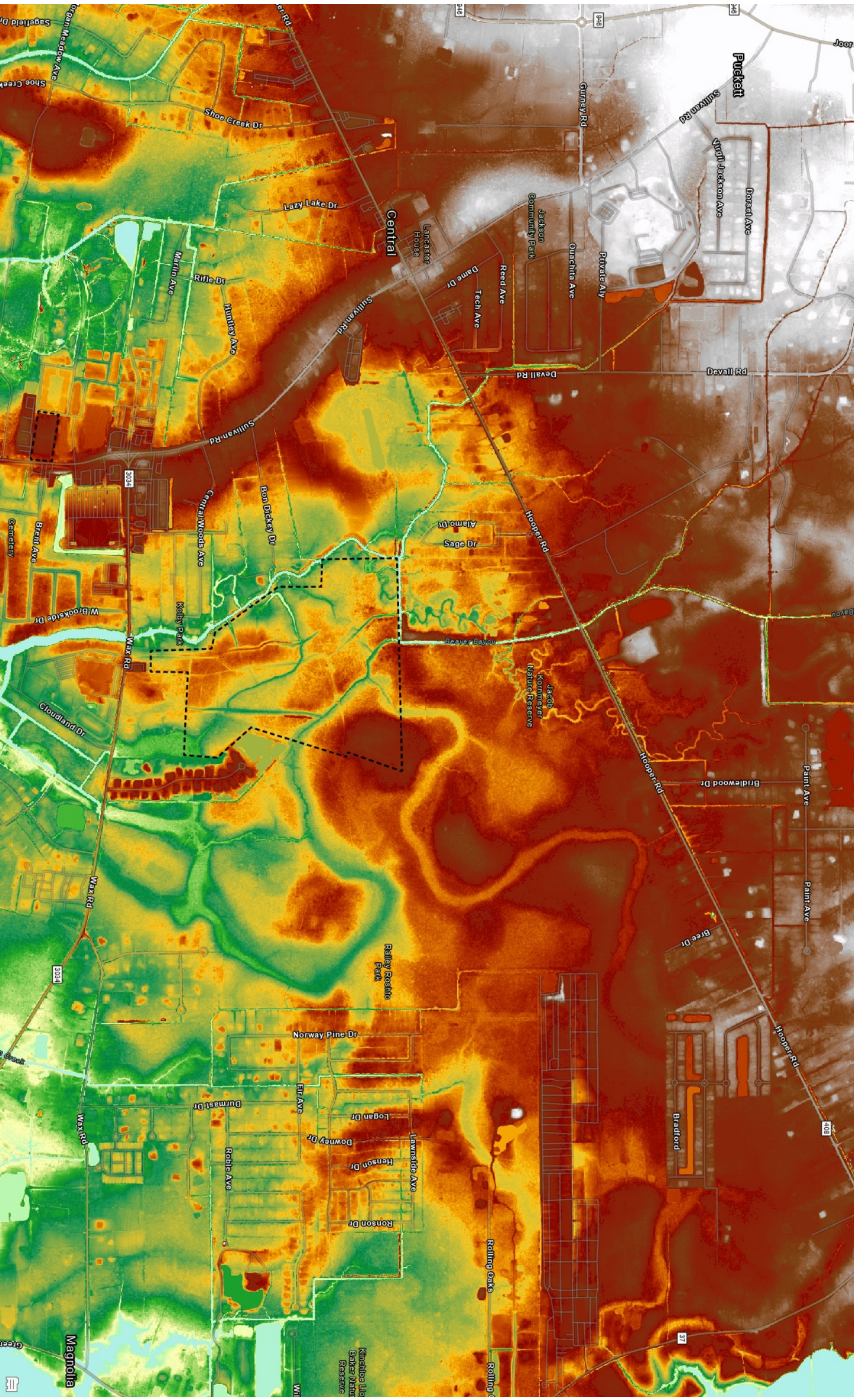
Proposed Development



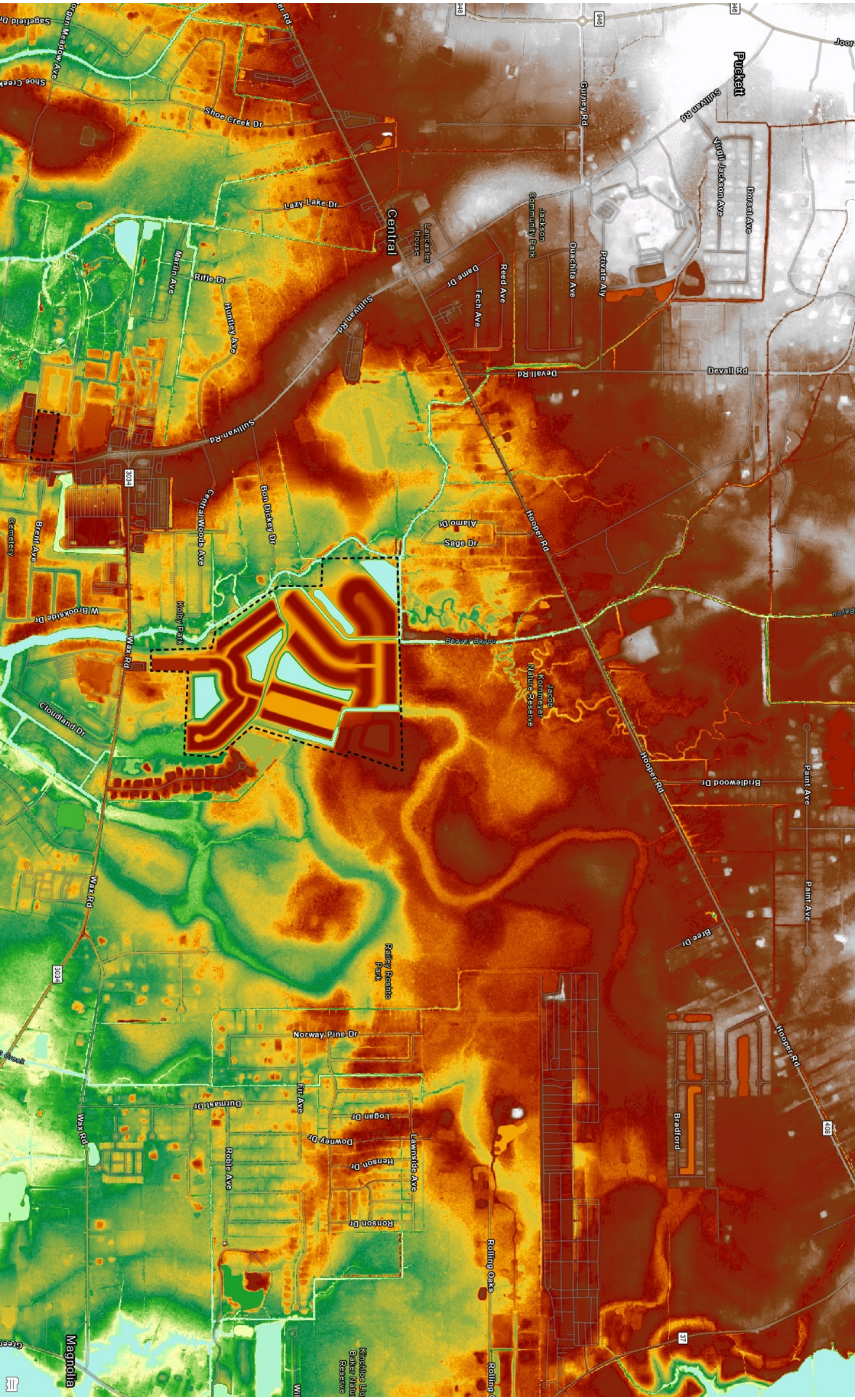
Prop. Development vs Conv. Zones



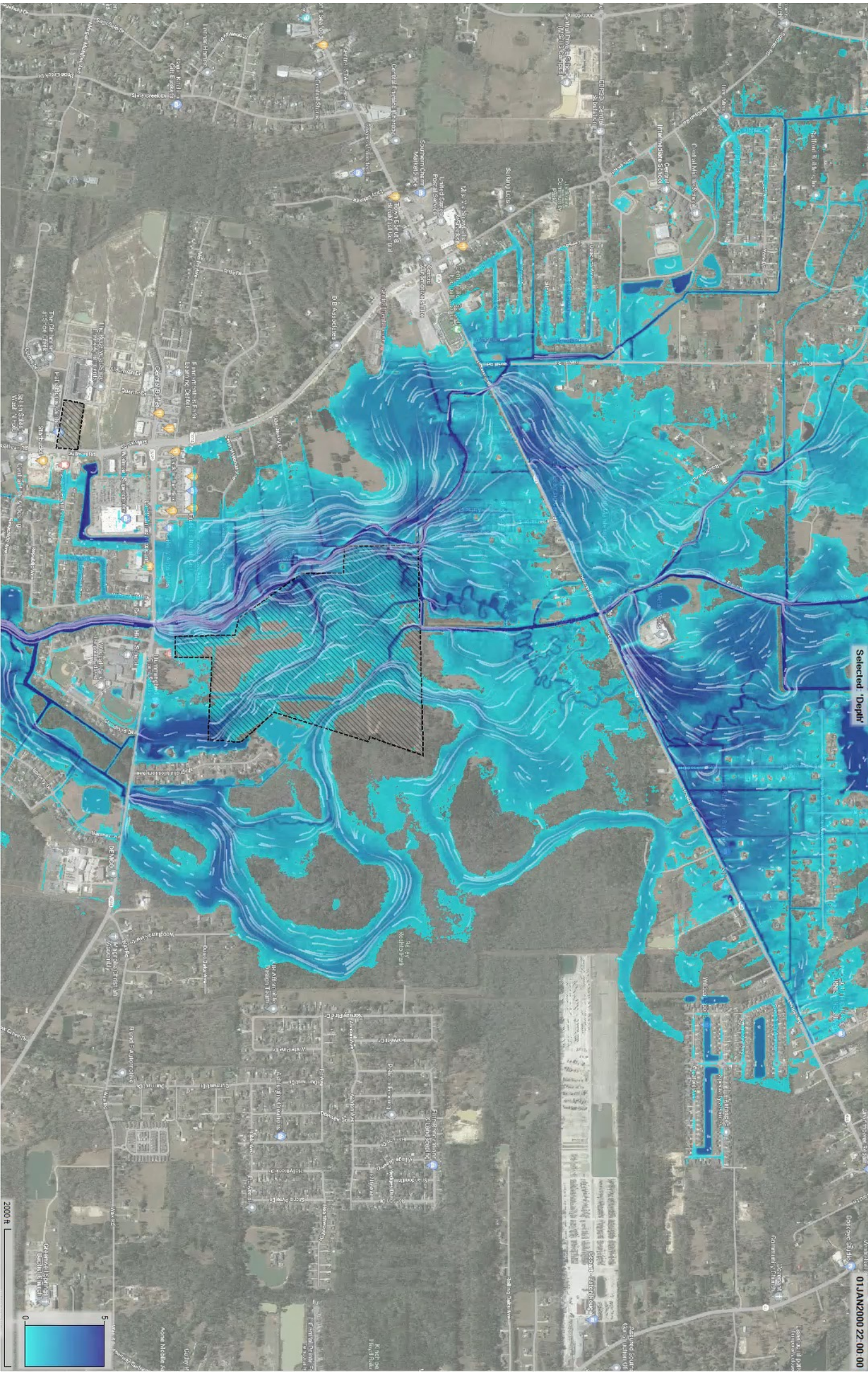
Existing Terrain



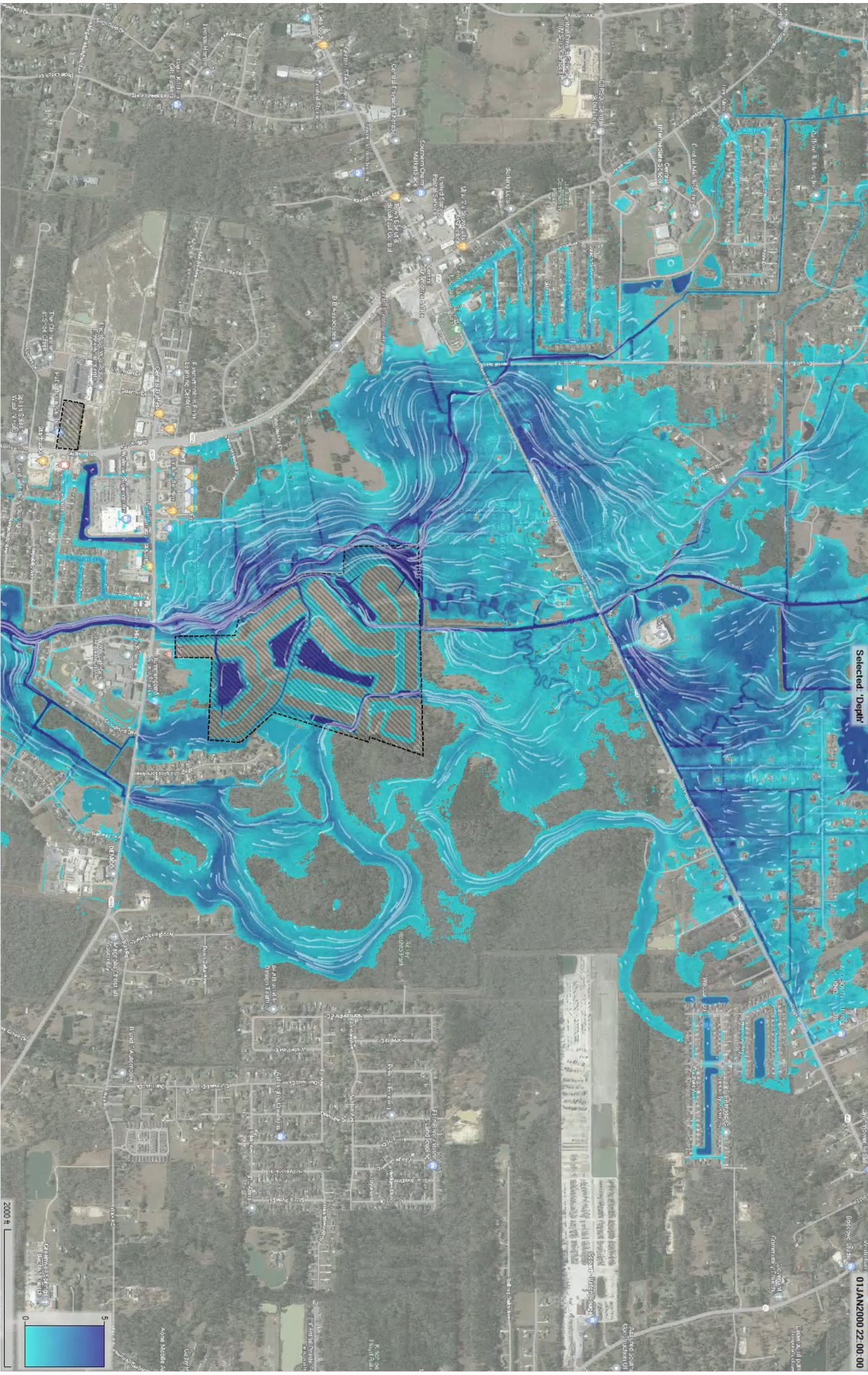
Proposed Terrain



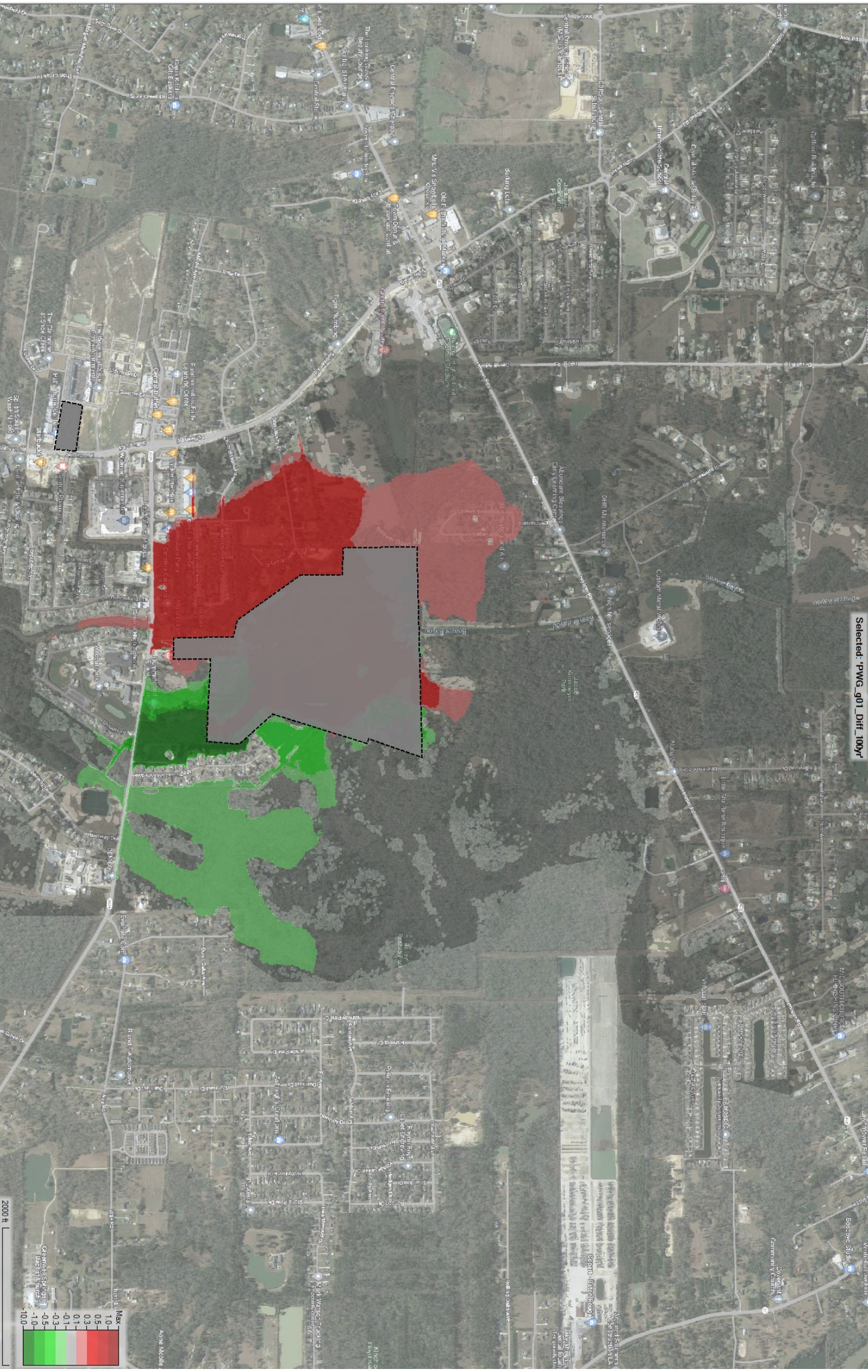
Existing 100-YR: Depth, Flow Paths



Proposed 100-YR: Depth, Flow Paths



Proposed 100-YR: Impacts



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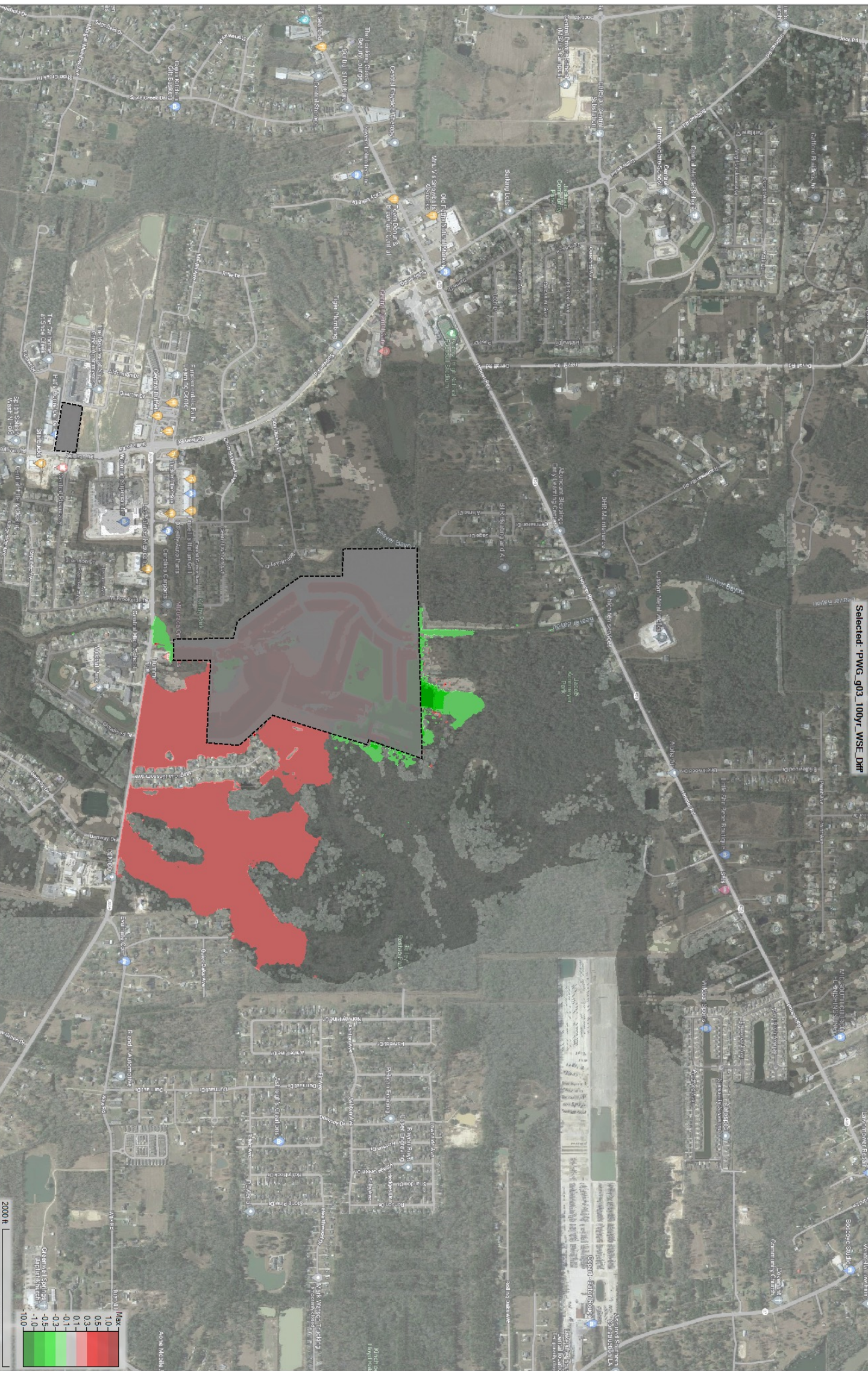

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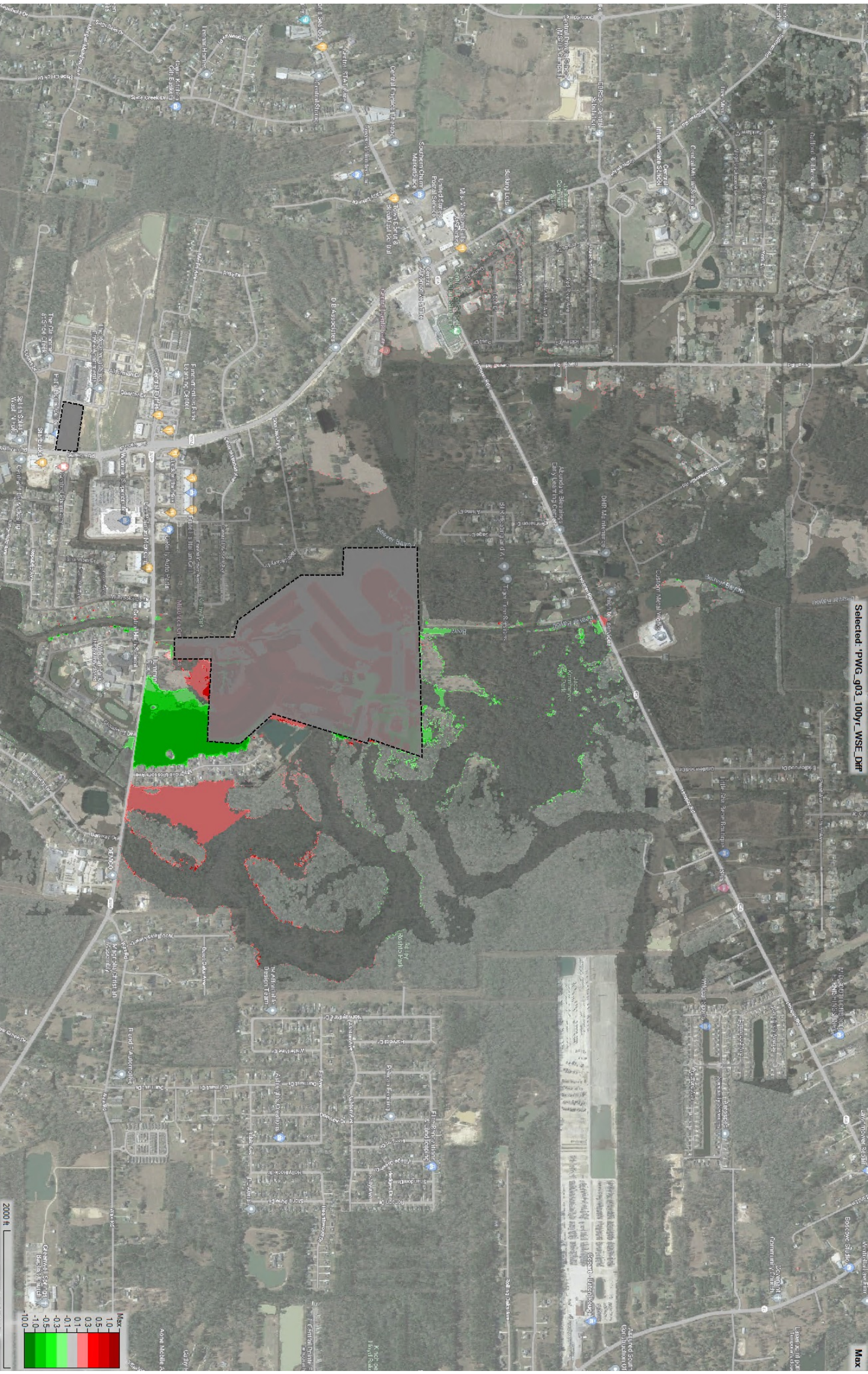


Living Effective Hydraulic Model

CSRS recently completed the following updates to maintain a living model.

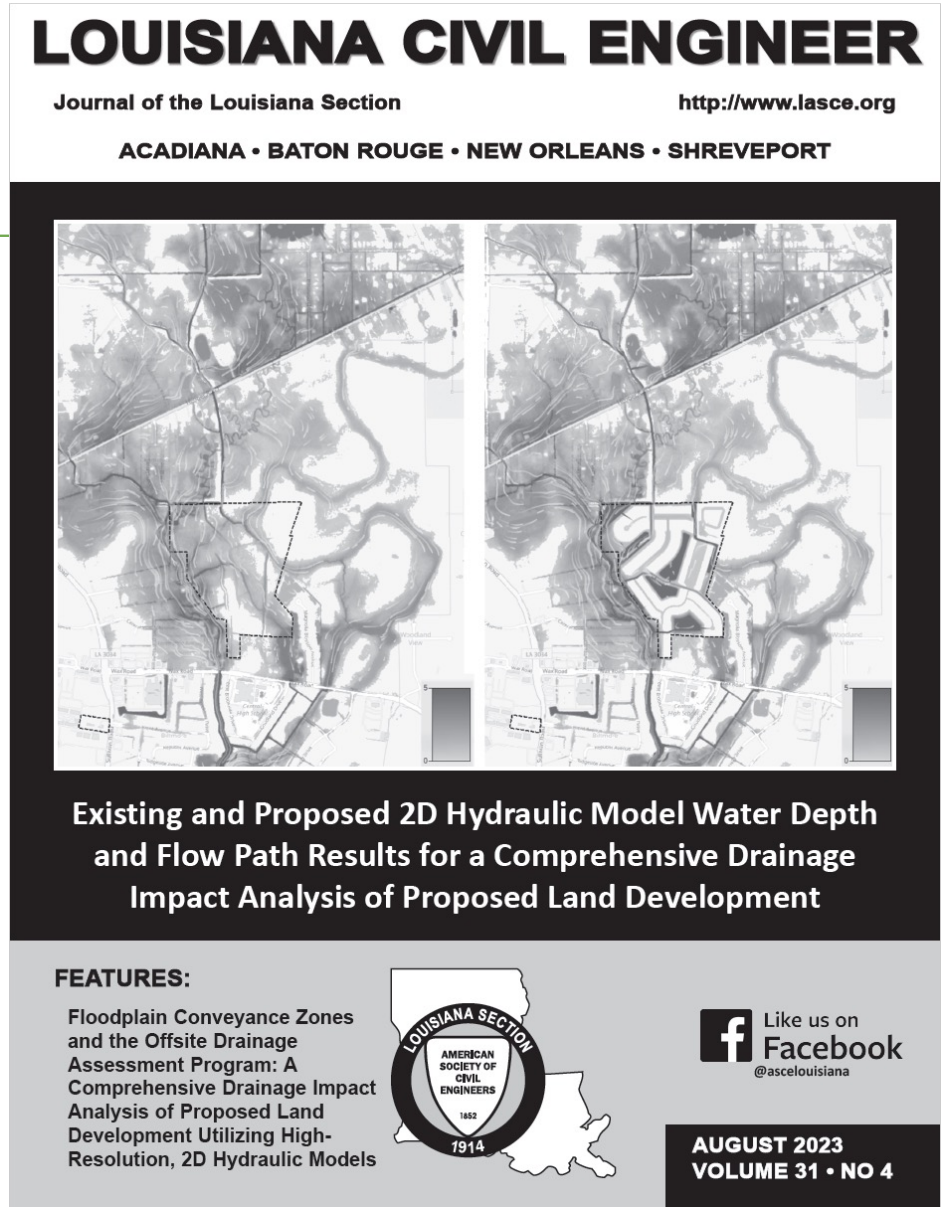
- Included development since 2019 in the Effective Hydraulic Models
- Updated Effective Hydraulic Models to the latest version of HEC-RAS
- Updated Floodplain Conveyance Zones based on updated models and use EBR FCZ methodology

Recently Publication

Cover Article in the August 2023 edition of the Louisiana Section of the American Society of Civil Engineers.

Floodplain Conveyance Zones and the Offsite Drainage Assessment Program: A Comprehensive Drainage Impact Analysis of Proposed Land Development Utilizing High-Resolution, 2D Hydraulic Models

http://www.lasce.org/documents/journal/2023-08.pdf



Agenda

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2 Using 2D Hydraulic Models to Manage Flood Risk in New Development

3 Q+A

Thank you!

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Stokka Brown
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