



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

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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



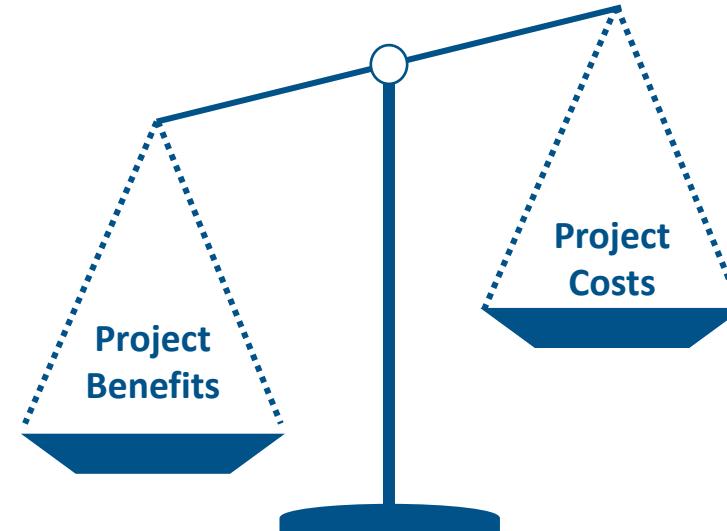
Agenda

- 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

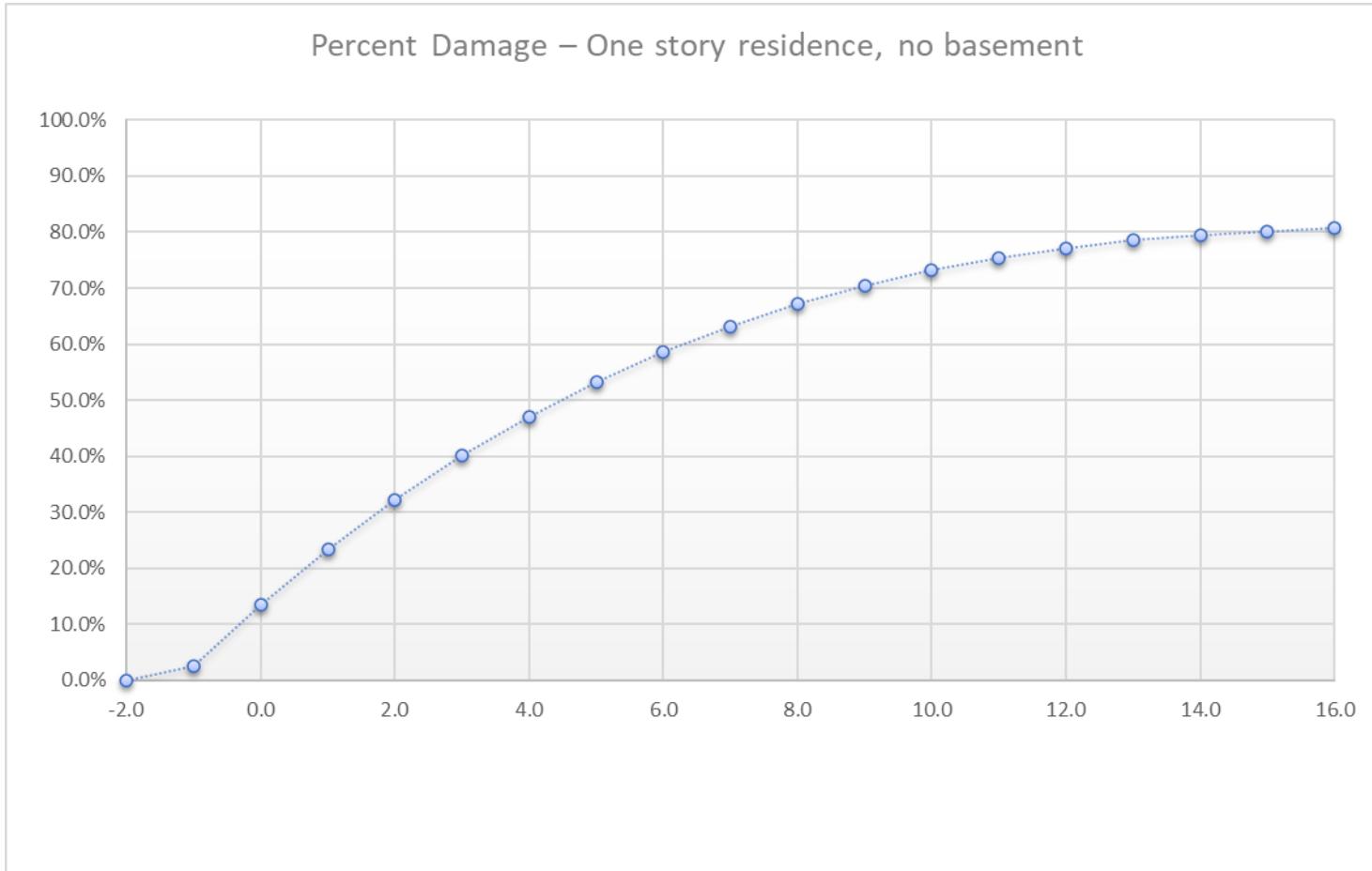


Expected Annual Flood Damages

- 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

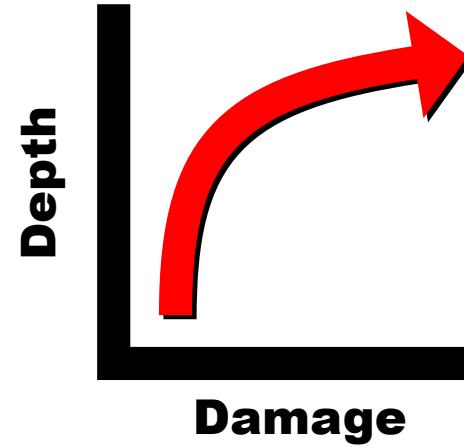
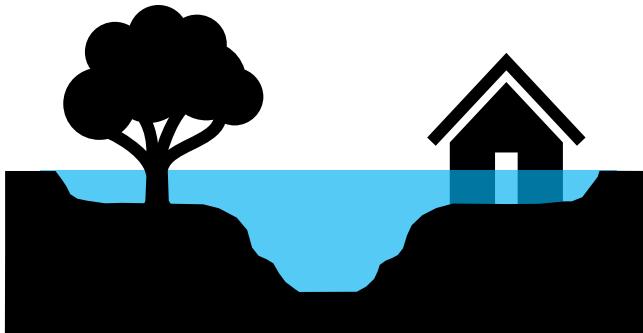


- Repair
 - Wet (yes or no)
 - Length
 - Number of Lanes
 - Type of Road
- Delay
 - Flood Duration (time impassable)
 - AADT
 - Detour Time
 - \$/vehicle/hour

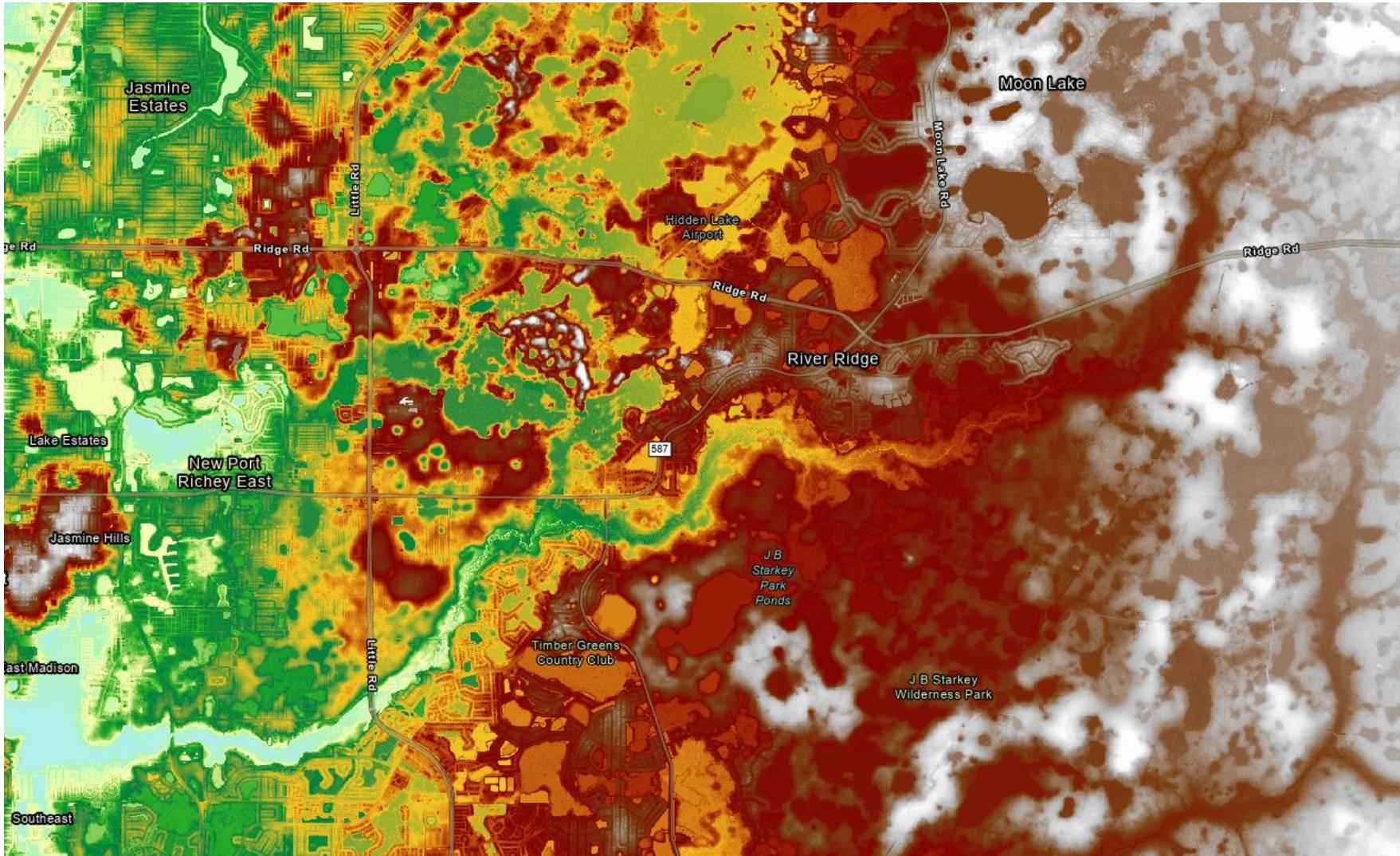


Flood Damages (\$)

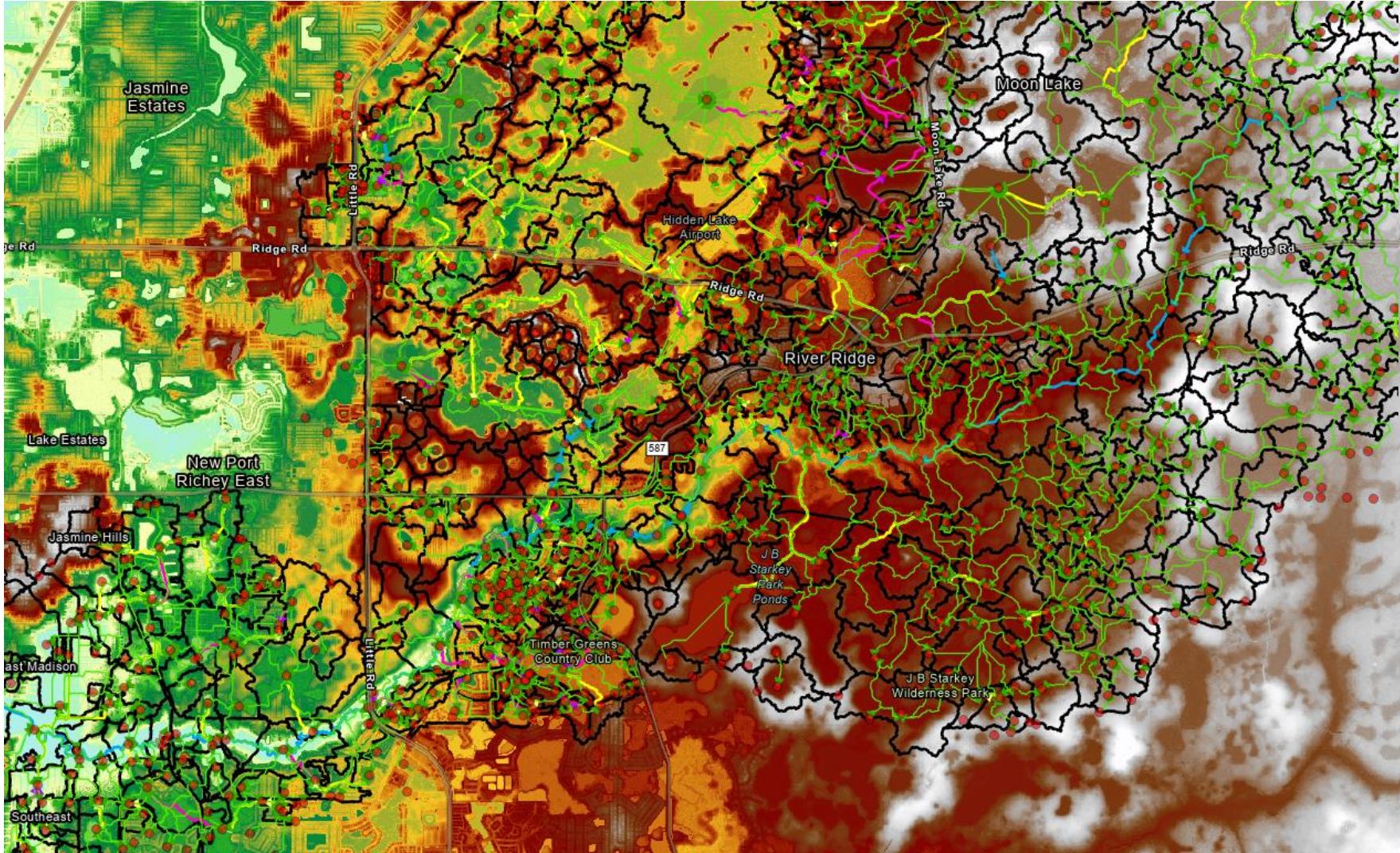
- Per Asset/Feature
 - Structures
 - Roads
- Flood Depth/Damage
- Summarize for area of interest



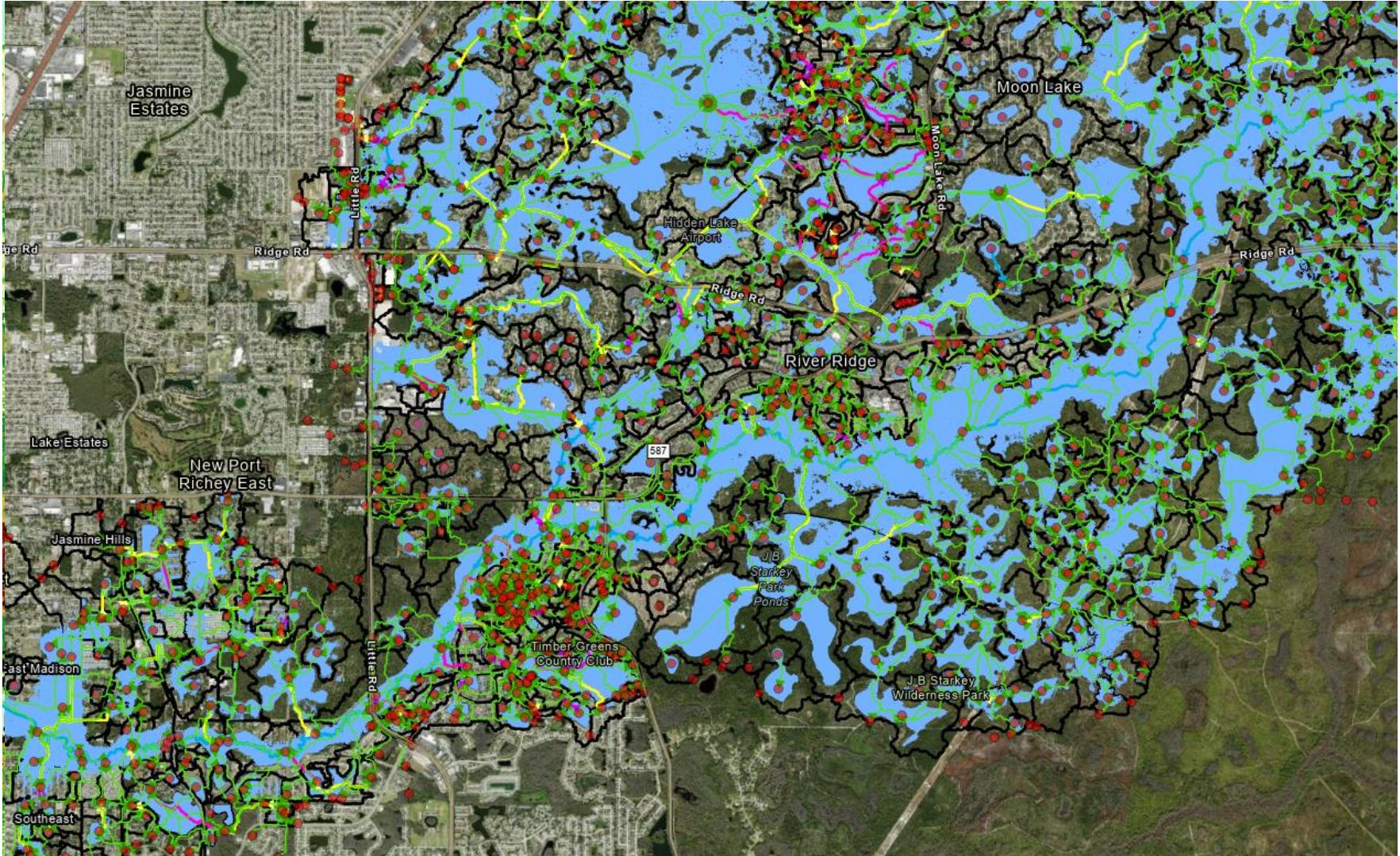
Automating Flood Damage Calculations



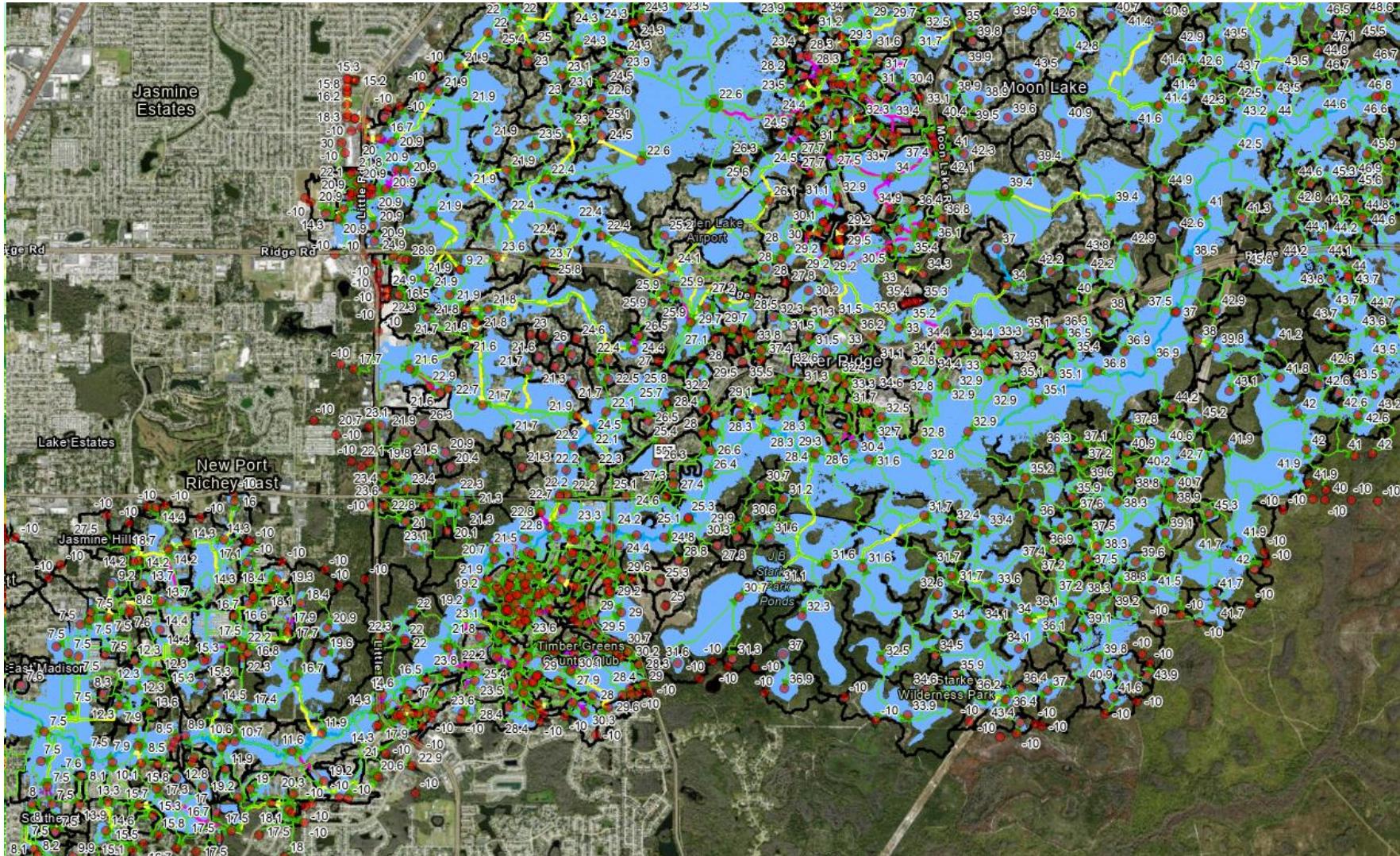
Automating Flood Damage Calculations



Automating Flood Damage Calculations

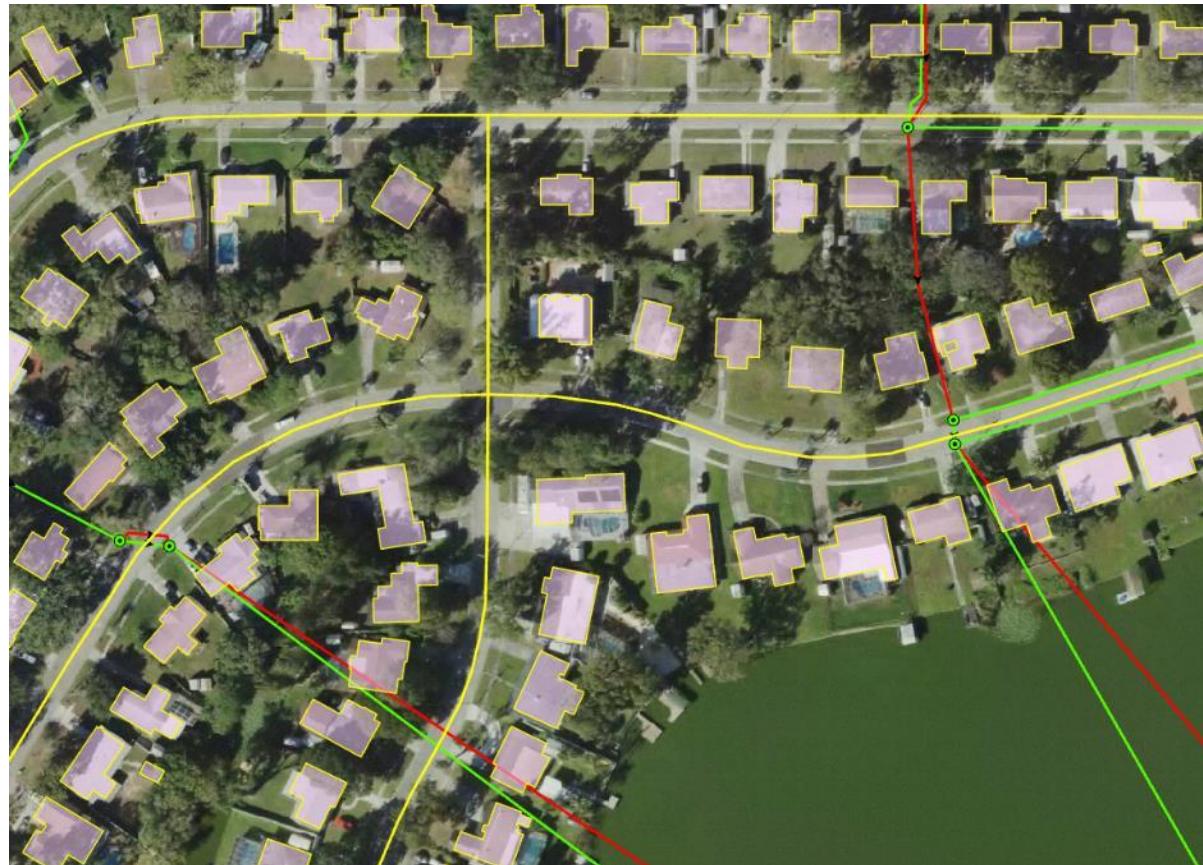


Automating Flood Damage Calculations



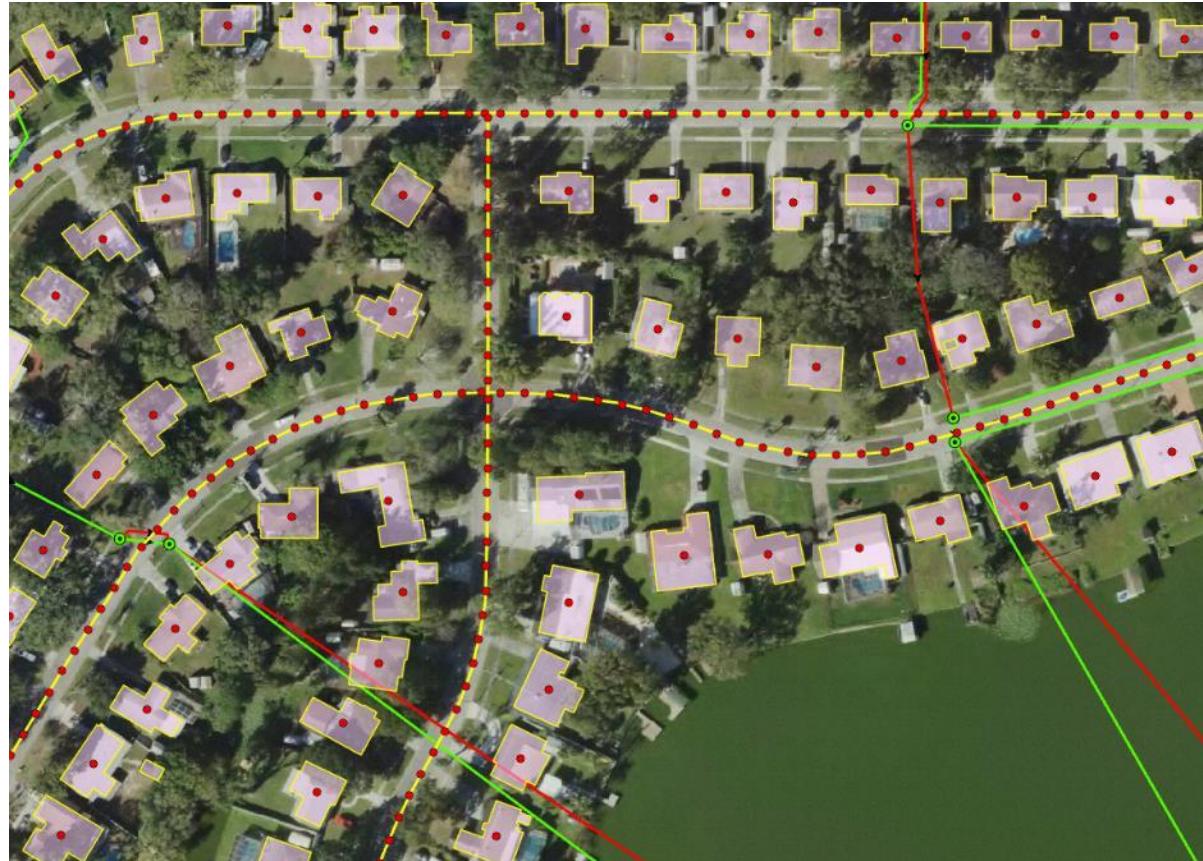
Automating Flood Damage Calculations

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



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Depth-Damage Curve Types

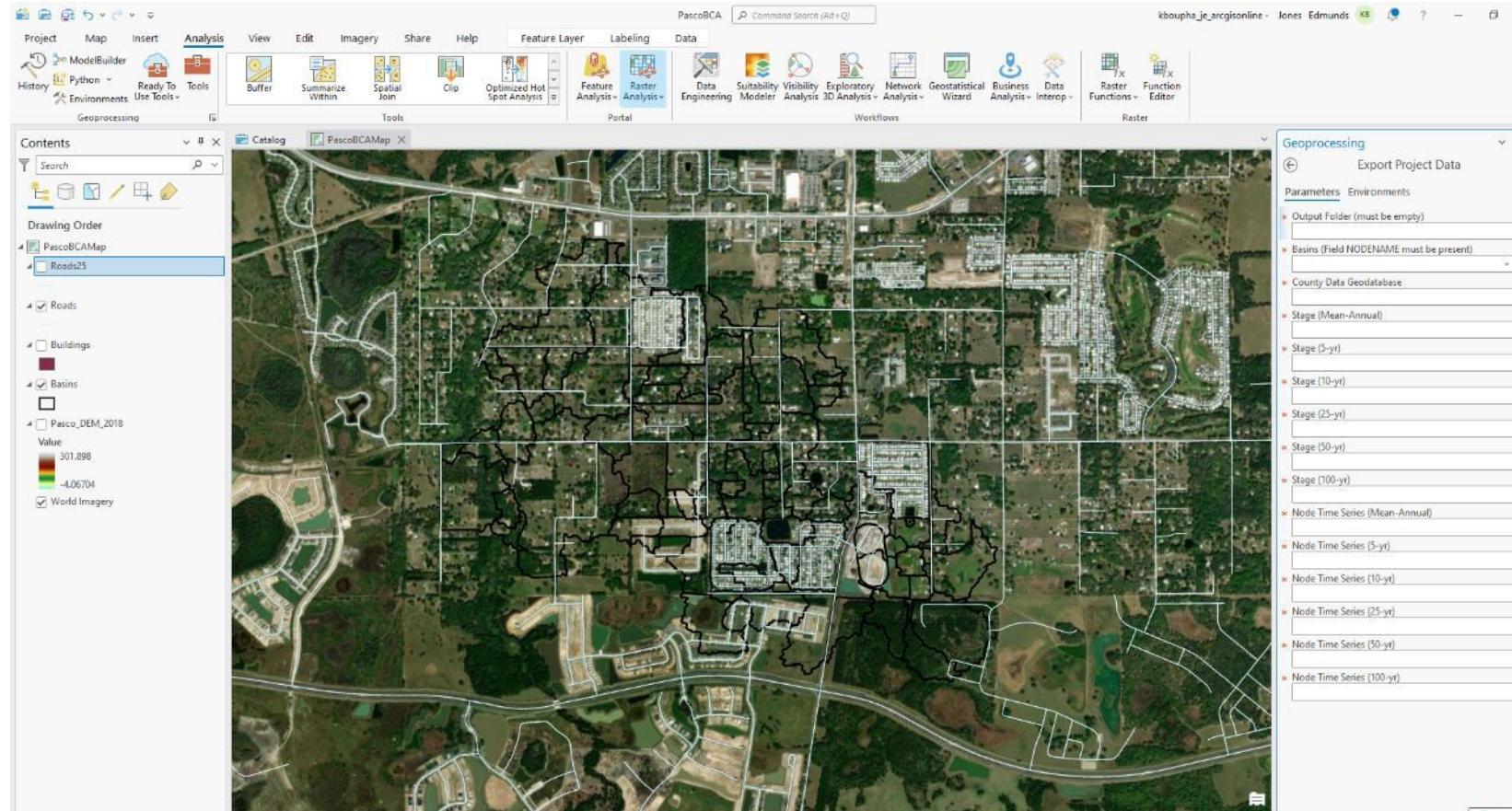
ID	Description	ID	Description
1	No Structure	17	Private Golf Course, structure
2	Average Agriculture, structure	18	Average Heavy Industrial, Structure
3	Airport, structure	19	Hospital, structure
4	Auto Dealer Big, structure	20	Clinic Eng
5	Average/Unknown	21	Industrial Light Eng
6	Bowling Alley, structure	22	Lumber, structure
7	Churches	23	Average Light Industrial, structure
8	Organization Hall, structure	24	Average Metals/Minerals processing, structure
9	Average College/University, structure	25	Gas/Butane Supply, structure
10	Condominium, living area on multi	26	Mobile Home
11	Average Government Services, struc	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, structure	57	Auto Repair, structure, composite water and duration
41	Sewage Treatment, structure	58	Auto Junk Yard, structure
42	One Story, no basement	59	Food Processor, structure
43	Two or More Stories, no basement	60	Warehouse, structure
44	Split Level, no basement	61	Metal Recycling, structure
45	Average Retail, Structure	62	Heavy Equipment Storage, structure
46	Supermarket, structure	63	Private Day Care, structure
47	Average Theatre, structure	64	Funeral Home, structure
48	Average Entertainment/Recreation, structure	65	Cemetery, structure
49	Utility Company, structure	66	Physical Fitness, structure

Tools and Web Application

- GIS Processing Tool
- Web Application



Tools and Web Application

The screenshot displays a web-based tool interface for 'BCA Tool' (Building Condition Assessment). The top navigation bar includes tabs for 'BCA Tool', 'Projects', 'Alternatives', 'Inundation', and 'Damages'. A user profile icon is also present in the top right.

The main content area shows a table of projects:

ID	Name	Date	Structure Value	Multiplier
423	Outfall Improvements	5/29/2025	1	
310	LaSalle Avenue Drainage	8/14/2023	1	
196	Drainage Improvements	5/16/2023	1	

Below the table are download buttons for 'Copy', 'Excel', 'CSV', 'PDF', and 'Print'.

A modal dialog box titled 'New Project' is open, prompting for 'Project Data' including 'Project Name' (input field), 'Discount Rate' (input field with value '7' and '%'), and file selection fields for 'Model Nodes File' (input field 'Choose file' with message 'No file chosen'), 'Model Peak Results File' (input field 'Choose file' with message 'No file chosen'), and 'Model Time-Series Results File' (input field 'Choose file' with message 'No file chosen'). It also includes a 'Time Series Increment (hours)' input field and sections for 'Structure Data' and 'Roadway Data'.

On the right, a sidebar displays the current project as 'Outfall Improvements' and a search bar. The 'Roadway Data' table is shown:

Play	Maximum Driveable Limit (ft)	Discount Rate (%)	Time Step (hr)
	0.5	7	0.25
	0.5	7	0.25
	0.5	7	0.125

Navigation buttons for 'Previous', '1', and 'Next' are at the bottom of the sidebar.

Tools and Web Application

BCA Tool Projects Alternatives **Inundation** ▾ Damages ▾ Benefit-Cost Application Constants 

PASCO
County Florida
Open Spaces. Forest Places.

Project:
Outfall Improvements

 [Property - Existing](#)  [Roadway - Existing](#)

[Copy](#) [Excel](#) [CSV](#) [PDF](#) [Print](#)

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

BCA Tool Projects Alternatives **Inundation** Damages▼ Benefit-Cost Application Constants 

PASCO COUNTY FLORIDA
Open Since: 1960 Places.

Project:
Outfall Improvements

[!\[\]\(df066fe55682b2c9295d48d23cc06f50_img.jpg\) Property - Existing](#) [!\[\]\(16c8dda5b2c8d903678ae1392fab538f_img.jpg\) Roadway - Existing](#)

[Copy](#) [Excel](#) [CSV](#) [PDF](#) [Print](#)

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

Showing 181 to 192 of 1,185 entries Previous 1 ... 15 **16** 17 ... 99 Next

Tools and Web Application

BCA Tool Projects Alternatives Inundation ▾ **Damages ▾** Benefit-Cost Application Constants 

PASCO COUNTY FLORIDA
OPEN SPACES. PLEASANT PLACES.

Project: **Outfall Improvements**

Summary  Property Detail  Roadway Detail  By Storm

Existing Annual Damages: \$3,093,846

 Copy  Excel  CSV  PDF  Print Search:

Item	2.33-year	5-year	10-year	25-year	50-year	100-year
Property-related	\$313,835	\$384,457	\$778,837	\$1,144,269	\$1,450,104	\$1,750,186
Roadway-related	\$2,940,918	\$3,525,157	\$5,635,671	\$7,103,878	\$7,964,363	\$9,086,780
Total	\$3,254,753	\$3,909,614	\$6,414,508	\$8,248,147	\$9,414,467	\$10,836,966

Showing 1 to 3 of 3 entries Previous 1 Next

Tools and Web Application

The screenshot shows a web-based application interface for project evaluation. The main menu at the top includes 'Projects', 'Alternatives', 'Inundation', 'Damages', 'Benefit-Cost' (which is currently selected), and 'Application Constants'. A user profile icon is in the top right. The main content area displays data for 'Alternative 2' under the 'Benefit-Cost' tab. The data is presented in a table format:

Item	Value
Annual Damage Without Project	\$175,924
Annual Damage With Project	\$4,468
Annual Damage Benefit	\$171,456
Discount Rate (%)	7
Project Useful Life	50
Present Value of Future Benefits	\$2,366,223
Project Cost	\$2,000,000
Benefit/Cost Ratio	1.18

Below this table, there is a 'Close' button. To the right of the main content, a sidebar shows project details for 'Drainage Improvements':

- Project: Drainage Improvements
- Benefit/Cost:
 - 1.76
 - 1.18
 - 0.18

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