Department of Public Works
CIP Resilience Priorities

City Council Resiliency Subcommittee
Infrastructure & Continuity of Operations for Essential Services
November 13, 2020

CIP RESILIENCE PRIORITIES
AGENDA

- **Focus**
  - Infrastructure Challenges
  - Master Stormwater Management Plan “MSMP”
    - Background
    - Improvements Evaluation Criteria
    - Improvement Opportunities
- **Expanded Focus**
  - Storm Resiliency & Hardening Efforts
    - Background
    - Scope Focus
    - Status
- **Summary**

INFRASTRUCTURE CHALLENGES
INCLUDED WITH CURRENT CIP

- Identified Road Flooding (MSMP & DSR)
  - Drainage System
  - Underdrain
- Identified Communities that Flood (MSMP & DSR)
  - McCoy's Creek
  - San Marco
- Identified Bulkhead Improvements
  - St. Johns River (County-wide)
  - Creeks/Tributaries (County-wide)
- Identified Drainage Outfall Improvements
  - County-wide Major Outfall Ditch Restoration/Cleaning (annual)

INFRASTRUCTURE CHALLENGES
INFRASTRUCTURE

Stormwater Management Assets

- 51,500 Inlets & Manholes
- 228 Stormwater Management Facilities “Ponds”
- 1,000 miles of Stormwater Pipe
- 209 miles of Major Outfalls
- 994 miles of Roadside & Other Ditches
- 10 Stormwater Pump Stations
- 4.5 miles of Bulkheads (201 locations)

MASTER STORMWATER MANAGEMENT PLAN **BACKGROUND**

- Developed in 2011
- Modeled City of Jacksonville's Major Stormwater Systems
- Evaluated opportunities for Stormwater Improvements
- Identified potential Stormwater Improvements

MASTER STORMWATER MANAGEMENT PLAN
BACKGROUND

Stormwater Management

- **Operations & Maintenance** – *Keep the system functioning*
  - Drainage System Repairs
  - Drainage System Functioning
- **Capital Improvements** – *Restore deteriorated systems and Improve challenged systems*
  - Drainage System Rehabilitation “System Restoration”
  - Capital Improvement Projects

MASTER STORMWATER MANAGEMENT PLAN
IMPROVEMENTS EVALUATION CRITERIA

Drainage System Rehabilitation "DSR"

Improve Deteriorated Systems

- **Types of Improvements**
  - System Repairs
    - Cave-In Repairs
    - Stormsewer Replacement
    - Pipe Lining
    - Outfall Reconstruction
  - System Functioning
    - Restoration of collection system
    - Insufficient collection system

MASTER STORMWATER MANAGEMENT PLAN
IMPROVEMENTS EVALUATION CRITERIA

Drainage System Rehabilitation "DSR"

- **Improvements are Prioritized by the following components:**
  - Nature & Age of Improvement
  - Severity of Flooding (Building/Property/Road)
  - Frequency of Flooding
  - Number of Structures (Buildings/Property) Impacted

MASTER STORMWATER MANAGEMENT PLAN
IMPROVEMENTS EVALUATION CRITERIA

Capital Improvement Projects "MSMP" Component

Improve Challenged Systems

- **Types of Improvements**
  - Significant improvements to the City's stormwater drainage system that will address deficiencies within an area and improve Flood Control, Water Quality and/or Maintenance Operations. Improvements such as:
    - Increasing Stormwater Collection System Capacity
    - Providing Stormwater Management Facilities "Ponds" for flood control and Water Quality Improvements
  - The focus is on providing an Enhanced Stormwater Management System for the City.

MASTER STORMWATER MANAGEMENT PLAN
IMPROVEMENTS EVALUATION CRITERIA

Capital Improvement Projects "MSMP" Component

- **Improvements are Prioritized by the following components:**
  - **Flood Control** – **60%** of Project Score
    - Structure "Building" Flooding (50% of value)
    - Arterial Road Flooding (30% of Value)
    - Local Road Flooding (20% of Value)
  - **Surface Water Quality Improvements** – **20%** of Project Score
    - Stormwater Treatment that reduces Nitrogen (BMAP support)
  - **Operation & Maintenance Improvements** – **20%** of Project Score
    - Focuses on open systems (ditches & outfalls) and the need to reduce flow velocities (eliminate scour & sediment transport)

MASTER STORMWATER MANAGEMENT PLAN
IMPROVEMENTS EVALUATION CRITERIA

I. **Water Quantity – Flooding Type/Severity/Frequency (60%)**. Each project is evaluated based on the type of flooding, severity of flooding and frequency of flooding.

Local Roadway Flooding (20% of Water Quality Score):
Evaluation based on the Comp Plan LOS Criteria
5 yr Storm & < 3 in. (so any flooding that exceeds 3 in. at crown)

Arterial Road Flooding (30% of Water Quantity Score):
Evaluation based on the Comp Plan LOS Criteria
10 yr Storm & < 3 in. (so any flooding that exceeds 3 in. at crown)
25 yr Storm & < 6 in. (so any flooding that exceeds 6 in. at crown)
100 yr Storm & < 9 in. (so any flooding that exceeds 9 in. at crown)

Structure Flooding (50% of Water Quantity Score)
Evaluation based on the Comp Plan LOS Criteria
25 yr Storm & No Structure Flooding (so any structure that floods)
100 yr Storm & No structure Flooding (so any structure that floods)

MASTER STORMWATER MANAGEMENT PLAN
IMPROVEMENTS EVALUATION CRITERIA

II. **Water Quality – Potential to remove TMDL nutrients (20%).** Each project is evaluated based on its ability to provide water quality treatment for total nitrogen. Regional facilities that provide detention times greater than 21 days, or other forms of treatment proven to reduce TN concentrations to the LSJR will receive the highest score in this category. Analysis of the load and potential removal was conducted based on preliminary estimates for drainage area, land use, and preliminary treatment technology. This category is scored as follows:

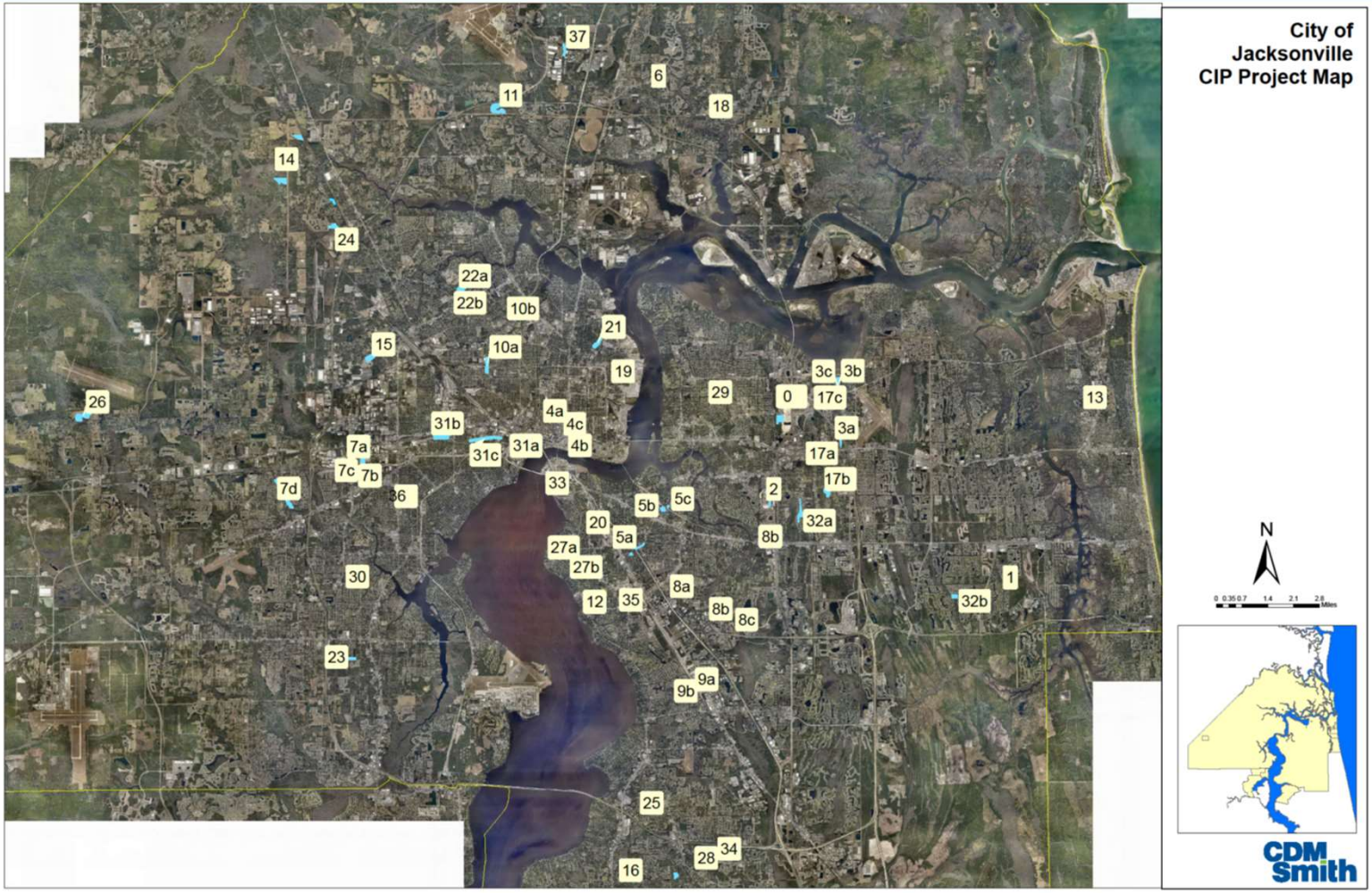
The scoring for this Goal is based on **the City's Main Stem BMAP need to provide for the Reduction of 20 Metric-Tons of Nitrogen per Year**. Consequently, each potential project was given a score based on the percent of the 20 MT of Nitrogen it will remove.

MASTER STORMWATER MANAGEMENT PLAN
IMPROVEMENTS EVALUATION CRITERIA

III. **Operations & Maintenance – Maintenance History (20%).** The City's Stormwater operation and maintenance efforts are most significantly impacted by the open drainage system components of our drainage system. This component is most adversely impacted by high stormwater flow with excessive velocities (more than 3 fps). The results of these excessive velocities is erosion (property scour), sediment transport downstream (adversely impacting natural creeks/tributaries/St. Johns River) and require significant on-going maintenance. Consequently, correcting these high velocities improves the City's Stormwater Management System and reduces operation and maintenance expenses.

The scoring for this Goal is based on eliminating the high flow velocities within open drainage systems. We have identified **432,278 LF of open drainage system in Jacksonville where the stormwater flow exceeds 3 fps**. Consequently, each potential project was given a score based on the percent of LF reduction.

MASTER STORMWATER MANAGEMENT PLAN
IMPROVEMENT OPPORTUNITIES



MASTER STORMWATER MANAGEMENT PLAN
IMPROVEMENTS

9/18/20

Stormwater Utility Capital Improvement Projects
Recently Completed, Active and Proposed for FY 20/21

CURRENT ACTIVE STORMWATER CAPITAL PROJECTS		
PROJECT TITLE	STATUS	BUDGET
SAN MATEO PK/KRAFT RD DRAINAGE IMPRVMNTS (DSR)	Construction Completed - contract closeout	$200,000
LOWER EASTSIDE DRAINAGE	Construction Completed - contract closeout	$10,512,459
NEWTOWN DRAINAGE (MYRTLE & BEAVER)	Under Design - 10% Complete	$6,142,687
LAKESHORE DR (DSR) CAPITAL IMPROVEMENT	Final Design; advertise September 2020.	$860,000
OLD PLANK ROAD OUTFALL	Construction Completed - contract closeout	$4,953,248
LA SALLE STREET OUTFALL	Design complete - Advertise September 2020	$5,694,910
HERSCHEL STREET CULVERT (DSR)	Construction Completed - contract closeout	$935,000
KNIGHTS LANE DRAINAGE IMPROVEMENT (DSR)	Construction Completed - contract closeout	$550,000
ROMILY DRIVE (DSR) - CAPITAL IMPROVEMENTS (DSR)	Construction Completed - contract closeout	$345,000
ALIMACANI TRAIL - CAPITAL IMPROVEMENTS (DSR)	Construction Completed - contract closeout	$431,250
JULINGTON/CORMORANT-LORETTO,CONVEYAN&PD	On Hold - 15% Complete	$1,687,050
TROUT/MONCRIEF POND	On Hold - 15% Complete	$2,408,650
HYDE PARK CIRCLE CAP IMPROVEMENT (DSR)	Construction Complete - Pending Contract Closeout	$256,000
CASCADE ROAD CAP IMPROVEMENT (DSR)	Construction Completed - contract closeout	$210,000
HARE AVENUE DRAINAGE IMPROVEMENTS (DSR)	Construction Completed - contract closeout	$146,268
HOWALT COURT DRAINAGE IMPROVEMENTS (DSR)	Construction Completed - contract closeout	$49,411
LILLY ROAD DRAINAGE IMPROVEMENTS (DSR)	Construction Completed - contract closeout	$251,101
LONGVIEW DRIVE S. DRAINAGE IMPROVEMENTS (DSR)	currently being awarded.	$300,000
PONCE DE LEON AVENUE DRAINAGE IMPROVEMENTS (DSR)	Final Design; advertise in October 2020.	$175,000
SPRING STREET DRAINAGE IMPROVEMENTS (DSR)	Under construction - 90% complete	$330,000
THORNWOOD LANE DRAINAGE IMPROVEMENTS (DSR)	Construction Completed - contract closeout	$300,000
SUNBEAM ROAD DRAINAGE IMPROVEMENTS (DSR)	Phase 1 construction is Construction Completed - contract closeout	$495,000
VIA VALENCIA DRAINAGE IMPROVEMENTS Phase I and Phase II (DSR)	Construction Completed - contract closeout	$1,099,250
HAMILTON CIRCLE DRAINAGE IMPROVEMENTS	Construction Completed - contract closeout	$202,164
COLLEN ROAD NORTH DRAINAGE IMPROVEMENTS (DSR)	Construction Completed - contract closeout	$190,000
GRANT AVENUE DRAINAGE IMPROVEMENTS (DSR)	Construction Completed - contract closeout	$201,000
PINEDALE AREA DRAINAGE IMPROVEMENTS	On Hold	$430,213
NOLAN STREET DRAINAGE IMPROVEMENTS (DSR)	Construction Completed - contract closeout	$250,000
McCoy's CREEK POND C	Construction Completed - contract closeout	$1,936,228
DRAINAGE SYSTEM REHAB - CAPITAL MAINTENANCE (DSR)	County-wide Projects at various stages of Completion	$4,200,000
Gaskins Road (DSR)	Final Design; advertise September 2020.	$350,000
Cedar Forest (DSR)	Construction Completed - contract closeout	$150,000
	Total:	**$45,741,889**
Active Design Project		
Design Complete - Construction Pending - Active Construction		

PROPOSED FY 19/20 STORMWATER CAPITAL PROJECTS		
PROJECT TITLE	Budget	FY 20/21
Burnett Park Road (DSR) - Capital Improvement	$500,000	$500,000
Free Avenue (DSR) - Capital Improvement	$254,000	$254,000
Irving Scott Drive (DSR) - Capital Improvement	$161,000	$161,000
Ponce De Leon (DSR) - Capital Improvement	$210,000	$210,000
San Jose Boulevard (DSR) - Capital Improvement	$205,000	$205,000
San Marie Drive (DSR) - Capital Improvement	$153,000	$153,000
Springrove Street (DSR) - Capital Improvement	$815,000	$815,000
Drainage System Rehab Capital Improvements - ENG (DSR)	$140,106,775	$256,000
Drainage System Rehab Capital Maintenance - RWSWMD (DSR)	$156,050,775	$4,200,000
Stormwater Pump Stations - Capital Maintenance	$1,050,000	$150,000
Dunn/Caney (Sapp Road Wet Detention)	$7,636,849	$3,571,188
Stormwater Projects Development & Feasibility Studies	$1,500,000	$250,000
		$10,725,188

STORM RESILIENCY & HARDENING EFFORTS **BACKGROUND**

Mayor's Storm Resiliency & Infrastructure Development Review Committee (SRAIDRC)

- Initiated by the Jacksonville Waterways Commission, August 2018
- Immediate or near-term solutions to flooding, tidal impacts, and water levels
- Convened from February – June 2019
- Identified the need for a Long-Term Strategy to ensure Infrastructure Resiliency in the Future
- Included Study Funding ($500K) within the FY 19/20 Budget CIP "**Storm Resiliency & Hardening**"

STORM RESILIENCY & HARDENING EFFORTS
BACKGROUND

COJ Resiliency Analysis & Design Implementation

STORM RESILIENCY and HARDENING

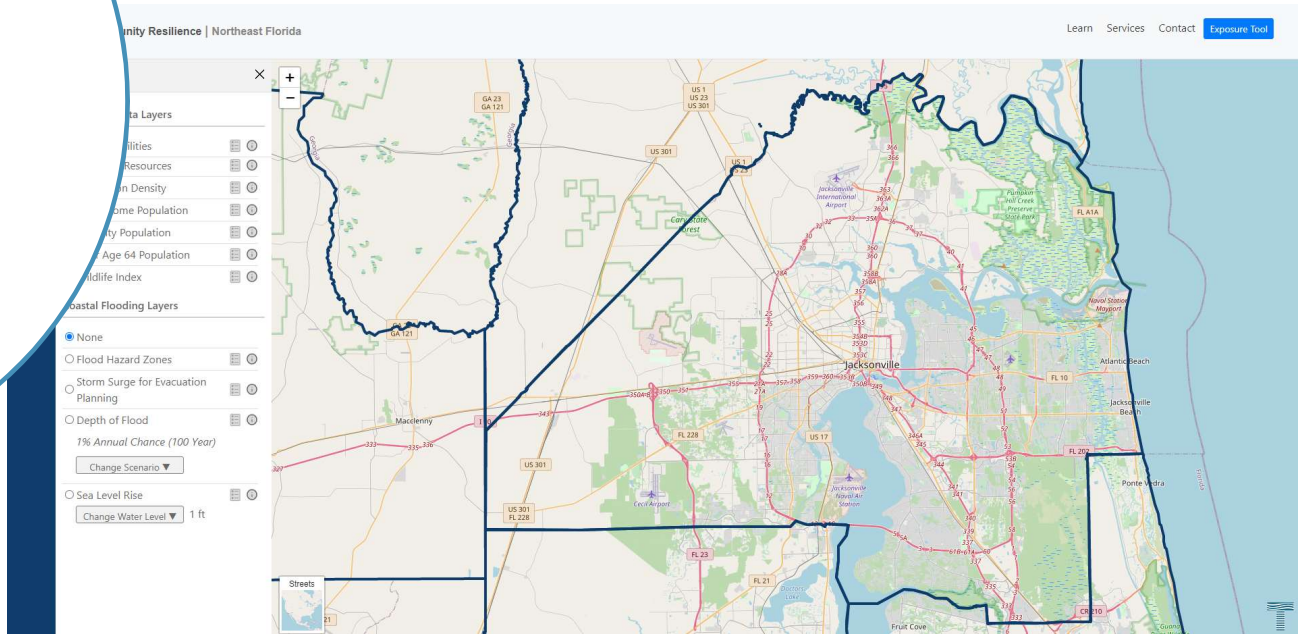
- Funding Allocation:
  - $500,000 in FY 19/20 CIP Budget
  - $75,000 funding allocated in FDEP Grant
- General Scope:
  - Determine Appropriate Design Standards for Jacksonville
  - Determine Critical Infrastructure for Jacksonville
  - Develop CIP Project Plan for Jacksonville

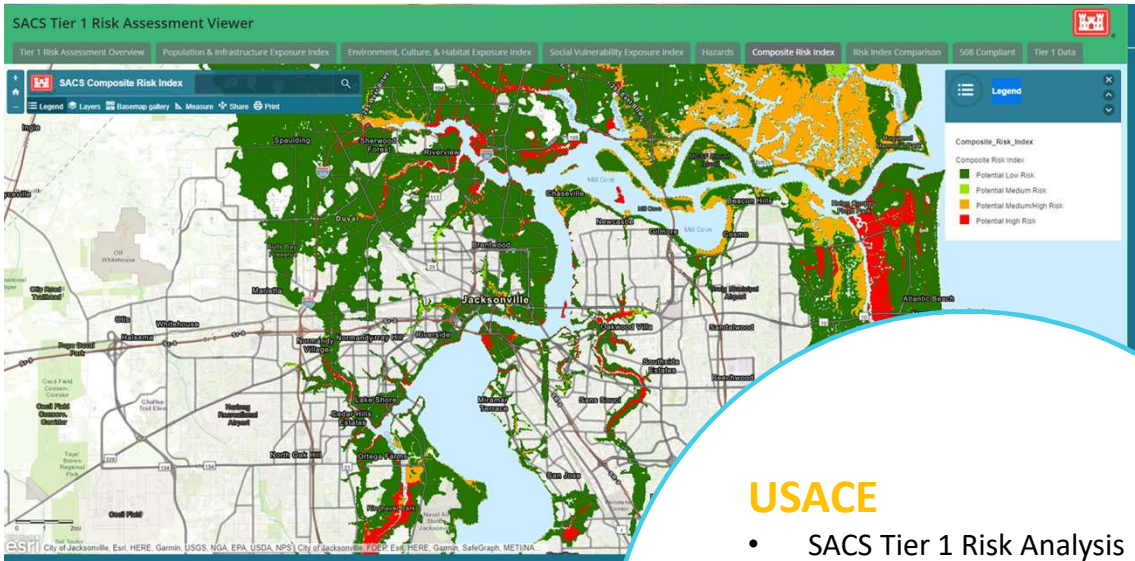
STORM RESILIENCY & HARDENING EFFORTS
SCOPE FOCUS

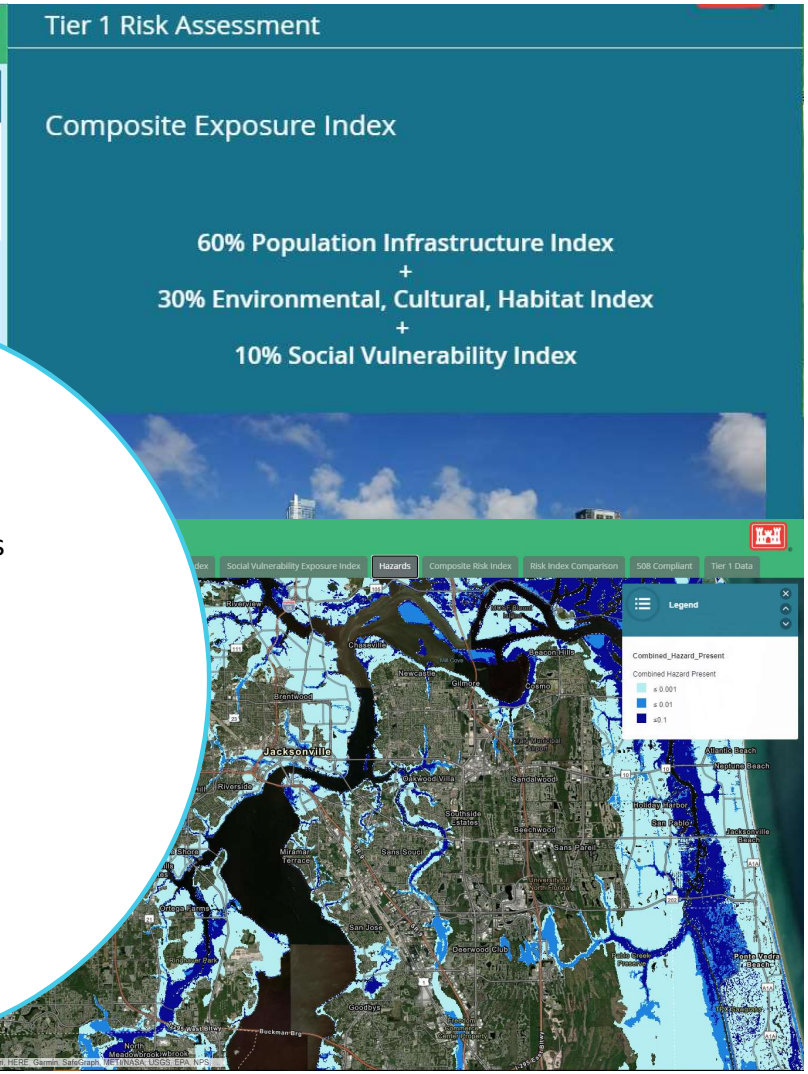
- Planning – Future Climate projections (2040/2070/2100)…near-term/mid-term/long-term
  - Sea Level Rise
  - Rainfall Precipitation Intensity-Duration & Frequency (5yr/10yr/25yr/100yr events)
- Determine appropriate Design Criteria
- Inventory Critical Infrastructure & Prioritize
  - Roads
  - Drainage
  - Bulkheads
  - Structures (Buildings)
- Develop prioritized Capital Improvement Project plan (5yr, 10yr, 25yr & 50yr)

Northeast Florida Regional Council

- Regional Resilience Exposure GIS Tool (R2ET)
- Vulnerable populations
- Env and Cultural assets
- Sea Level Rise (1-6ft)
- 10 to 100-yr storm events
- Hurricane-based surge events
- St Johns River







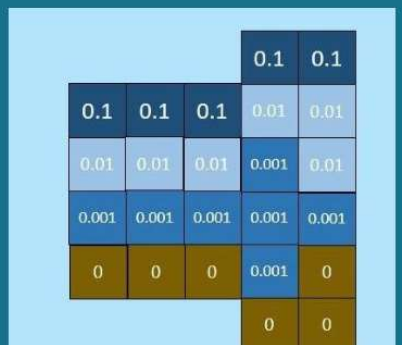
USACE

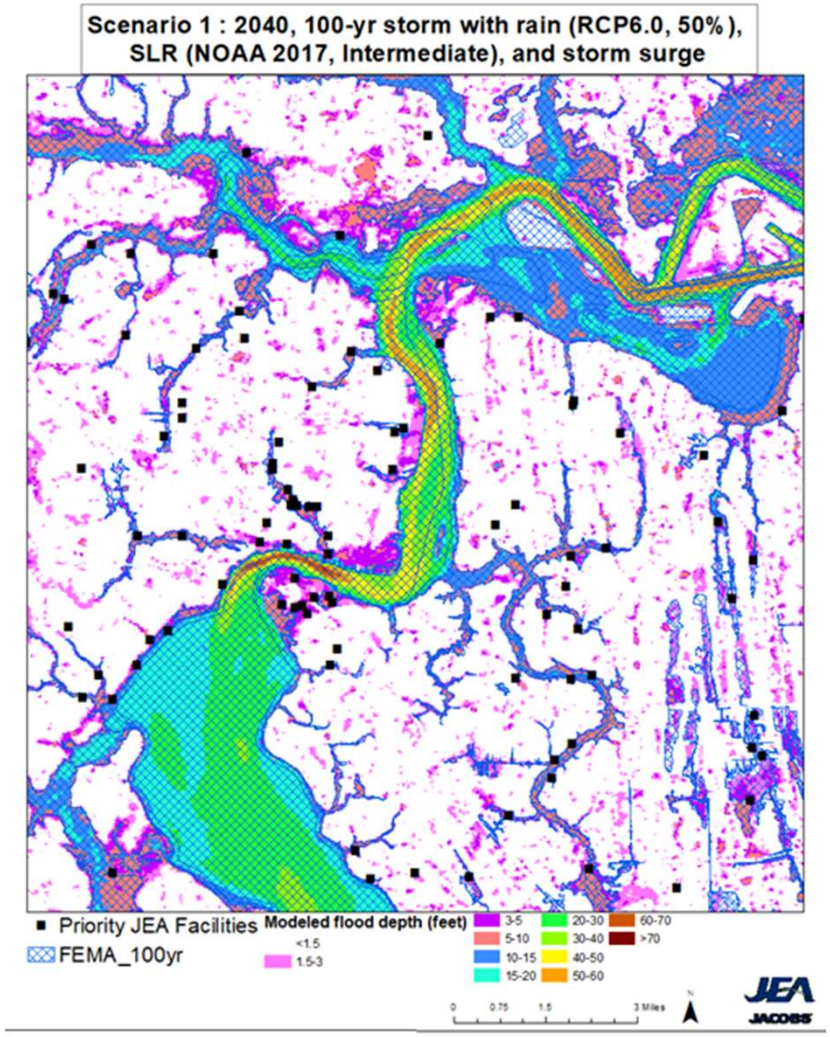
- SACS Tier 1 Risk Analysis
- Infrastructure density
- Population density
- Env and Cultural assets
- Vulnerable populations
- Sea level rise (3ft)
- 100-yr storm event
- 10-yr surge event

Hazard Index

- **10% Annual Chance Water Levels** - USACE Engineering Research Center (ERDC) - Statistical analysis of Tide Gauge Data
  - Probability .1
- **1% Annual Chance Water Levels** - FEMA National Flood Hazard L
  - Probability .01
- **Category 5 Maximum of Maximums (MOM)** - NOAA National Stor Maps, SLOSH Model.
  - Probability .001

Hazard Grids intersected to create a combined hazard grid:





JEA

- JEA Resiliency Analysis
- JEA assets
- Sea Level Rise (1-6ft)
- Future rainfall projections
- Future Surge Modeling
- St Johns River

Northeast Florida Regional Council

- Regional Resilience Exposure GIS Tool (R2ET)
- Vulnerable populations
- Env and Cultural assets
- Sea Level Rise (1-6ft)
- 10 to 100-yr storm events
- Hurricane-based surge events
- St Johns River

USACE

- SACS Tier 1 Risk Analysis
- Infrastructure density
- Population density
- Env and Cultural assets
- Vulnerable populations
- Sea level rise (3ft)
- 100-yr storm event
- 10-yr surge event

JEA

- JEA Resiliency Analysis
- JEA assets
- Sea Level Rise (1-6ft)
- Future rainfall projections
- Future Surge Modeling
- St Johns River

Northeast Florida Regional Council

- Regional Resilience Exposure GIS Tool (R2ET)
- **Vulnerable populations**
- **Env and Cultural assets**
- **Sea Level Rise (1-6ft)**
- 10 to 100-yr storm events
- Hurricane-based surge events
- St Johns River

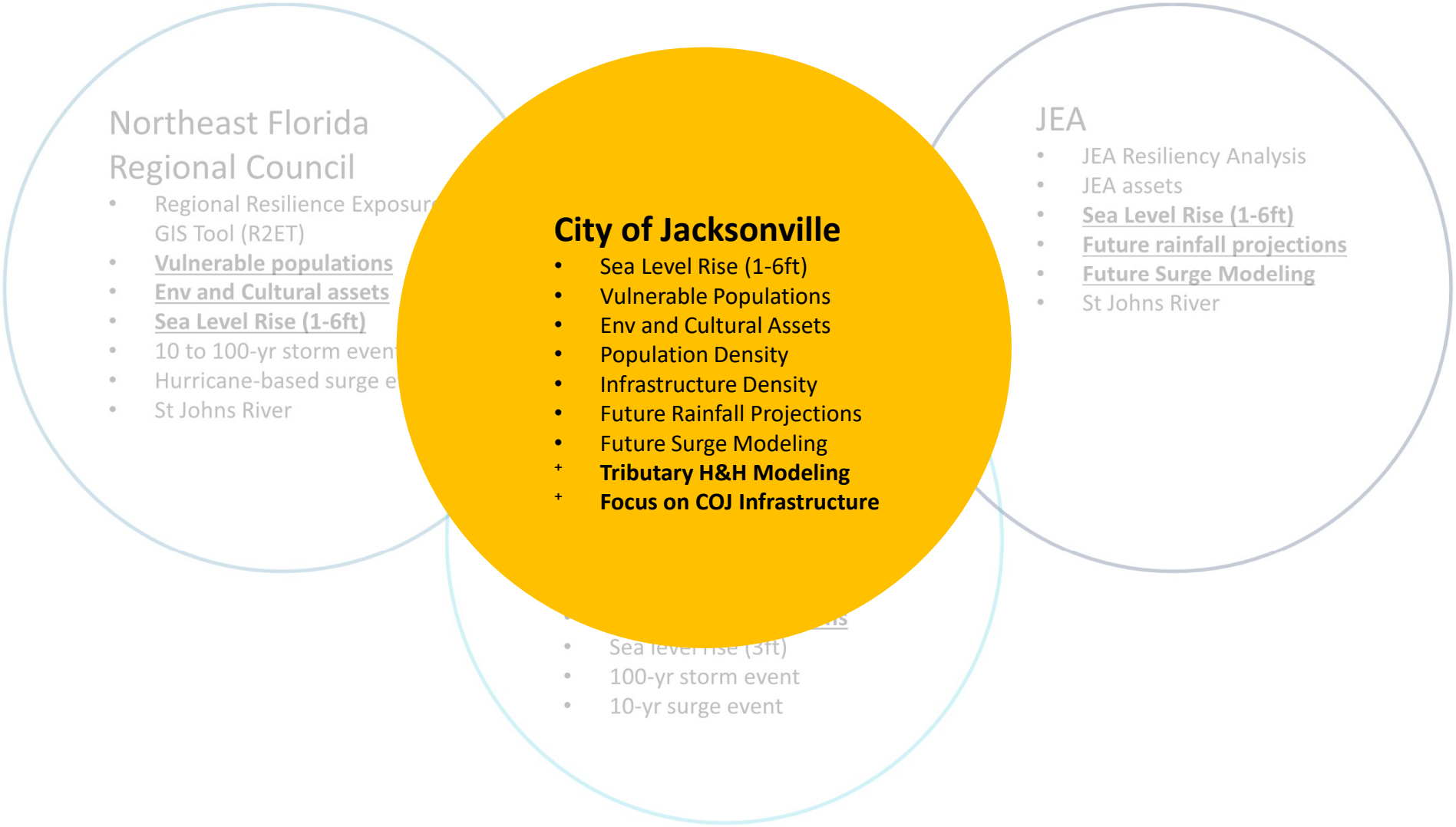
USACE SACS Tier 1

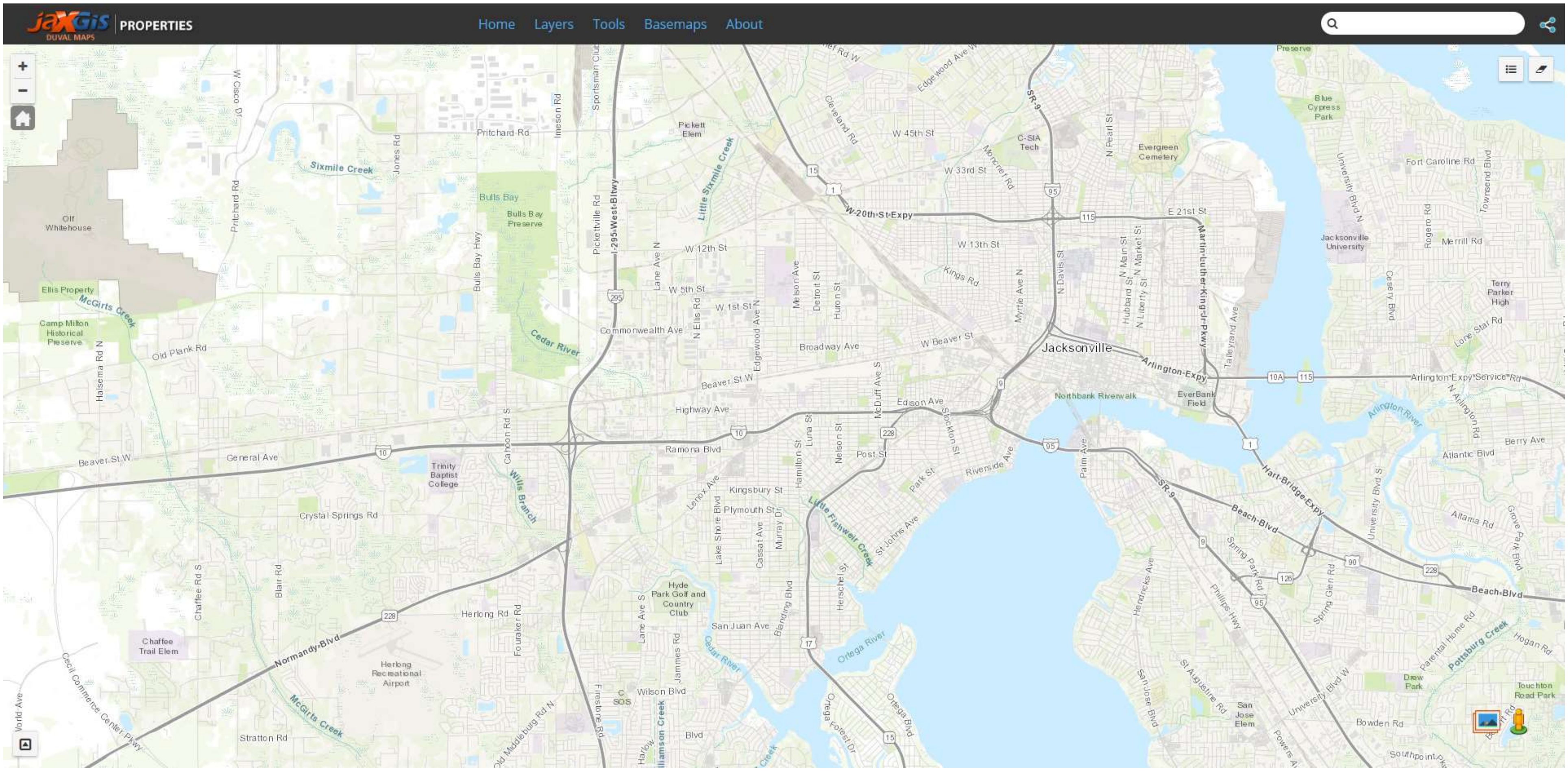
- SACS Tier 1 Risk Analysis
- **Infrastructure density**
- **Population density**
- **Env and Cultural assets**
- **Vulnerable populations**
- Sea level rise (3ft)
- 100-yr storm event
- 10-yr surge event

JEA

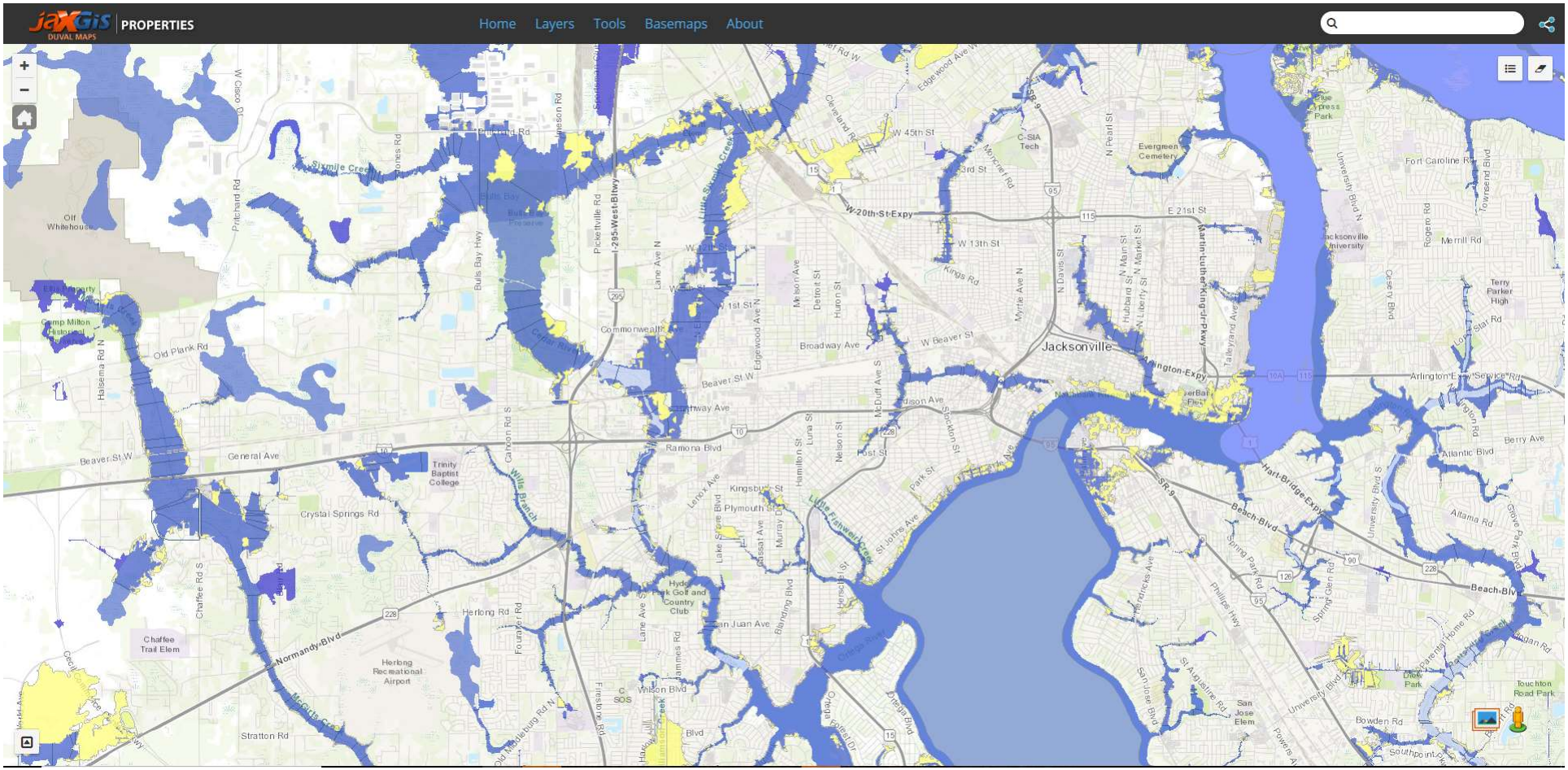
- JEA Resiliency Analysis
- JEA assets
- **Sea Level Rise (1-6ft)**
- **Future rainfall projections**
- **Future Surge Modeling**
- St Johns River


Northeast Florida Regional Council
Regional Resilience Exposur
GIS Tool (R2ET)
Vulnerable populations
Env and Cultural assets
Sea Level Rise (1-6ft)
10 to 100-yr storm even
Hurricane-based surge e
St Johns River
City of Jacksonville
Sea Level Rise (1-6ft)
Vulnerable Populations
Env and Cultural Assets
Population Density
Infrastructure Density
Future Rainfall Projections
Future Surge Modeling
JEA
JEA Resiliency Analysis
JEA assets
Sea Level Rise (1-6ft)
Future rainfall projections
Future Surge Modeling
St Johns River
Sea level rise (3ft)
100-yr storm event
10-yr surge event


Northeast Florida Regional Council
• Regional Resilience Exposur
GIS Tool (R2ET)
• Vulnerable populations
• Env and Cultural assets
• Sea Level Rise (1-6ft)
• 10 to 100-yr storm even
• Hurricane-based surge e
• St Johns River
City of Jacksonville
• Sea Level Rise (1-6ft)
• Vulnerable Populations
• Env and Cultural Assets
• Population Density
• Infrastructure Density
• Future Rainfall Projections
• Future Surge Modeling
+ Tributary H&H Modeling
+ Focus on COJ Infrastructure
• Sea level rise (3ft)
• 100-yr storm event
• 10-yr surge event
JEA
• JEA Resiliency Analysis
• JEA assets
• Sea Level Rise (1-6ft)
• Future rainfall projections
• Future Surge Modeling
• St Johns River



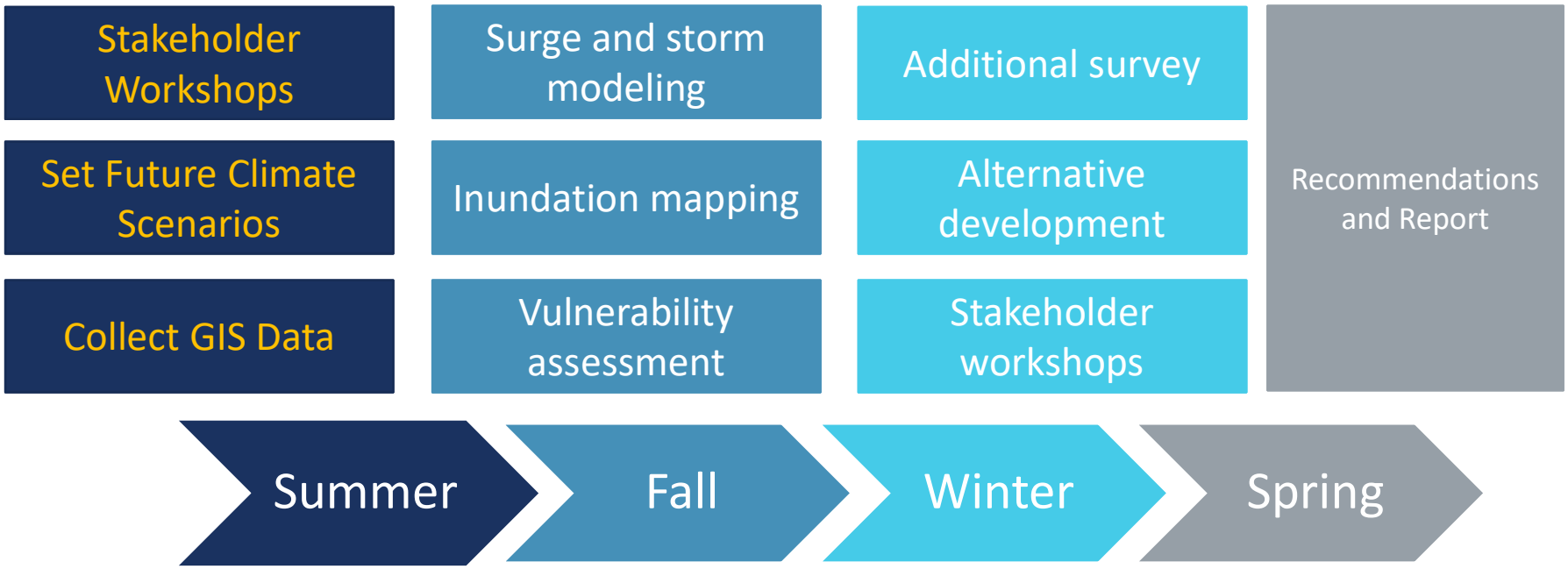
PROPERTIES
Home
Layers
Tools
Basemaps
About
Jacksonville
Sixmile Creek
Pritchard Rd
Bulls Bay
Bulls Bay Preserve
Cedar River
Old Plank Rd
Beaver St W
General Ave
Crystal Springs Rd
Normandy Blvd
Herlong Rd
Herlong Recreational Airport
Trinity Baptist College
Ellis Property
Camp Milton Historical Preserve
Chaffee Trail Elem
Stratton Rd
W 45th St
W 33rd St
W 20th St Expy
W 13th St
W 12th St
W 5th St
W 1st St
Commonwealth Ave
Broadway Ave
W Beaver St
Highway Ave
Ramona Blvd
Edison Ave
Post St
Kingsbury St
Plymouth St
Riverside Ave
St Johns Ave
San Juan Ave
Hyde Park Golf and Country Club
Wilson Blvd
Ortega River
Northbank Riverwalk
EverBank Field
Arlington Expy
Arlington River
Hart Bridge Expy
Beach Blvd
Atlantic Blvd
Jacksonville University
Fort Caroline Rd
Merrill Rd
Evergreen Cemetery
Bowden Rd
San Jose Elem
Touchton Road Park


JaxGIS DUVAL MAPS
PROPERTIES
Home
Layers
Tools
Basemaps
About
Jacksonville
Beaver St W
General Ave
Old Plank Rd
Crystal Springs Rd
Normandy Blvd
Herlong Rd
Stratton Rd
Ramona Blvd
Broadway Ave
W Beaver St
Kings Rd
W 13th St
W 45th St
W 20th St Expy
I-295 West Bltwy
Pritchard Rd
Bulls Bay Hwy
Pickettville Rd
Lane Ave N
Edgewood Ave N
Myrtle Ave N
N Davis St
Hubbard St
N Main St
N Market St
N Liberty St
Martin Luther King Jr Pkwy
Talleyrand Ave
Arlington Expy
Arlington Expy/Service Rd
Atlantic Blvd
Berry Ave
Beach Blvd
Hart Bridge Expy
SR 9
Altama Rd
Spring Park Rd
Spring Glen Rd
Phillips Hwy
San Jose Blvd
St Augustine Rd
University Blvd N
University Blvd S
Fort Caroline Rd
Townsend Blvd
Merrill Rd
Roger Rd
Casey Blvd
Terry Parker High
Lone Star Rd
Touchton Road Park
Bowden Rd
Southpoint
Evergreen Cemetery
C-TEC Tech
Jacksonville University
Blue Cypress Park
Trinity Baptist College
Chaffee Trail Elem
Herlong Recreational Airport
Hyde Park Golf and Country Club
Camp Milton Historical
Off Whitehouse
Sixmile Creek
Little Sixmile Creek
Wills Branch
Little Fishweir Creek
Cedar River
Cleveland Rd
Commonwealth Ave
Broadway Ave
Lenox Ave
Kingsbury St
Plymouth St
Lake Shore Blvd
Hamilton St
Luna St
Nelson St
McDuff Ave S
Stockton St
Post St
Park St
St Johns Ave
Murray Hill
Blanding Blvd
Henrietta St
San Juan Ave
Lane Ave
Jammes Rd
Firestone Rd
Wilson Blvd
Old Middleburg Rd N
Chaffee Rd S
Canon Rd S
Halsema Rd N
Edgewood Ave
Detroit St
Huron St
Melson Ave
Ortega Blvd
Emerson Expy
Ortega River
Cedar River
Hardee Park
Ortega Park
Ortega Forest
Ortega Forest Dr
Ortega Blvd
Ortega Hill
Hardee Hill
Ortega Hill Dr
Ortega Forest Dr
Ortega Forest Blvd
Ortega Forest Ln
Ortega Forest Ct
Ortega Forest Cir
Ortega Forest Pl
Ortega Forest Way
Ortega Forest Trail
Ortega Forest Path
Ortega Forest Loop
Ortega Forest Run
Ortega Forest Walk
Ortega Forest Drive
Ortega Forest Boulevard
Ortega Forest Lane
Ortega Forest Court
Ortega Forest Circle
Ortega Forest Place
Ortega Forest Terrace
Ortega Forest Crossing
Ortega Forest Parkway
Ortega Forest Highway
Ortega Forest Expressway
Ortega Forest Freeway
Ortega Forest Turnpike
Ortega Forest Tollway
Ortega Forest Bypass
Ortega Forest Beltway
Ortega Forest Ring
Ortega Forest Circle
Ortega Forest Square
Ortega Forest Plaza
Ortega Forest Mall
Ortega Forest Center
Ortega Forest Hub
Ortega Forest Junction
Ortega Forest Intersection
Ortega Forest Crossroads
Ortega Forest Roundabout
Ortega Forest Traffic Circle
Ortega Forest Rotary
Ortega Forest Interchange
Ortega Forest Overpass
Ortega Forest Underpass
Ortega Forest Bridge
Ortega Forest Tunnel
Ortega Forest Viaduct
Ortega Forest Aqueduct
Ortega Forest Causeway
Ortega Forest Boardwalk
Ortega Forest Pier
Ortega Forest Wharf
Ortega Forest Dock
Ortega Forest Marina
Ortega Forest Harbor
Ortega Forest Port
Ortega Forest Airport
Ortega Forest Heliport
Ortega Forest Seaplane Base
Ortega Forest Spaceport
Ortega Forest Launch Pad
Ortega Forest Runway
Ortega Forest Taxiway
Ortega Forest Apron
Ortega Forest Hangar
Ortega Forest Control Tower
Ortega Forest Terminal
Ortega Forest Gate
Ortega Forest Concourse
Ortega Forest Baggage Claim
Ortega Forest Customs
Ortega Forest Immigration
Ortega Forest Security
Ortega Forest Checkpoint
Ortega Forest Boarding
Ortega Forest Departure
Ortega Forest Arrival
Ortega Forest Transfer
Ortega Forest Connection
Ortega Forest Layover
Ortega Forest Stopover
Ortega Forest Destination
Ortega Forest Origin
Ortega Forest Route
Ortega Forest Flight
Ortega Forest Trip
Ortega Forest Journey
Ortega Forest Voyage
Ortega Forest Cruise
Ortega Forest Tour
Ortega Forest Excursion
Ortega Forest Adventure
Ortega Forest Expedition
Ortega Forest Quest
Ortega Forest Mission
Ortega Forest Operation
Ortega Forest Campaign
Ortega Forest Project
Ortega Forest Program
Ortega Forest Initiative
Ortega Forest Plan
Ortega Forest Strategy
Ortega Forest Tactic
Ortega Forest Method
Ortega Forest Technique
Ortega Forest Procedure
Ortega Forest Process
Ortega Forest System
Ortega Forest Network
Ortega Forest Infrastructure
Ortega Forest Framework
Ortega Forest Architecture
Ortega Forest Design
Ortega Forest Model
Ortega Forest Prototype
Ortega Forest Simulation
Ortega Forest Test
Ortega Forest Experiment
Ortega Forest Trial
Ortega Forest Evaluation
Ortega Forest Assessment
Ortega Forest Review
Ortega Forest Audit
Ortega Forest Inspection
Ortega Forest Survey
Ortega Forest Study
Ortega Forest Research
Ortega Forest Analysis
Ortega Forest Report
Ortega Forest Document
Ortega Forest Publication
Ortega Forest Book
Ortega Forest Article
Ortega Forest Paper
Ortega Forest Thesis
Ortega Forest Dissertation
Ortega Forest Abstract
Ortega Forest Summary
Ortega Forest Conclusion
Ortega Forest Recommendation
Ortega Forest Suggestion
Ortega Forest Proposal
Ortega Forest Request
Ortega Forest Application
Ortega Forest Form
Ortega Forest Permit
Ortega Forest License
Ortega Forest Certificate
Ortega Forest Diploma
Ortega Forest Degree
Ortega Forest Qualification
Ortega Forest Skill
Ortega Forest Ability
Ortega Forest Talent
Ortega Forest Gift
Ortega Forest Blessing
Ortega Forest Curse
Ortega Forest Spell
Ortega Forest Magic
Ortega Forest Wizard
Ortega Forest Witch
Ortega Forest Sorcerer
Ortega Forest Enchantress
Ortega Forest Warlock
Ortega Forest Necromancer
Ortega Forest Demon
Ortega Forest Angel
Ortega Forest Ghost
Ortega Forest Spirit
Ortega Forest Soul
Ortega Forest Mind
Ortega Forest Body
Ortega Forest Heart
Ortega Forest Brain
Ortega Forest Lung
Ortega Forest Liver
Ortega Forest Kidney
Ortega Forest Stomach
Ortega Forest Intestine
Ortega Forest Colon
Ortega Forest Rectum
Ortega Forest Anus
Ortega Forest Penis
Ortega Forest Vagina
Ortega Forest Uterus
Ortega Forest Ovary
Ortega Forest Testicle
Ortega Forest Prostate
Ortega Forest Breast
Ortega Forest Nipple
Ortega Forest Milk
Ortega Forest Blood
Ortega Forest Sweat
Ortega Forest Tear
Ortega Forest Saliva
Ortega Forest Urine
Ortega Forest Feces
Ortega Forest Vomit
Ortega Forest Semen
Ortega Forest Sperm
Ortega Forest Egg
Ortega Forest Embryo
Ortega Forest Fetus
Ortega Forest Baby
Ortega Forest Child
Ortega Forest Teenager
Ortega Forest Adult
Ortega Forest Elderly
Ortega Forest Old Person
Ortega Forest Corpse
Ortega Forest Skeleton
Ortega Forest Bone
Ortega Forest Skull
Ortega Forest Rib
Ortega Forest Spine
Ortega Forest Pelvis
Ortega Forest Femur
Ortega Forest Tibia
Ortega Forest Fibula
Ortega Forest Patella
Ortega Forest Humerus
Ortega Forest Radius
Ortega Forest Ulna
Ortega Forest Carpal
Ortega Forest Metacarpal
Ortega Forest Phalanx
Ortega Forest Tarsal
Ortega Forest Metatarsal
Ortega Forest Phalanx
Ortega Forest Clavicle
Ortega Forest Scapula
Ortega Forest Sternum
Ortega Forest Coccyx
Ortega Forest Sacrum
Ortega Forest Vertebra
Ortega Forest Cervical
Ortega Forest Thoracic
Ortega Forest Lumbar
Ortega Forest Sacral
Ortega Forest Coccygeal
Ortega Forest Atlas
Ortega Forest Axis
Ortega Forest Odontoid
Ortega Forest Process
Ortega Forest Foramen
Ortega Forest Canal
Ortega Forest Groove
Ortega Forest Notch
Ortega Forest Fossa
Ortega Forest Facet
Ortega Forest Condyle
Ortega Forest Tubercle
Ortega Forest Trochanter
Ortega Forest Epicondyle
Ortega Forest Crest
Ortega Forest Line
Ortega Forest Tuberosity
Ortega Forest Head
Ortega Forest Neck
Ortega Forest Shaft
Ortega Forest Diaphysis
Ortega Forest Epiphysis
Ortega Forest Metaphysis
Ortega Forest Periosteum
Ortega Forest Endosteum
Ortega Forest Marrow
Ortega Forest Cartilage
Ortega Forest Ligament
Ortega Forest Tendon
Ortega Forest Muscle
Ortega Forest Fascia
Ortega Forest Aponeurosis
Ortega Forest Retinaculum
Ortega Forest Bursa
Ortega Forest Synovium
Ortega Forest Joint
Ortega Forest Articulation
Ortega Forest Suture
Ortega Forest Gomphosis
Ortega Forest Syndesmosis
Ortega Forest Synchondrosis
Ortega Forest Symphysis
Ortega Forest Diarthrosis
Ortega Forest Amphiarthrosis
Ortega Forest Synarthrosis
Ortega Forest Hinge
Ortega Forest Pivot
Ortega Forest Ball and Socket
Ortega Forest Saddle
Ortega Forest Condyloid
Ortega Forest Plane
Ortega Forest Gliding
Ortega Forest Rotation
Ortega Forest Flexion
Ortega Forest Extension
Ortega Forest Abduction
Ortega Forest Adduction
Ortega Forest Circumduction
Ortega Forest Pronation
Ortega Forest Supination
Ortega Forest Inversion
Ortega Forest Eversion
Ortega Forest Dorsiflexion
Ortega Forest Plantarflexion
Ortega Forest Opposition
Ortega Forest Reposition
Ortega Forest Elevation
Ortega Forest Depression
Ortega Forest Protraction
Ortega Forest Retraction
Ortega Forest Lateral Flexion
Ortega Forest Medial Rotation
Ortega Forest Lateral Rotation
Ortega Forest Horizontal Abduction
Ortega Forest Horizontal Adduction
Ortega Forest Vertical Abduction
Ortega Forest Vertical Adduction
Ortega Forest Diagonal Abduction
Ortega Forest Diagonal Adduction
Ortega Forest Combined Movements
Ortega Forest Range of Motion
Ortega Forest Active Motion
Ortega Forest Passive Motion
Ortega Forest Resistive Motion
Ortega Forest Assistive Motion
Ortega Forest Isometric Contraction
Ortega Forest Isotonic Contraction
Ortega Forest Concentric Contraction
Ortega Forest Eccentric Contraction
Ortega Forest Isokinetic Contraction
Ortega Forest Plyometric Contraction
Ortega Forest Ballistic Contraction
Ortega Forest Static Contraction
Ortega Forest Dynamic Contraction
Ortega Forest Tonic Contraction
Ortega Forest Phasic Contraction
Ortega Forest Twitch Contraction
Ortega Forest Tetanic Contraction
Ortega Forest Clonic Contraction
Ortega Forest Spasm
Ortega Forest Cramp
Ortega Forest Tremor
Ortega Forest Fasciculation
Ortega Forest Myoclonus
Ortega Forest Dystonia
Ortega Forest Chorea
Ortega Forest Athetosis
Ortega Forest Ballismus
Ortega Forest Tic
Ortega Forest Stereotypy
Ortega Forest Dyskinesia
Ortega Forest Akathisia
Ortega Forest Parkinsonism
Ortega Forest Bradykinesia
Ortega Forest Hypokinesia
Ortega Forest Akinesia
Ortega Forest Rigidity
Ortega Forest Cogwheel Rigidity
Ortega Forest Lead Pipe Rigidity
Ortega Forest Postural Instability
Ortega Forest Gait Disturbance
Ortega Forest Festinating Gait
Ortega Forest Shuffling Gait
Ortega Forest Freezing Gait
Ortega Forest Ataxia
Ortega Forest Dysmetria
Ortega Forest Dysdiadochokinesia
Ortega Forest Intention Tremor
Ortega Forest Rebound Phenomenon
Ortega Forest Hypotonia
Ortega Forest Hypertonia
Ortega Forest Spasticity
Ortega Forest Clasp-Knife Response
Ortega Forest Hyperreflexia
Ortega Forest Hyporeflexia
Ortega Forest Areflexia
Ortega Forest Babinski Sign
Ortega Forest Clonus
Ortega Forest Hoffman Sign
Ortega Forest Tromner Sign
Ortega Forest Chaddock Sign
Ortega Forest Oppenheim Sign
Ortega Forest Gordon Sign
Ortega Forest Schaefer Sign
Ortega Forest Mendel-Bechterew Sign
Ortega Forest Rossolimo Sign
Ortega Forest Hoffmann-Tinel Sign
Ortega Forest Phalen Sign
Ortega Forest Durkan Sign
Ortega Forest Carpal Tunnel Syndrome
Ortega Forest Cubital Tunnel Syndrome
Ortega Forest Radial Tunnel Syndrome
Ortega Forest Pronator Teres Syndrome
Ortega Forest Anterior Interosseous Syndrome
Ortega Forest Posterior Interosseous Syndrome
Ortega Forest Guyon Canal Syndrome
Ortega Forest Thoracic Outlet Syndrome
Ortega Forest Scalenus Anticus Syndrome
Ortega Forest Costoclavicular Syndrome
Ortega Forest Hyperabduction Syndrome
Ortega Forest Pectoralis Minor Syndrome
Ortega Forest Quadrangular Space Syndrome
Ortega Forest Suprascapular Nerve Entrapment
Ortega Forest Long Thoracic Nerve Palsy
Ortega Forest Dorsal Scapular Nerve Palsy
Ortega Forest Axillary Nerve Palsy
Ortega Forest Musculocutaneous Nerve Palsy
Ortega Forest Median Nerve Palsy
Ortega Forest Ulnar Nerve Palsy
Ortega Forest Radial Nerve Palsy
Ortega Forest Brachial Plexus Injury
Ortega Forest Erb's Palsy
Ortega Forest Klumpke's Palsy
Ortega Forest Horner's Syndrome
Ortega Forest Pancoast Tumor
Ortega Forest Superior Sulcus Tumor
Ortega Forest Apical Lung Cancer
Ortega Forest Mediastinal Tumor
Ortega Forest Thymoma
Ortega Forest Lymphoma
Ortega Forest Hodgkin's Disease
Ortega Forest Non-Hodgkin's Lymphoma
Ortega Forest Leukemia
Ortega Forest Acute Lymphoblastic Leukemia
Ortega Forest Acute Myeloid Leukemia
Ortega Forest Chronic Lymphocytic Leukemia
Ortega Forest Chronic Myeloid Leukemia
Ortega Forest Hairy Cell Leukemia
Ortega Forest Myelodysplastic Syndrome
Ortega Forest Myeloproliferative Disorder
Ortega Forest Polycythemia Vera
Ortega Forest Essential Thrombocythemia
Ortega Forest Primary Myelofibrosis
Ortega Forest Chronic Idiopathic Myelofibrosis
Ortega Forest Agnogenic Myeloid Metaplasia
Ortega Forest Myelofibrosis with Myeloid Metaplasia
Ortega Forest Myelofibrosis Secondary to Polycythemia Vera
Ortega Forest Myelofibrosis Secondary to Essential Thrombocythemia
Ortega Forest Myelofibrosis Secondary to Chronic Myeloid Leukemia
Ortega Forest Myelofibrosis Secondary to Myelodysplastic Syndrome
Ortega Forest Myelofibrosis Secondary to Myeloproliferative Disorder
Ortega Forest Myelofibrosis Secondary to Leukemia
Ortega Forest Myelofibrosis Secondary to Lymphoma
Ortega Forest Myelofibrosis Secondary to Hodgkin's Disease
Ortega Forest Myelofibrosis Secondary to Non-Hodgkin's Lymphoma
Ortega Forest Myelofibrosis Secondary to Thymoma
Ortega Forest Myelofibrosis Secondary to Mediastinal Tumor
Ortega Forest Myelofibrosis Secondary to Apical Lung Cancer
Ortega Forest Myelofibrosis Secondary to Superior Sulcus Tumor
Ortega Forest Myelofibrosis Secondary to Pancoast Tumor
Ortega Forest Myelofibrosis Secondary to Horner's Syndrome
Ortega Forest Myelofibrosis Secondary to Erb's Palsy
Ortega Forest Myelofibrosis Secondary to Klumpke's Palsy
Ortega Forest Myelofibrosis Secondary to Brachial Plexus Injury
Ortega Forest Myelofibrosis Secondary to Radial Nerve Palsy
Ortega Forest Myelofibrosis Secondary to Ulnar Nerve Palsy
Ortega Forest Myelofibrosis Secondary to Median Nerve Palsy
Ortega Forest Myelofibrosis Secondary to Musculocutaneous Nerve Palsy
Ortega Forest Myelofibrosis Secondary to Axillary Nerve Palsy
Ortega Forest Myelofibrosis Secondary to Dorsal Scapular Nerve Palsy
Ortega Forest Myelofibrosis Secondary to Long Thoracic Nerve Palsy
Ortega Forest Myelofibrosis Secondary to Suprascapular Nerve Entrapment
Ortega Forest Myelofibrosis Secondary to Quadrangular Space Syndrome
Ortega Forest Myelofibrosis Secondary to Pectoralis Minor Syndrome
Ortega Forest Myelofibrosis Secondary to Hyperabduction Syndrome
Ortega Forest Myelofibrosis Secondary to Costoclavicular Syndrome
Ortega Forest Myelofibrosis Secondary to Scalenus Anticus Syndrome
Ortega Forest Myelofibrosis Secondary to Thoracic Outlet Syndrome
Ortega Forest Myelofibrosis Secondary to Guyon Canal Syndrome
Ortega Forest Myelofibrosis Secondary to Posterior Interosseous Syndrome
Ortega Forest Myelofibrosis Secondary to Anterior Interosseous Syndrome
Ortega Forest Myelofibrosis Secondary to Pronator Teres Syndrome
Ortega Forest Myelofibrosis Secondary to Radial Tunnel Syndrome
Ortega Forest Myelofibrosis Secondary to Cubital Tunnel Syndrome
Ortega Forest Myelofibrosis Secondary to Carpal Tunnel Syndrome

STORM RESILIENCY & HARDENING EFFORTS
RESULTS OF THE RESILIENCY STUDY

- Establish critical elevations for vulnerable infrastructure
- Develop inundation maps to see areas that are at risk in 2040 and 2070
- Potential CIP Projects:
  - Raise roadways and evacuation routes
  - Increased outfall sizes
  - Increase Stormwater Management Facility “Pond” size
  - Raising bulkheads
  - Green Infrastructure
  - Relocations and buy-outs
  - Land use policy changes
  - Stormwater/flood policy changes
  - Updated design standards for future conditions

STORM RESILIENCY & HARDENING EFFORTS
STATUS



DEPARTMENT OF PUBLIC WORKS
SUMMARY

- **Maintain the City's Existing Infrastructure**
  - Operations & Maintenance
  - DSR…Bulkhead…Bridges
- **Determine appropriate "New" Design Standards**
  - Storm Resiliency & Hardening Study
- **Identify Critical Infrastructure**
  - Storm Resiliency & Hardening Study
- **Prioritize Capital Improvements Projects**
  - Storm Resiliency & Hardening Study
- **Implement Prioritized Capital Improvement Plan**

Department of Public Works
CIP Resilience Priorities

Thank You

City Council Resiliency Subcommittee – Infrastructure &
Continuity of Operations for Essential Services
November 13, 2020