Balancing Remedial and Restoration Objectives for Sediment Capping on an Urban River

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Agenda

- Site background
- Overall project objectives
- River restoration objectives
- River restoration challenges
- Analysis and design
- Implementation

Background – former MGP in Flint, MI

Photo courtesy of Special Collections and University Archives, Kettering University

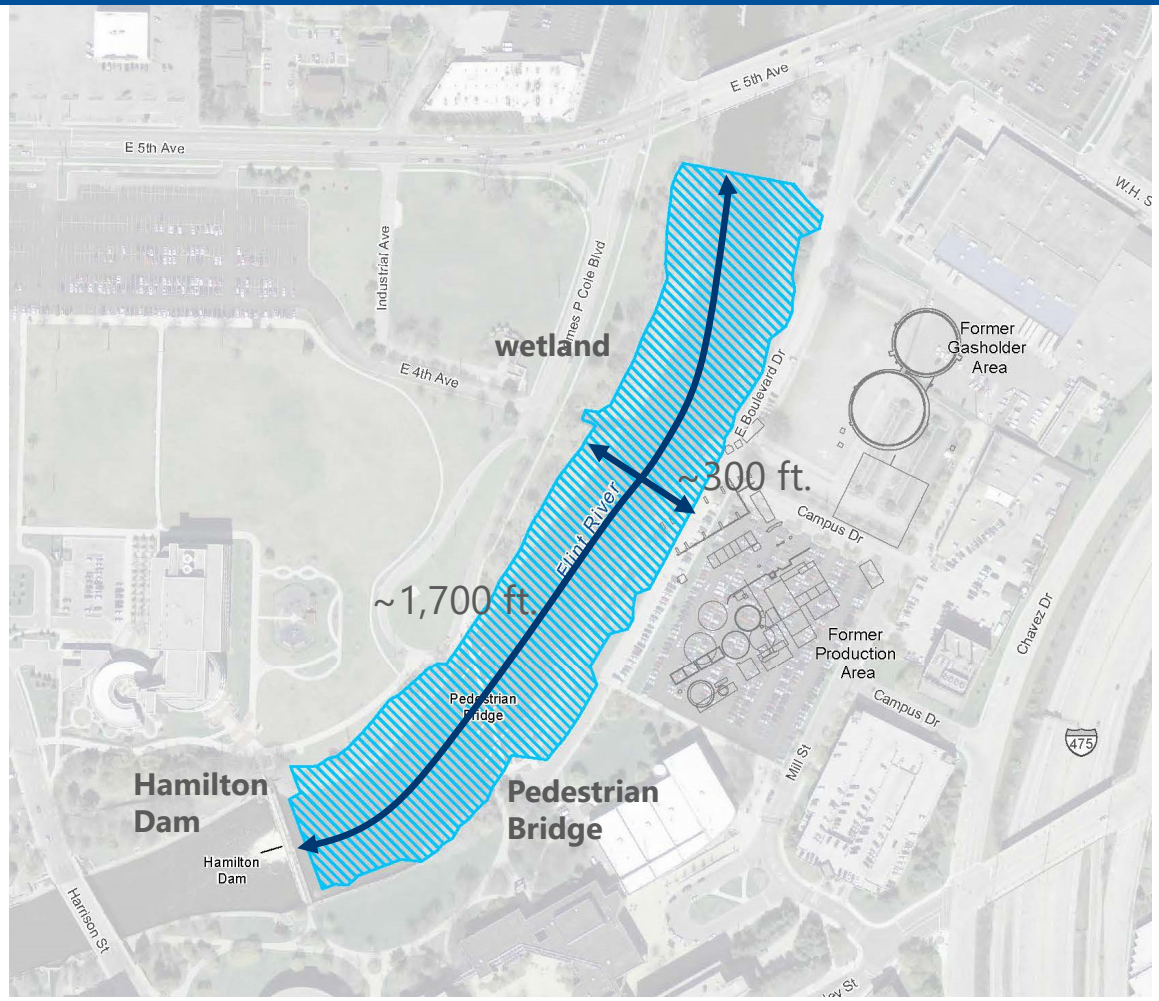
Overall project objectives

1. Address direct contact exposure pathway for MGP-related impacts
2. Meet MDEQ compliance criteria for groundwater venting to the river
3. Restore riverbanks and infrastructure

River restoration objectives

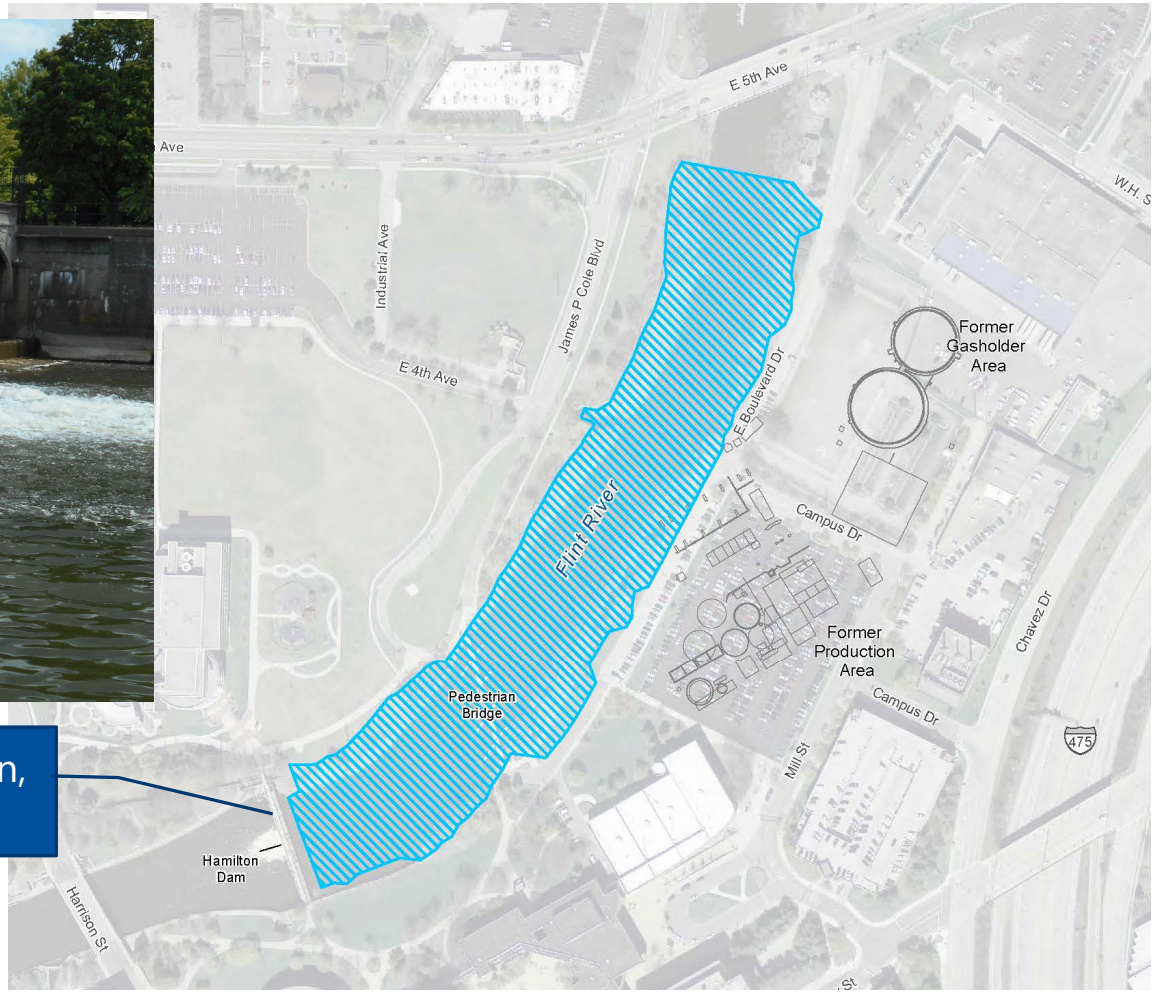
1. Protect cap
2. Meet floodplain requirements
3. Provide floodplain bench with re-created wetland
4. Replace and improve riverbank vegetation
5. Compatibility with dam removal alternatives
5. Increase bedform diversity
6. Provide sediment transport

Project reach



River restoration challenges – Hamilton Dam

High hazard dam – poor condition, pending removal



River restoration challenges – campus pedestrian bridge

Old rail bridge piers, pilings

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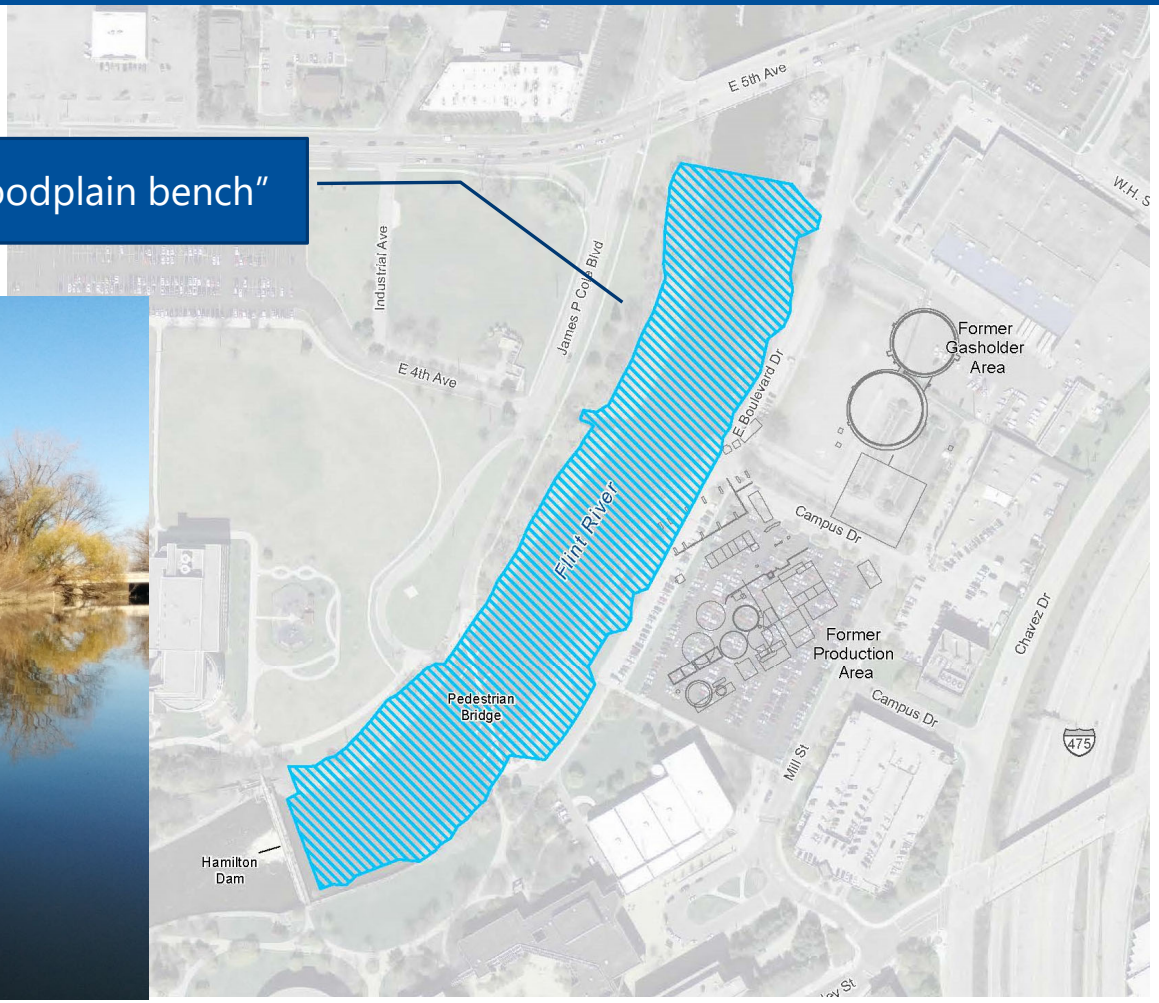
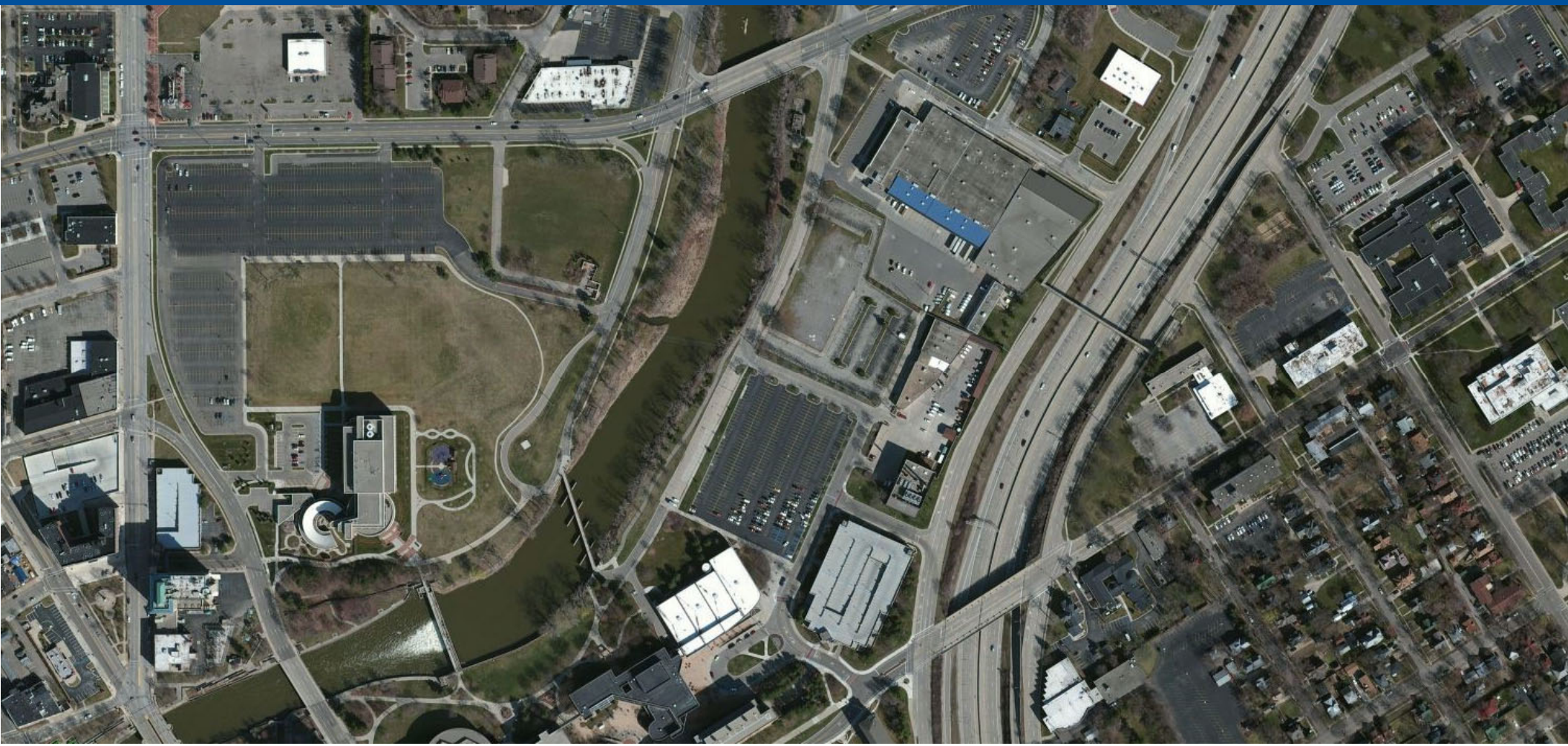
River restoration challenges – adjacent wetland

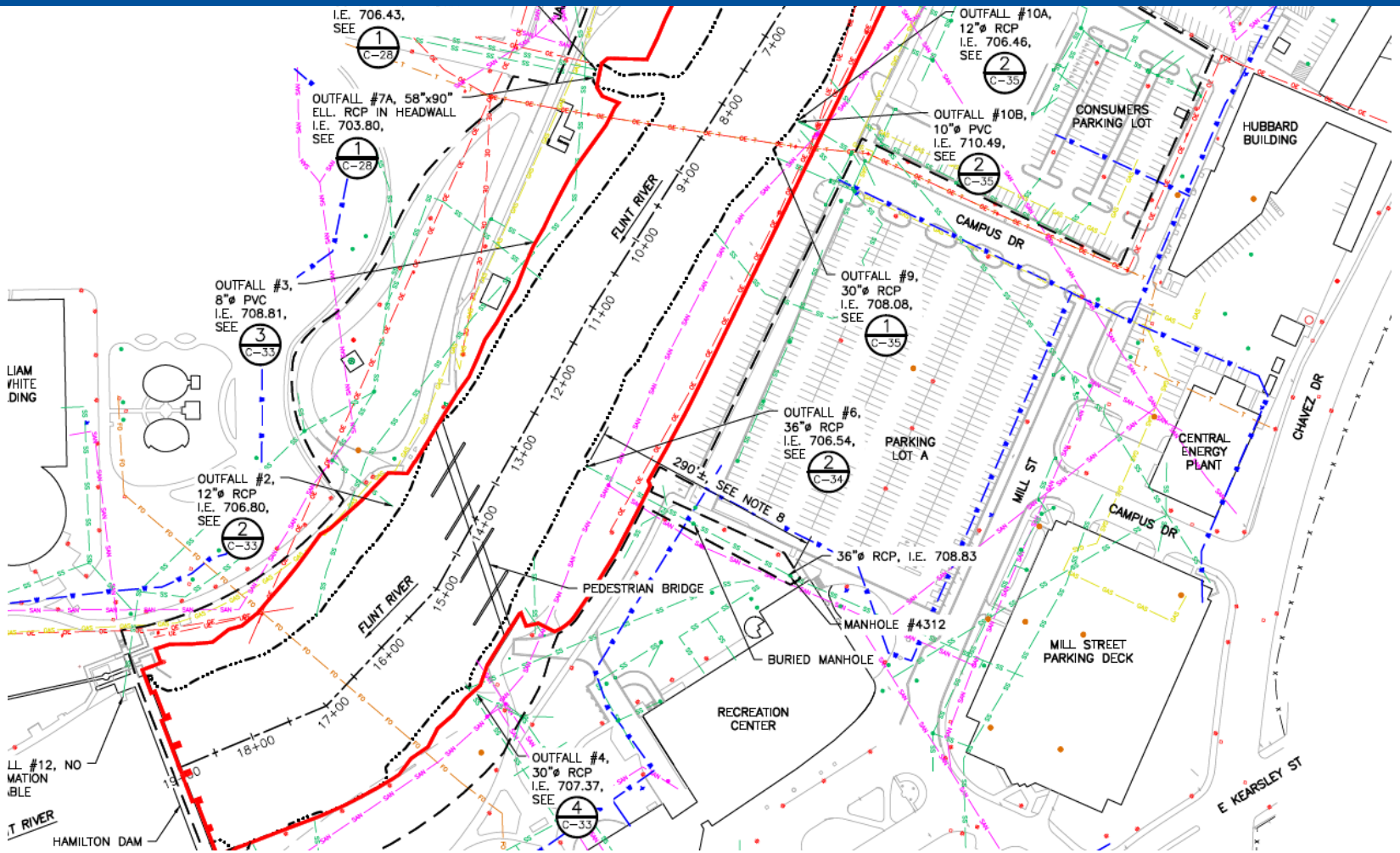
Wetland "floodplain bench"



River restoration challenges – adjacent infrastructure

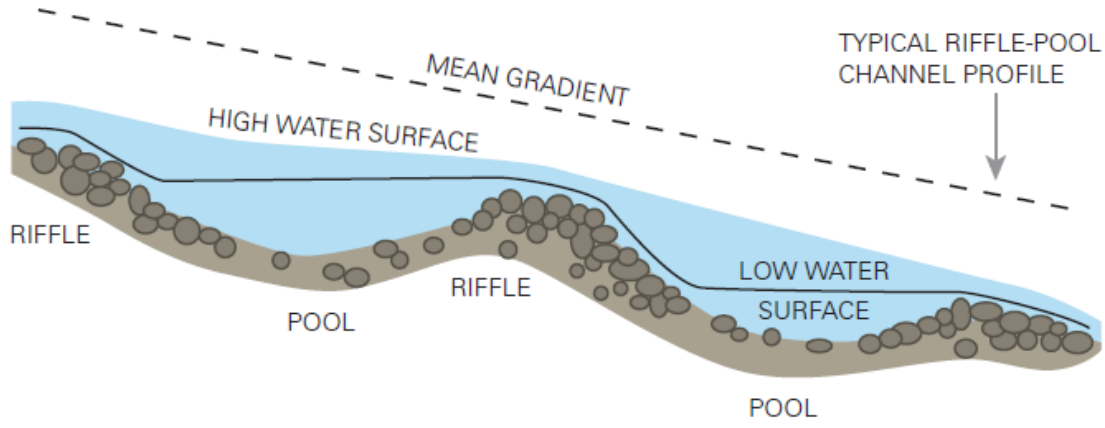


River restoration challenges – adjacent infrastructure



Analysis and Design

1. Provide and protect barrier
2. Address groundwater venting
3. Address hydrostatic pressure
4. Provide floodplain bench
5. Provide bedform diversity
   - Newbury riffles
   - Riprap surface infilling



Source: Adapted from Knighton (1998)

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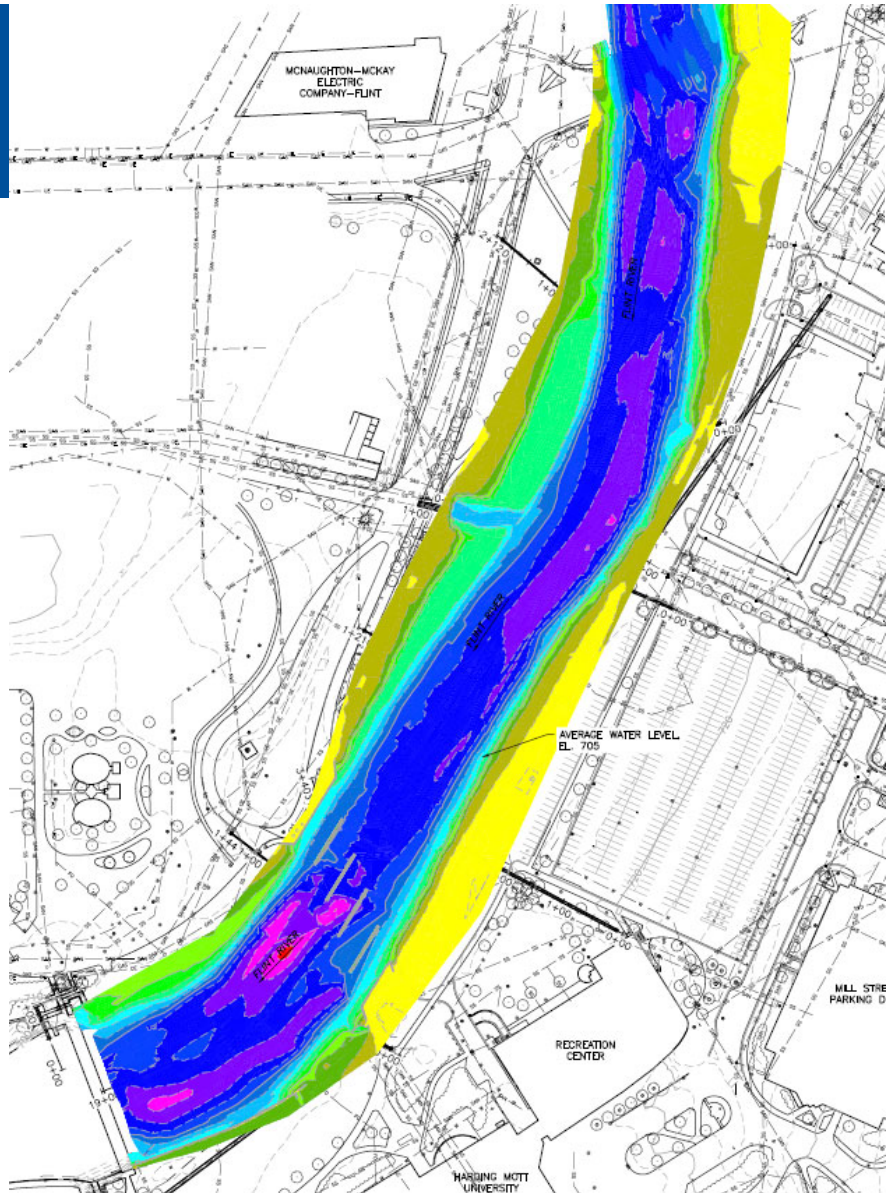
River system



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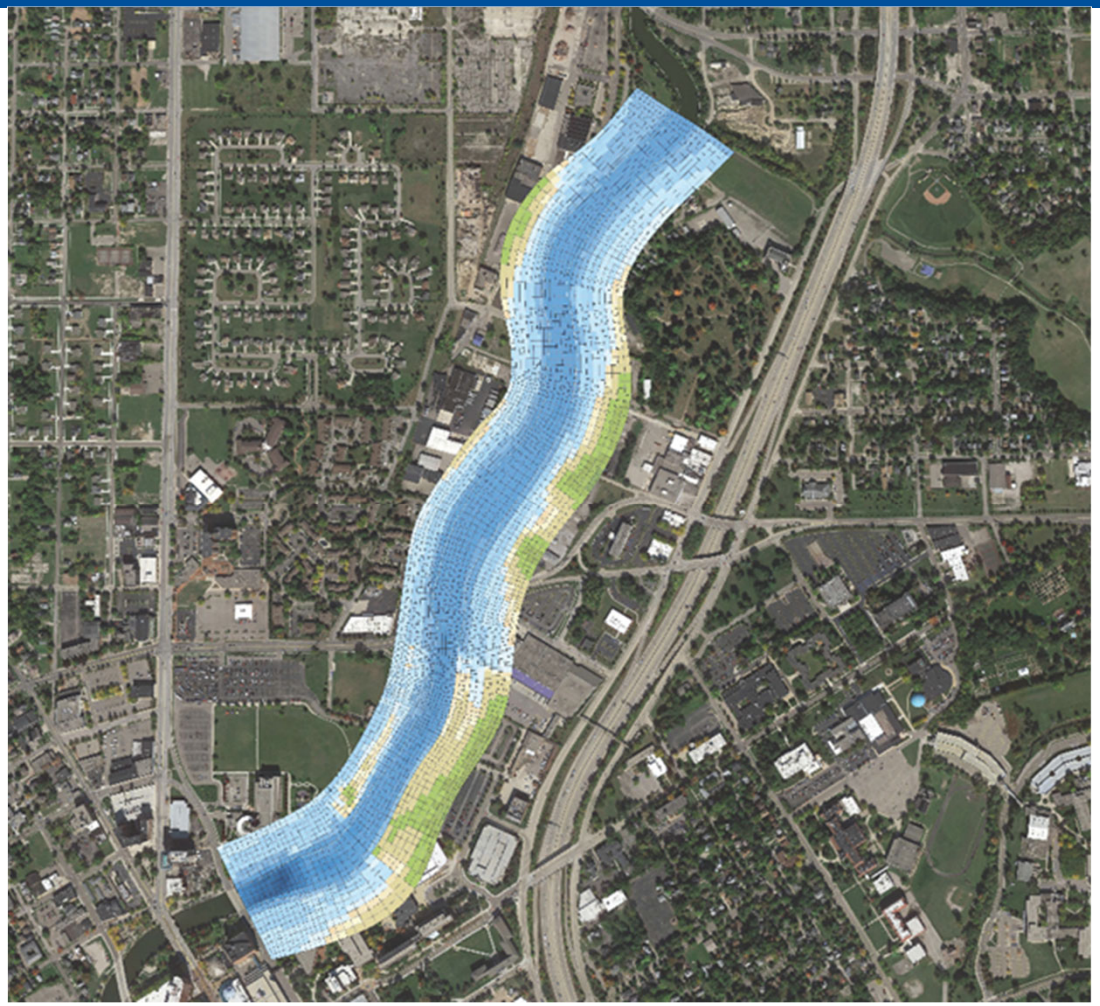
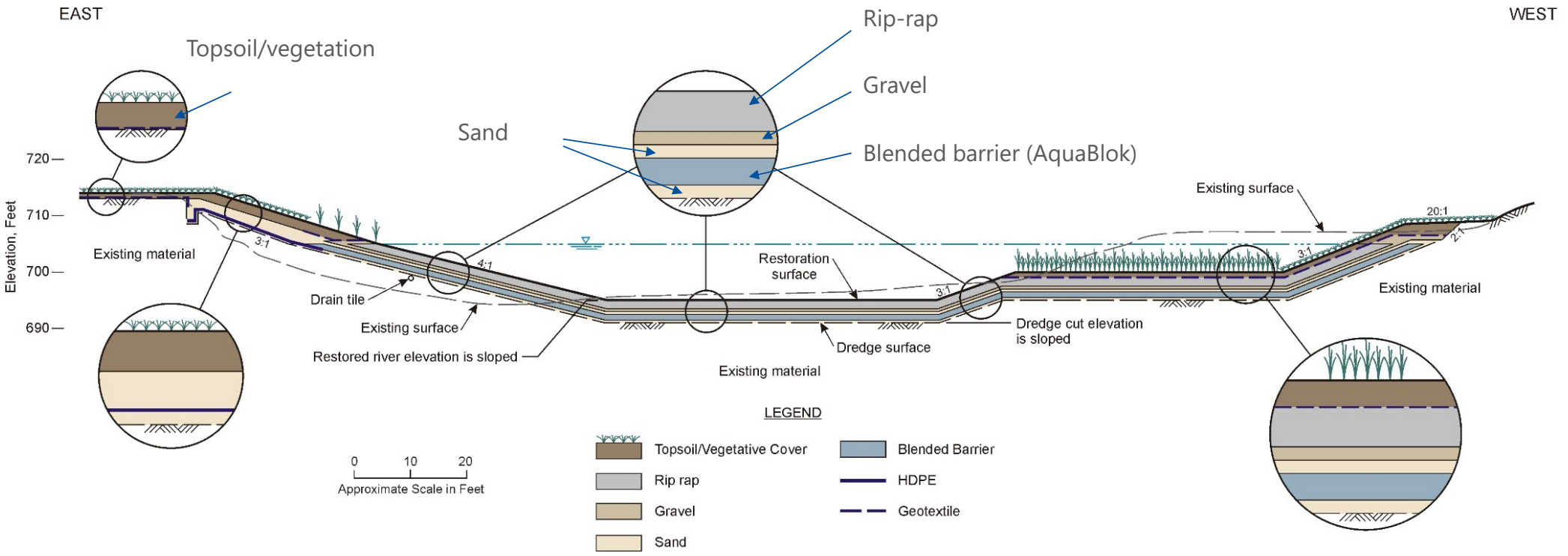
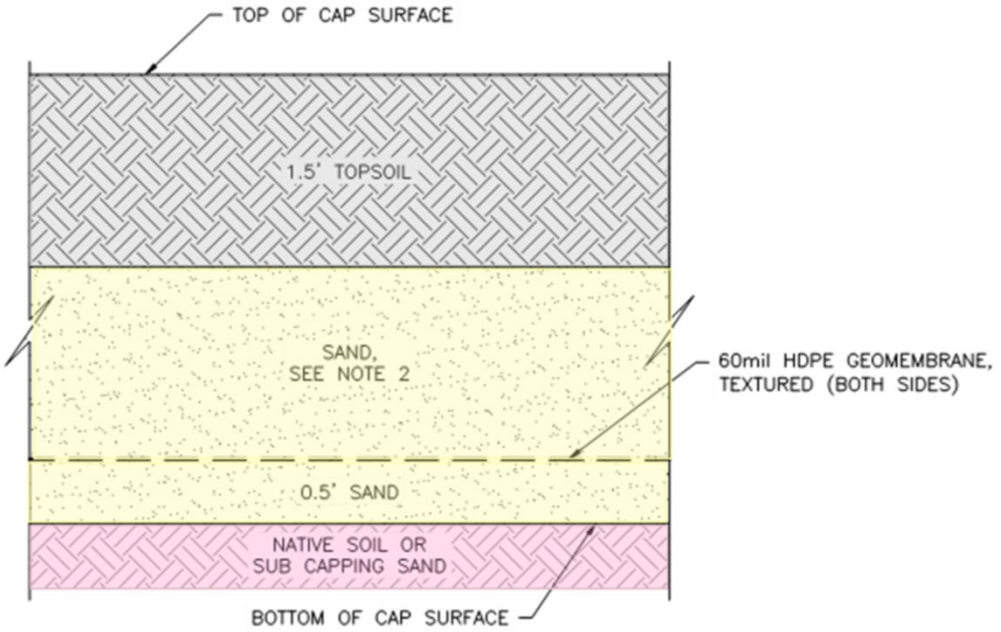
Delft 3d Model – grid and bathymetry



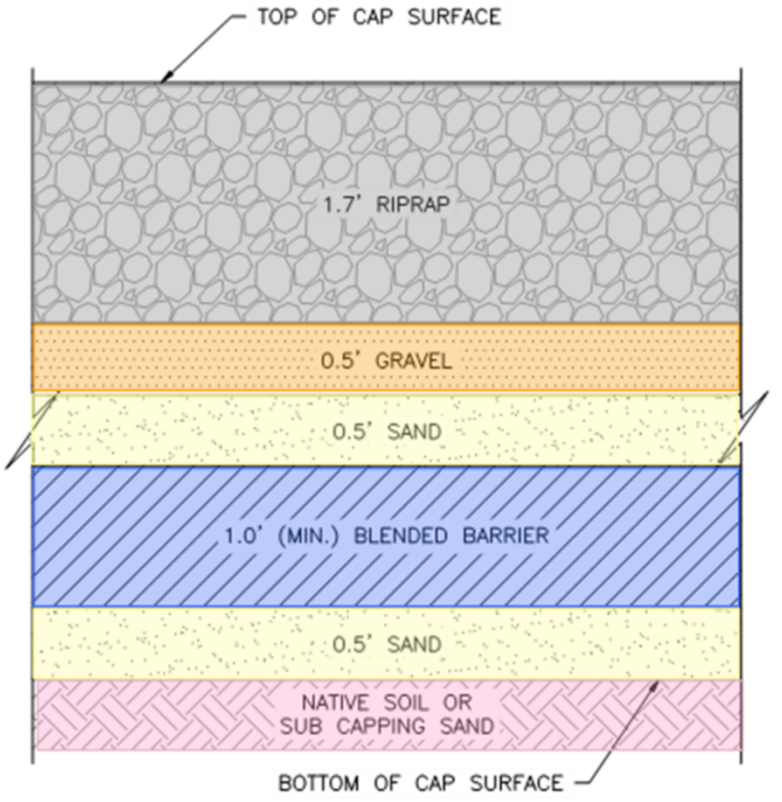
Sediment cap design



Sediment cap design

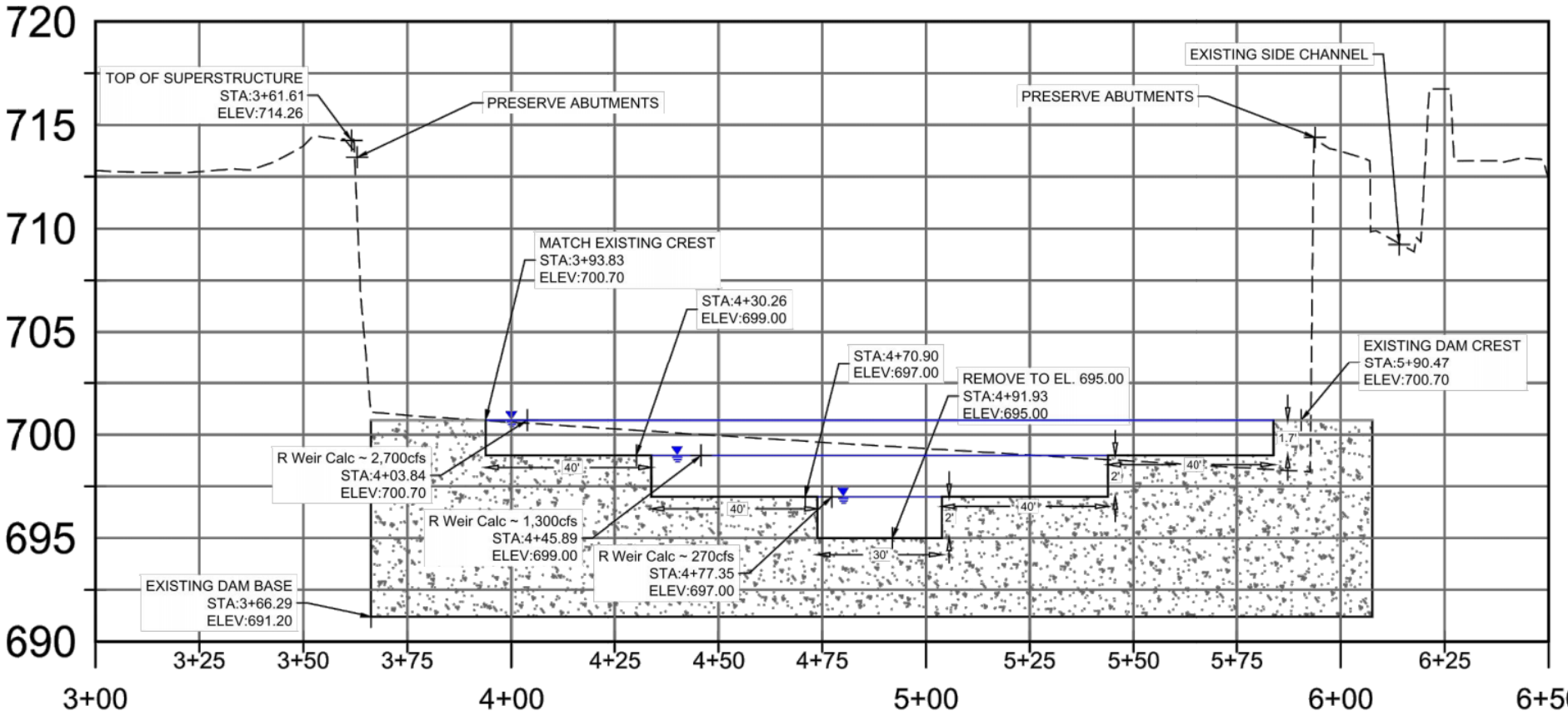


River Bank Section



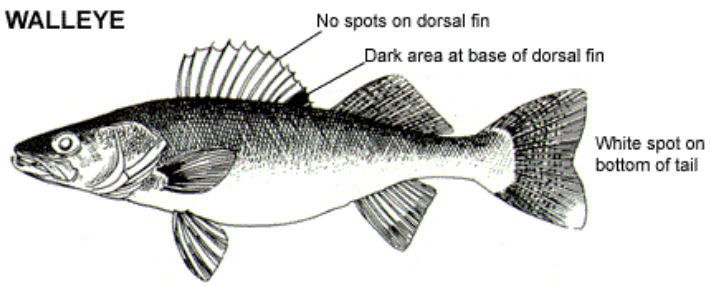
River Bottom Section

Proposed notching of Hamilton Dam

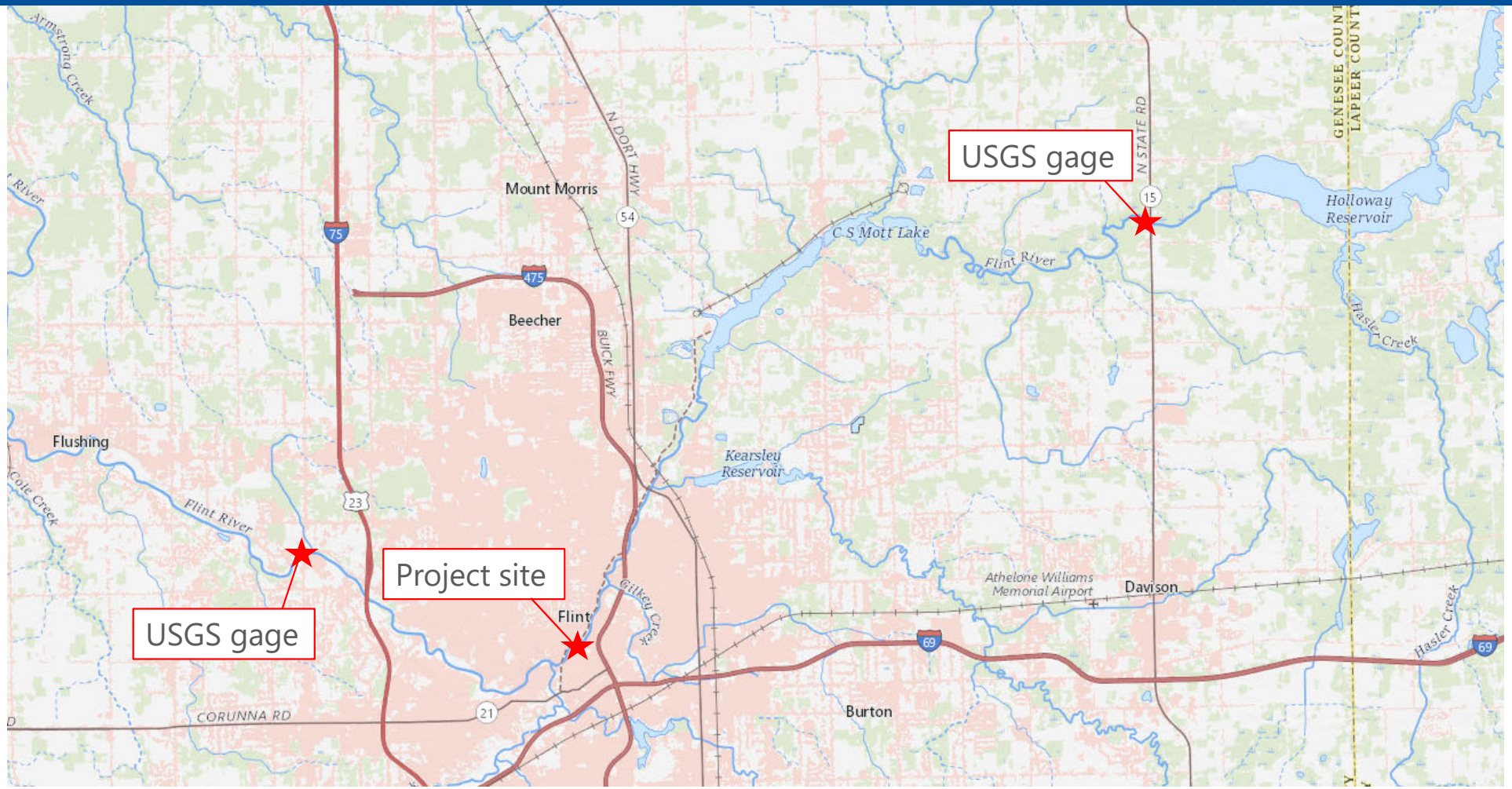


Sediment cap design – incorporating diversity elements with armoring

1. Floodplain bench
   - Increase floodplain connectivity and provide additional habitat within the floodplain
   - Function as wetland once modifications to downstream dam are complete
2. Riffles
   - Increase bedform diversity
3. Rip rap surface infilling with gravel
   - Improve spawning habitat for fish
4. Restore bank vegetation



Flint River


USGS gage
Project site
USGS gage
Mount Morris
Beecher
Flushing
Flint
Burton
Davison
C S Mott Lake
Holloway Reservoir
Kearsley Reservoir
Athelone Williams Memorial Airport
Flint River
Hasler Creek
Gilkey Creek
Colie Creek
Armstrong Creek
N DORT HWY
BUICK FWY
N STATE RD
CORUNNA RD
GENESEE COUNTY
LAPEER COUNTY
75
475
54
15
23
21
69

Higher frequency discharge analysis – USGS Regional Curves

USGS
science for a changing world

Prepared in cooperation with the Michigan Department of Environmental Quality, Michigan Department of Transportation, U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service

Estimated Bankfull Discharge for Selected Michigan Rivers and Regional Hydraulic Geometry Curves for Estimating Bankfull Characteristics in Southern Michigan Rivers

Scientific Investigations Report 2009–5133

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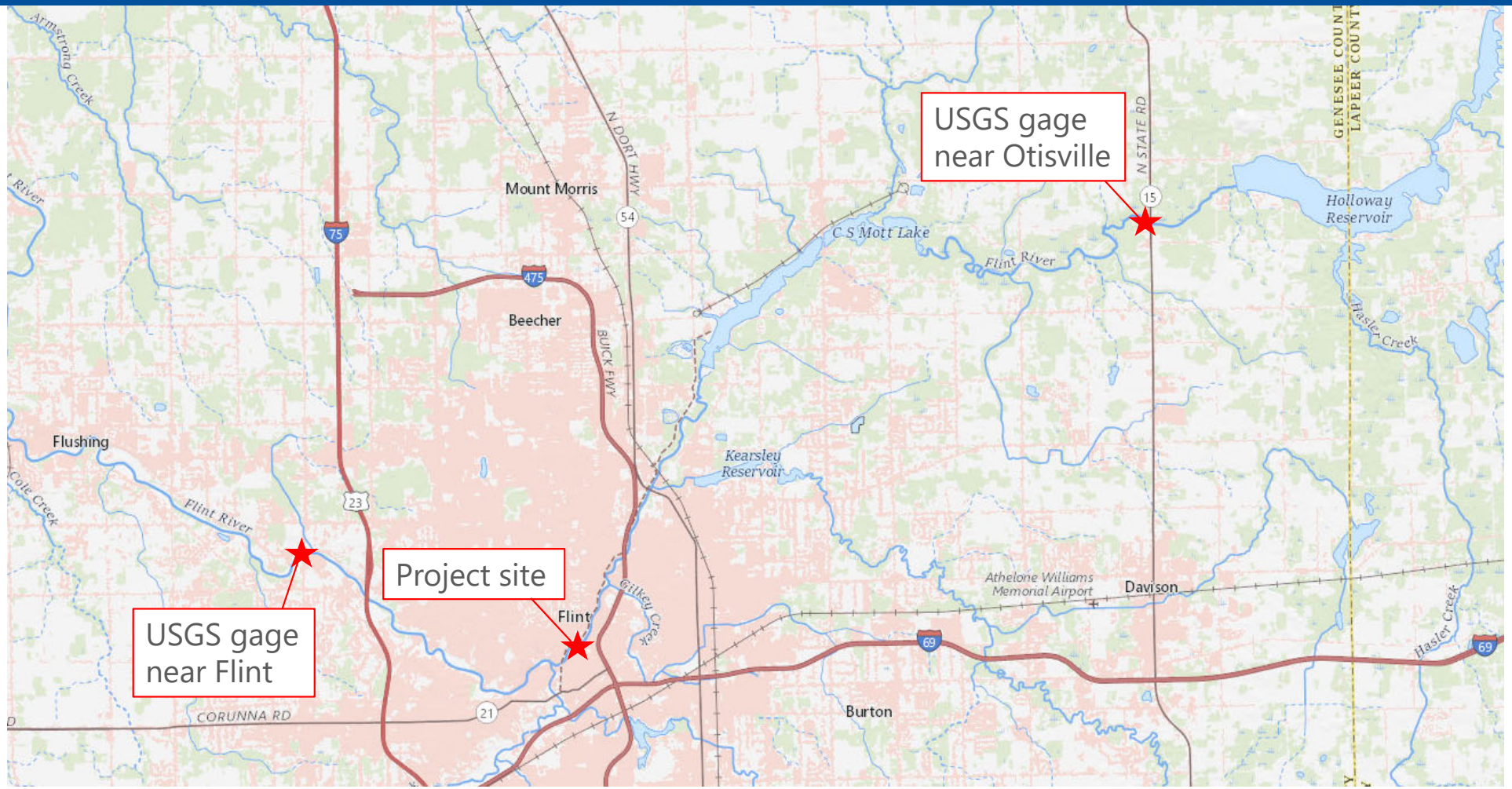
Flint River


USGS gage near Otisville
Project site
USGS gage near Flint
Mount Morris
Beecher
Flushing
Flint
Burton
Davison
Athelone Williams Memorial Airport
Kearsley Reservoir
C S Mott Lake
Holloway Reservoir
Flint River
Armstrong Creek
Colie Creek
Gilkey Creek
Hasler Creek
N DORT HWY
BUICK FWY
N STATE RD
CORUNNA RD
GENESEE COUNTY
LAPEER COUNTY
75
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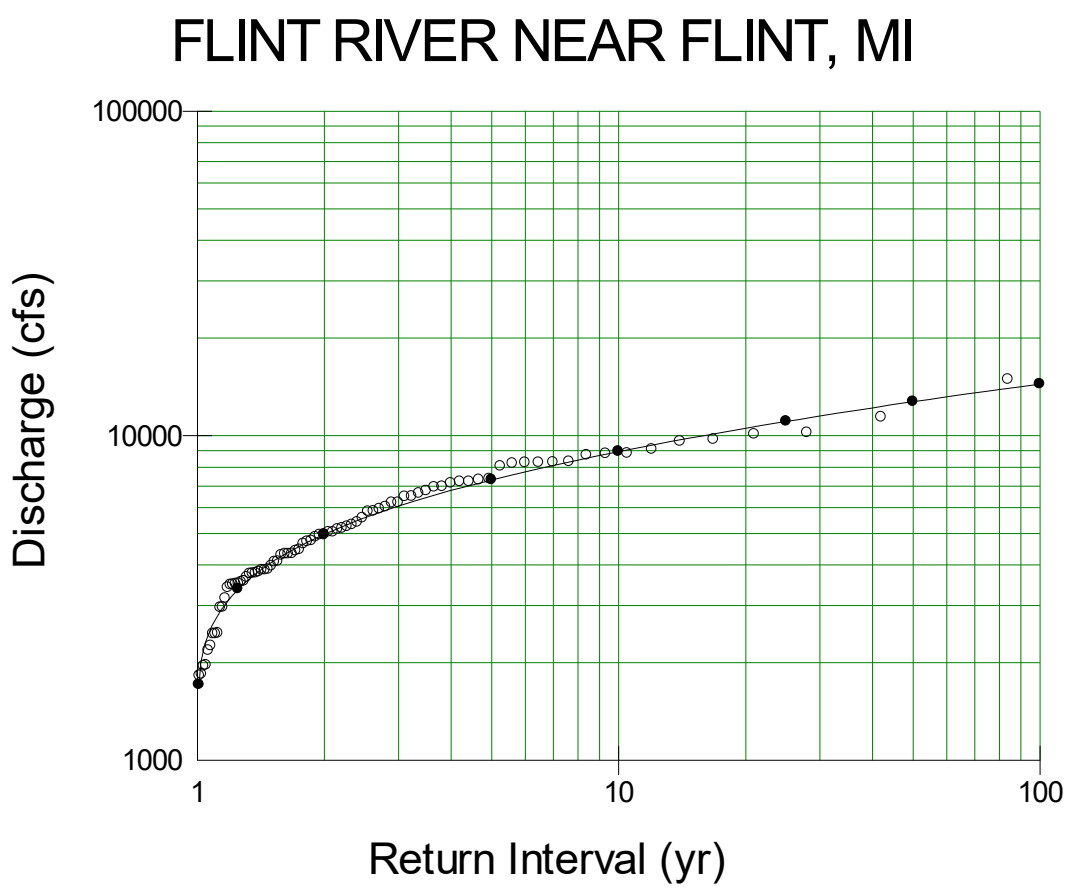
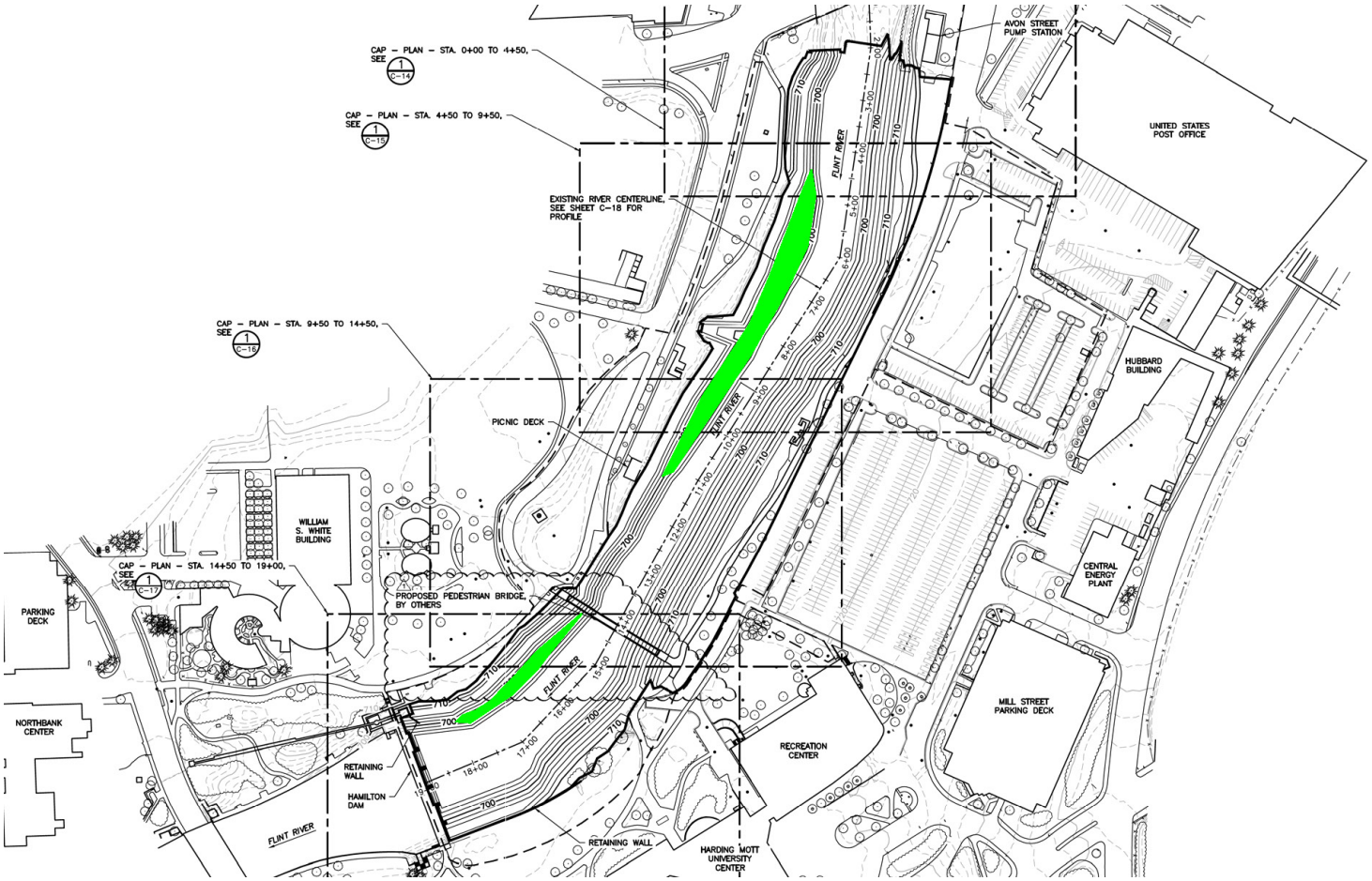
Higher frequency discharge analysis – Log Pearson III

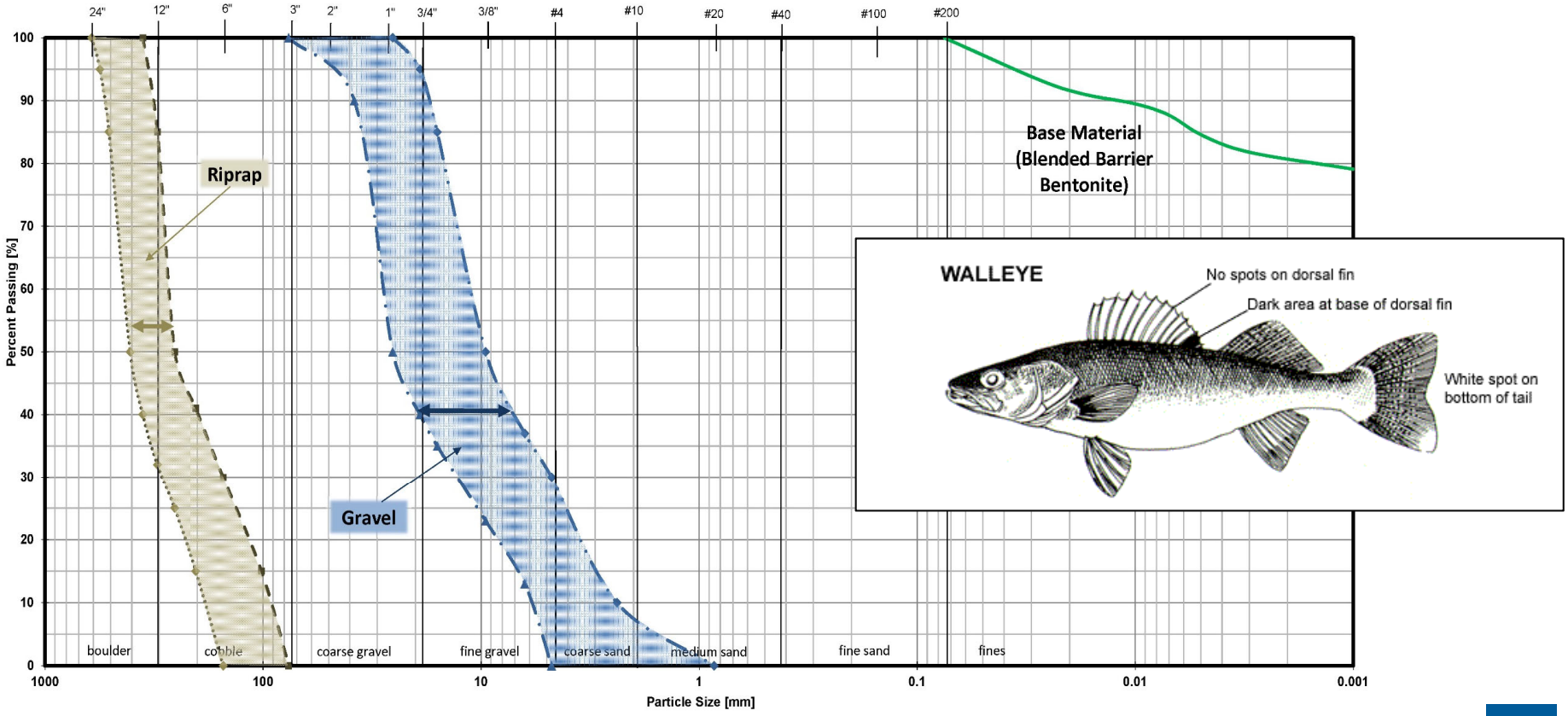


Floodplain bench



Floodplain bench – currently submerged

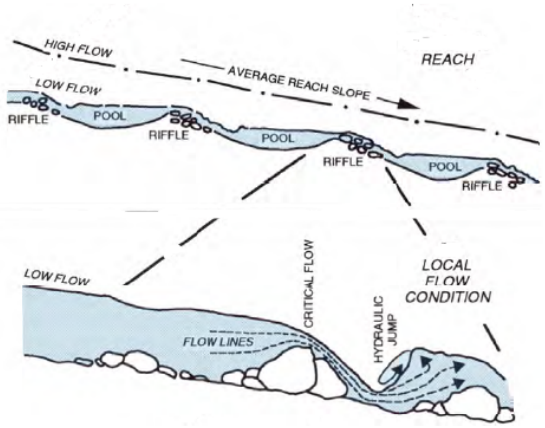
Gravel infilling to provide spawning habitat



Newberry Riffles

Stream Restoration Hydraulics
Part 1: Theory

A selection of Canadian stream restoration projects and studies based on traditional one-dimensional steady flow hydraulic equations and natural channel reference sites are collected as case studies in this volume. The projects were undertaken between 1976 and 2016 and continue to function, often with new features created by subsequent flood flows and riparian zone recovery.



Robert Newbury PhD PEng

www.newbury-hydraulics.com **web edition Part 1of 2**

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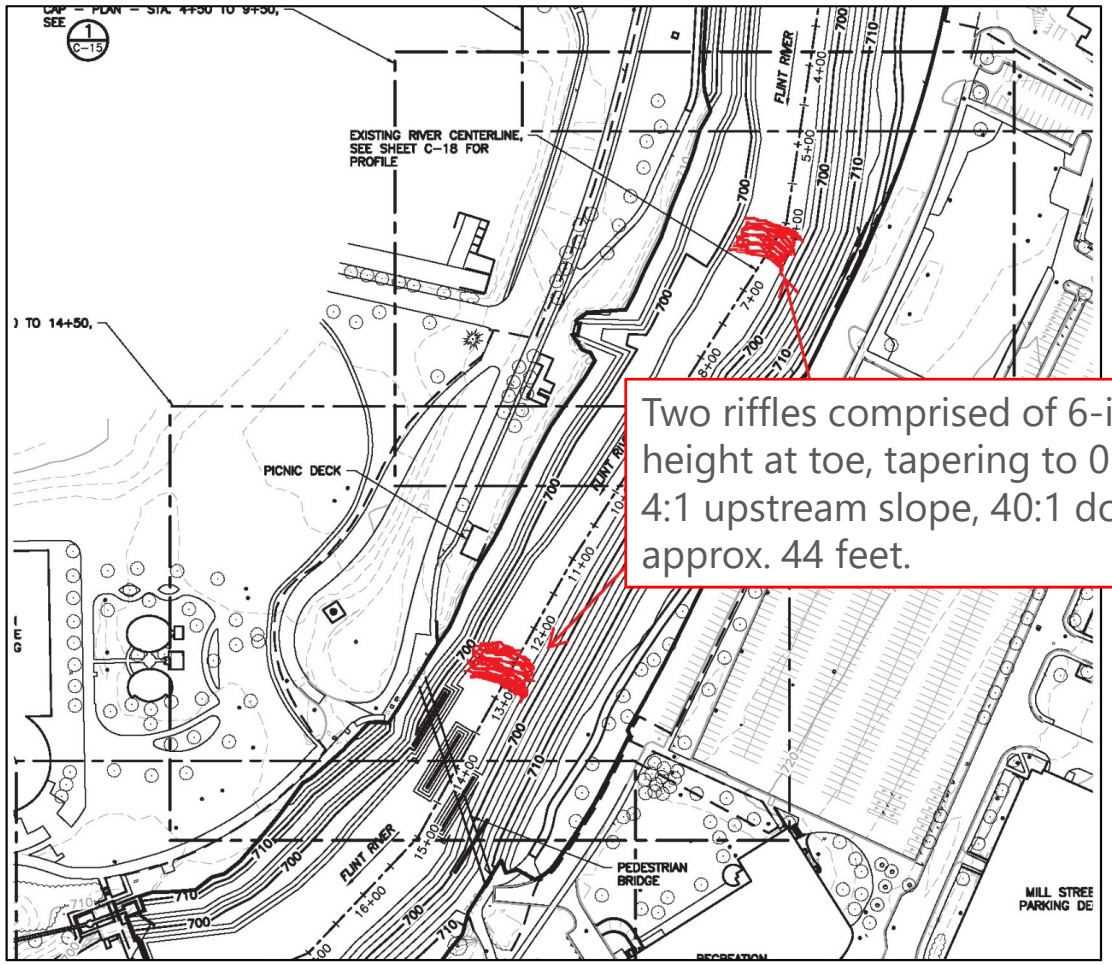
Newberry Riffles



Two riffles comprised of 6-inch minus material, 12-inch height at toe, tapering to 0-inch toward channel center; 4:1 upstream slope, 40:1 downstream slope. Total length approx. 44 feet.

Vegetation

- Native grasses, sedges and wildflowers
- Mix varies by elevation and location
- Trees and shrubs
  - River Birch
  - White Pine
  - White, Red and Bur Oak
  - Triumph Elm

Riverbank Mix:

Scientific Name	Common Name	% of Mix by Weight
Bouteloua curtipendula	Sideoats grama	25%
Carex stricta	Tussock sedge	2%
Echinacea purpurea	Purple coneflower	1%
Helianthus pauciflorus	Stiff sunflower	2%
Monarda didyma	Bee balm	2%
Panicum virgatum	Switch grass	15%
Schizachyrium scoparium	Little bluestem grass	35%
Solidago rigida	Rigid goldenrod	2%
Spartina pectinata	Prairie cordgrass	15%
Symphyotrichum leave	Smooth aster	1%
	Total	100%

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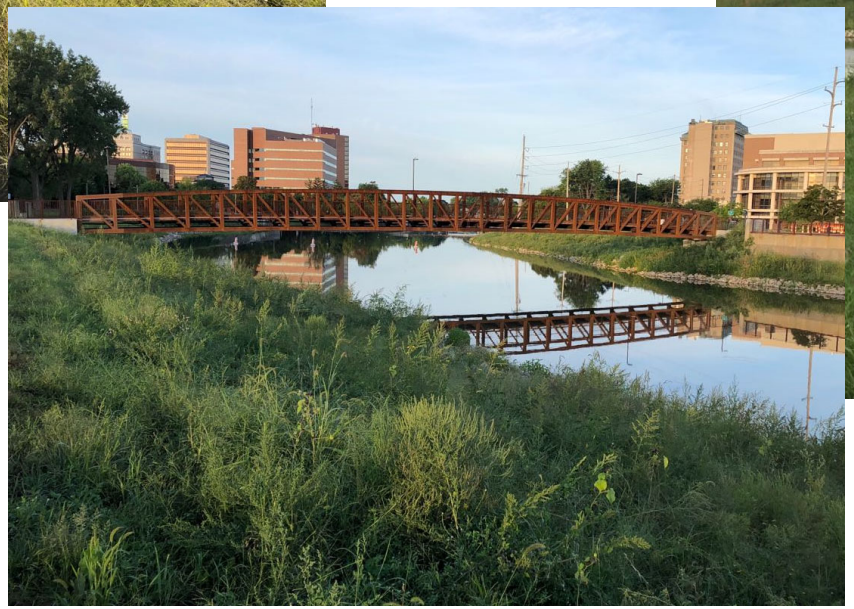
Vegetation



Implementation - construction challenges

- Changing current velocity
- Drastic water elevation fluctuations
- Cap installation within close proximity to dam
- Deep excavation adjacent to river
- Turbidity management

River turbidity management

- Changing river currents
- Storm surges
- Proximity to dam

- Adaptive process
  - Curtains
  - Moonpool
  - Air/Bubble Curtain

Final product

Questions?