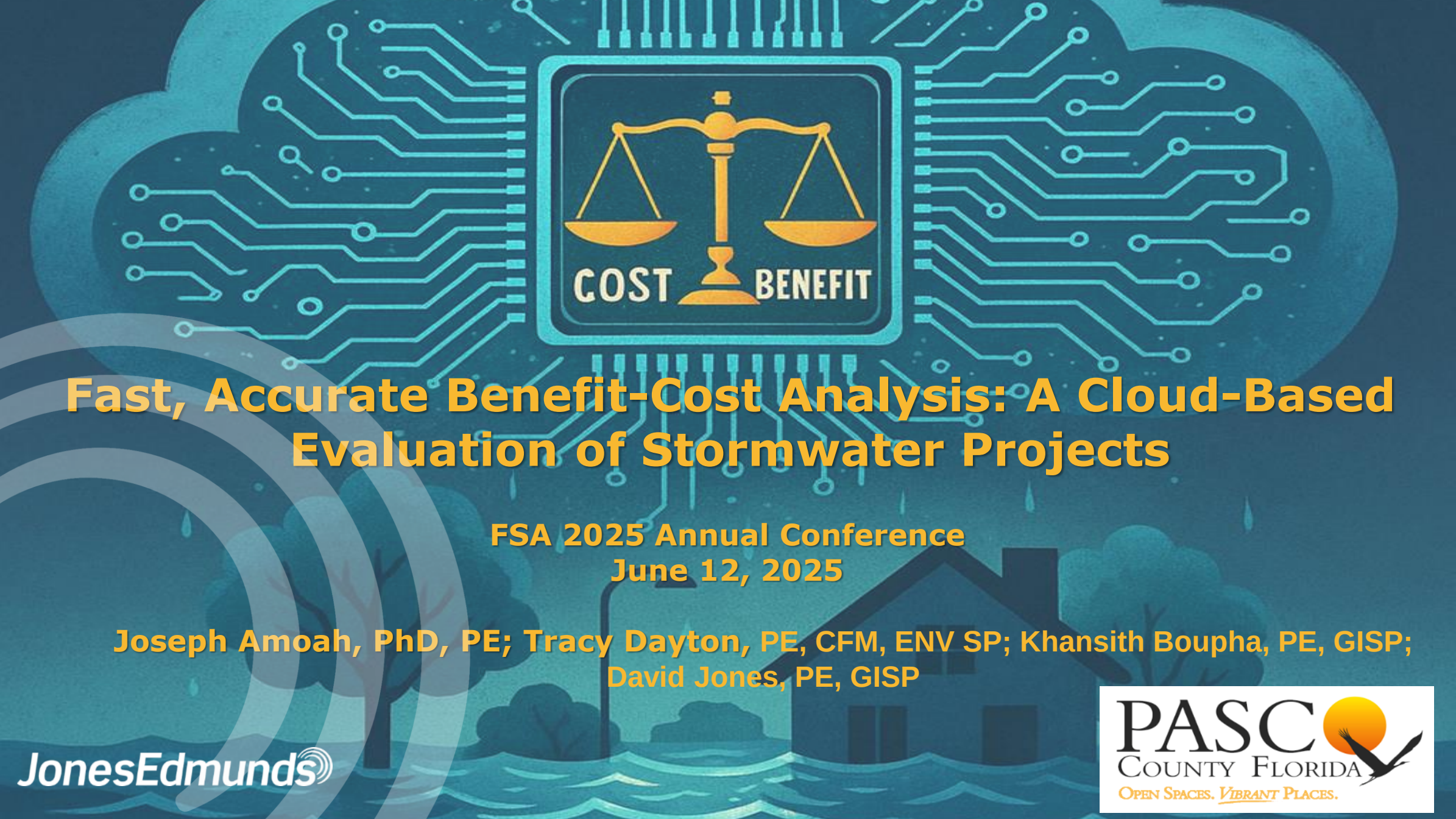


# Fast, Accurate Benefit-Cost Analysis: A Cloud-Based Evaluation of Stormwater Projects

**FSA 2025 Annual Conference**
**June 12, 2025**

**Joseph Amoah, PhD, PE; Tracy Dayton, PE, CFM, ENV SP; Khansith Boupha, PE, GISP; David Jones, PE, GISP**

JonesEdmunds

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# Introduction

- BCA improvements were needed
- BCA Process was automated
- Tools and web application were developed
- Extended use as project planning tool was discovered

# Better Projects

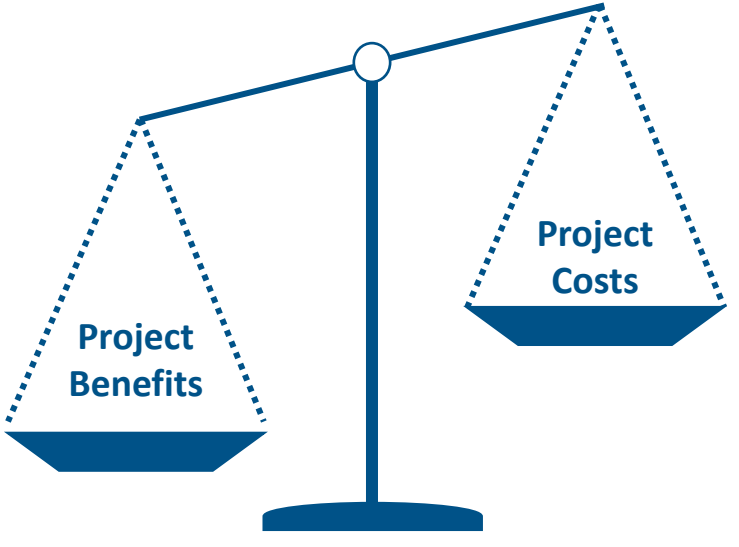
- More focused and directed (Where they are most needed)
- More beneficial projects (the “right project”)
- More cost-effective projects

# Agenda

- What is a BCA?
- Automating BCA Process
- Tools and web application
- Use as BMP decision support system

# Benefit-Cost Analysis (BCA)

- Cost-effectiveness of project
- Future flood risk reduction benefits
- Calculate Flood Damages Twice
  1. Before Project ("as-is")
  2. After Project
- Benefits = Before - After
- Compare benefits to costs
- Ratio: Benefits/Costs

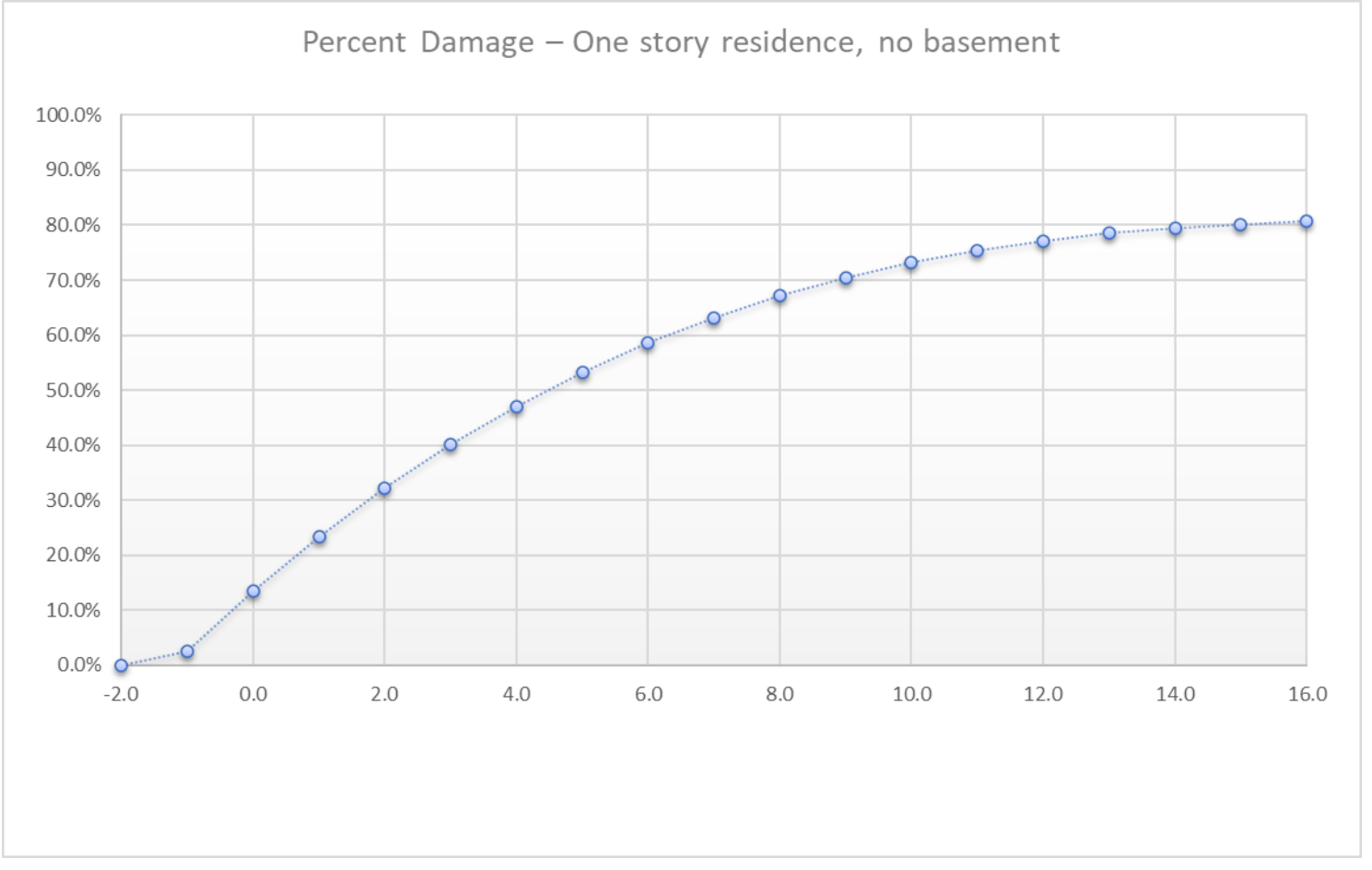


# Expected Annual Flood Damages

- Structures
- Roads
- Flood Depth/Damage
- Probability-based
- Damages Annualized

| Storm | Annual Probability | Damages |
|---|---|---|
| 1-year | 100% | $ |
| 2.33-year | 43% | $$ |
| 5-year | 20% | $$$ |
| 10-year | 10% | $$$$ |
| 25-year | 4% | $$$$$ |
| 50-year | 2% | $$$$$$ |
| 100-year | 1% | $$$$$$$ |

# Example Depth-Damage Curve



# Flood Damage Components

**Structures:**

- Structure
- Contents
- Displacement
- Vehicle

**Roadway:**

- Delay
- Repair

# Flood Damages - Components and Variables

## Structures

- Structure
  - Flood Depth, FF
  - Type (Depth-Damage Curve)
  - Assigned Structure Value
- Contents (residential only)
  - Flood Depth, FF
  - Depth-Damage Curve
  - Assigned Structure Value
- Displacement (residential only)
  - Flood Depth, FF
  - Time Displaced
  - Square Feet
- Vehicle (residential only)
  - Flood Depth, Driveway
  - Type (Depth-Damage Curve)
  - Vehicle Value

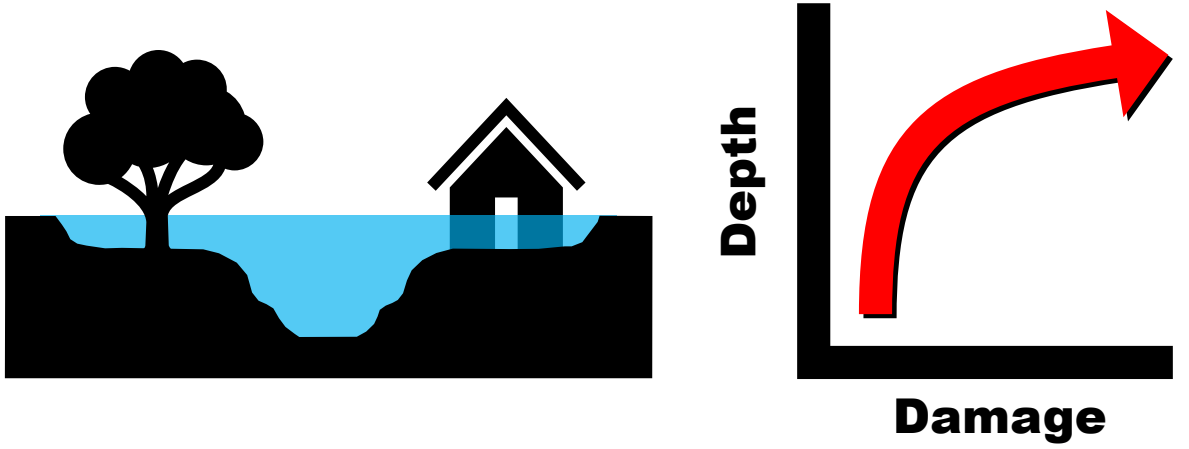
# Flood Damages - Components and Variables

## Roadway

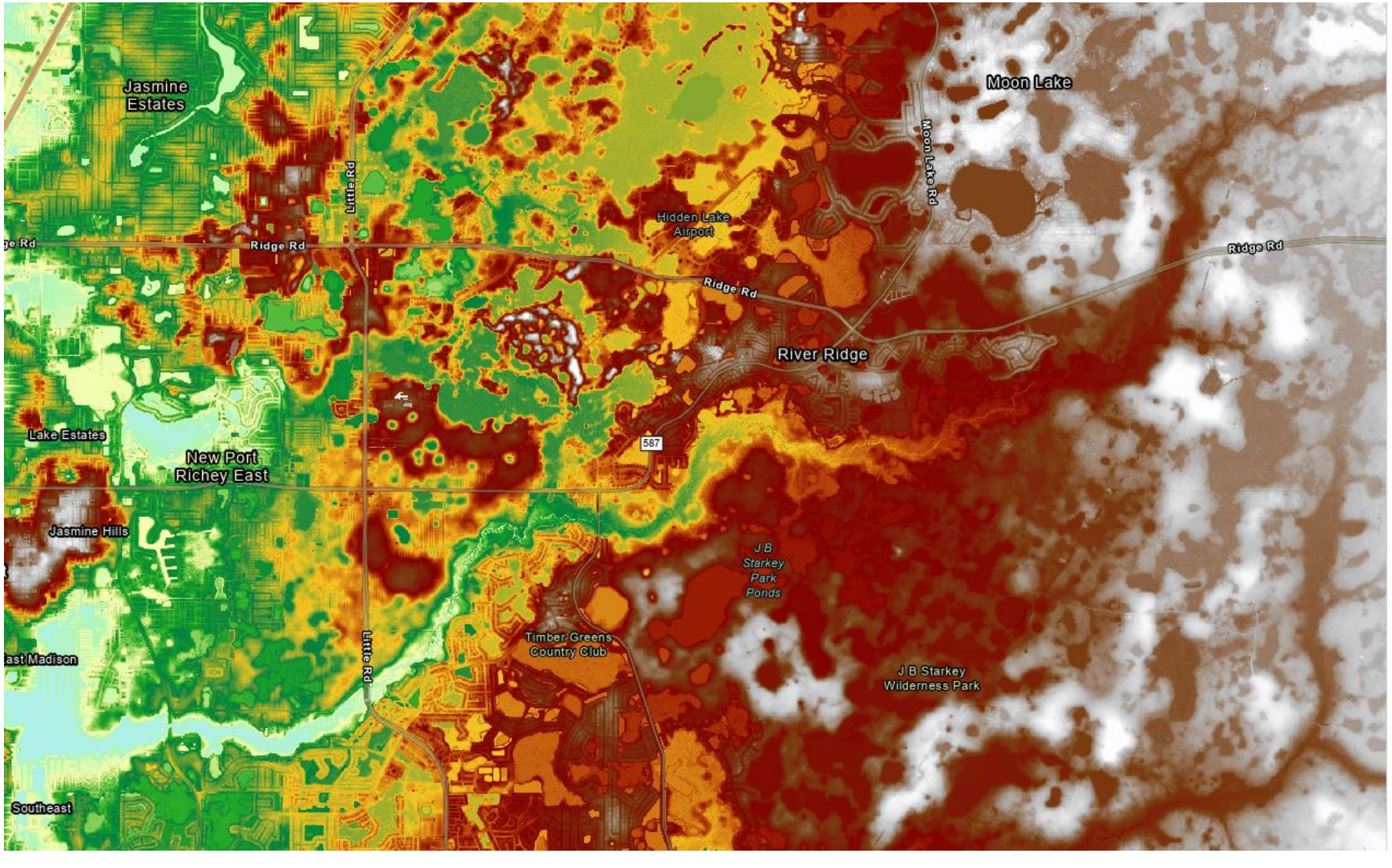
- Repair
  - Wet (yes or no)
  - Length
  - Number of Lanes
  - Type of Road
- Delay
  - Flood Duration (time impassable)
  - AADT
  - Detour Time
  - $/vehicle/hour

# Flood Damages ($)

- Per Asset/Feature
  - Structures
  - Roads
- Flood Depth/Damage
- Summarize for area of interest



# Automating Flood Damage Calculations



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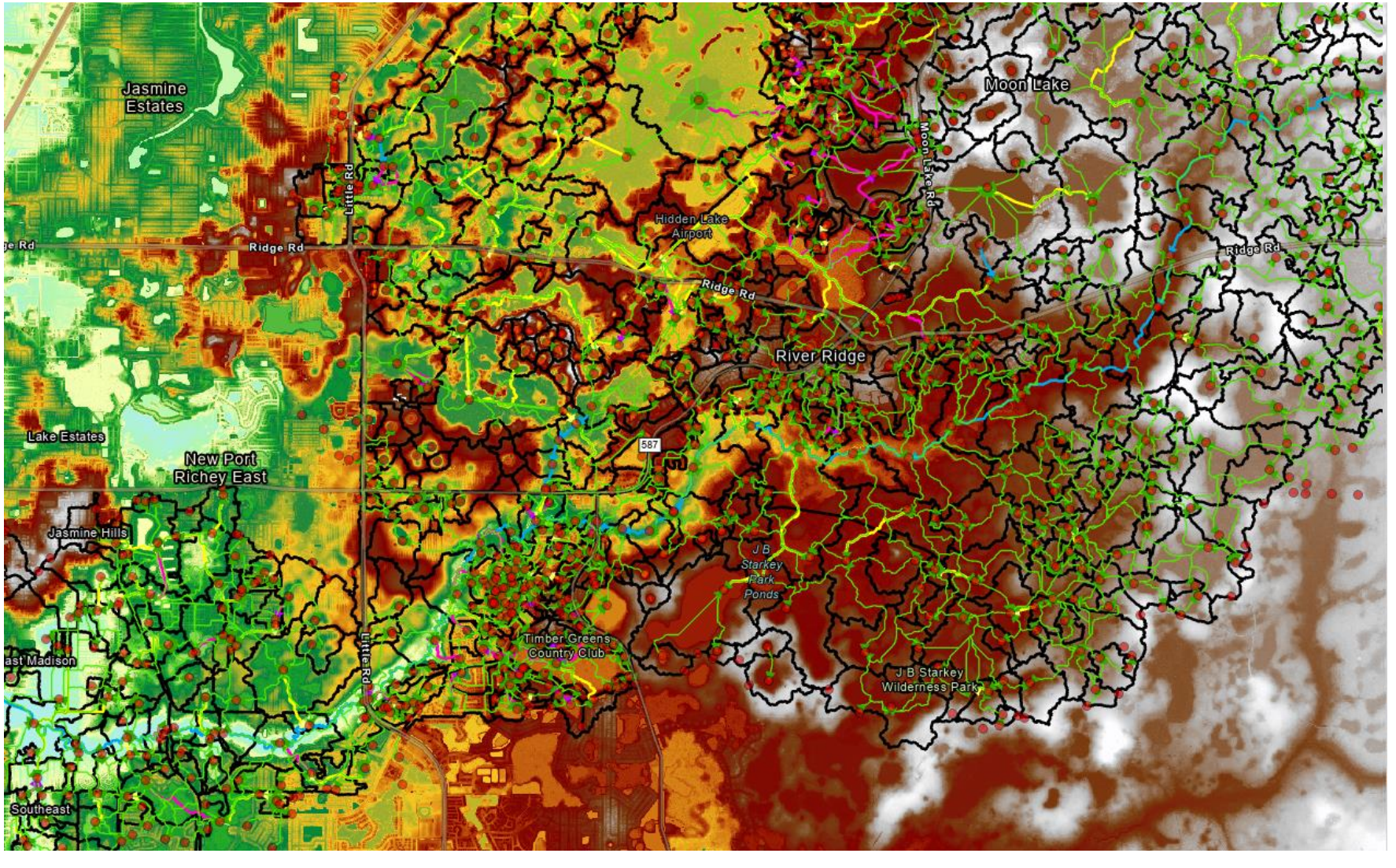

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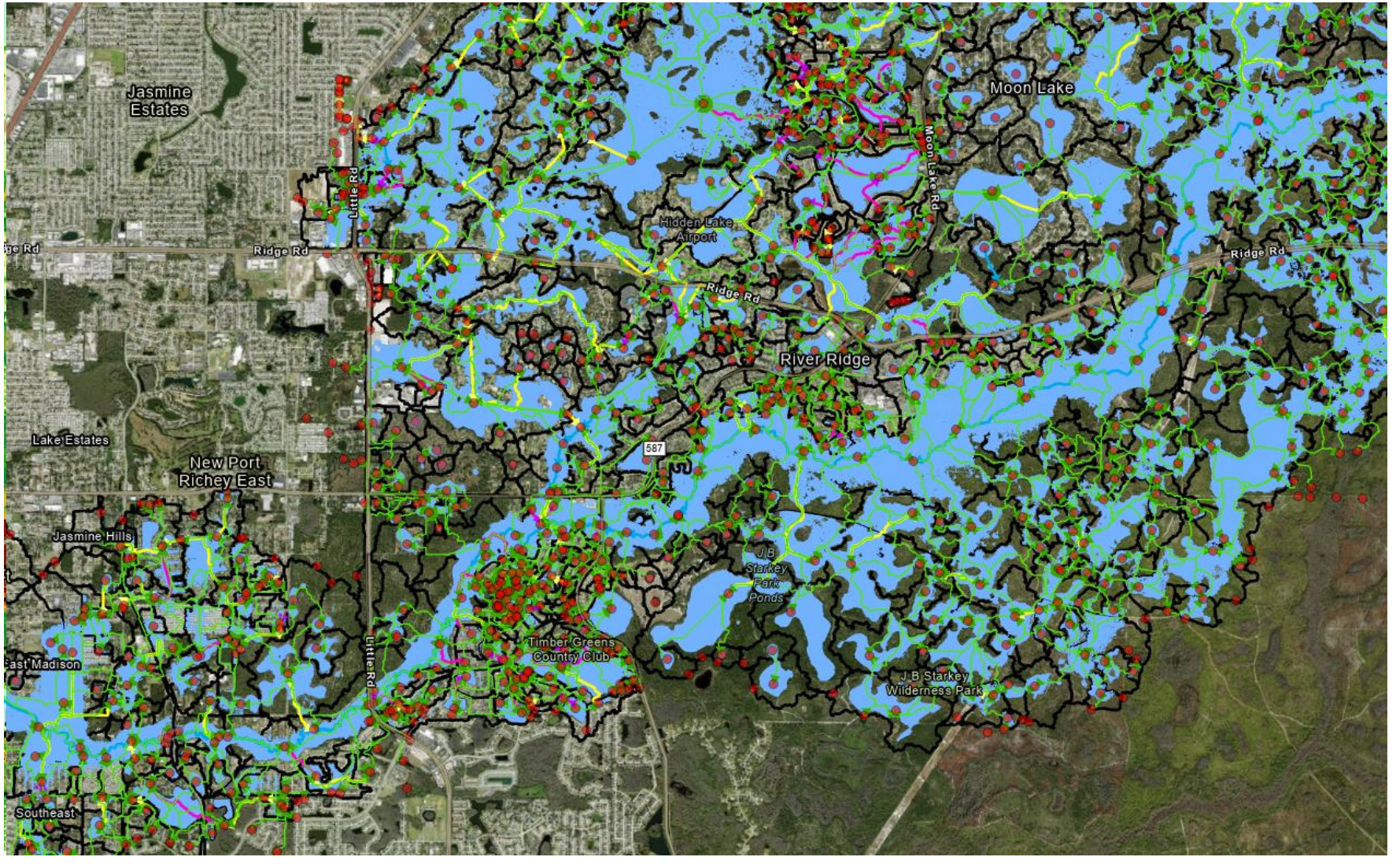

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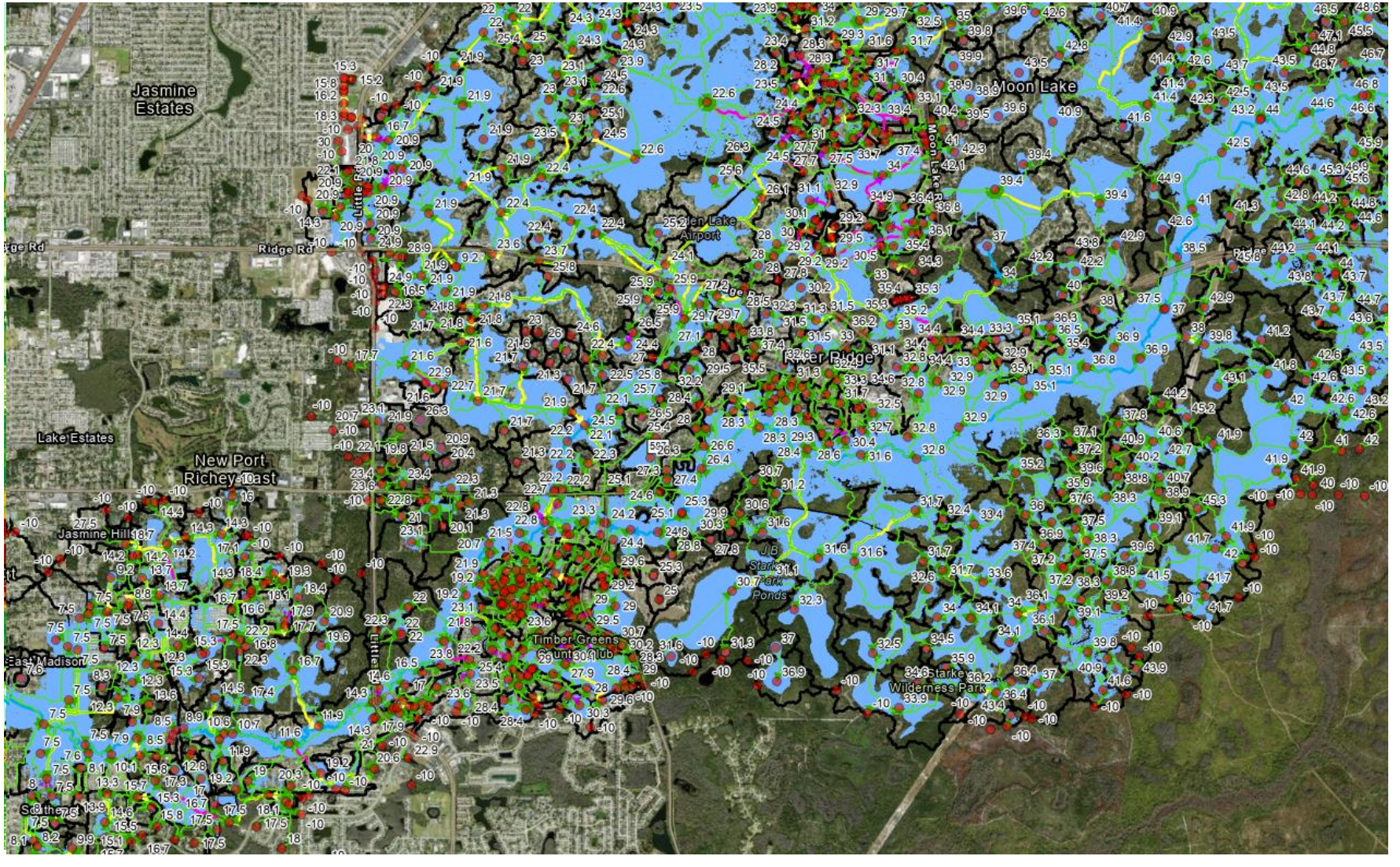
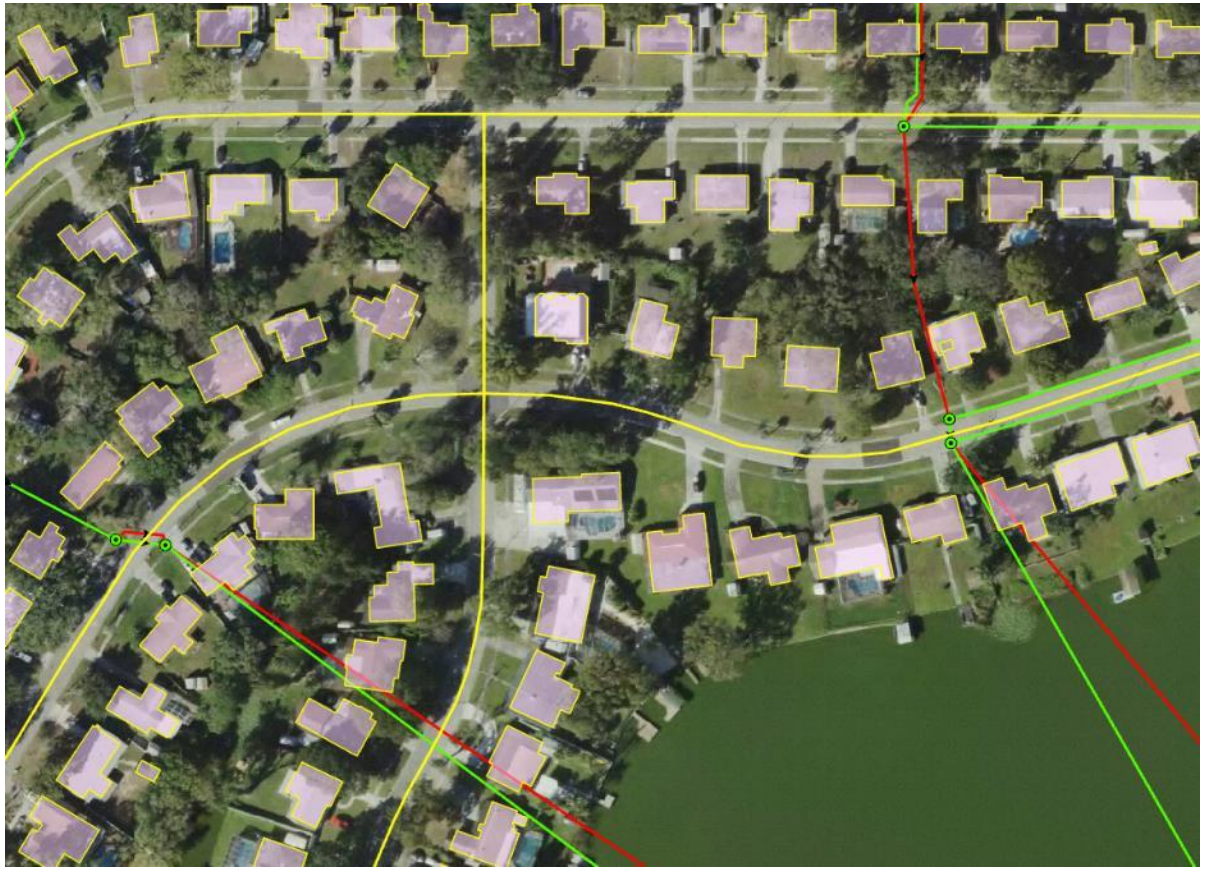


# Automating Flood Damage Calculations

- Countywide Datasets
  - Structures w/ estimated FF
  - 3D Roads
  - Parcel Mappings
- Models – Node locations and model results
- Flood Damages



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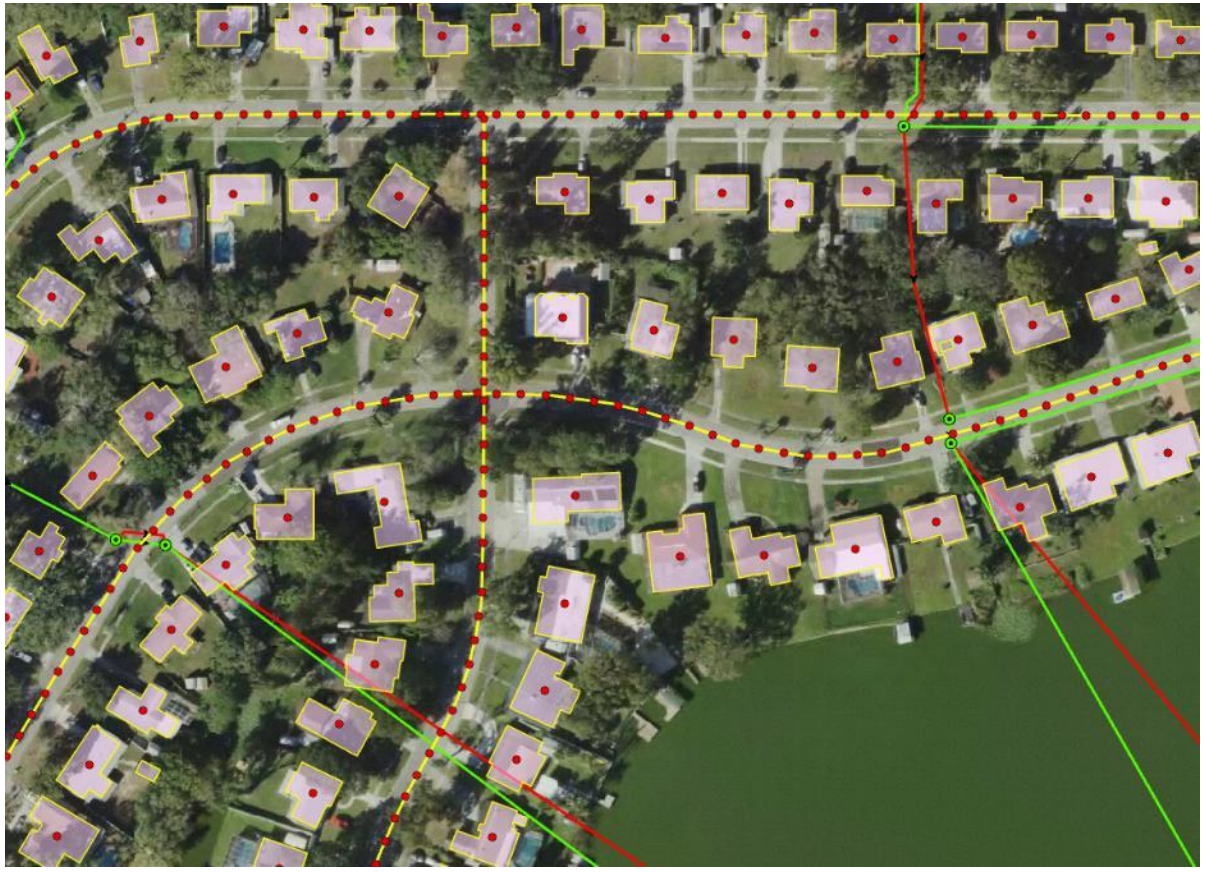

# Automating Flood Damage Calculations

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# Depth-Damage Curve Types

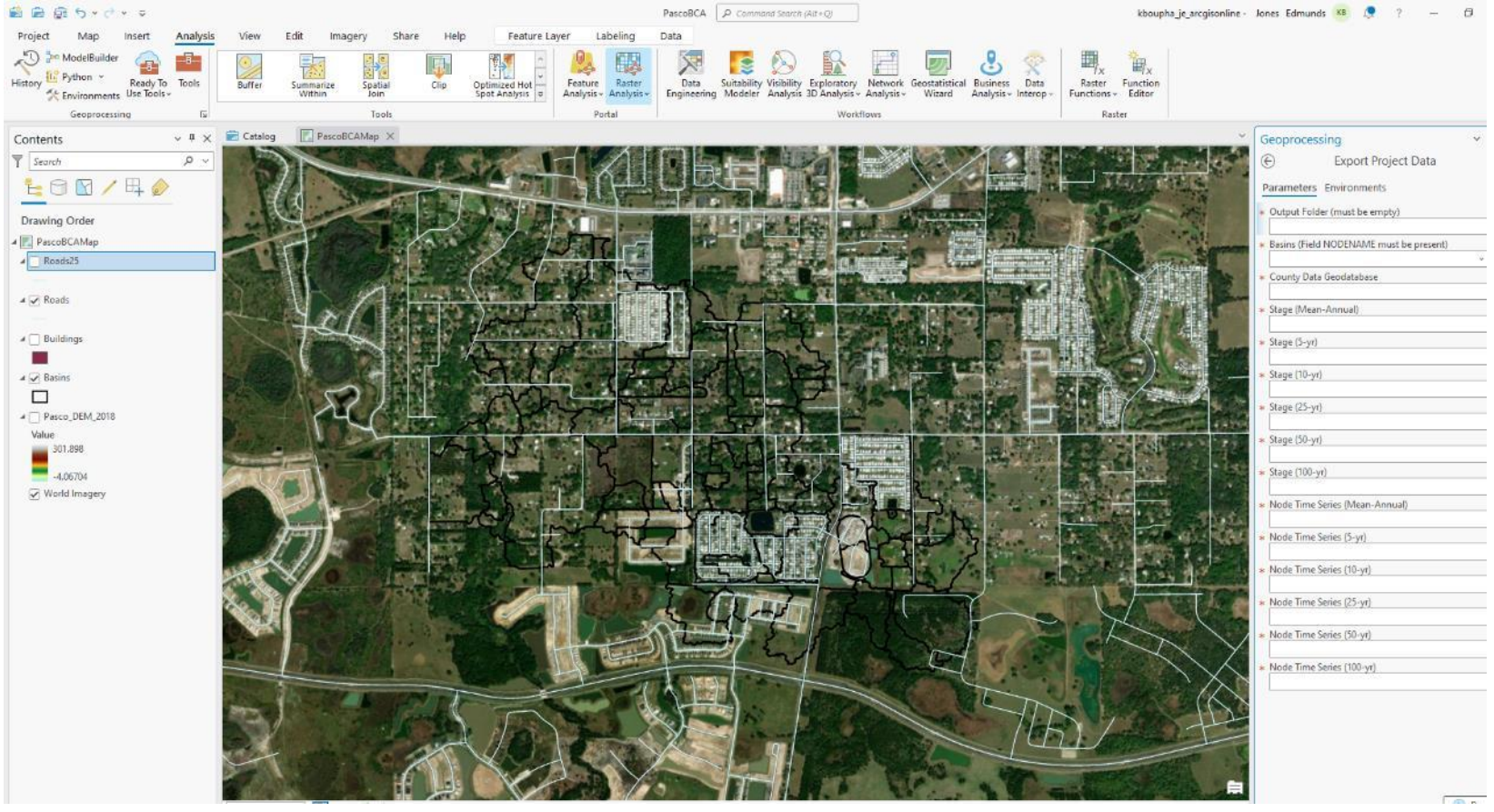
| ID | Description | ID | Description |
|---|---|---|---|
| 1 | No Structure | 17 | Private Golf Course, structure |
| 2 | Average Agriculture, structure | 18 | Average Heavy Industrial, Structure |
| 3 | Airport, structure | 19 | Hospital, structure |
| 4 | Auto Dealer Big, structure | 20 | Clinic Eng |
| 5 | Average/Unknown | 21 | Industrial Light Eng |
| 6 | Bowling Alley, structure | 22 | Lumber, structure |
| 7 | Churches | 23 | Average Light Industrial, structure |
| 8 | Organization Hall, structure | 24 | Average Metals/Minerals processing, structure |
| 9 | Average College/University, structu | 25 | Gas/Butane Supply, structure |
| 10 | Condominium, living area on multi | 26 | Mobile Home |
| 11 | Average Government Services, stru | 27 | Cemetery, structure |
| 12 | Retail Clothing | 28 | Motel Unit, structure |
| 13 | Drive-In Theater, structure | 29 | Apartments, Structure |
| 14 | Bank, structure | 30 | Municipal Storage Warehouse, structure |
| 15 | Florist, structure | 31 | Private Club, structure |
| 16 | Recreation Facilities, structure | 32 | Nursing Home, structure |

# Depth-Damage Curve Types

| ID | Description | ID | Description |
|---|---|---|---|
| 33 | Big Office Commercial, structure | 50 | Average Wholesale, Structure |
| 34 | Office 1 Story | 51 | Garage, structure |
| 35 | Office Building, structure | 52 | Drug, Super, structure |
| 36 | Average School, structure | 53 | Warehouse |
| 37 | Fast Food | 54 | Medical Clinic, structure |
| 38 | Non-Fast Food | 55 | Boat Sales/Service, structure |
| 39 | Service Station, structure | 56 | Car Wash, structure |
| 40 | Average Personal and Repair Services, structur | 57 | Auto Repair, structure, composite water and duration |
| 41 | Sewage Treatment, structure | | |
| 42 | One Story, no basement | 58 | Auto Junk Yard, structure |
| 43 | Two or More Stories, no basement | 59 | Food Processor, structure |
| 44 | Split Level, no basement | 60 | Warehouse, structure |
| 45 | Average Retail, Structure | 61 | Metal Recycling, structure |
| 46 | Supermarket, structure | 62 | Heavy Equipment Storage, structure |
| 47 | Average Theatre, structure | 63 | Private Day Care, structure |
| 48 | Average Entertainment/Recreation, structure | 64 | Funeral Home, structure |
| 49 | Utility Company, structure | 65 | Cemetery, structure |
| | | 66 | Physical Fitness, structure |

# Tools and Web Application

- GIS Processing Tool
- Web Application



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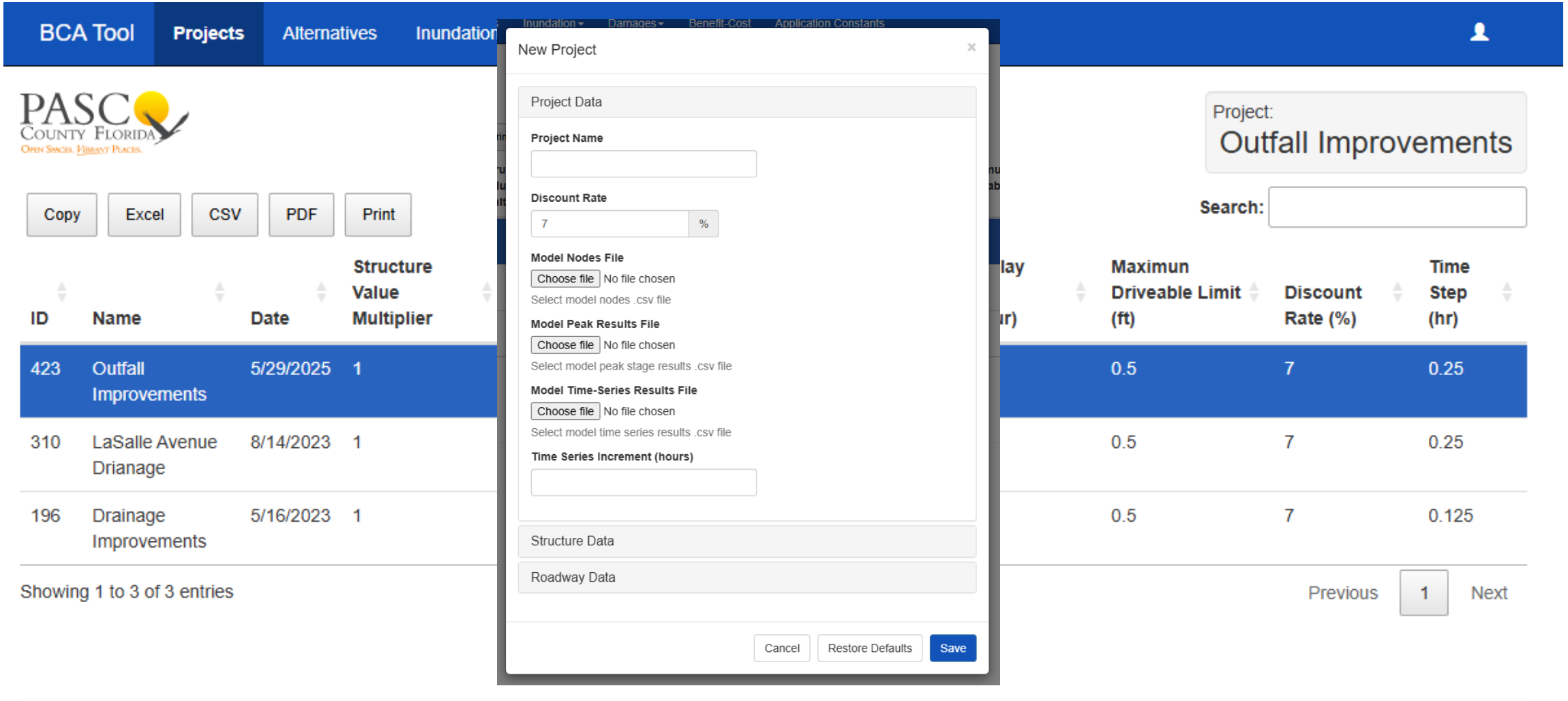
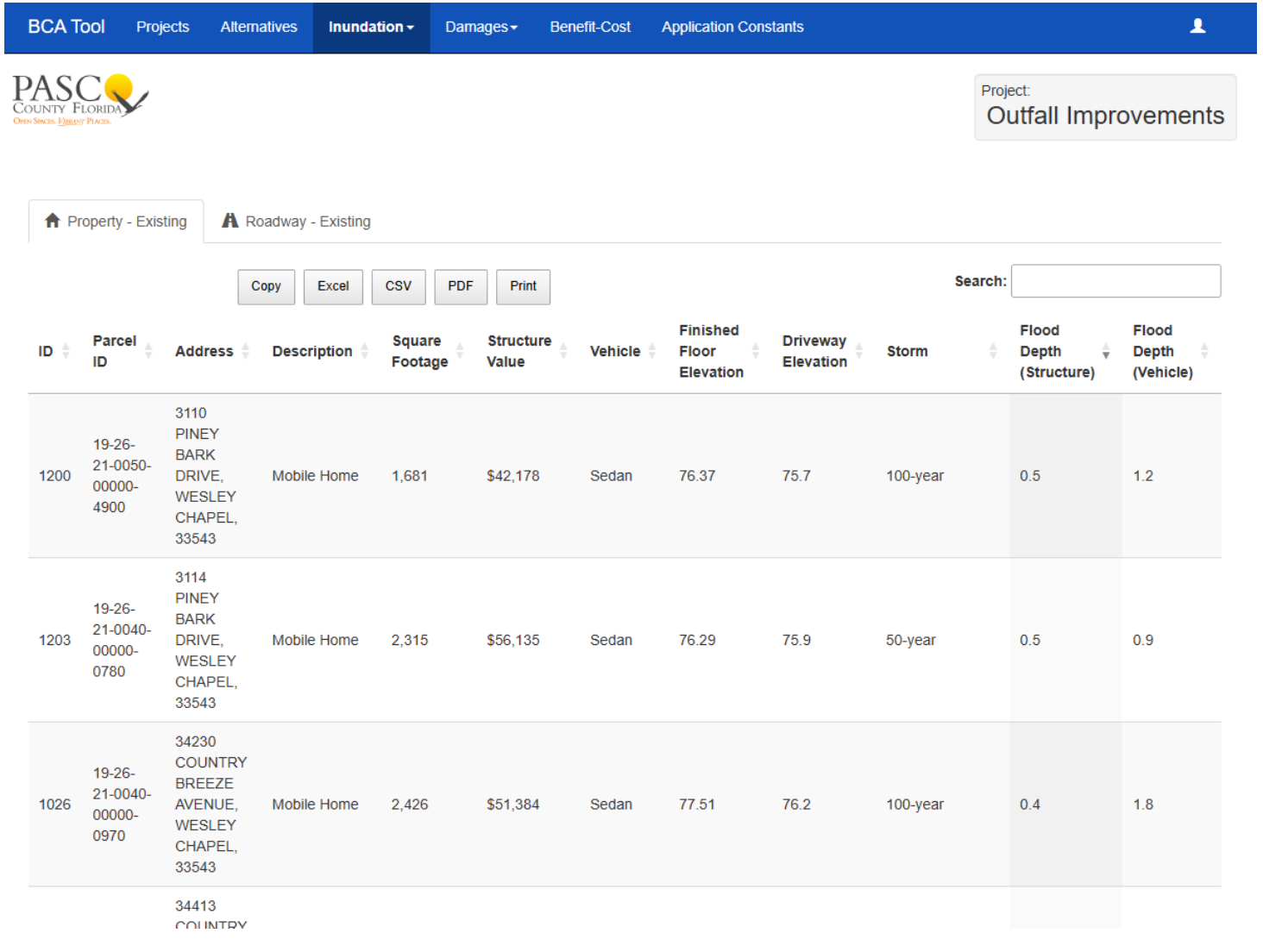
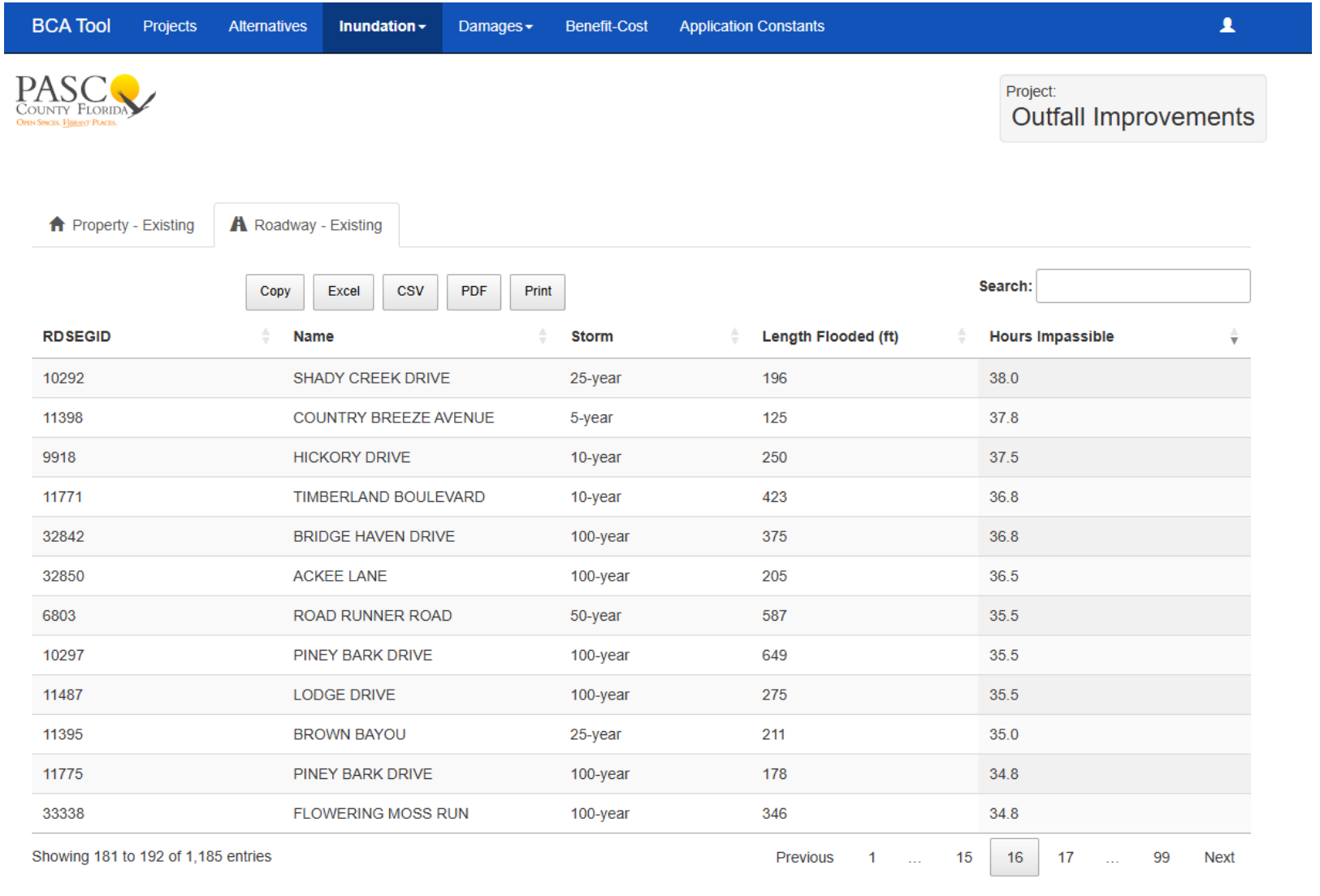


# Tools and Web Application



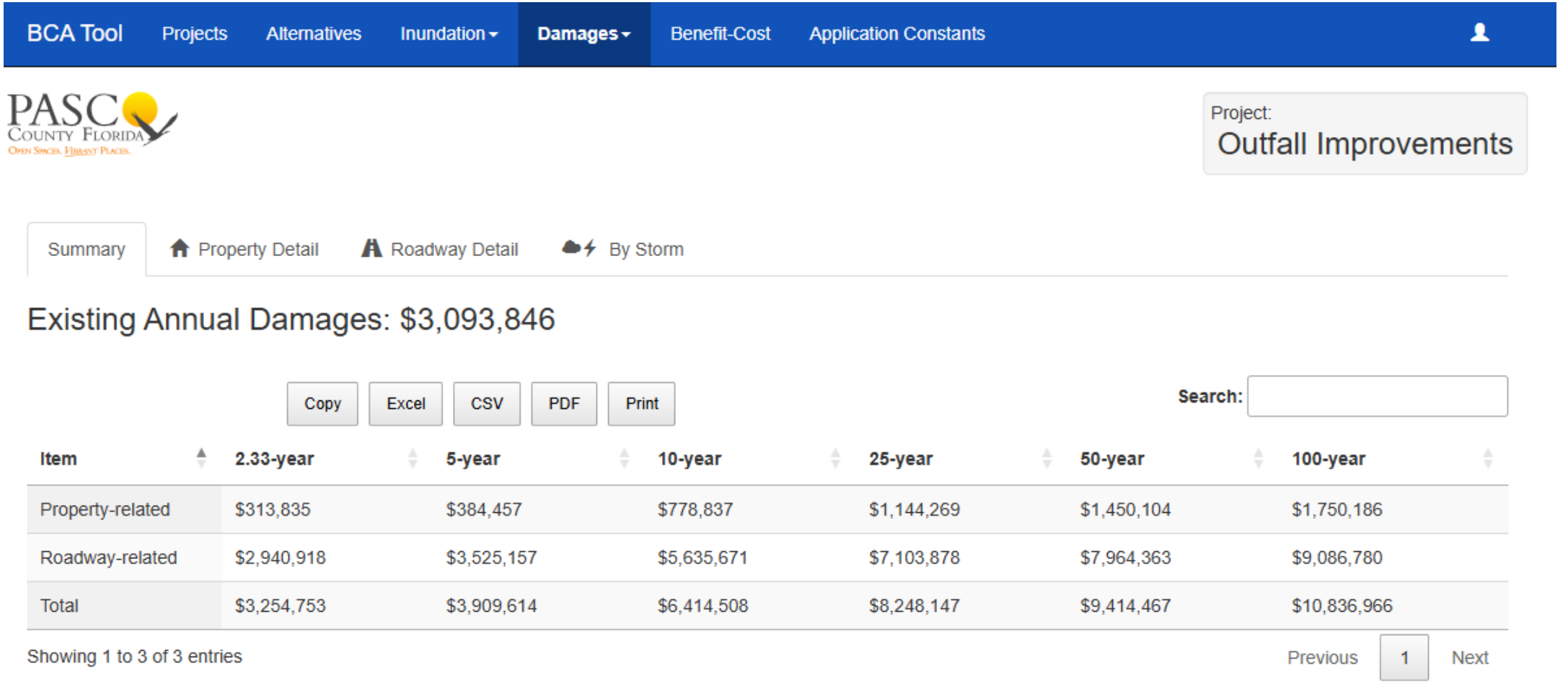

| ID | Parcel ID | Address | Description | Square Footage | Structure Value | Vehicle | Finished Floor Elevation | Driveway Elevation | Storm | Flood Depth (Structure) | Flood Depth (Vehicle) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1200 | 19-26-21-0050-00000-4900 | 3110 PINEY BARK DRIVE, WESLEY CHAPEL, 33543 | Mobile Home | 1,681 | $42,178 | Sedan | 76.37 | 75.7 | 100-year | 0.5 | 1.2 |
| 1203 | 19-26-21-0040-00000-0780 | 3114 PINEY BARK DRIVE, WESLEY CHAPEL, 33543 | Mobile Home | 2,315 | $56,135 | Sedan | 76.29 | 75.9 | 50-year | 0.5 | 0.9 |
| 1026 | 19-26-21-0040-00000-0970 | 34230 COUNTRY BREEZE AVENUE, WESLEY CHAPEL, 33543 | Mobile Home | 2,426 | $51,384 | Sedan | 77.51 | 76.2 | 100-year | 0.4 | 1.8 |
| | | 34413 COUNTRY | | | | | | | | | |

# Tools and Web Application




| RDSEGID | Name | Storm | Length Flooded (ft) | Hours Impassible |
|---|---|---|---|---|
| 10292 | SHADY CREEK DRIVE | 25-year | 196 | 38.0 |
| 11398 | COUNTRY BREEZE AVENUE | 5-year | 125 | 37.8 |
| 9918 | HICKORY DRIVE | 10-year | 250 | 37.5 |
| 11771 | TIMBERLAND BOULEVARD | 10-year | 423 | 36.8 |
| 32842 | BRIDGE HAVEN DRIVE | 100-year | 375 | 36.8 |
| 32850 | ACKEE LANE | 100-year | 205 | 36.5 |
| 6803 | ROAD RUNNER ROAD | 50-year | 587 | 35.5 |
| 10297 | PINEY BARK DRIVE | 100-year | 649 | 35.5 |
| 11487 | LODGE DRIVE | 100-year | 275 | 35.5 |
| 11395 | BROWN BAYOU | 25-year | 211 | 35.0 |
| 11775 | PINEY BARK DRIVE | 100-year | 178 | 34.8 |
| 33338 | FLOWERING MOSS RUN | 100-year | 346 | 34.8 |

# Tools and Web Application



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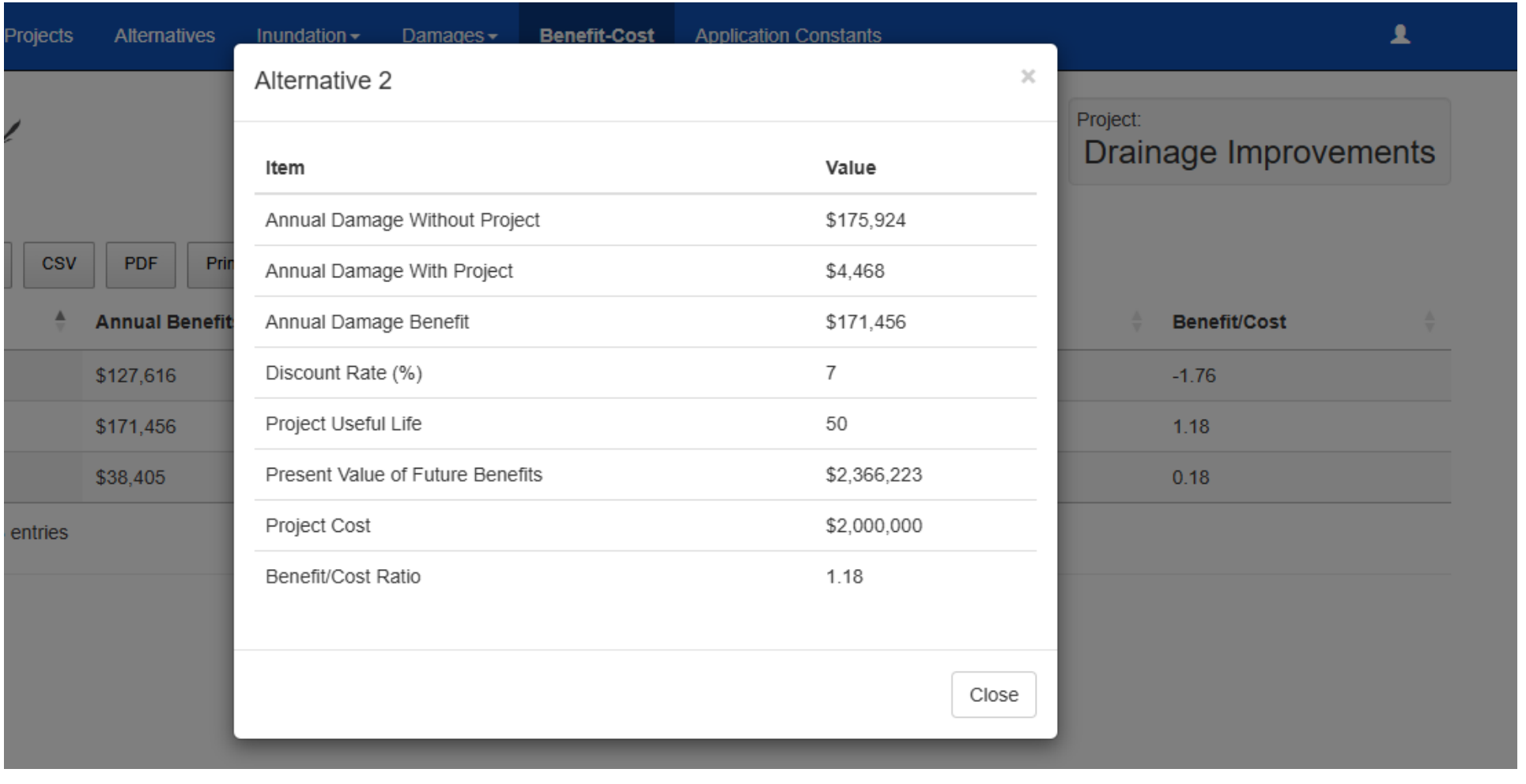

# Because it is Automated…

- Easily apply to entire watershed or jurisdiction
- Use the flood damage calculations to identify and rank needs
- Point us to locations where BMPs are needed - impacts to people
- Support decision making
- Improve flooding conditions
- Social equity

# Questions

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