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From Urban Canal to Natural Stream: Utilizing Stream Restoration Concepts to Improve Water Quality, Habitat, and Resilience

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Outline

- Introduction to Urban Channels
- Overview of Joe's Creek Project
- Stream Restoration Project Approach
- Benefits of Stream Restoration
- Summary



Introduction to Urban Channels

Urban Channels and “Urban Stream Syndrome”

Largely impervious watershed

Flashy hydrograph

Scour, erosion, sedimentation

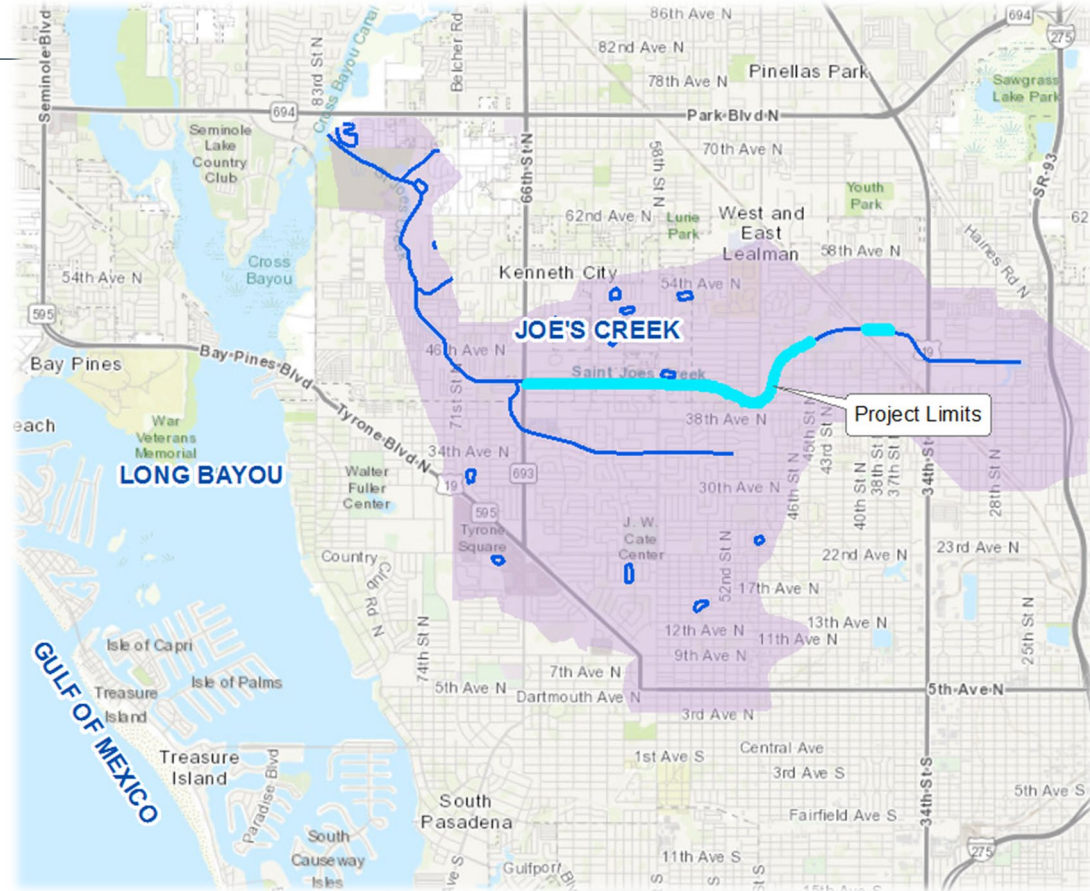
- Loss of floodplain function
- Reduced resilience to flooding
- Reduced habitat and biodiversity
- Bank failures and property loss
- Reduced nutrient attenuation
- High O&M costs

Urban Channels



Joe's Creek Channel 1

- Pinellas County Project
- Located near St. Petersburg, FL
- Approximately 2.5 miles of channelized creek
- Highly urbanized 9,250 acre watershed
- Remaining 3 miles of Joe's Creek extend to Long Bayou and Gulf of Mexico



Joe's Creek Channel Restoration Project

- Steep, tall, sandy banks
- Erosion and mass wasting after storm event
- Primary project goal = Bank Stabilization



Stream Restoration Project Approach

Approaches to Bank Stabilization

Hard Armor



Bank Slope Reduction

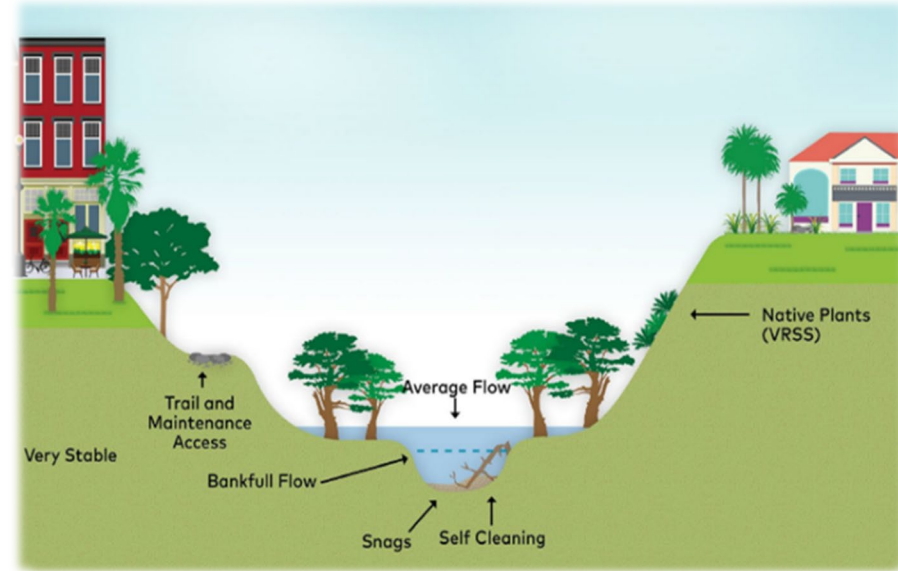


Natural Channel Stream Restoration



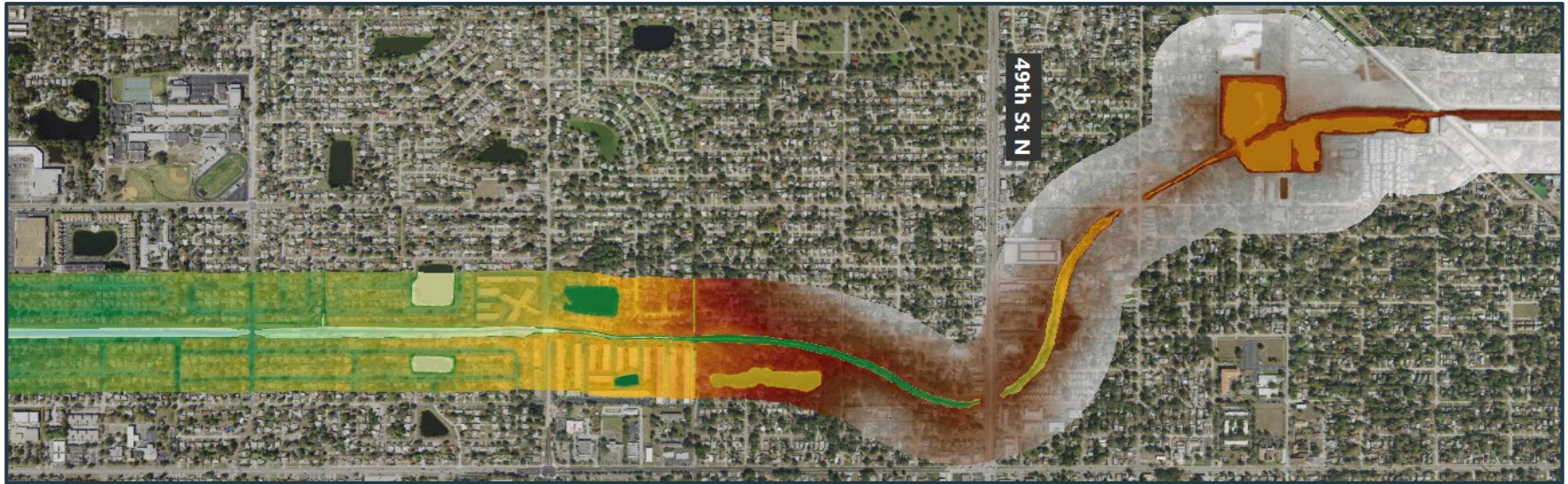
Natural Channel Design Stream Restoration

- Fit multi-stage channel into footprint of urban channel
- Floodplain creation and reconnection
 - Riparian habitat
 - Slows flows, reduces shear stresses
 - Treatment and recharge in wetlands
- Addition of meanders, pools, and riffles
 - Natural sediment sumps
 - Aquatic habitat creation
 - Nutrient reduction through hyporheic exchange



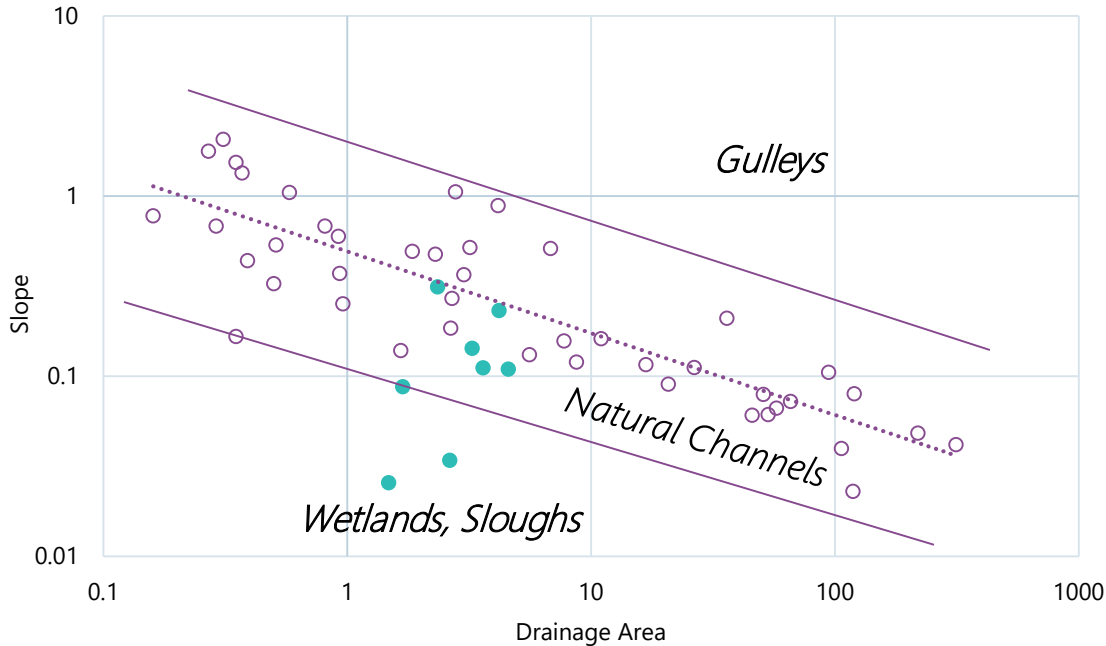
Will a natural stream fit your site conditions?

Stream restoration may be most desirable option, but may not always be possible



Will your site provide sufficient stream power?

Regional Empirical Equations (Kiefer et al. 2015)

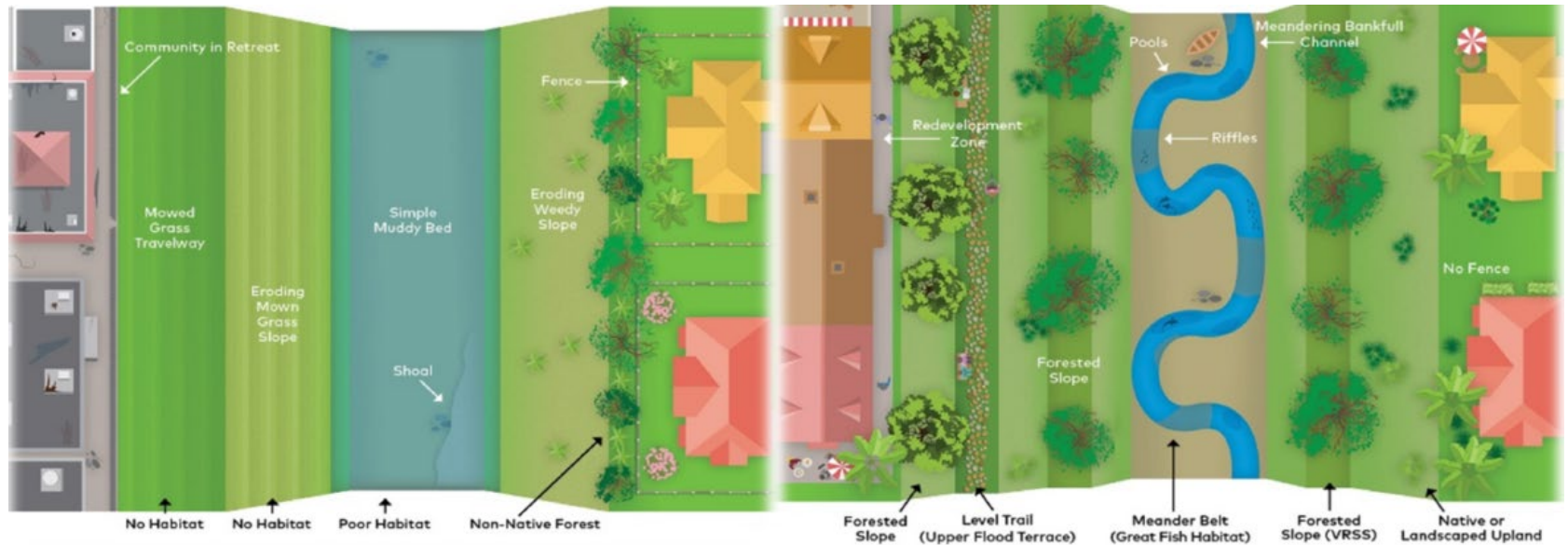


- Based on comprehensive survey of FL streams
- Estimate values required for self-sustaining channel based on site slopes and drainage areas
 - Floodplain geometry
 - Bankfull channel geometry



Does your site have room for the natural stream?

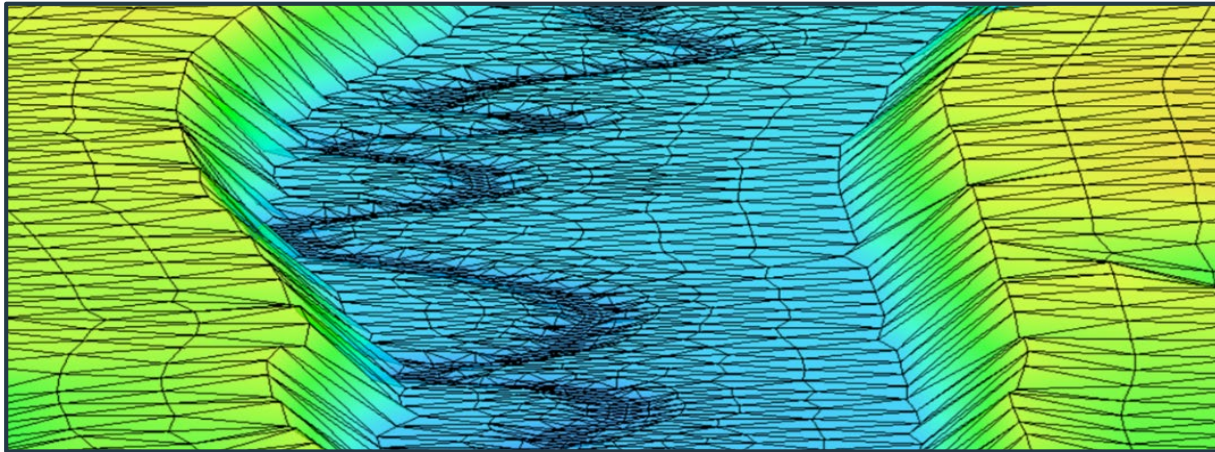
Account for ROW, utility conflicts, existing structures, conservation easements, and boundary conditions such as tie-in elevations



Modeling Designed Stream

2D Models for shear stresses and velocities

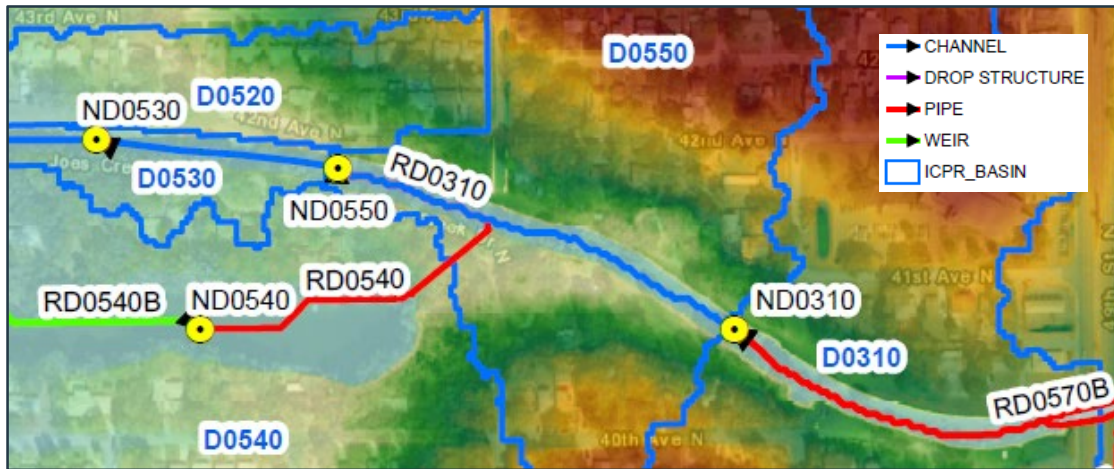
- Assess design/material requirements
- Compare multiple design alternatives
- Prioritize channel segments in need of restoration



Modeling Designed Stream

1D Models for flooding impacts

- Screen designs for adverse impacts and appropriate flow/stage
- Show flooding benefits of design
- Integrate design into existing municipal models



Benefits of Natural Channel Stream Restoration

Joe's Creek Conceptual Design Alternatives Comparison

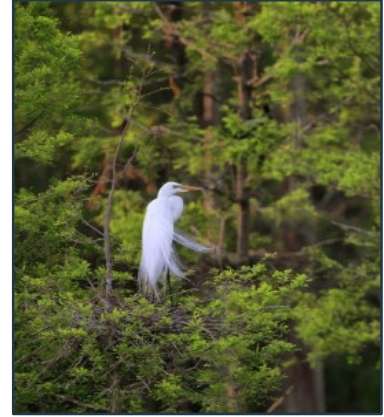
Stream Restoration chosen as preferred design

- Greatest reduction of modelled shear stresses
- Natural materials provided same resistance to stresses as hard armoring
- Provided most additional flood storage volume
- Cost comparable to hard armoring
- Provided the most additional benefits



Benefits of Stream Restoration

- Provide bank stabilization/reduce erosion and sedimentation
- Improve/create habitat
- Create recreational opportunities (kayaking, fishing, birdwatching)
- Reduce O&M needs/costs
- Reduce flooding impacts
- Improve resilience
- Substantial water quality improvement



Water Quality Improvements from Stream Restoration

- Joe's Creek is not currently impaired for nutrients, but:
 - Pinellas County wants to protect downstream waters
 - If watershed conditions change, a natural channel in Joe's Creek can mitigate many potential water quality impacts
- Can be one of the most cost-effective nutrient removal methods
 - Previous study showed TN reductions from 600-1200 lb TN/mile of restoration



Water Quality Credits for Stream Restoration as a BMP

- FDEP is supportive of water quality credits for stream restoration.
- Currently projects evaluated on case-by-case basis.
- Water quality monitoring data and focused study to estimate project specific load reductions.
- Wood, stakeholders, and FDEP working toward developing standardized categorical reductions for stream restoration projects.
- Joe's Creek is one of several demonstration projects to quantify benefits.



Summary

- Urban canals are subject to erosion, bank failure, and negative water quality, habitat, and flooding impacts.
- Stream restoration can address most issues associated with urban channels/streams.
- Project site needs to have right conditions, or stream will not be a self-maintaining natural channel.



Summary

- Stream restoration provides many ecological, social, and financial benefits.
- Where possible, stream restoration is a useful BMP for water quality and flood control.



wood.



Acknowledgements:

- Pinellas County
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- Southwest Florida Water Management District
- Florida Department of Environmental Protection

wood.

woodplc.com

What is Bankfull?

- Flow that fills a stable alluvial channel to the elevation of the active floodplain
- “Most effective streamflow for doing work that results in the average morphological characteristics of channels.” (Dunne & Leopold, 1978)
- Morphologically significant – represents **breakpoint between processes of channel formation (erosion) and floodplain formation (deposition)** (Copeland et al., 2000)

