Evaluation of Riparian Re-Vegetation on Streambank Stability and Erosion

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Unhealthy Streambanks

- 55% of the river and stream miles in the United States are reported to be in poor condition due to streamside disturbance and poor riparian vegetation cover (USEPA 2013).
- Increases in human population along with industrial, commercial, and residential development place heavy demands on stream corridors.
- Increase of introduced invasive vegetation that hinders the growth of native species and reduces the habitat variety.

Unhealthy Streambanks

The increased stress placed on many streams and rivers have been adversely affected resulting in streambank erosion causing:

- High sediment loads
- Reduced reservoir storage capacity
- Degraded water quality
- Effect aquatic wildlife species and richness
- Loss of natural riparian habitats
- Loss of landuse, property values, and human safety

Unhealthy Streambanks

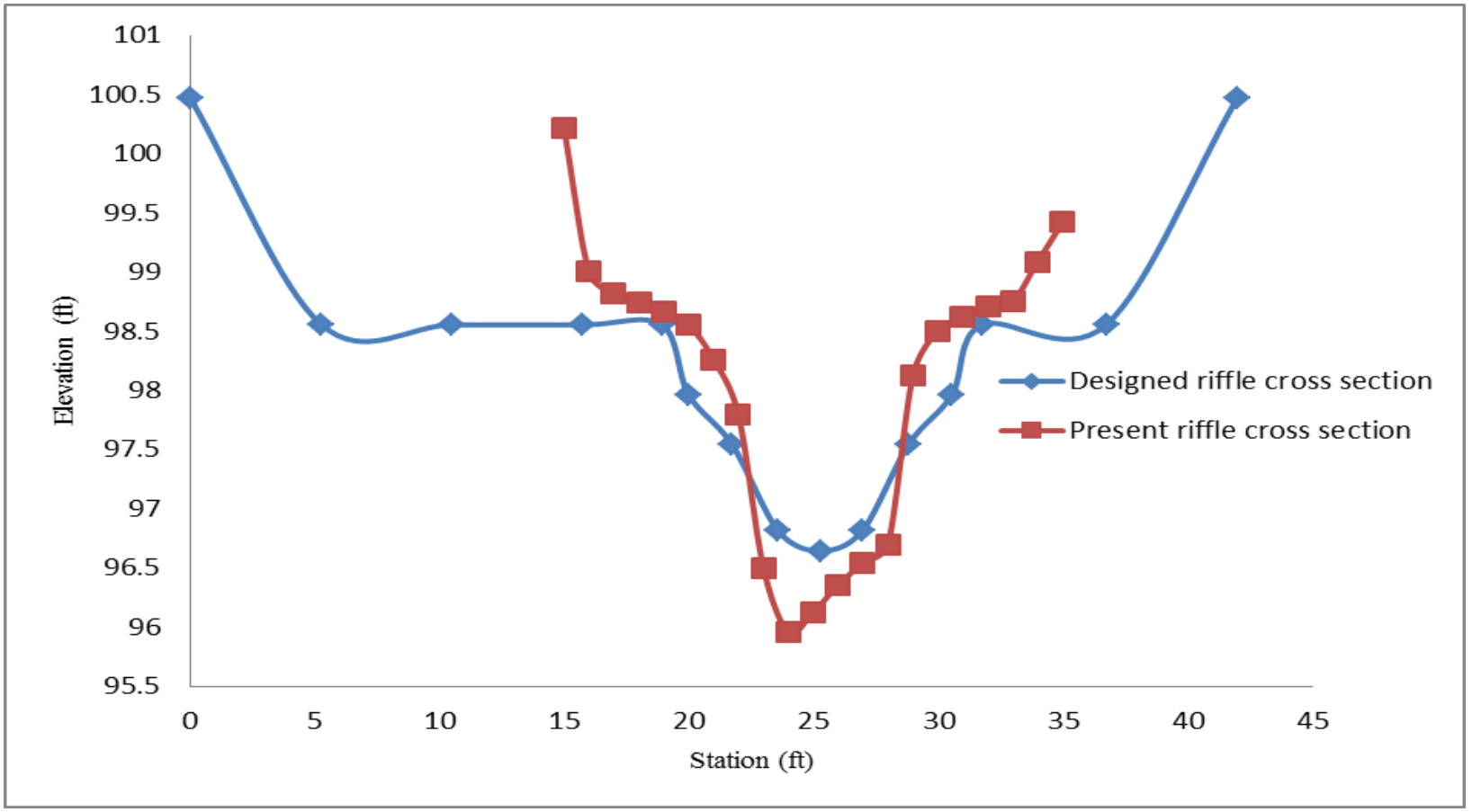
- The United States Department of Agricultural (USDA) estimated soil erosion costs of up to $44.39 billion in U.S.

Stream Restoration

- Due to erosion and its effects, historically engineers have channelized and destroyed the ecology and function of streams along with the streams riparian vegetation.

Natural Channel Approach

- Dimension
- Pattern
- Profile



Natural Channel Approach

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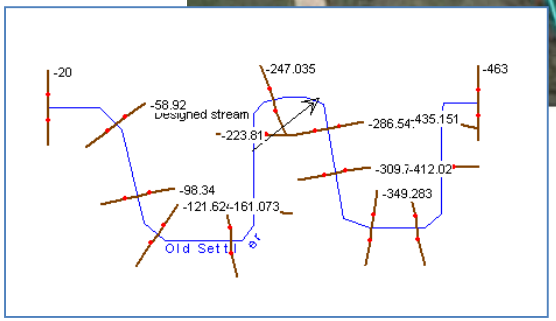
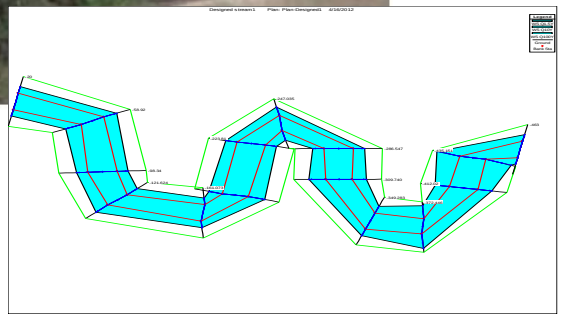
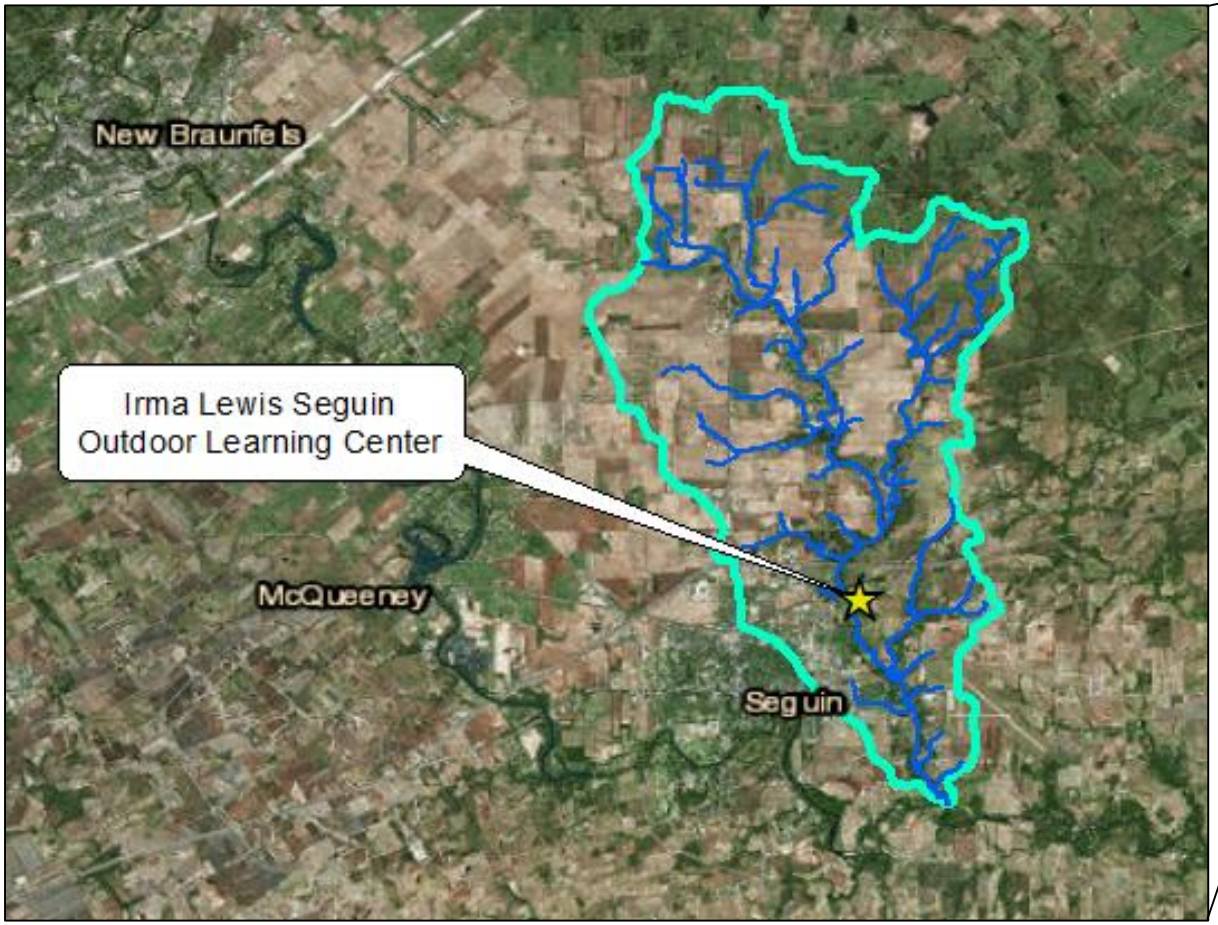




Project Description

- Natural Channel Approach can be costly and work intensive.
- Study a more cost efficient way to help stabilize banks and lower erosion and sedimentation.
- Funded through a Clean Water Act Section 319 non-point source grant from the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency.

Study Site
Geronimo Creek

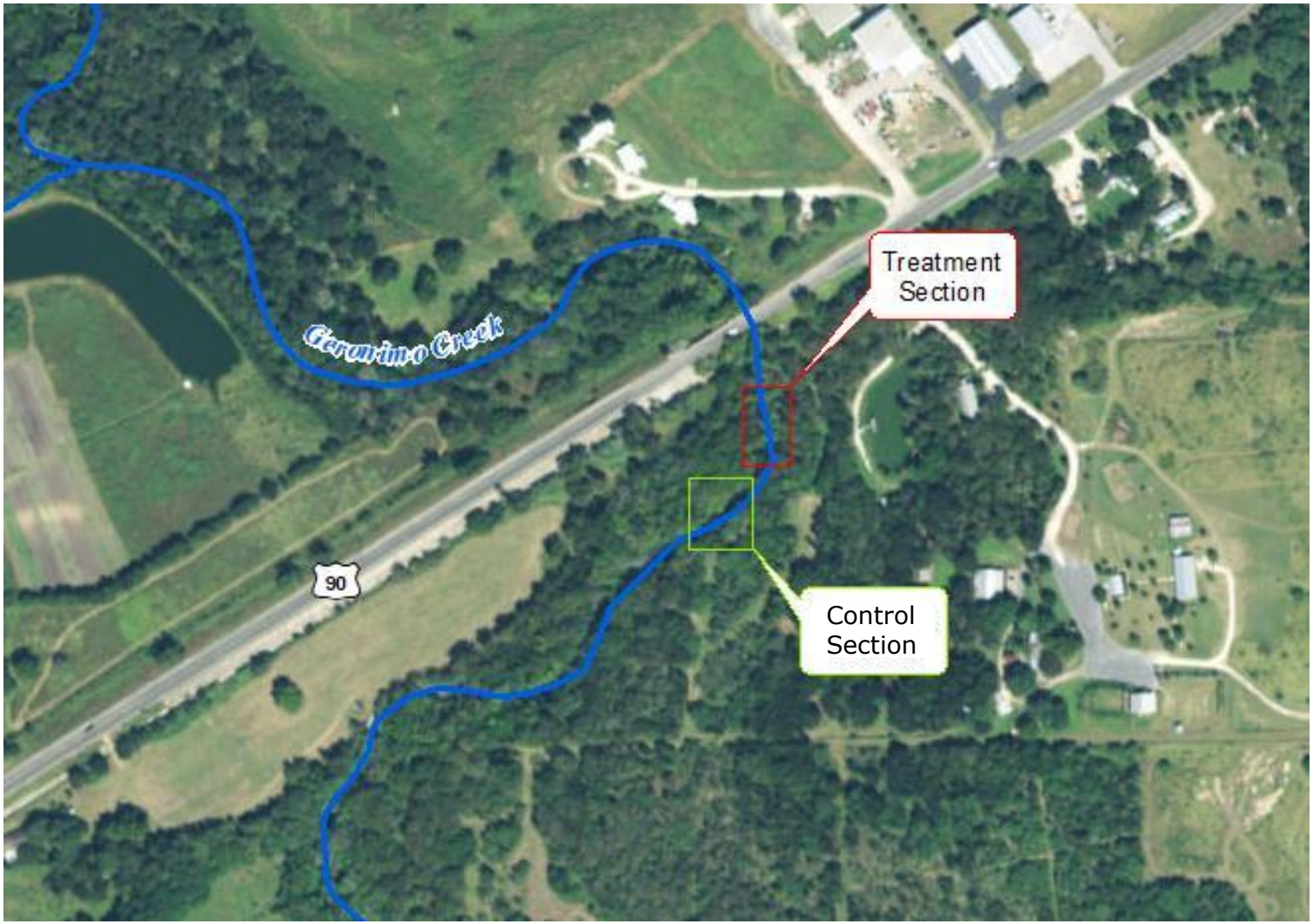


- 41 mi^2
- Spring fed
- Clay soils
- 31” annual rainfall

Project Hypothesis

- Implementation of streambank revegetation along moderately eroded streambanks along with a buffer strip can reduce the streambank erosion and degradation.

Study Site



Study Site

Treatment Section (Upstream)

Study Site

Control Section (Downstream)

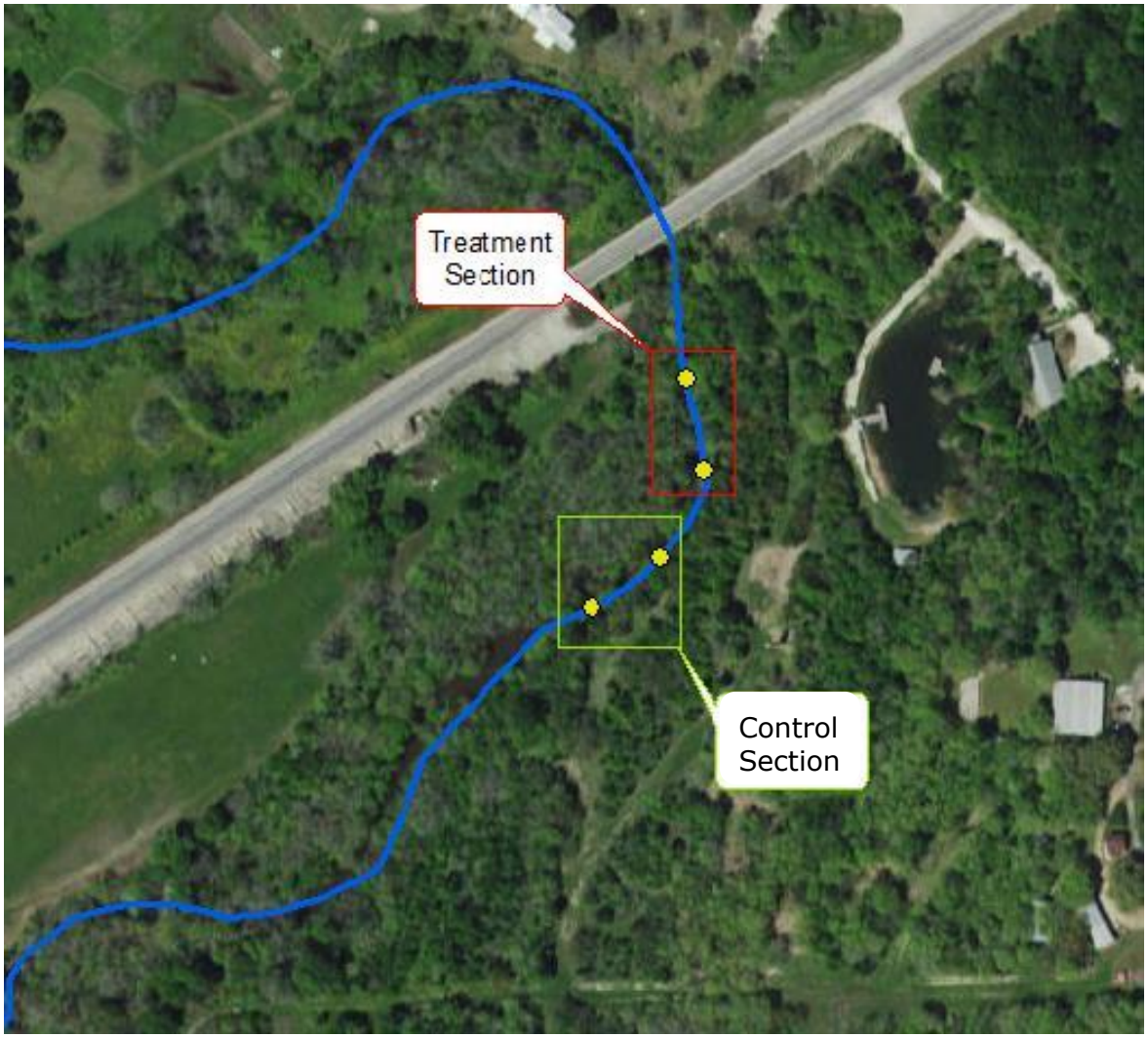
Project Methods

- Total Suspended Solids (TSS) sampling
- Cross-sectional surveys
- Pebble Counts
- Erosion pins
- BEHI

Project Monitoring

- Sampling for Total Suspended Solids (TSS) quarterly and storm event-based.
- Measure sediment load coming in and out of each section.

Project Monitoring



Treatment Section

Control Section

ISCO Automated Water Samplers

Project Monitoring

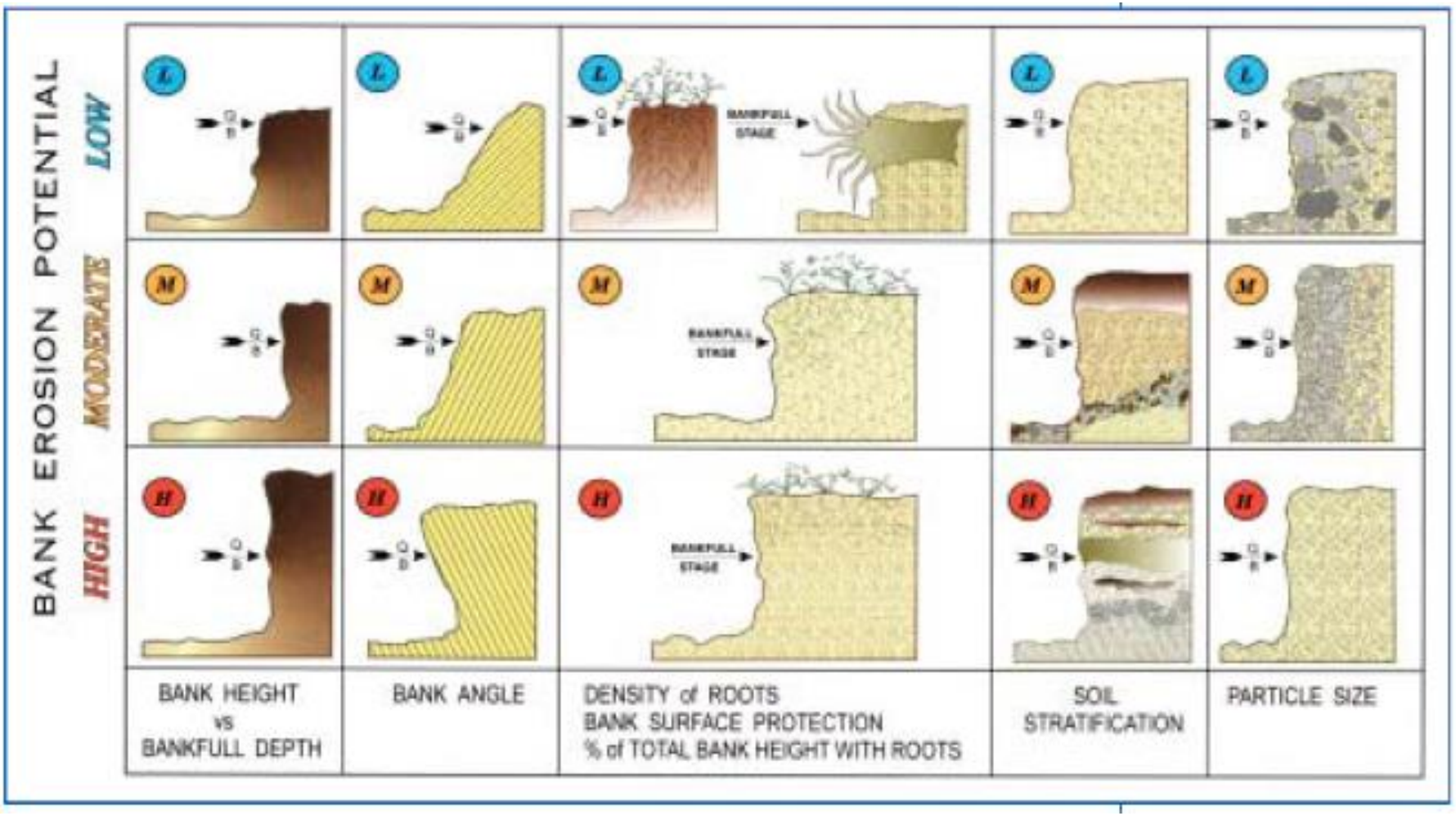
- 4 cross-sections each at treatment and control sections.
- Conduct pebble counts and surveys of each cross-section and the longitudinal profile of the stream annually.

Project Monitoring

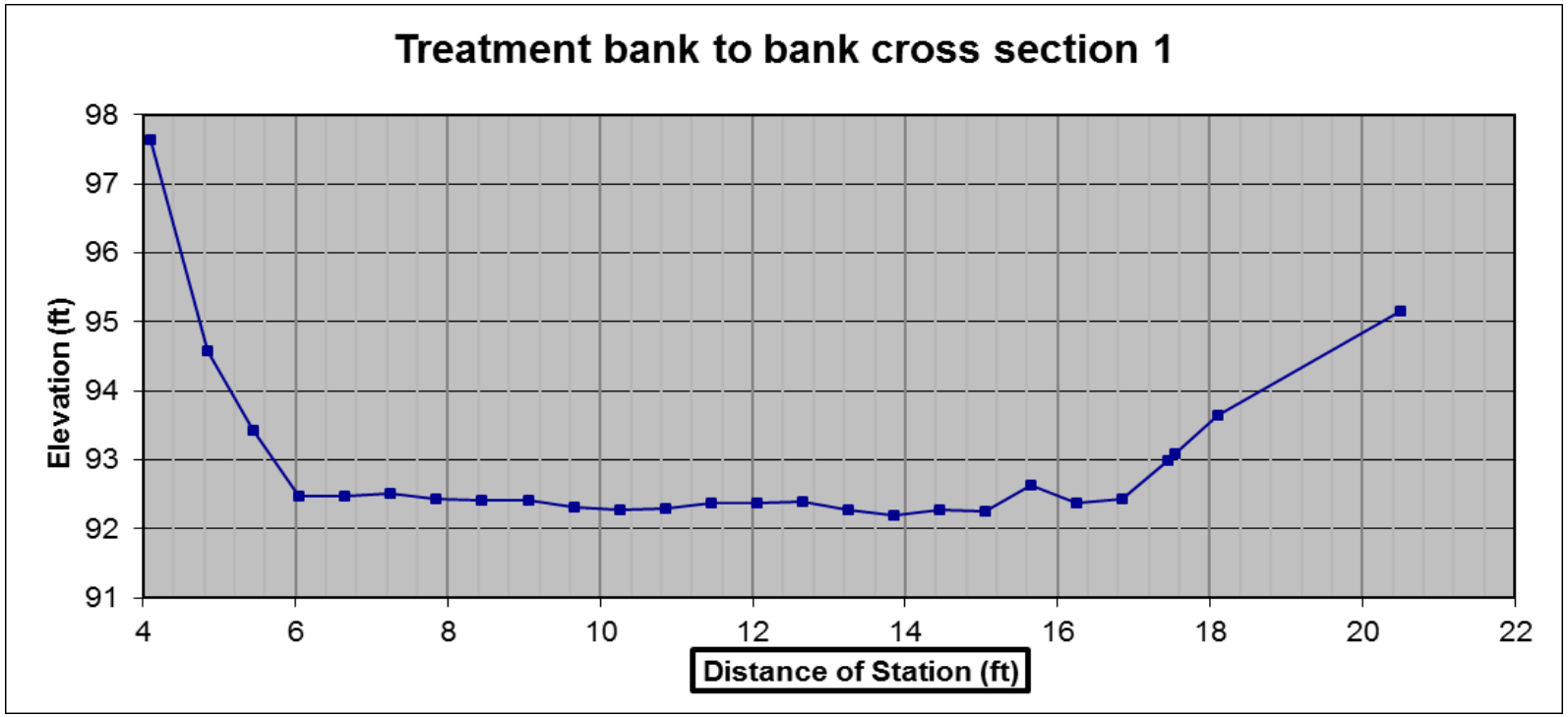
- Measure erosion pins quarterly to monitor streambank recession rate.
- 6 pins at each cross-section.

Project Monitoring

Erosion Hazard Index (BEHI)



Initial Evaluation of Treatment Section



BEHI

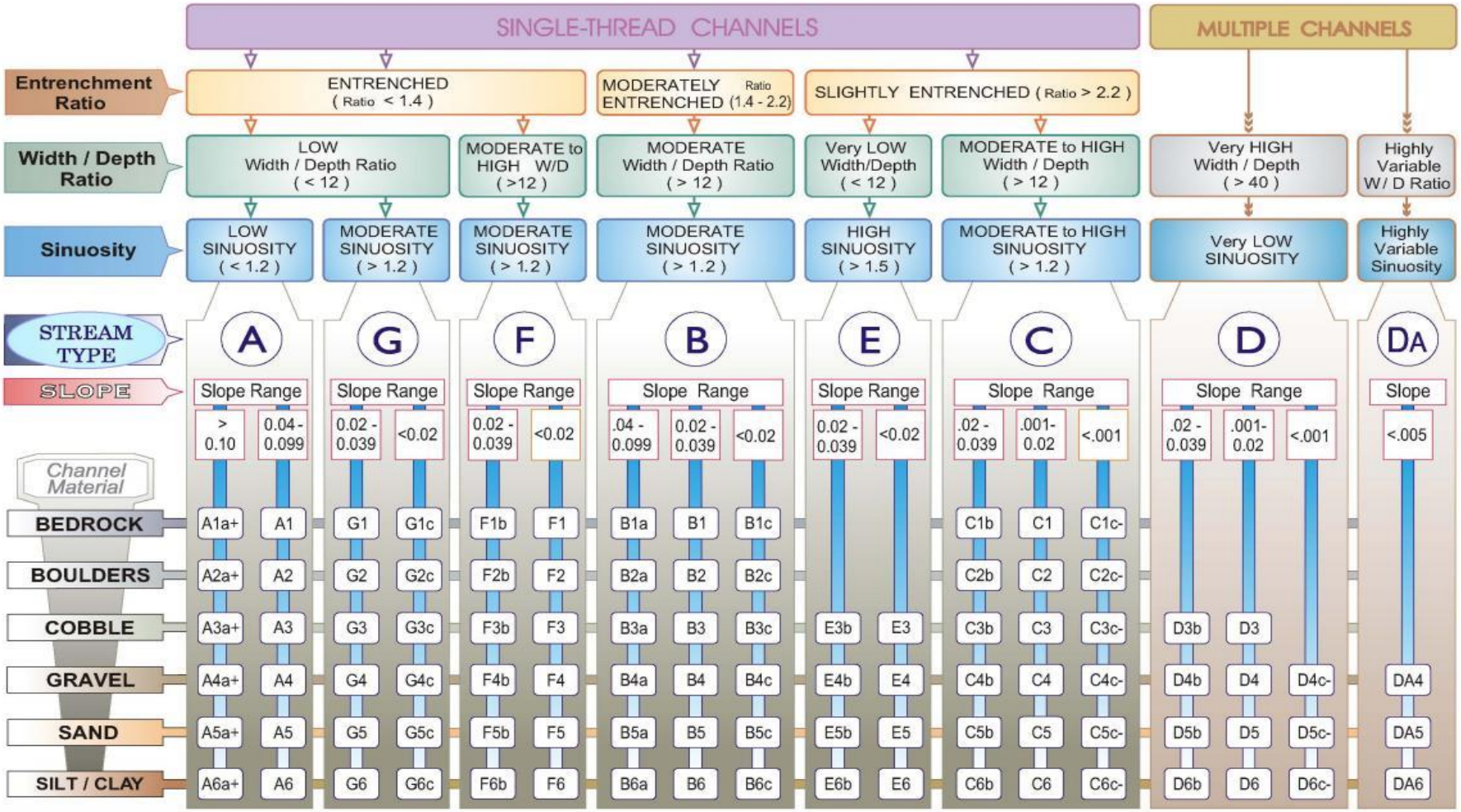
Pebble Count D50 clay

Classification: C6 morphing to a G6c

Left bank: 29.75 (Mod/High)

Right Bank: 20.4 (Moderate)

The Key to the Rosgen Classification of Natural Rivers



KEY to the *ROSGEN* CLASSIFICATION of NATURAL RIVERS. As a function of the "*continuum of physical variables*" within stream reaches, values of ***Entrenchment*** and ***Sinuosity*** ratios can vary by +/- 0.2 units; while values for ***Width / Depth*** ratios can vary by +/- 2.0 units.

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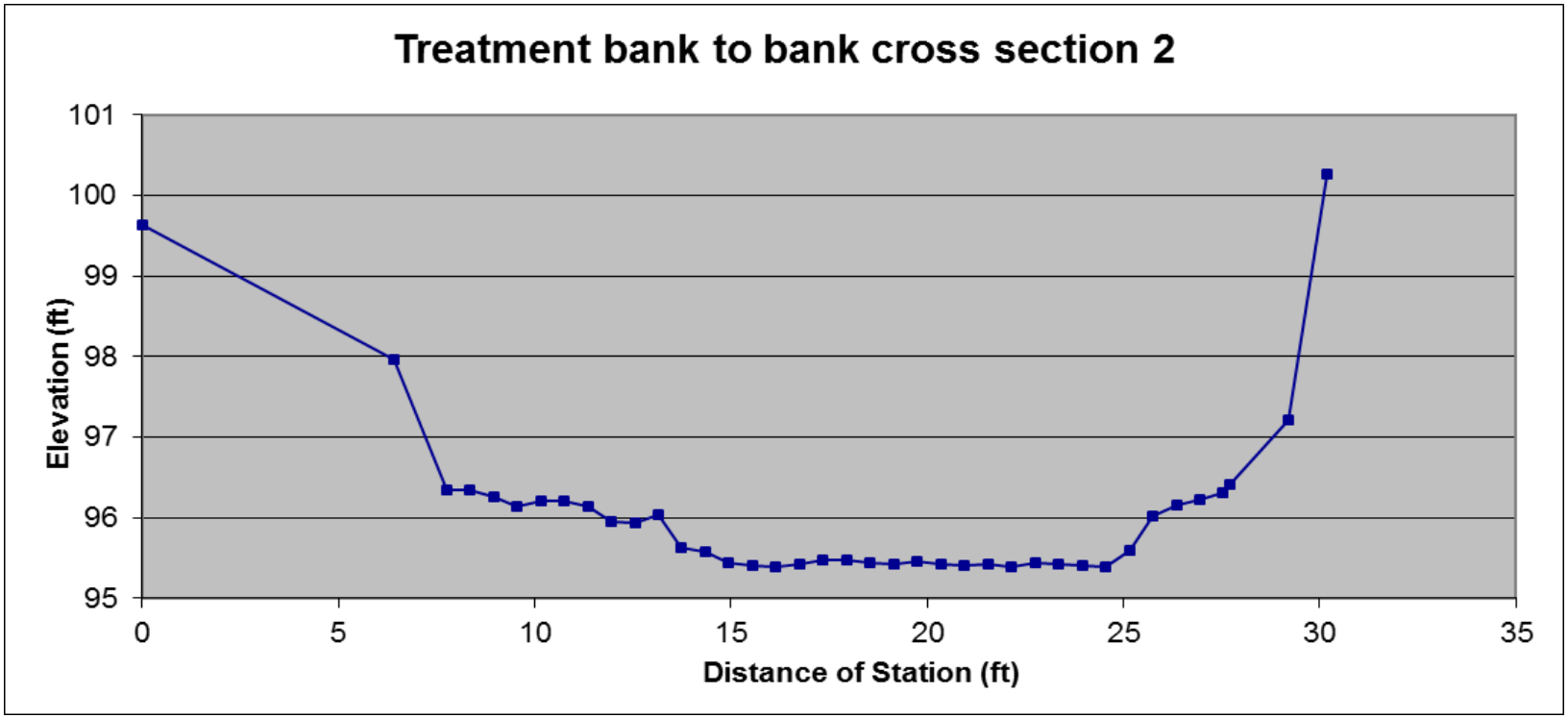
Initial Evaluation of Treatment Section



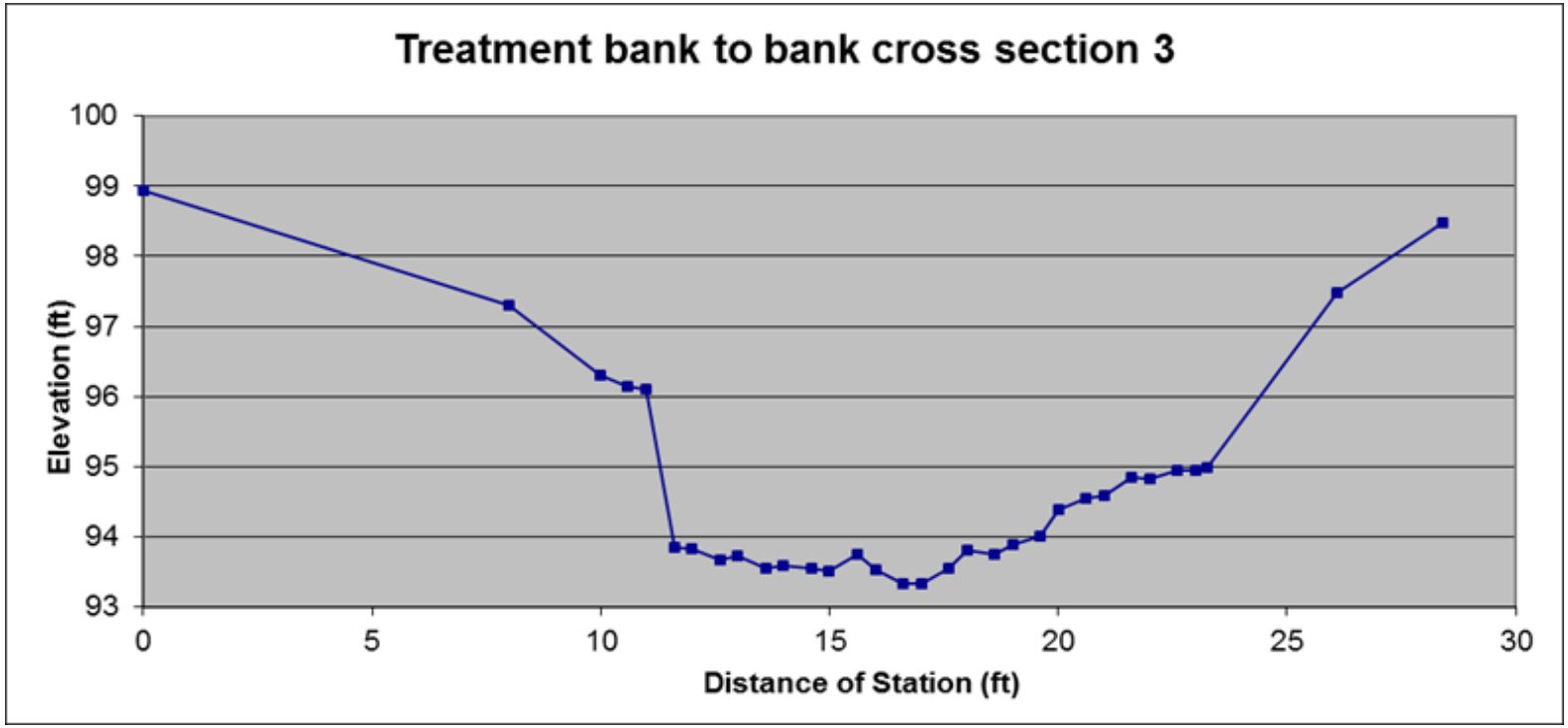
BEHI

Classification: C6

Left bank: 19.3 (Low/Mod)

Right Bank: 19.1 (Low/Mod)

Initial Evaluation of Treatment Section



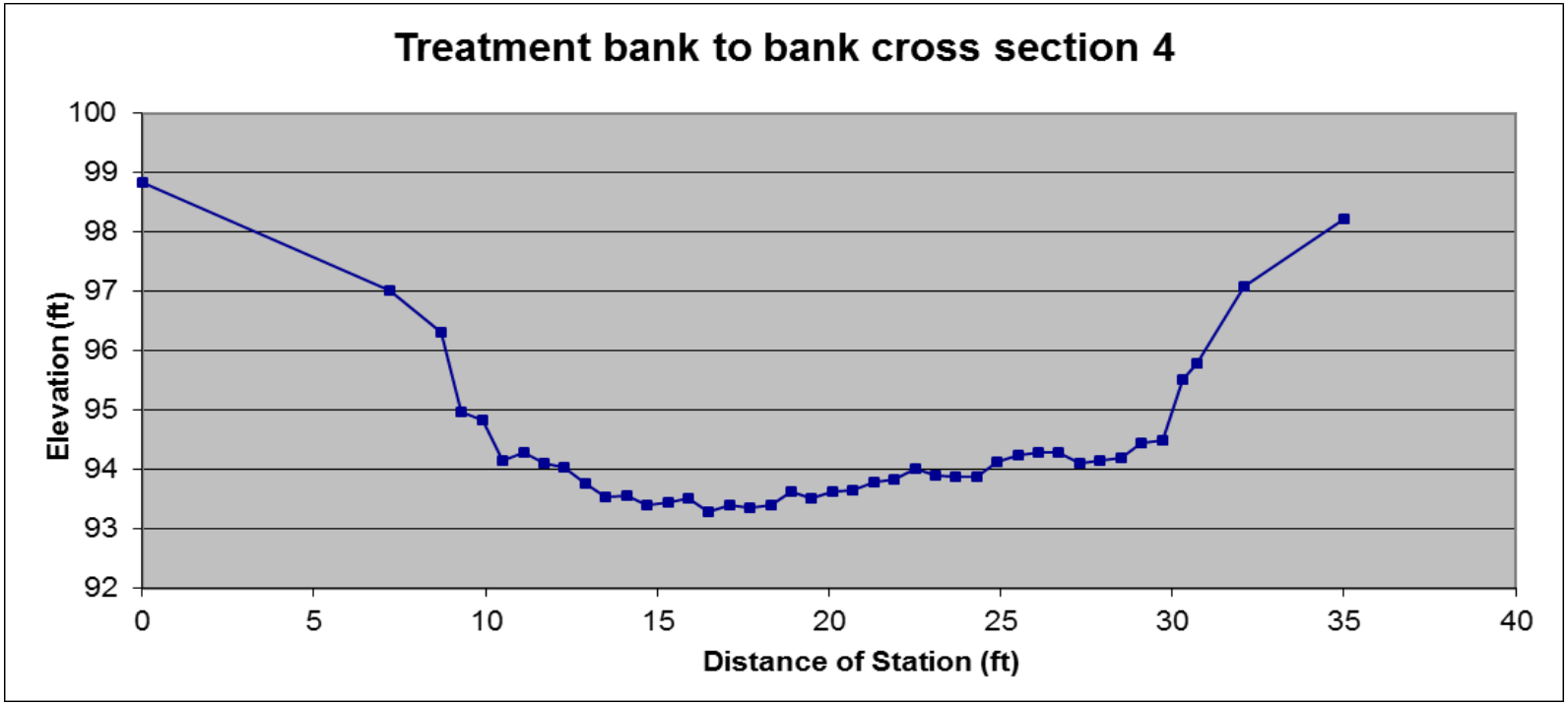
BEHI

Classification: C6

Left bank: 24.58 (Moderate)

Right Bank: 24.5 (Moderate)

Initial Evaluation of Treatment Section



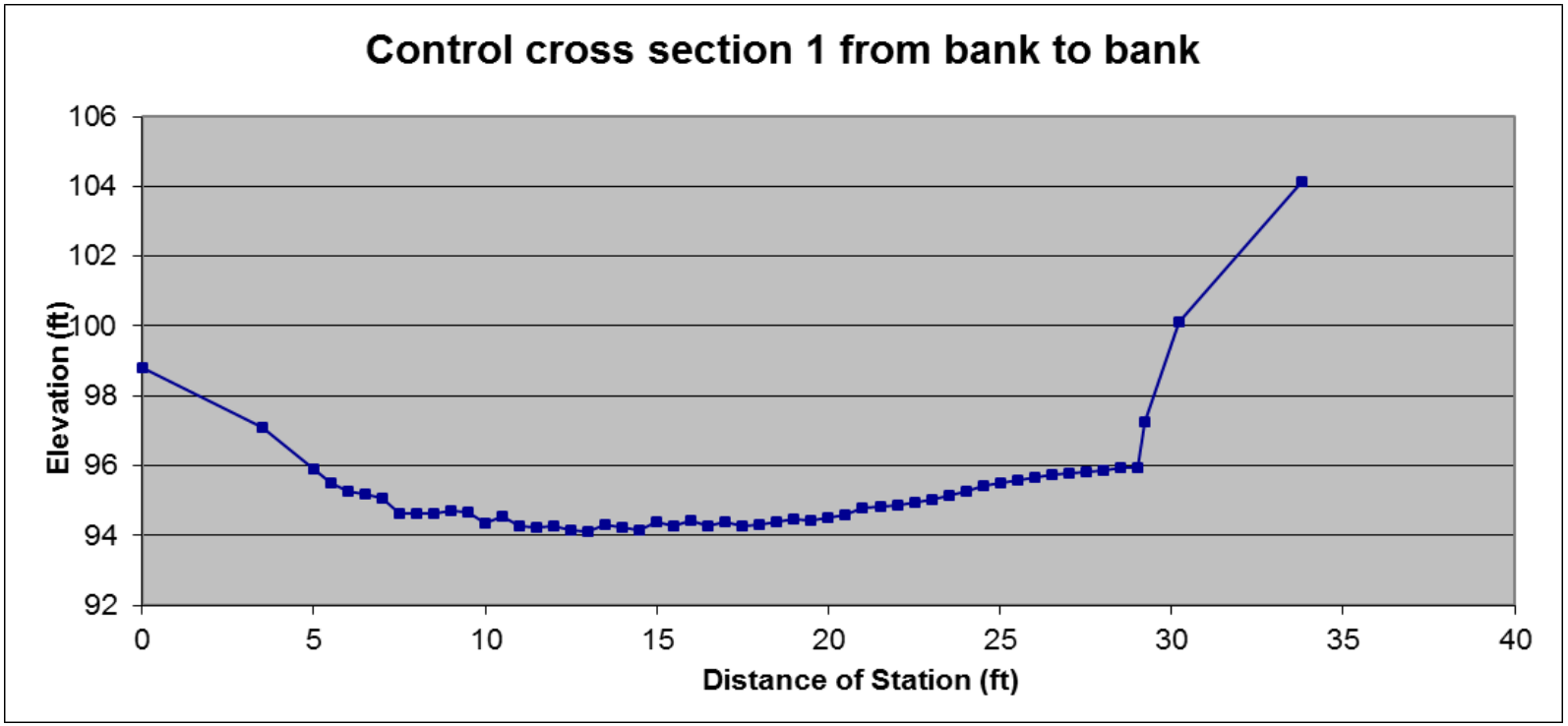
BEHI

Classification: G6c

Left bank: 21.7 (Moderate)

Right Bank: 22.4 (Moderate)

Initial Evaluation of Treatment Section



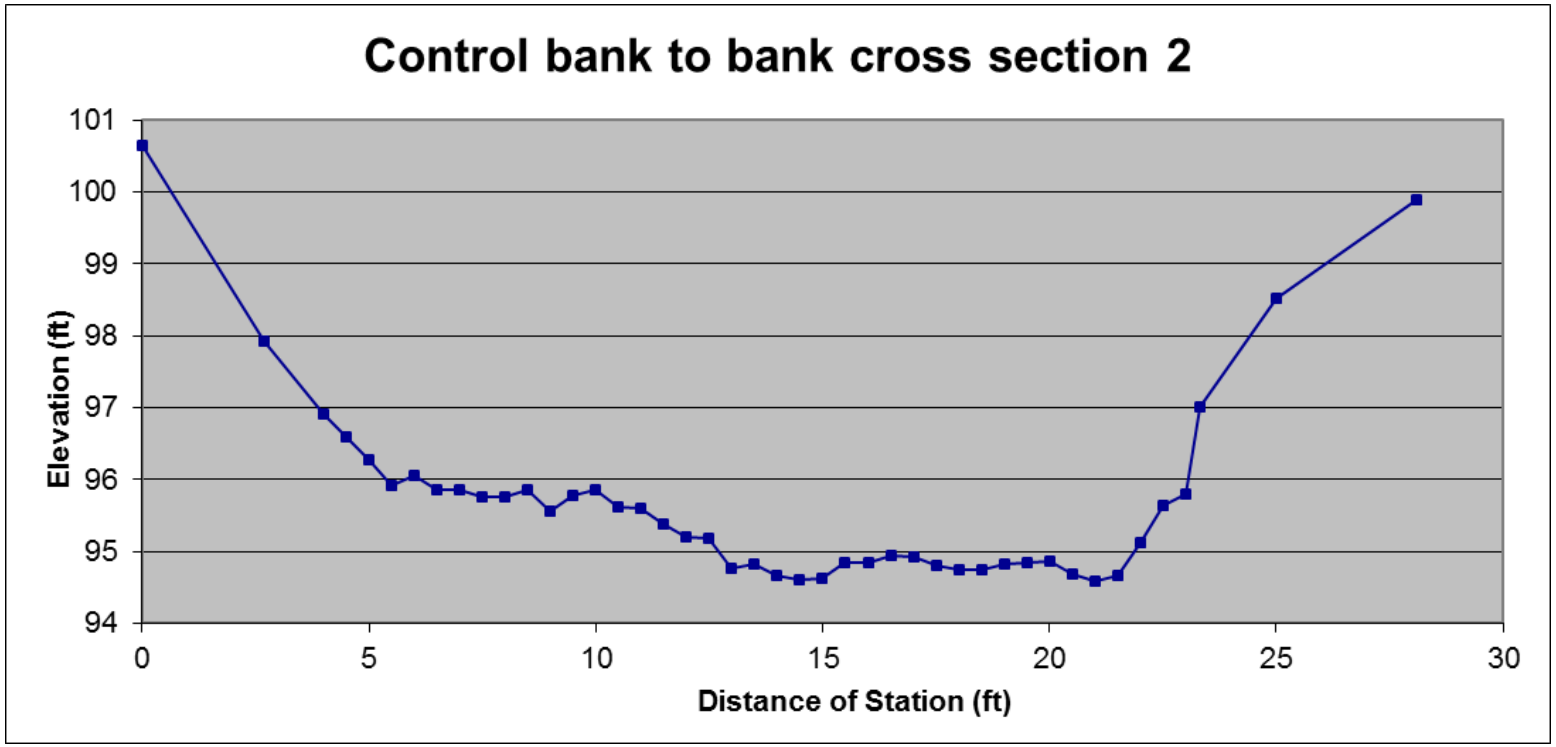
BEHI

Classification: G6c

Left bank: 34.8 (High)

Right Bank: 28.9 (Moderate)

Initial Evaluation of Control Section



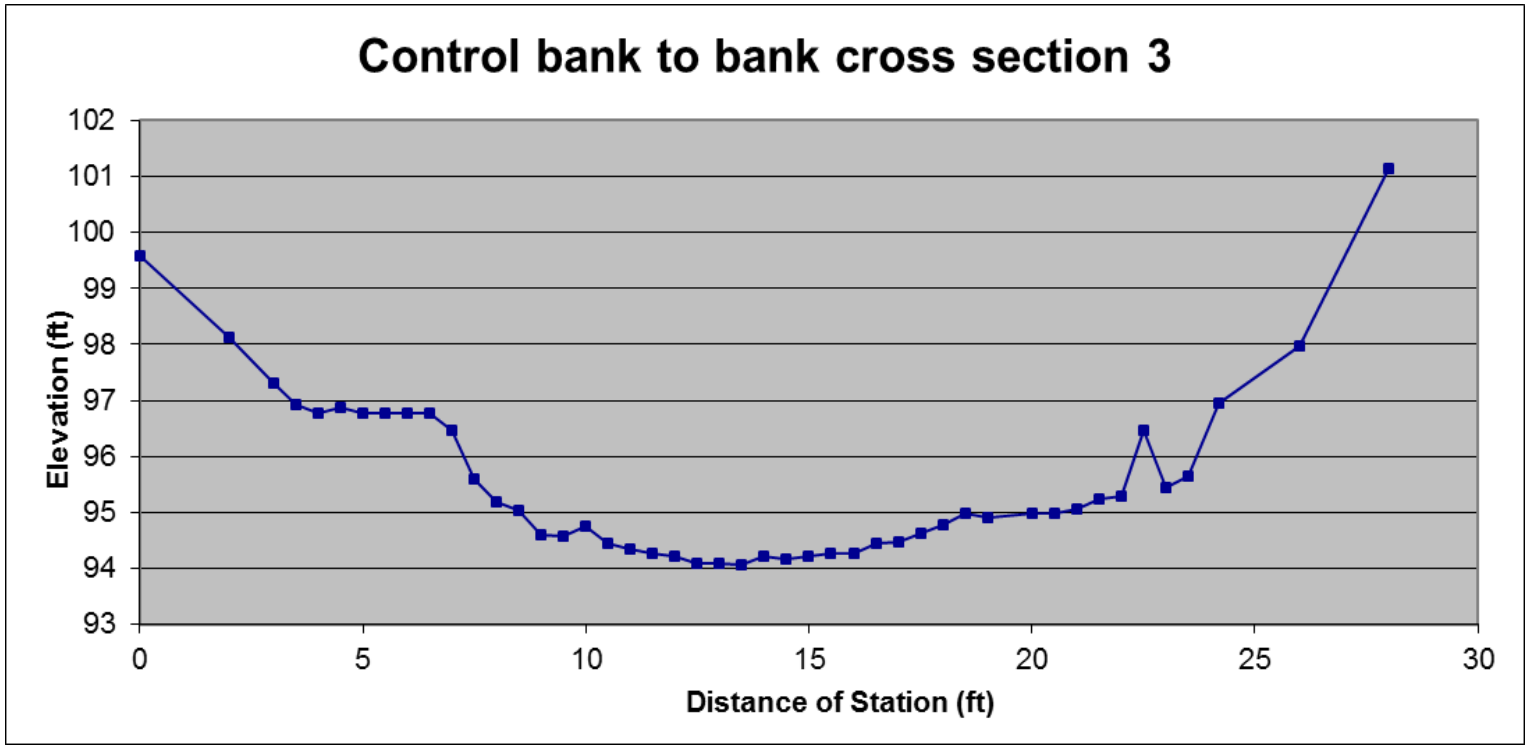
BEHI

Classification: G6c

Left bank: 34.8 (High)

Right Bank: 23.4 (Moderate)

Initial Evaluation of Control Section



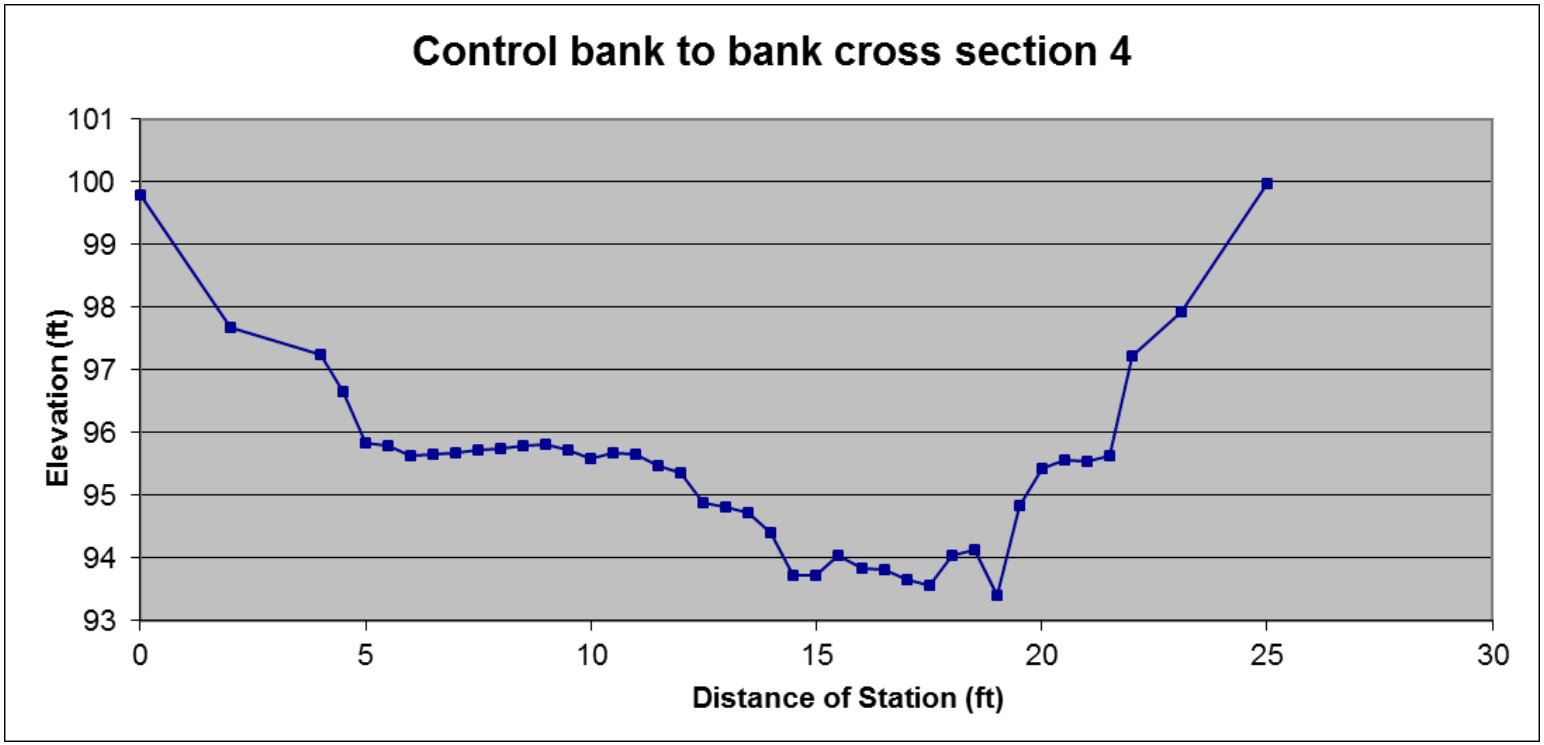
BEHI

Classification: G6c

Left bank: 34.8 (High)

Right Bank: 28.9 (Moderate)

Initial Evaluation of Control Section



BEHI

Classification: G6c

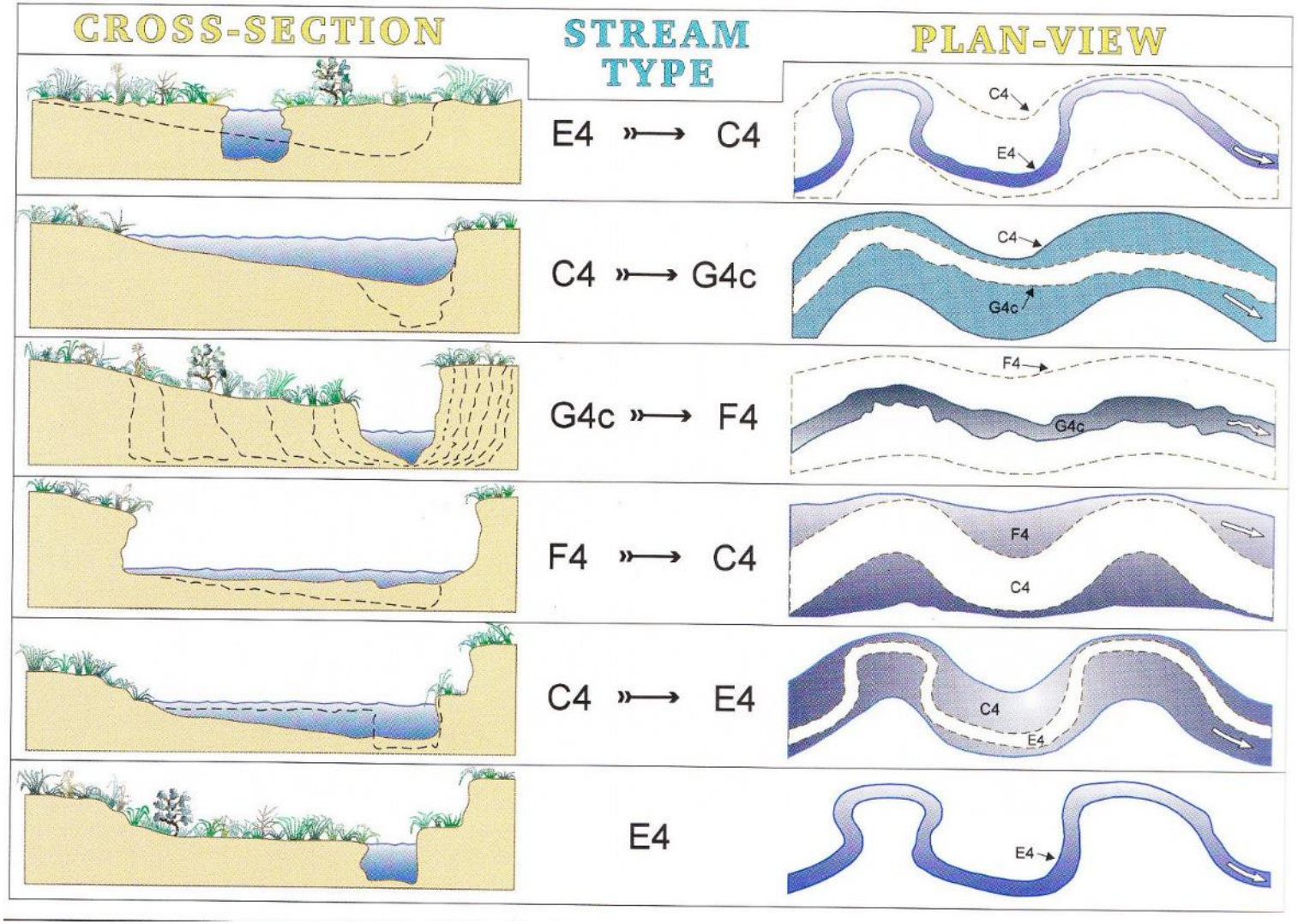
Left bank: 30.9 (High)

Right Bank: 30.75 (High)

Initial Evaluation Conclusion

- Channel evolution from a C6 to a G6c.
  - Upstream section had 2 cross sections that classified as C6 while the other two were either a G6c.
  - The 4 cross sections downstream indicated a G6c stream.
  - BEHI shows that the left bank is more erosion prone than the right bank
  - the downstream segment is a little more erosion prone than the upstream side.

Initial Evaluation Conclusion



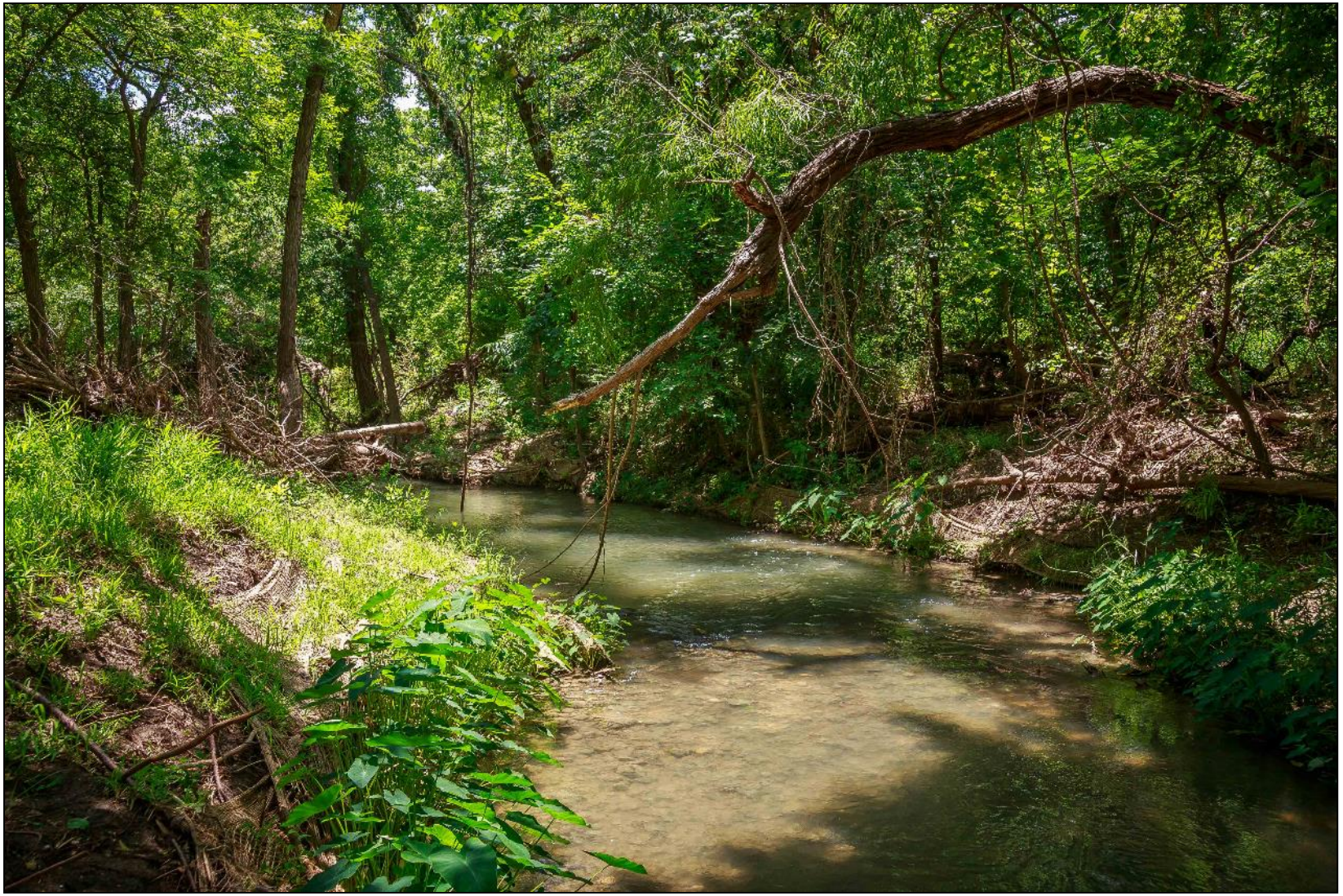
Planting of Native Vegetation

Consulted:

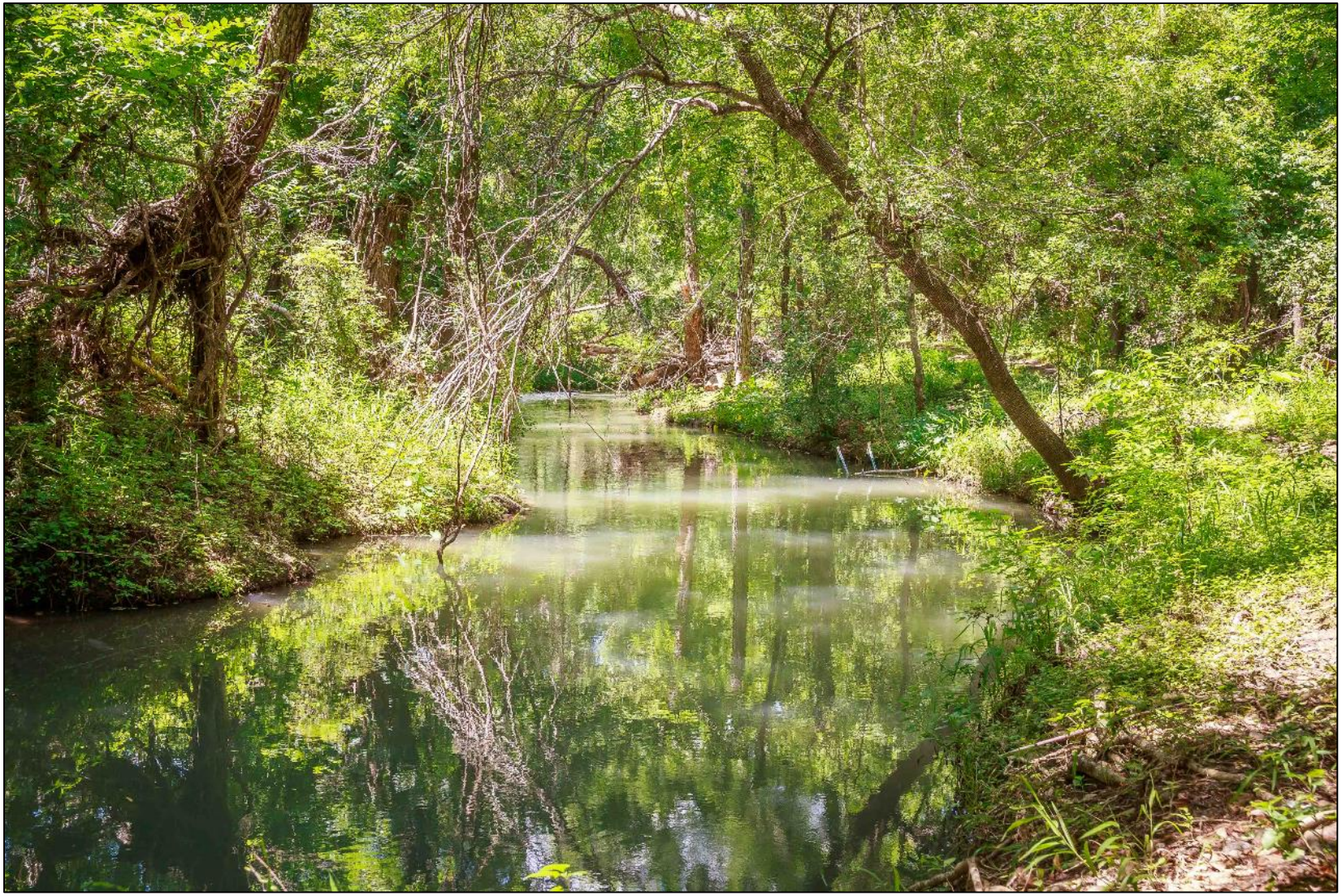
- Natural Resources Conservation Service
- Texas Parks & Wildlife Department
- Local plant nurseries.

Common Name	**Scientific Name**
cardinalflower	*Lobelia cardinalis*
obedient plant	*Physostegia virginiana*
Emory's sedge	*Carex emoryi*
creeping spikerush	*Eleocharis montevidensis*
beaked spikerush	*Eleocharis rostellata*
scouringrush horsetail	*Equisetum hyemale*
white star sedge	*Rhynchospora colorata*
Cherokee sedge	*Carex cherokeensis*
purpletop tridens	*Triden flavus*
Texas blue grass	*Poa arachnifera*
Leavenworth's sedge	*Carex leavenworthii*
stream sedge	*Carex blanda*
creek sedge	*Carex amphibola*
inland sea oats	*Chasmanthium latifolium*
Turk's cap	*Malvaviscus arboreus*
roughleaf dogwood	*Cornus drummondii*
black willow	*Salix nigra*

Treatment Section after Planting



Treatment Section after Planting



Treatment Section after Planting

Flow Measurements

- Measured flow in two ways to back calculate Manning's Roughness Coefficient:
  - Hand held flow meter
  - Doppler radar boat
- Results were crosschecked with the collected geomorphological measurements:
  - n= 0.021

Expected Results

- After 2 years of monitoring, results should show that the treatment section compared to the control section should have:
  - Lower sediment loads
  - Lower erosion rates
  - Lower BEHI score
  - Better stabilized banks

  Just by planting native vegetation and leaving an untouched buffer strip.

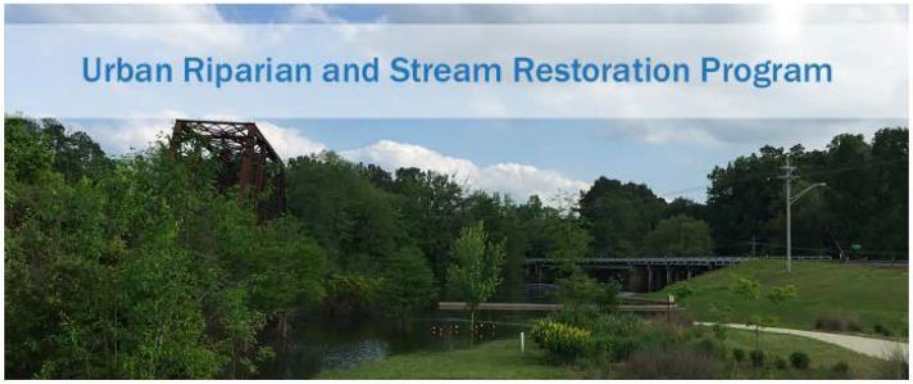
Urban Riparian & Stream Restoration Training

- 15 one-day trainings and 1 advanced three-day training in year 3.
- Geared toward professionals interested in conducting restoration projects
- Help attendees understand urban stream functions
  - what the impacts of development on urban streams look like
  - recognize healthy and degraded stream systems
  - assess and classify a stream using the Bank Erosion Hazard Index (BEHI)
  - Comprehend what natural versus traditional restoration techniques

Training Outline

1. Hydrologic cycle
2. Introduction to stream morphology
   a) Bankfull discharge
   b) Stability
   c) Channel measurements
3. Stream classification
4. Stream instability
5. Stream restoration
6. Stabilization structures
7. Vegetation
8. Monitoring and evaluation

Urban Riparian and Stream Restoration Program



Training Agenda | 8:30 am - 4:00 pm

8:30 am **Welcome and Protecting Water Quality by Restoring Riparian Corridors**
- **Clare Entwistle**, Texas Water Resources Institute

9:00 am **Stream Processes, Classifications of Streams, and Stream Restoration**
- **Dr. Fouad Jaber**, Texas A&M AgriLife

11:00 am **Photo Monitoring of Restoration and Stream Trailer Video**
- **Nathan** or **Destiny**, Texas Water Resources Institute

11:30 am **Local Watershed Update**
- Local Watershed Contact

12:00 pm **Lunch (Provided)**

12:30 pm **Prepare for the Field**
- **Dr. Fouad Jaber**, Texas A&M AgriLife

1:00 pm **Field Analysis Stations (30 minute Stations, bring boots or waders)**
- Stream Inspection: **Dr. Fouad Jaber**, Texas A&M AgriLife
- Stream Surveying: **Clare Entwistle** & **Nathan Glavy**, TWRI
- Stream Substrate Analysis: **Destiny Russell**, TWRI
- Stream Trailer (4th station if available at location)

3:00 pm **Data Analysis, Course Evaluation and Wrap Up**

Texas Water Resources Institute — make every drop count
Texas A&M AgriLife Research | Extension
Ecological Engineering Program — Texas A&M AgriLife
Texas A&M Forest Service
Texas Riparian Association
TCEQ
Soil Water TSSWCB
Texas Parks & Wildlife — Life's better outside. — Proud Partner
USDA NRCS — United States Department of Agriculture, Natural Resources Conservation Service

Funding provided through a Clean Water Act Section 319(h) nonpoint source grant from the Texas Commission on Environmental Quality and U.S. Environmental Protection Agency.

Value of Program

- 61% plan to take action on restoration activities based on information they learned at the workshop
- 35% of participants anticipate benefiting economically as a direct result of information learned at the workshop.
- 99% of participants would recommend this workshop to others
- 87% of participants found the information presented at the course quite or extremely valuable

	% Plan to Adopt	% Undecided	% Will not Adopt
Stream Design and Construction	73%	19%	8%
Riparian Re-vegetation	87%	11%	2%
Vanes	46%	41%	13%
J-Hook	55%	34%	11%
Cross Vane	51%	37%	12%
Manage Bare Ground	82%	12%	6%
Managing invasives	86%	14%	0%
Limiting access of humans and animals to streams	80%	15%	5%
Photo Monitoring	80%	17%	3%

Upcoming Training Location

- Houston area
  - Wednesday, August 16, 2018
  - Bear Branch Park, The Woodlands, TX
  - Partners: Houston- Galveston Area Council and Harris County Flood Control District

Questions?

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*Funded through a Clean Water Act Section 19 non-point source grant from TCEQ and EPA.