VULNERABILITY ASSESSMENT OF OSTDS TO SEA LEVEL RISE AND STORM SURGE TO DEVELOP ADAPTATION PLANS IN ST. AUGUSTINE, FL

PRESENTATION TO FLORIDA WATER & CLIMATE ALLIANCE

WEBINAR – SEPTEMBER 20, 2021

CITY OF ST. AUGUSTINE - JESSICA BEACH, P.E., CHIEF RESILIENCE OFFICER
WILDWOOD CONSULTING, INC. - TRICIA KYZAR, PHD, SPATIAL ANALYST/PROJECT MANAGER
INTRODUCTION

• GRANT FUNDED PROJECT THROUGH FDEP’S FLORIDA RESILIENT COASTLINES PROGRAM (FRCP)
  ✓ $75,000 FULLY FUNDED GRANT

• IN PARTNERSHIP WITH THE UNIVERSITY OF FLORIDA
  ✓ DR. TRICIA KYZAR (FORMERLY PHD CANDIDATE - DEPT. OF URBAN AND REGIONAL PLANNING)
  ✓ DR. EBAN BEAN, P.E., PRINCIPAL INVESTIGATOR - DEPT. OF AGRICULTURAL AND BIOLOGICAL ENGINEERING

• PROJECT DURATION – OCTOBER 2020 – JUNE 2021
WHAT IS THE PROJECT?

• PROJECT TASKS
  ✓ ASSESS THE VULNERABILITY OF IDENTIFIED ONSITE TREATMENT AND DISPOSAL SYSTEMS (OSTDS) TO MULTIPLE CLIMATE CHANGE RELATED PARAMETERS
  ✓ CALCULATE NITROGEN EXPORTS UNDER CURRENT CONDITIONS USING ARCNLET
  ✓ REPORT ON STATE OF WASTEWATER TREATMENT (WWT) TECHNOLOGIES
    o COSTS AND FUNDING OPPORTUNITIES
  ✓ PRESENT FINDINGS TO THE PUBLIC
    o IDENTIFYING AREAS THAT ARE SUITABLE FOR STRATEGIC PLANNING INITIATIVES BECAUSE THEY ARE AT RISK OF SLR, STORM SURGE, ELEVATED GROUNDWATER TABLES AND/OR SOILS NOT SUITABLE FOR SEPTIC EFFLUENT PROCESSING
Data Acquisition

- Property Appraisal CAMA
- Sanitary Soils
- Sea Level Rise
- High Tide Flooding
- Storm Surge
- Groundwater Elevation
- FDOH FWMI
- Digital Elevation Model
- Groundwater N
- SSURGO Database
- National Hydrography Data

- DOR Use Code Homestead Exemption Status Subdivisions
- Location of Sanitary Soil Ratings
- 1-foot 2-foot 3-foot SLR Inundation depth
- Areas of Potential High Tide Flooding
- Potential Storm Surge Depths
- Historical Record of GW Levels
- Septic system locations
- Topographical Elevation
- Historical Record of N Levels in GW
- Hydraulic Conductivity Porosity
- Waterbodies

Vulnerability Assessment

- Vulnerability assessment scores for individual septic systems
- Average of vulnerability assessment scores for subdivisions
- Identification of hotspots and cold spots

ArcNLET Modeling

- Estimation of nitrogen loading to waterbodies
- Identification of contributing septic systems

Which septic systems have high vulnerability assessment scores (hotspots) and contribute to nitrogen loading?
## Risk Rating Values and Weights

<table>
<thead>
<tr>
<th>Risk Parameter</th>
<th>Low – 1</th>
<th>2</th>
<th>Medium - 3</th>
<th>4</th>
<th>High - 5</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm Surge (Hurricane) &amp; Elevation (ft.)</td>
<td>Cat 1 &amp; &gt; 10 ft.</td>
<td></td>
<td>Cat 1 &amp; 7-10 ft.</td>
<td></td>
<td>Cat 1 &amp; &lt; 7 ft.</td>
<td>20%</td>
</tr>
<tr>
<td>Soils</td>
<td>Slightly Limited</td>
<td></td>
<td>Moderately Limited</td>
<td></td>
<td>Severely Limited</td>
<td>30%</td>
</tr>
<tr>
<td>Rise in Groundwater (in./yr)</td>
<td>1.5 in./yr</td>
<td>2.1 in./yr</td>
<td>2.7 in./yr</td>
<td>3.3 in./yr</td>
<td>3.8 in./yr</td>
<td>30%</td>
</tr>
<tr>
<td>Sea-level rise scenario (ft.)</td>
<td>3 ft.</td>
<td></td>
<td>2 ft.</td>
<td></td>
<td>1 ft.</td>
<td>20%</td>
</tr>
</tbody>
</table>

### Multi-Criteria Vulnerability Assessment / Indicator Based Vulnerability Assessment
VULNERABILITY ASSESSMENT

- HIGH SCORES = MORE VULNERABLE
- LOW SCORES = LESS VULNERABLE
HOTSPOT ANALYSIS

• ESRI’S HOTSPOT ANALYSIS TOOL
  • CALCULATES THE STATISTICAL SIGNIFICANCE OF THE CLUSTERING OF HIGH AND LOW VALUES
  • HIGH VALUES ARE HOT SPOTS
    • HIGH Z-VALUE AND LOW P-VALUE, CLUSTERING IS STATISTICALLY SIGNIFICANT
  • LOW VALUES ARE COLD SPOTS
    • LOW Z-VALUE AND LOW P-VALUE, CLUSTERING IS STATISTICALLY SIGNIFICANT
  • RESULTS ARE ‘BIN’D IN CONFIDENCE INTERVALS

<table>
<thead>
<tr>
<th></th>
<th>Cold Spot</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Hot Spot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cl</td>
<td>99%</td>
<td>95%</td>
<td>90%</td>
<td>0</td>
<td>90%</td>
<td>95%</td>
<td>99%</td>
</tr>
<tr>
<td>Bin</td>
<td>-3</td>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
HOT SPOT ANALYSIS

![Map showing hot spot analysis with counts for different Gi_Bin categories (3, 2, 1, 0, -1, -2, -3) and a bar chart showing the number of septic locations per Gi_Bin level.]
ARCNLET MODELING

• A TOOL USED IN ARCGIS DESKTOP SOFTWARE

• ESTIMATES NITROGEN OUTPUTS TO WATERBODIES FROM SOURCE LOCATIONS (OSTDS)

• INPUT DATA: DEM, HYDRAULIC CONDUCTIVITY, POROSITY, WATERBODIES, SOURCE LOCATIONS

• DEVELOPS A GROUNDWATER FLOW MODEL TO ESTIMATE NITRATE PLUMES AND LOAD ESTIMATES

  • PROJECT USED A SMOOTHING FACTOR OF 50, ALL OTHER DEFAULT SETTINGS

  • NO₃ ONLY
<table>
<thead>
<tr>
<th>Water Body ID</th>
<th>Waterbody Name</th>
<th>OSTDS Plumes to Reach Waterbody</th>
<th>Mass Output Load (lbs/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Salt Run</td>
<td>46</td>
<td>1,290.60</td>
</tr>
<tr>
<td>12</td>
<td>Stokes Creek</td>
<td>51</td>
<td>592.88</td>
</tr>
<tr>
<td>2</td>
<td>Oyster Creek (within Evergreen Cemetery)</td>
<td>29</td>
<td>380.97</td>
</tr>
<tr>
<td>5</td>
<td>San Sebastian River north of Red House Branch</td>
<td>4</td>
<td>114.86</td>
</tr>
<tr>
<td>8</td>
<td>San Sebastian River from ~Bernard St to Matanzas River</td>
<td>11</td>
<td>79.80</td>
</tr>
<tr>
<td>4</td>
<td>Red House Branch</td>
<td>5</td>
<td>45.44</td>
</tr>
<tr>
<td>7</td>
<td>San Sebastian River from ~Bella Vista Blvd to ~Bernard St</td>
<td>2</td>
<td>42.38</td>
</tr>
<tr>
<td>13</td>
<td>Wetland/Marsh areas off Casa Cola Creek</td>
<td>2</td>
<td>16.78</td>
</tr>
</tbody>
</table>
Estimate of Years to Inundation of Septic Drainfields by Rising Groundwater Elevations

Number of Septic Systems Estimated to be Inundated

<table>
<thead>
<tr>
<th>Estimated of Years to Inundation</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>[4, 9]</td>
<td>544</td>
</tr>
<tr>
<td>(9, 14)</td>
<td>447</td>
</tr>
<tr>
<td>(14, 19)</td>
<td>500</td>
</tr>
<tr>
<td>(19, 24)</td>
<td>347</td>
</tr>
<tr>
<td>(24, 29)</td>
<td>31</td>
</tr>
<tr>
<td>(29, 34)</td>
<td></td>
</tr>
<tr>
<td>(34, 39]</td>
<td></td>
</tr>
</tbody>
</table>

Estimate of Years to Groundwater Inundation of Septic Drainfields

- 4 - 9
- 9 - 14
- 14 - 19
- 19 - 24
- 24 - 29
- 29 - 34
- 34 - 39
- W/WW Service Area
KEY TAKEAWAYS

• VULNERABILITY ASSESSMENT PROVIDED CRITICAL NEW INFORMATION THAT REVEALED THREATS TO SOME LOCATIONS FROM STORM SURGE, HIGH TIDE FLOODING AND SEA LEVEL RISE

• ARCNLET MODELING PROVIDED CRITICAL NEW INFORMATION THAT REVEALED ESTIMATED NITROGEN EXPORTS BASED ON CURRENT CONDITIONS

• RISING GROUNDWATER IS THE CURRENT GREATEST THREAT IN THIS STUDY AREA
  • THE VALUES USED TO ESTIMATE GROUNDWATER RISE NEED TO BE VALIDATED WITH MORE MONITORING LOCATIONS (THERE IS A PROPOSAL OUT TO SUPPORT THIS)
IN SUMMARY

• PLANNING LEVEL TOOL TO HELP IDENTIFY AREAS TO TARGET UPGRADES TO EXISTING SEPTIC SYSTEMS

• COORDINATION WITH ST JOHNS COUNTY

• TARGET VARIOUS FUNDING OPTIONS IDENTIFIED TO ASSIST WITH THE UPGRADES

• MAKE THIS INFORMATION PUBLICALLY AVAILABLE

✓ STORYMAP:
  HTTPS://STORYMAPS.ARCGIS.COM/STORIES/B44A8EFFD9D943228125C48F2C0151DA

✓ SUBMIT PUBLIC COMMENTS AND INPUT TO STORMWATER@CITYSTAUG.COM
QUESTIONS AND DISCUSSION

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https://floridadep.gov/rcp/florida-resilient-coastlines-program