Goldcrest Brook

A Case Study for Stormwater Management

Peter Dalrymple,
Stormwater Quality Monitoring Program Coordinator,
City of Salem

Presentation Outline

- Hydromodification (brief explanation)
- Goldcrest Brook (overview)
- Why Goldcrest Brook illustrates the importance of:
  - Rigorous design standards
  - Riparian buffers
  - Having accurate utility data

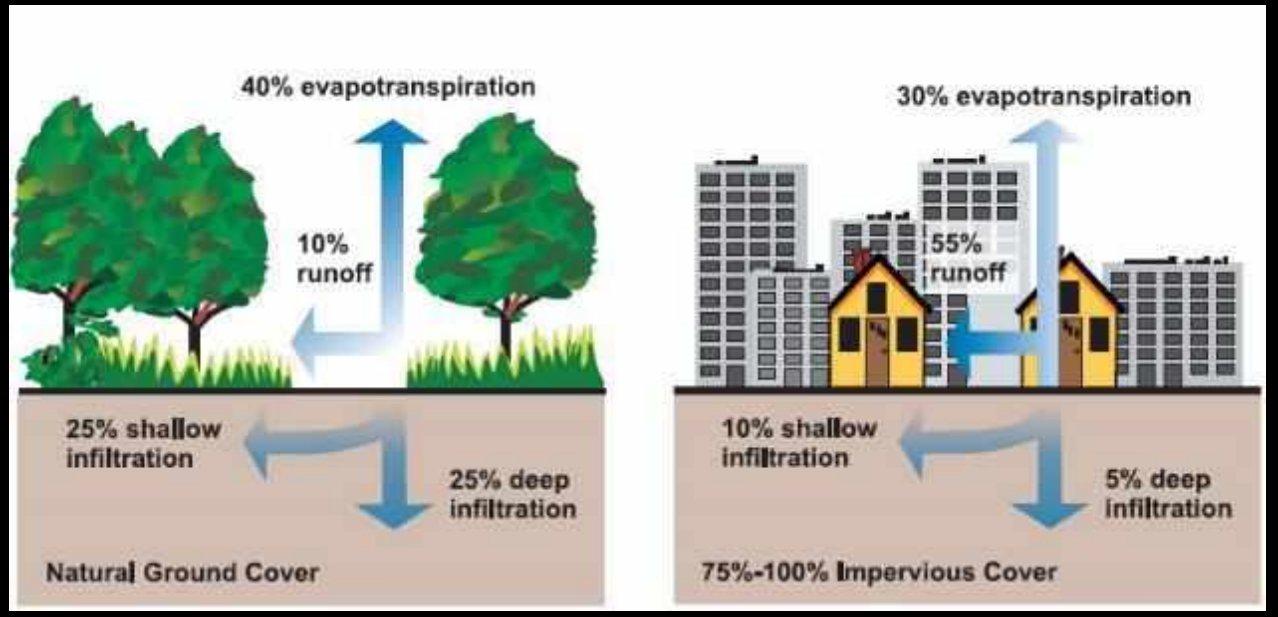
What is Hydromodification?

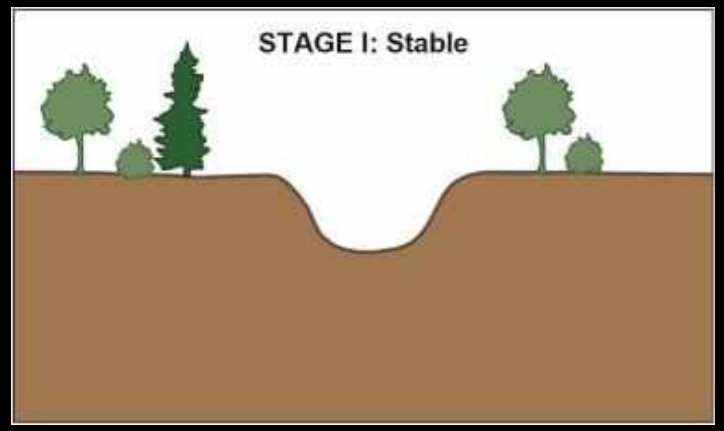
Blanket term for how alterations in land use change the hydrologic characteristics of streams.

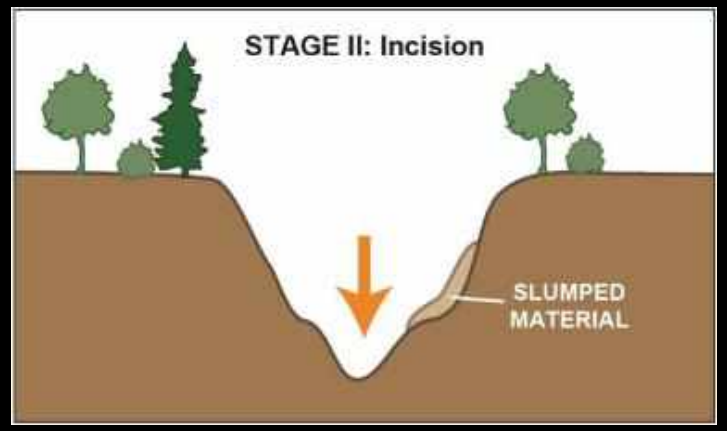
When we add impervious surface, we….

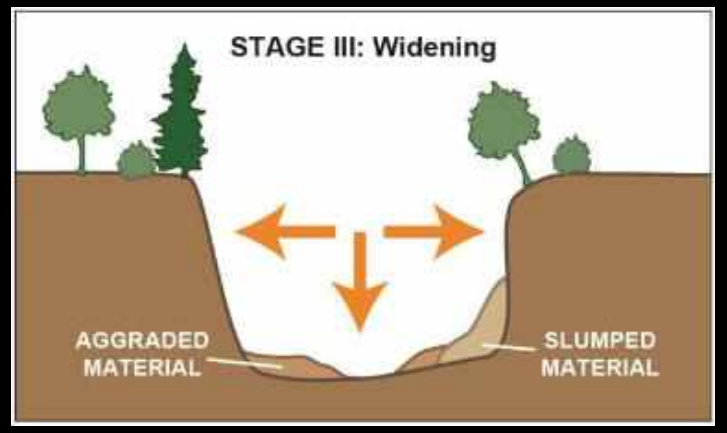
- Increase stormwater runoff by reducing infiltration, evapotranspiration, and interception
- Reduce coarse sediment supply by piping tributaries and capping supplies of coarse sediment

<u>This affects stream channels!</u>









Geomorphic Stages

Increased flows and/or decreased coarse sediment load in channels with adjustable beds starts a sequence of channel adjustments that begin with channel incision (downcutting).

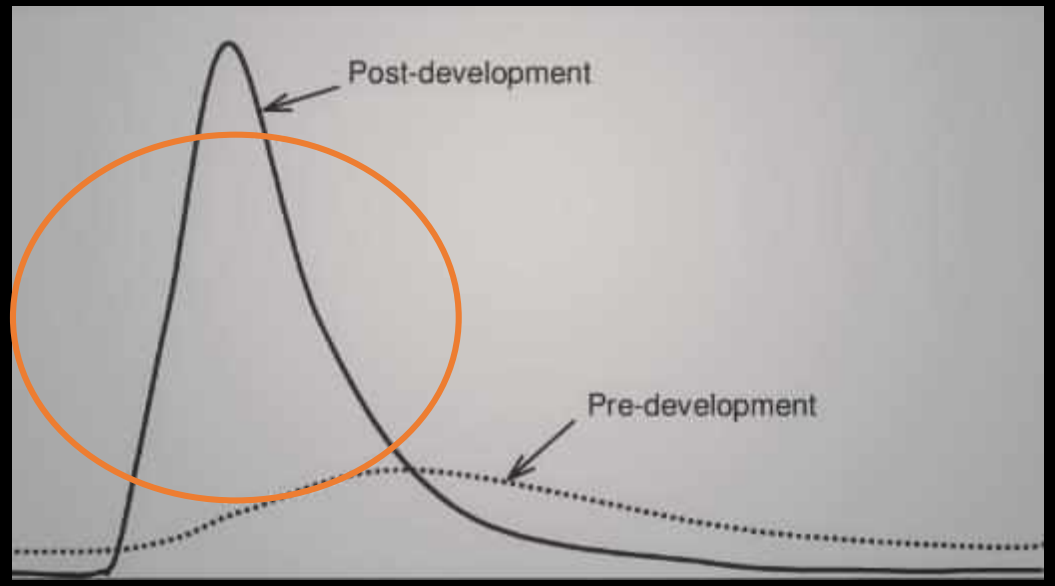
What's the big deal?

Decrease in:

- Channel stability
- Water quality
- Aquatic habitat
- Aesthetics

Increase in:

- Flooding risk
- Infrastructure risk
- Erosion
- Permit non-compliance



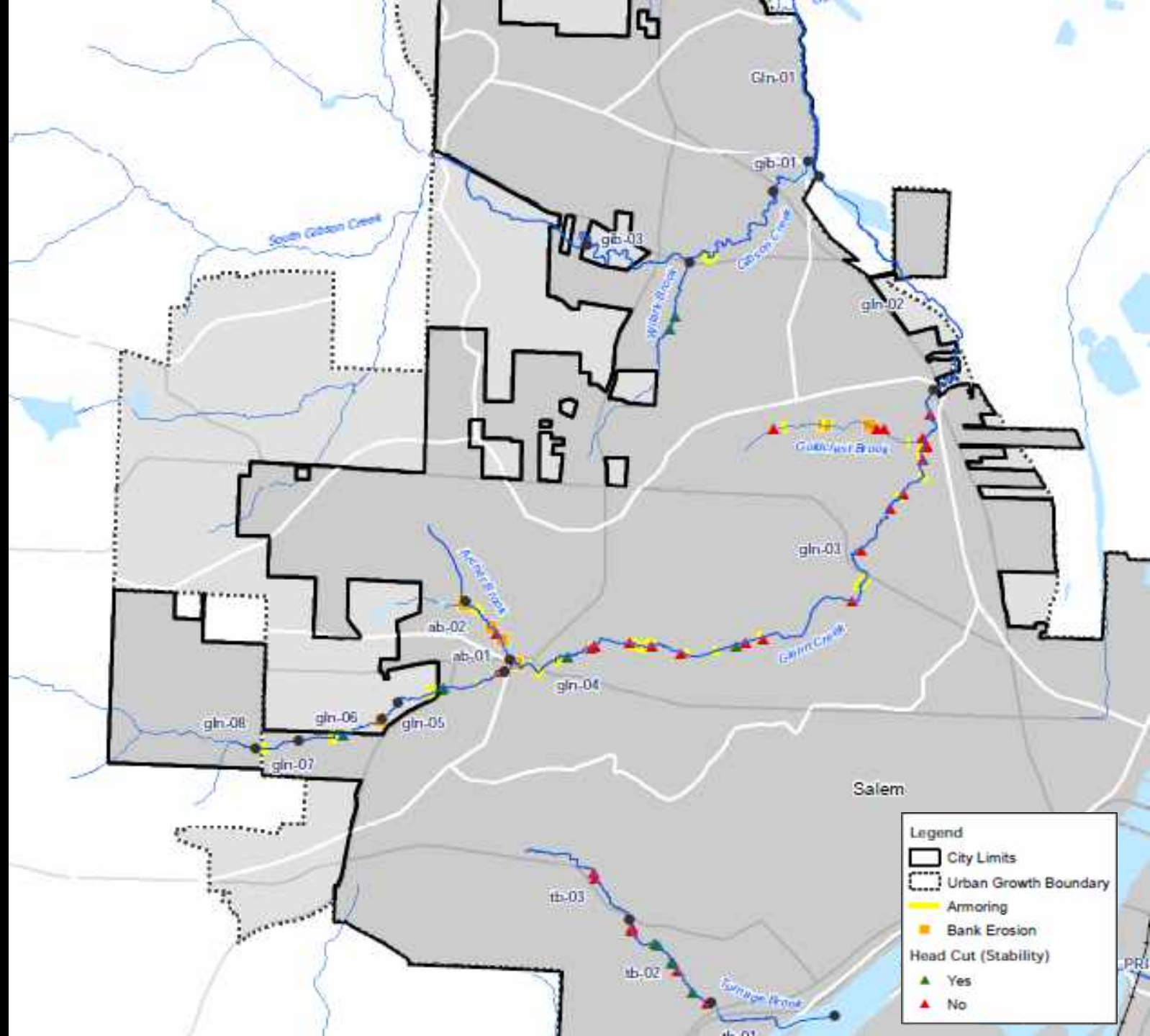
MS4 Permit - Hydromodification Assessment (2012)

Assess impacts of MS4 discharges, including erosion, sedimentation, and/or alteration to stormwater flow, volume and duration that may cause or contribute to water quality degradation.

MS4 Permit - Hydromodification Assessment (2012)

Collect data to inform future stormwater management decisions related to hydromodification based on local conditions and needs;

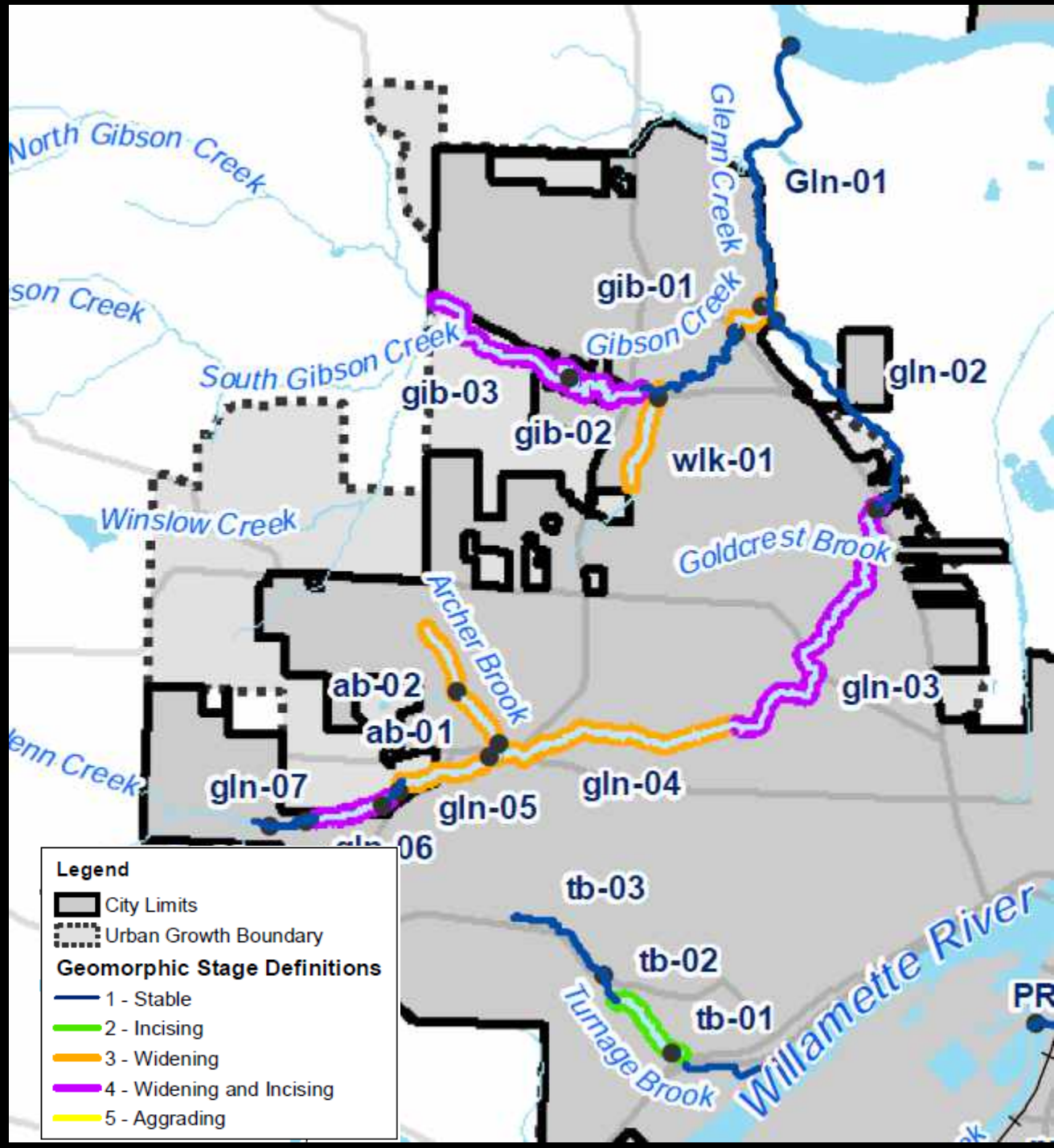
Identify/develop strategies to address hydromodification within the permittee's jurisdiction;



MS4 Permit - Hydromodification Assessment (2012)

Identify strategies and priorities for preventing or reducing hydromodification impacts related to the permittee's MS4 discharges; and,

Identify or develop effective tools to reduce hydromodification.



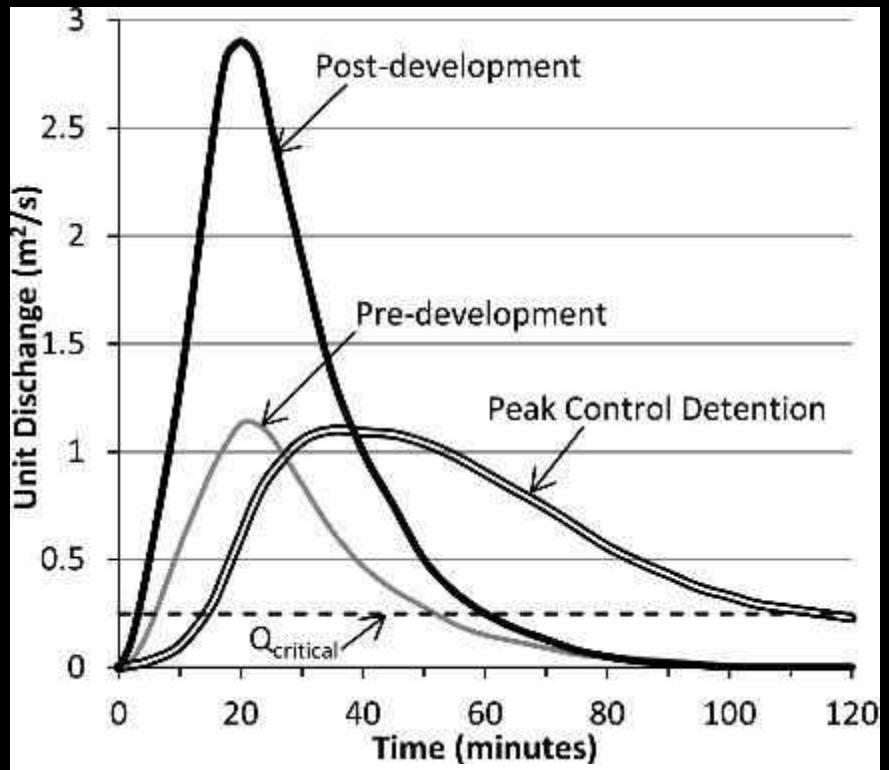
Update Design Standards

Old:

- Targeted flood prevention
- Did not necessarily prevent erosive flows
- May have even prolonged channel forming flows (effective discharge)

New:

- Detain erosive flows by retaining post-development flow
- Required discharge rate <= pre-developed discharge for 50% of 2-year, 24-hour storm
- Treatment of 80% Average Annual Rainfall
- Store 100-year storm event



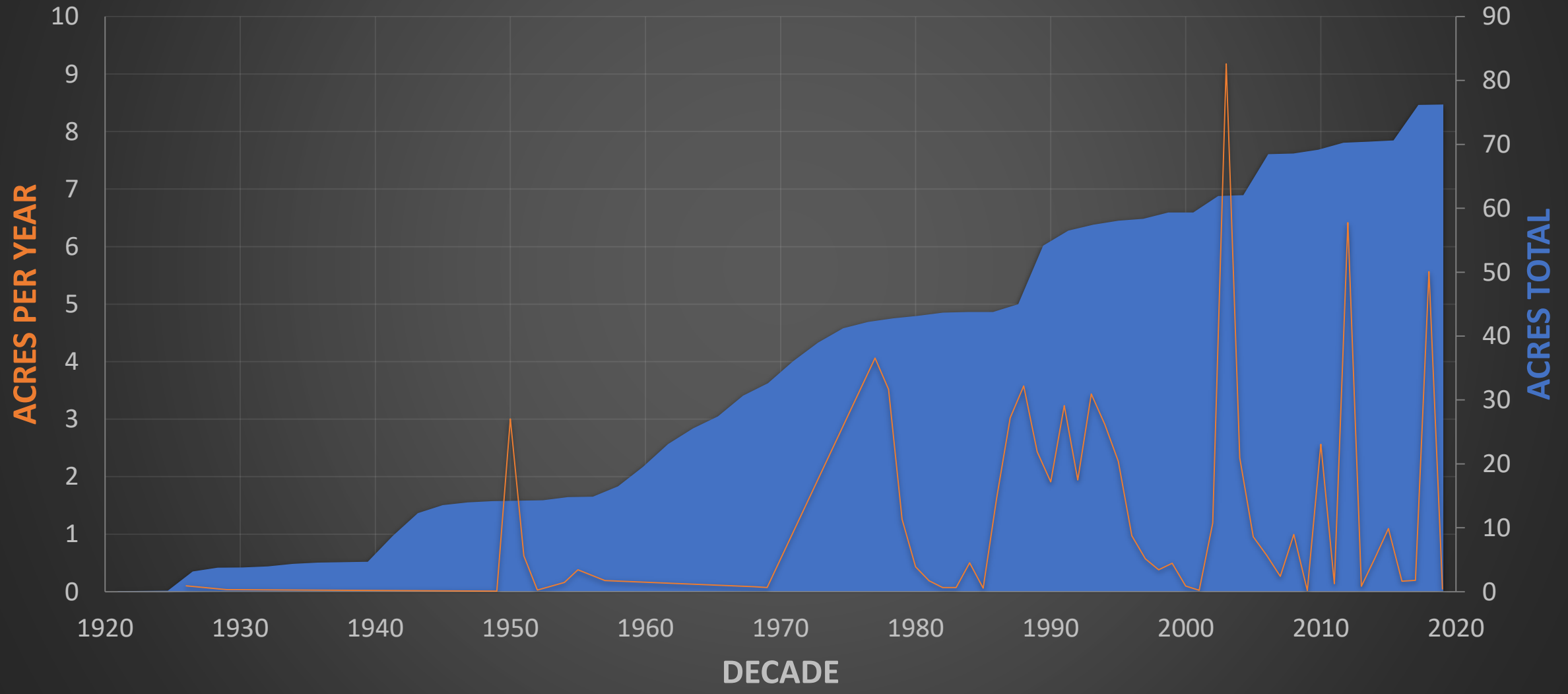
JAWRA Journal of the American Water Resources Association, Volume: 53, Issue: 5, Pages: 1032-1047, First published: 21 July 2017, DOI: (10.1111/1752-1688.12548)

Goldcrest Brook

Basin Overview

- Small tributary of Glenn Creek
- Annexed by the city in 1967
- Developed primarily using older design standards
- Development is relatively recent (last 40 year)
- Emerges from an outfall
- 189 acres
- 41% impervious surface
- Stream is 0.66 miles long

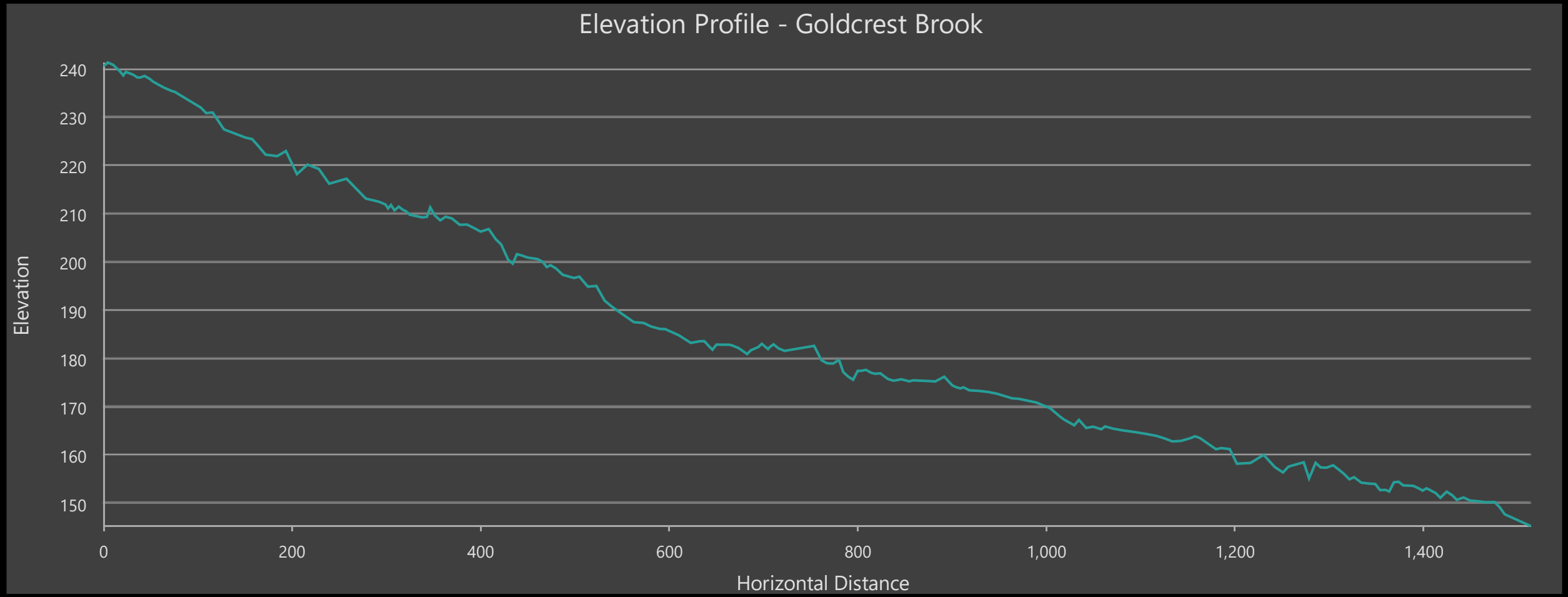
Impervious Surface in the Goldcrest Brook Catchment




Impervious Surface 1961-2020
Goldcrest Brook


N
0
0.1
0.2
0.3
0.4
0.5
Miles

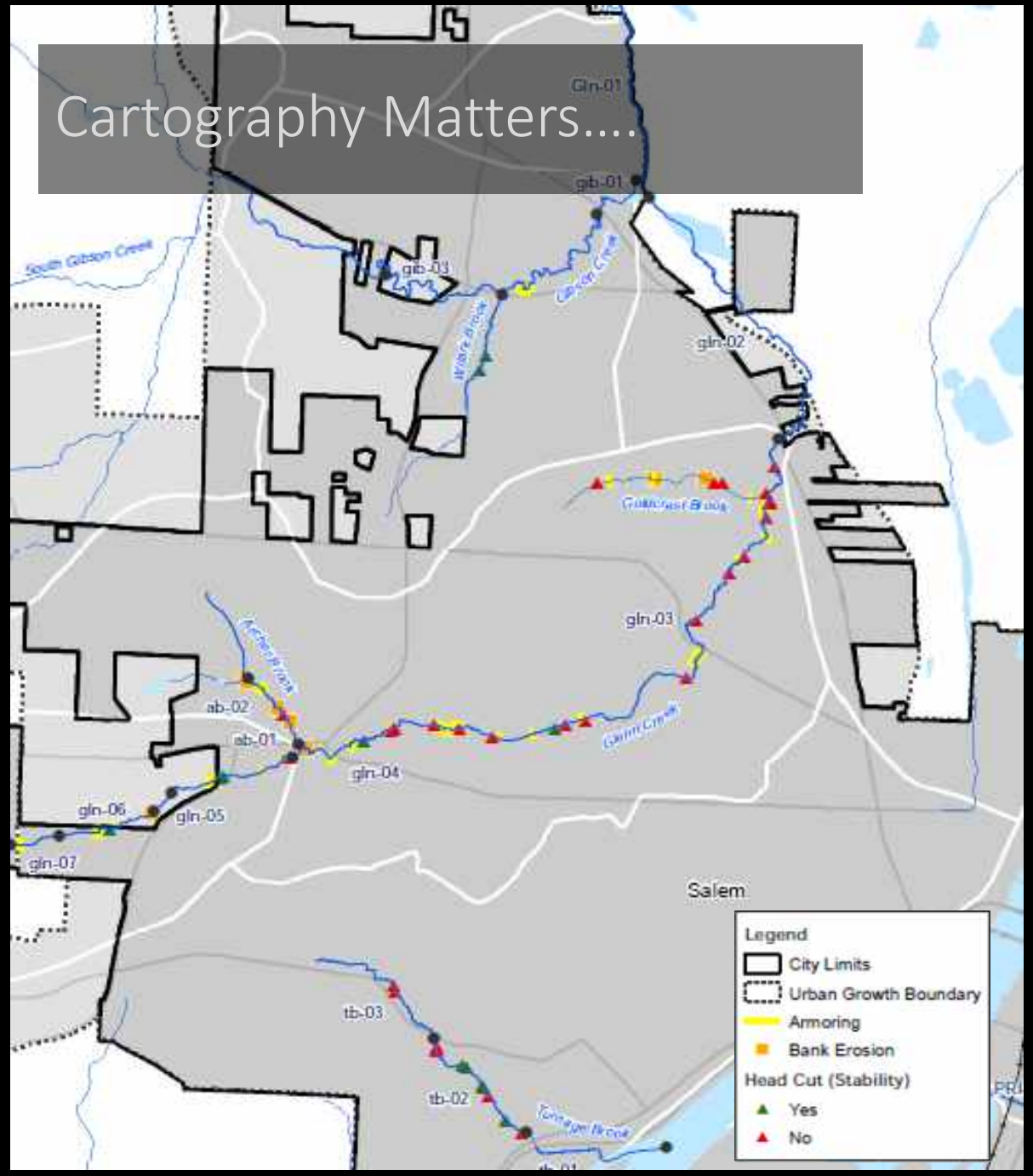
Steep Gradient: 328 ft/mile

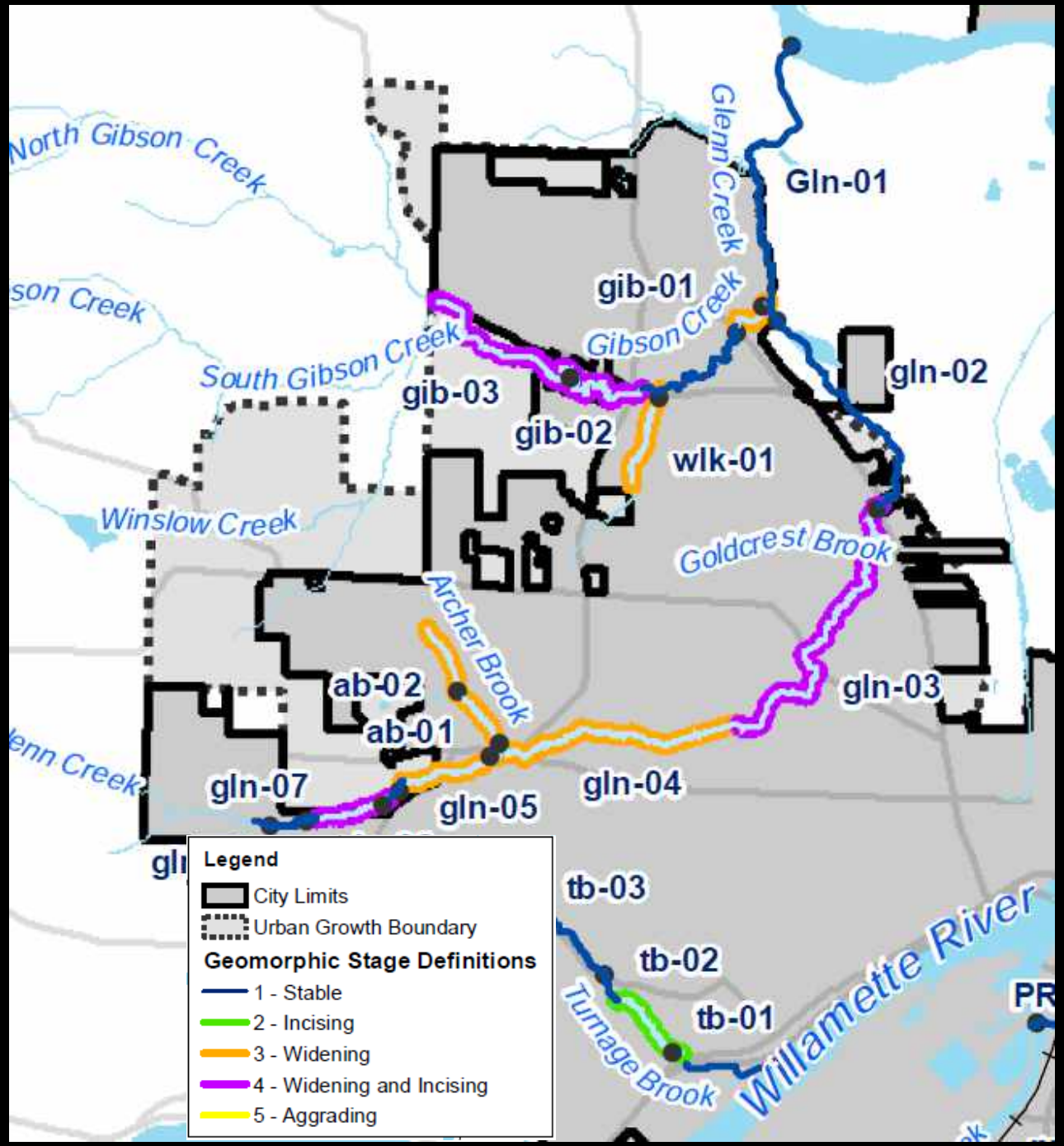


Why Study Goldcrest Brook?

- In 2018 we received a customer complaint regarding stream bank erosion
- “Bank is eroding more rapidly in the last 5-10 years”
- Field investigation showed signs of rapid adjustment

Cartography Matters….





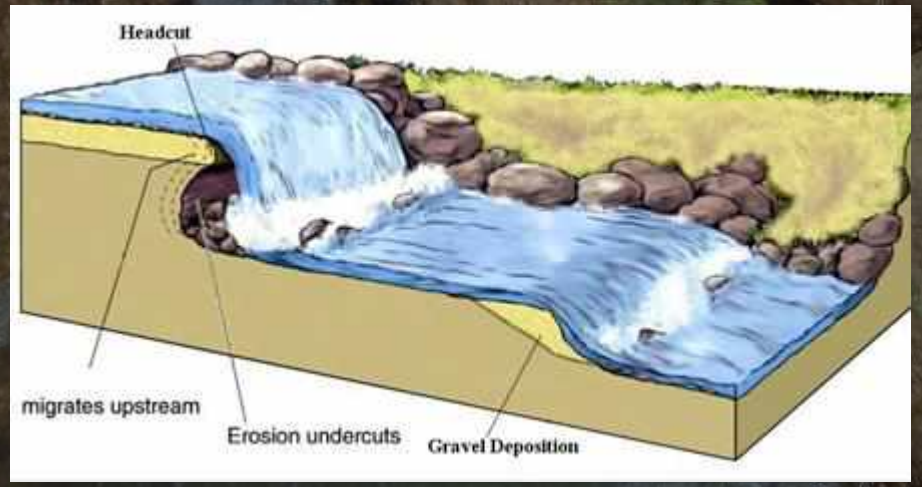
Onsite Conditions…

- Deeply incised channel
- Steep, slumping banks
- No coarse sediment
  - Was it washed away?
  - Was it there to begin with?

Head Cutting

(small waterfalls instream bed)

- Indicative of channel adjustment
- Stream out of equilibrium
- Stream deepens before it widens as it accommodates new flow regime

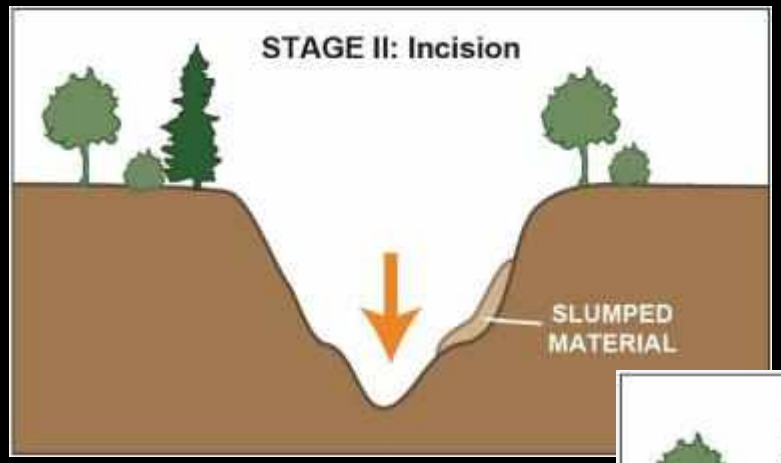


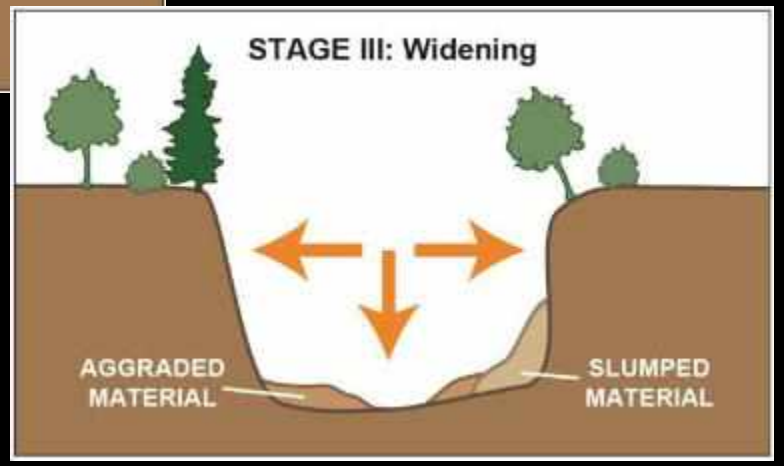
http://www.clrp.cornell.edu/nuggets_and_nibbles/articles/2016/stream.html

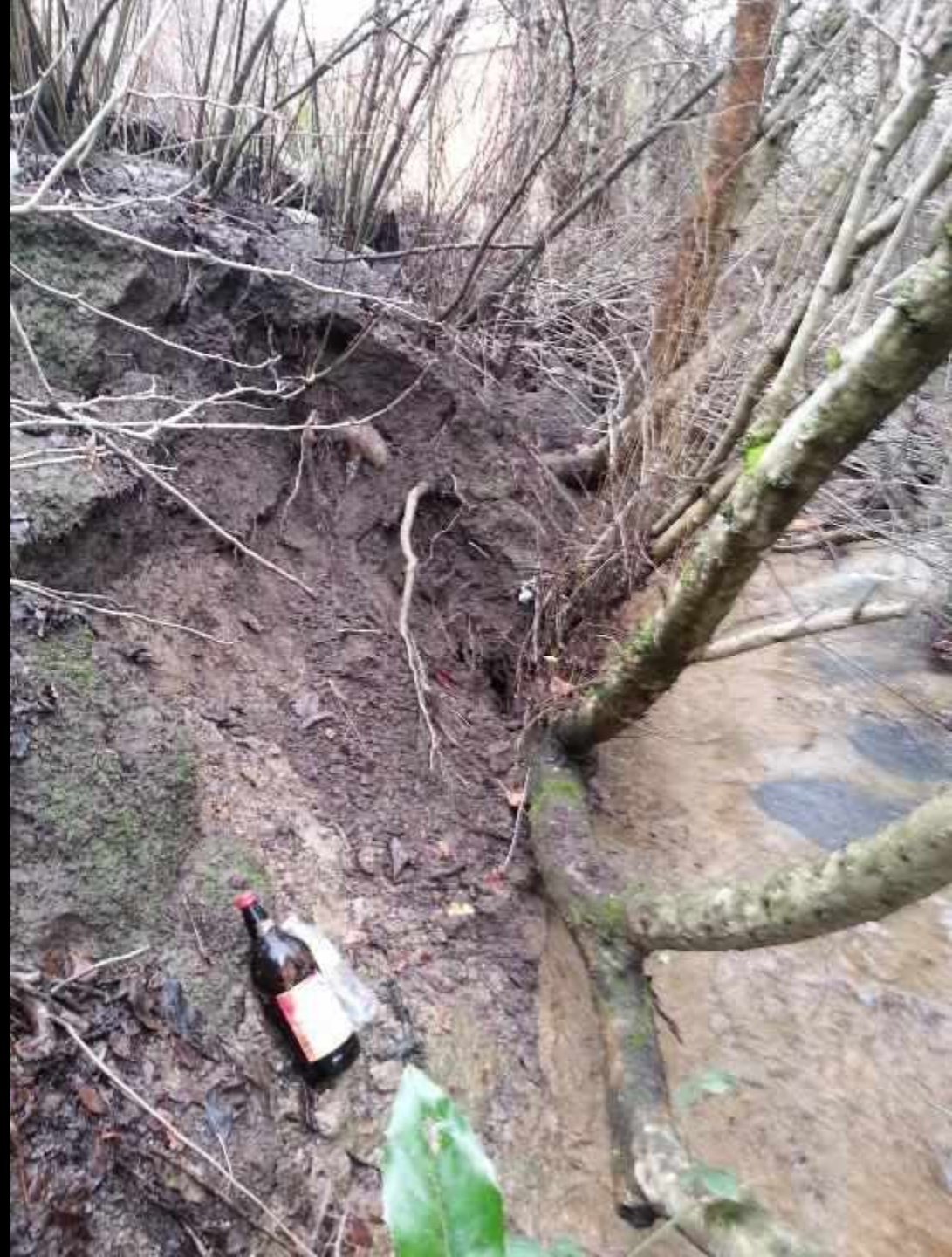
Exposed Sanitary Sewer Laterals

Bank Failure

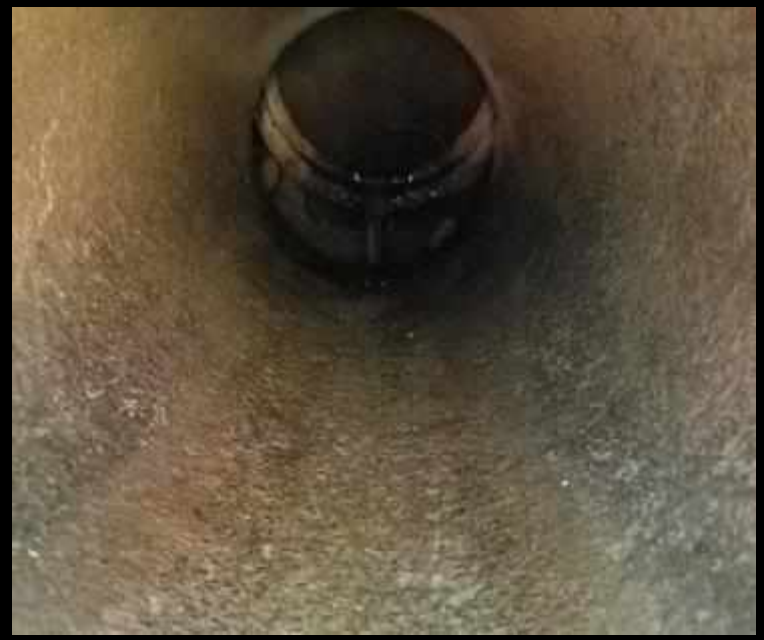
- Widening to adjust to new channel depth







Bank Failure Cont’d



Undermining of Outfalls

Upstream Conditions

Just Downstream

Warning

If you are prone to motion sickness, you may want to look away for a moment….

Conditions Further Downstream

Conditions Further Downstream

Roof drains throughout stream drain directly to stream….

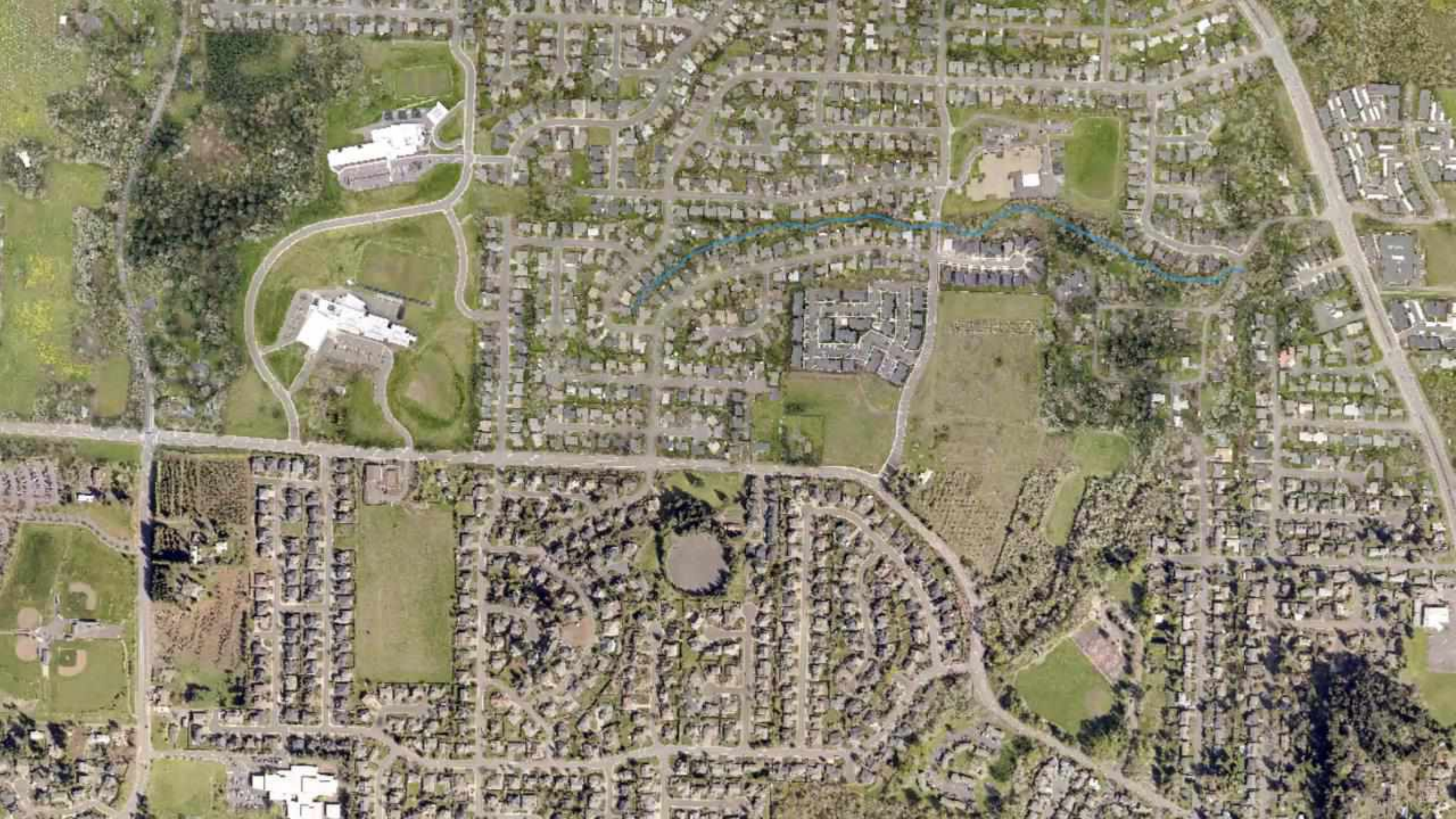
Mitigation Strategies?

- No program to assist with erosion issues on private property
- Stream past the point where planting will stabilize bank
- Owner funded options are costly and have downstream impacts
- Stream access is limited
- Limited information on prior conditions

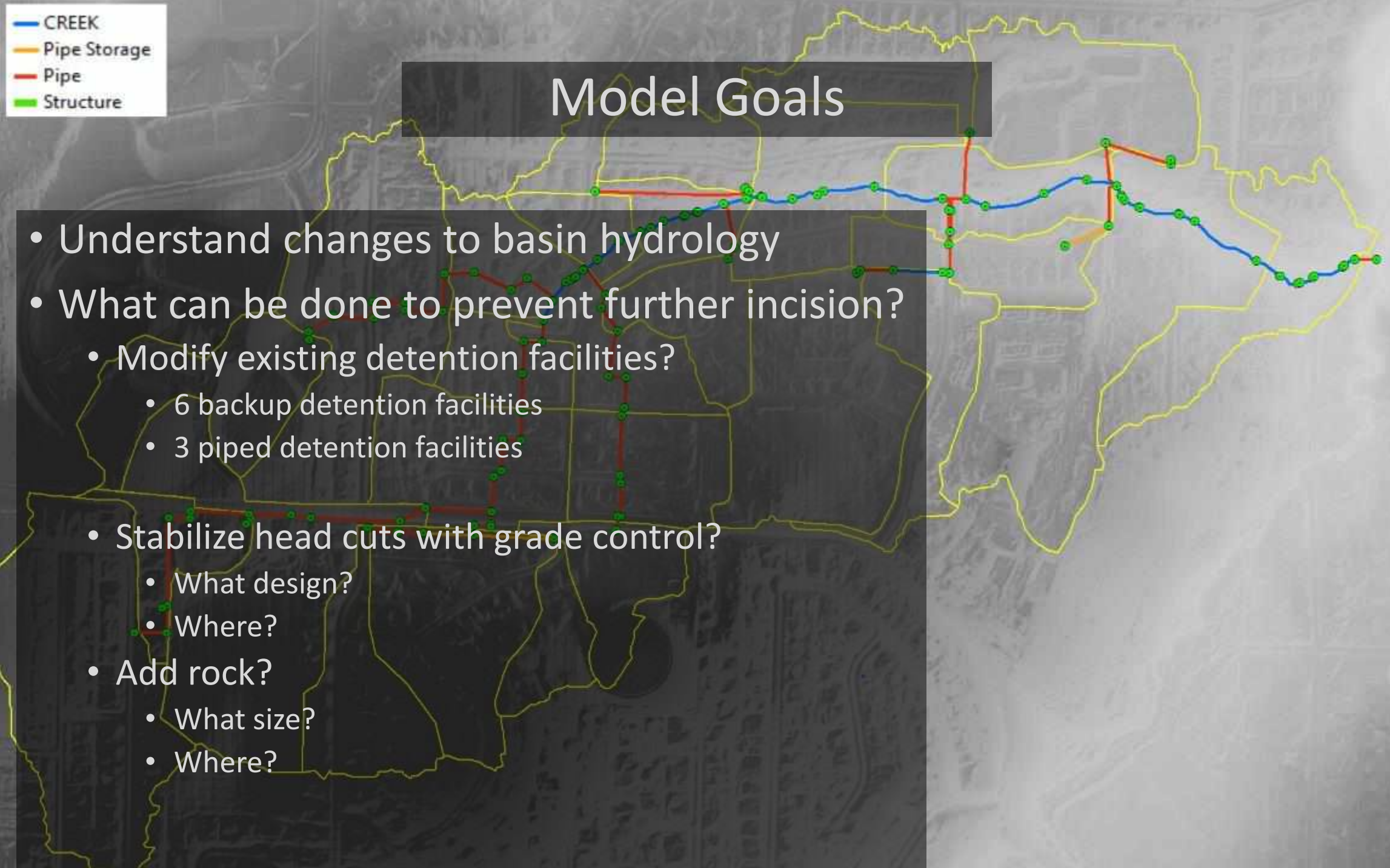
Need to slow the process that is already in place

- Turn off the tap (retrofit basins)
- Explore grade control options
- Stabilize head cuts
- Restore coarse sediment supply
- Downspout disconnect

ESA. Wolfe, Czarnomski



We Need a Model



Model Goals

- Understand changes to basin hydrology
- What can be done to prevent further incision?
  - Modify existing detention facilities?
    - 6 backup detention facilities
    - 3 piped detention facilities
  - Stabilize head cuts with grade control?
    - What design?
    - Where?
  - Add rock?
    - What size?
    - Where?

What will the model tell us?

- Where is the water coming from?
- How much?
- What are the velocities?
- How much capacity do we have in existing basins/storage pipes?
- How do we resize existing orifices?
- Where is the best location for grade control?
- What conceptual designs do we use?

Model Steps, Inputs, and Challenges

Rain and Stream Flow Data

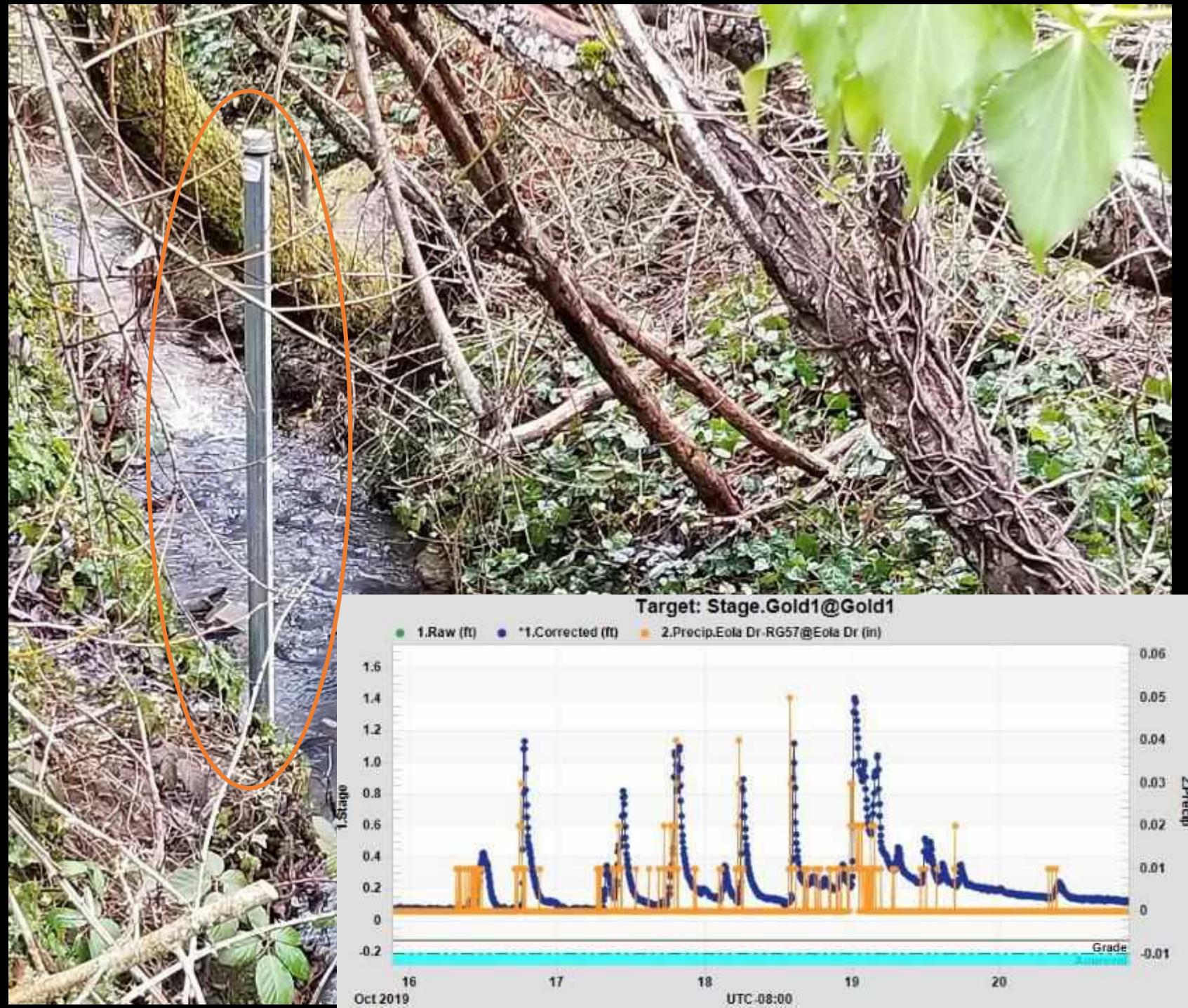
- Already have established rain gauges ✔
- Need Stream Gauging Stations
- Flow Measurements

Temporary Gauging Stations

Challenges:

- Gauge Pool
- Undercut Banks
- Flashy Response
- Limited Access

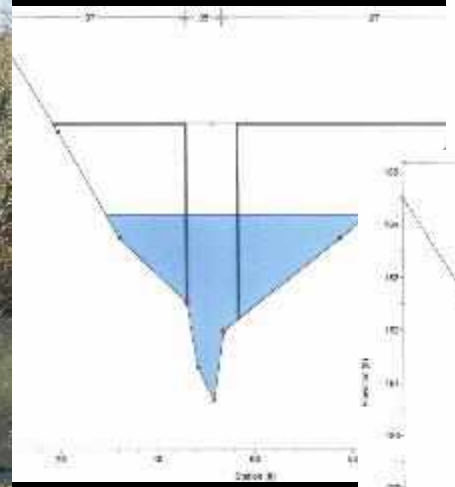
https://www.inspectortools.com/Onset-HOBO-Bluetooth-BLE-Water-Level-MX2001-03-p/onmx2001-03.htm

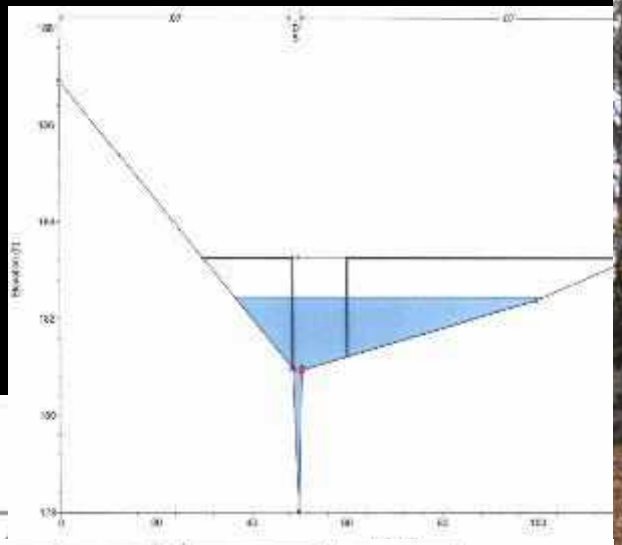


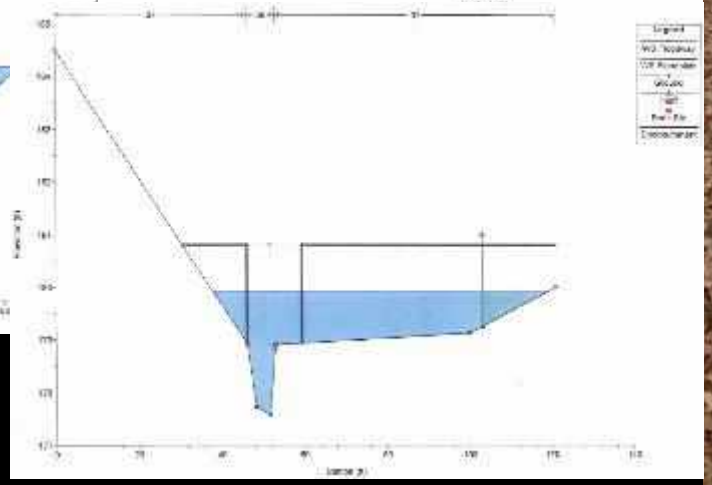
Stream Survey

Cross-section Measurements

- Survey Control
- Brush Clearance
- Stream Access







Stream Survey Challenges

- Brush Clearance
- Limited Access
- Labor Intensive

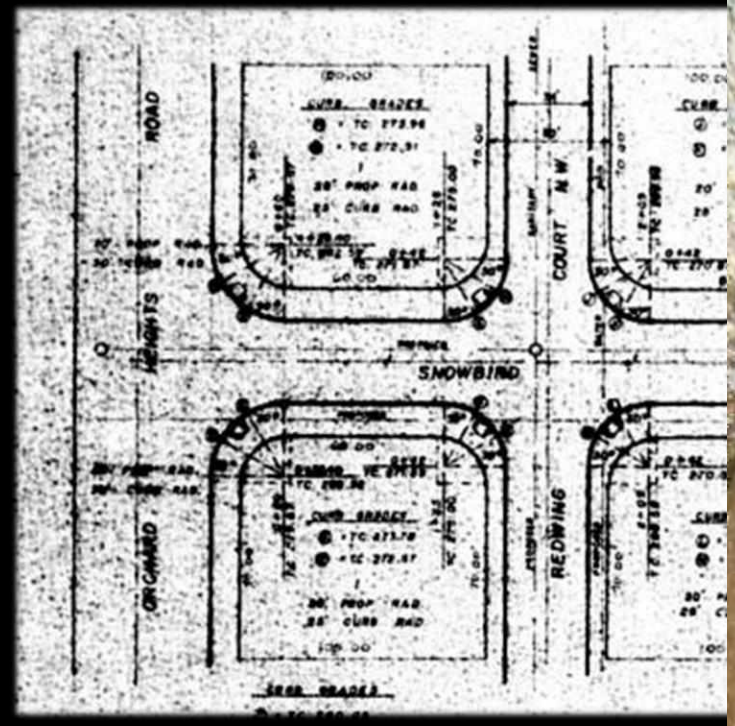
Utility Data

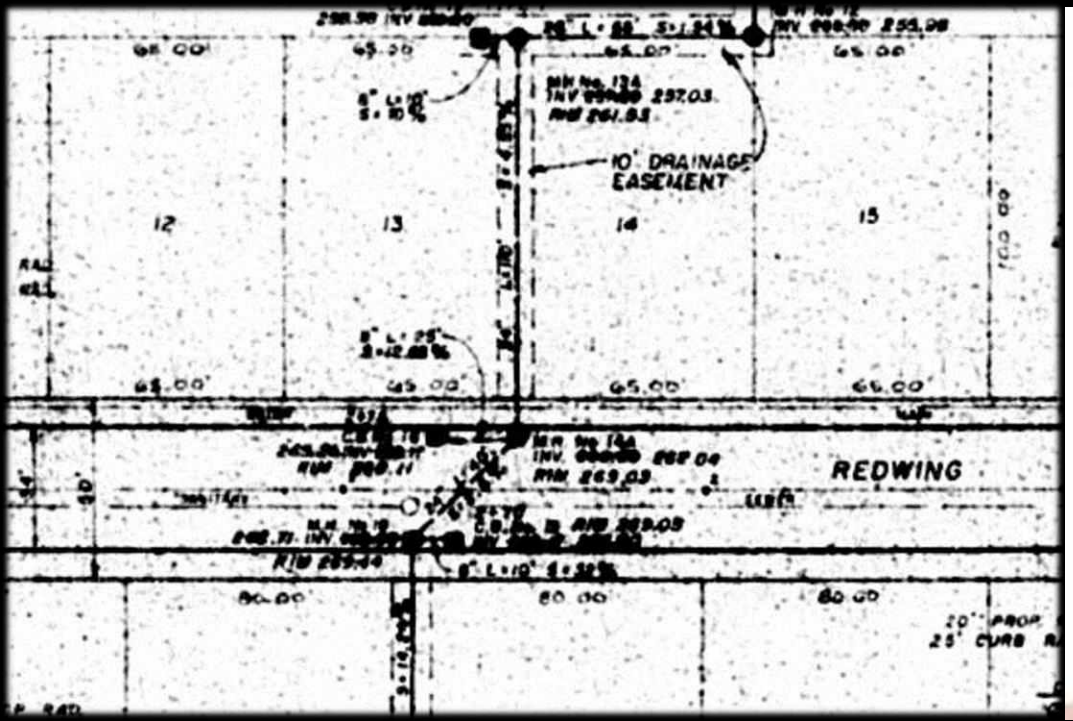
196 inlets
104 manholes
67 nodes (outfalls or junctions)
311 Mains
8 Detention Basins
3 Detention Pipes

Utility Data Challenges

- Missing asset data
- Inaccurate, illegible as-builts
- Limited Access
- Traffic Control
- Benchmark lineage

Rim & invert elevations for 113 of 678 structures field verified





A year and a half later…

Consultants are building and calibrating the model

Setbacks & Riparian Buffers

- Allow streams to adjust to modified hydrologic landscapes without impact to private property and/or public resources
- Reduce impacts from discrepancies between design standards and non-standard streams
- Allow easier access to for mitigation and/or restoration when necessary

Regulations for Riparian Buffers

Floodplain Ordinance (601.070(7)): 15 feet to the waterway centerline, or 10 feet to the top of a recognizable bank, whichever is greater (new construction and substantial improvements)

- Goldcrest Brook is not in FEMA mapped Special Flood Hazard Area

SRC 802.030(b): Dedicate a drainage and maintenance easement that is as minimum of 15-feet from centerline, 10 feet from the top of the recognizable bank or 100-year floodway, whichever is greater…only triggered with non-residential developments

- Goldcrest Brook is residential development

Tree and Native Vegetation code (Chapter 808): limits removal of trees/vegetation within the riparian corridor (50-feet horizontally from the top of bank on each side). The can create a natural setback if there are native vegetation or trees identified, but is not a clear "building setback".

- Goldcrest Brook formerly agricultural land, limited native vegetation at time of development

Conclusion

- Rigorous stormwater design standards should prevent future Goldcrest Brook scenarios
- Riparian buffers allow streams to respond to dynamic landscapes and buy time if needed
- Access corridors will improve maintenance, data collection, inspection, and restoration
- Good utility data and quality as-builts on the front end improve responses on the back end

Photo Credits

All maps, animations, and images created by Peter Dalrymple unless stated below

Flooding in Tulsa	**https://www.wunderground.com/cat6/Historic-flooding-Arkansas-River-Oklahoma-and-Arkansas**
Geomorphic Stages	ESA Hydromodification Presentation, City of Salem, 2012
House Falling into Stream	https://www.stltoday.com/news/local/govt-and-politics/landslide-destroys-shed-takes-yards-along-maline-creek/article_1afff6ee-0112-5870-ae01-48a8234dc057.html
Storm Drain	https://www.mcall.com/news/local/allentown/mc-nws-allentown-who-pays-stormwater-fee-20171207-story.html
Impervious vs pervious	http://www.stormwater.allianceforthebay.org/glossary-of-terms/impervious
Headcut Illustration	http://www.clrp.cornell.edu/nuggets_and_nibbles/articles/2016/stream.html
Headcut Stabilization	ESA Hydromodification Presentation, City of Salem, 2012
Model Map 1 & 2	Erik McCarthy, WEST Consultants, 2020
Level Logger	https://www.inspectortools.com/Onset-HOBO-Bluetooth-BLE-Water-Level-MX2001-03-p/onmx2001-03.htm
Surveyor and Total Station	Hans Hadley, WEST Consultants, 2020
Staring at the Computer	http://en.mugtama.com/human-rights/item/14236-you-aren-t-going-to-go-blind-from-staring-at-a-computer-too-long.html

Questions?

Peter Dalrymple,
Stormwater Quality Monitoring Program Coordinator,
City of Salem
pdalrymple@cityofsalem.net

Abstract provided for Presentation at the Mid-Willamette Valley Outreach Group's 2020 Erosion Control and Stormwater Management Summit

Goldcrest Brook: A Case Study in Stormwater Management

The stream channel in West Salem's Goldcrest Brook is changing rapidly. To prevent the loss of private property from eroding stream banks, the City of Salem has hired an engineering firm to develop a hydraulic and hydrologic model of the stream and basin. The City will use the model results to identify contributing factors and possible mitigation strategies for controlling streambank erosion within the study area. The challenges and site conditions encountered during this project highlight the importance of robust stormwater design standards, riparian buffers, stormwater facility maintenance agreements, and accurate utility data for protecting streamside properties in a post-development landscape.