Stantec

The Growing & Evolving Benefits of Stream Restoration

From Resiliency to Stormwater BMPs – How Will the Industry Continue to Adapt?

J. George Athanasakes
October 30, 2018

Presentation Outline

- Evolution of Funding Sources
- Key Drivers of Restoration by Region
- Stormwater BMP
- Key BMP to Build Resilient Communities
- Continued Evolution
- Conclusions

Evolution of Funding Sources

- Municipalities
- Grant Programs
- Philanthropy
- Mitigation
- Stormwater BMPs/MS4 Program/Sediment TMDLs
- Large Capital Projects
- Future Funding?

Overview of Mitigation

- It all Started with the Clean Water Act
- 2008 Final Compensatory Mitigation Rule
- Forms of Mitigation
  - On-Site
  - Mitigation Banks
  - In Lieu Fee Programs
- All Forms Offer Viable Mitigation

On Site Mitigation

- Direct Mitigation for Project Impact
- Simplified Permitting Process
- Can be a Piece-Meal Approach
- Cost Considerations

Mitigation Banking

- Requires Upfront Investment
- Once Approved Owner Sells Credits
- Credits Approved for Sale Based on Release Schedule
- Private Investment

In Lieu Fee

- Provides Means to Pool Mitigation Dollars
- Allows for Larger More Comprehensive Restoration Projects
- Typically Paid at a Set Rate Per Unit of Impact

Typical ILF Costs per Credit Foot

- North Carolina - $507
- Kentucky - $280 - $710
- Tennessee - $400 - $600
- Virginia - $375 - $700

"…environmental regulation is driving a $25-billion-per year restoration industry that directly employs more people than coal mining, logging, or steel production — but fewer than oil and gas or auto manufacturing"

— Todd BenDor, UNC

Drivers by Region

- Eastern US - Mitigation
- Central US – Grants
- Western US – Endangered Species
- Drivers Evolving
  - Mitigation Expanding
  - Water Quality Programs

Nutrient Reduction Offset Credit – Chesapeake Bay

- Bay Declared a National Treasure
- Bay TMDL Established 2025 Pollution Reduction Goals
  - 6 Bay States
  - DC Area
- Influence of MS4 Programs
- Goal is to Reduce Pollution Levels by 20-25% over 2009 Levels*

**Cost estimated at $7-10 Billion.*

Ways to Generate Credits

1 - Credit for Preventing Sediment Loss During Storm Flows

2 - Credit for Instream & Riparian Nutrient Processing within the Hyporheic Zone During Base Flow

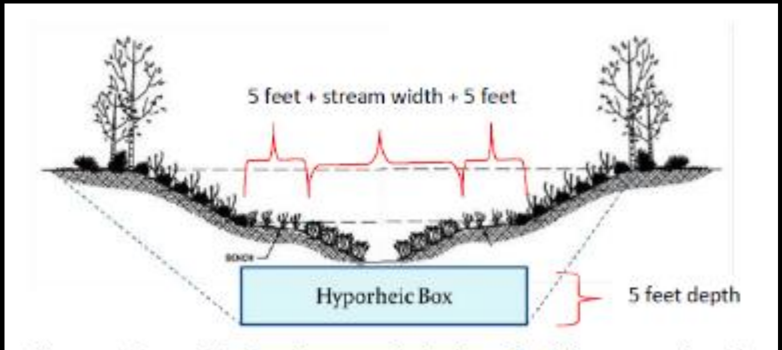
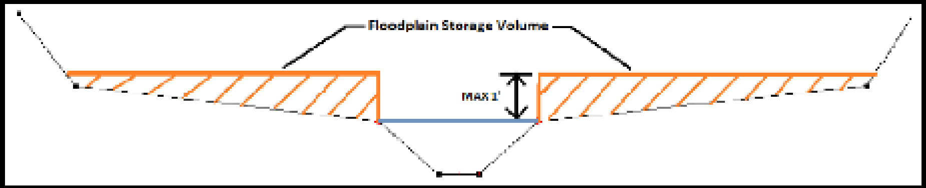
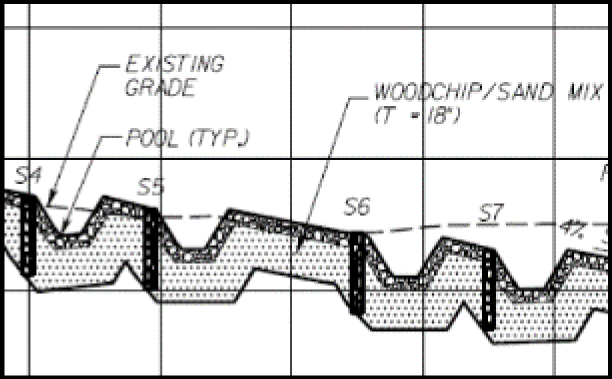


Figure 2. Hyporheic box that extends the length of the restored reach

3 - Credit for Floodplain Reconnection Volume



4 - Dry Channel Regenerative Stormwater Conveyance as an Upland Stormwater Retrofit



Nutrient Removal Cost Summary

• Traditional Stormwater	$20-75K per LB P
• Nutrient Bank (in VA only)	$15-20K per LB P
• Stream Restoration	$2 -9K per LB P

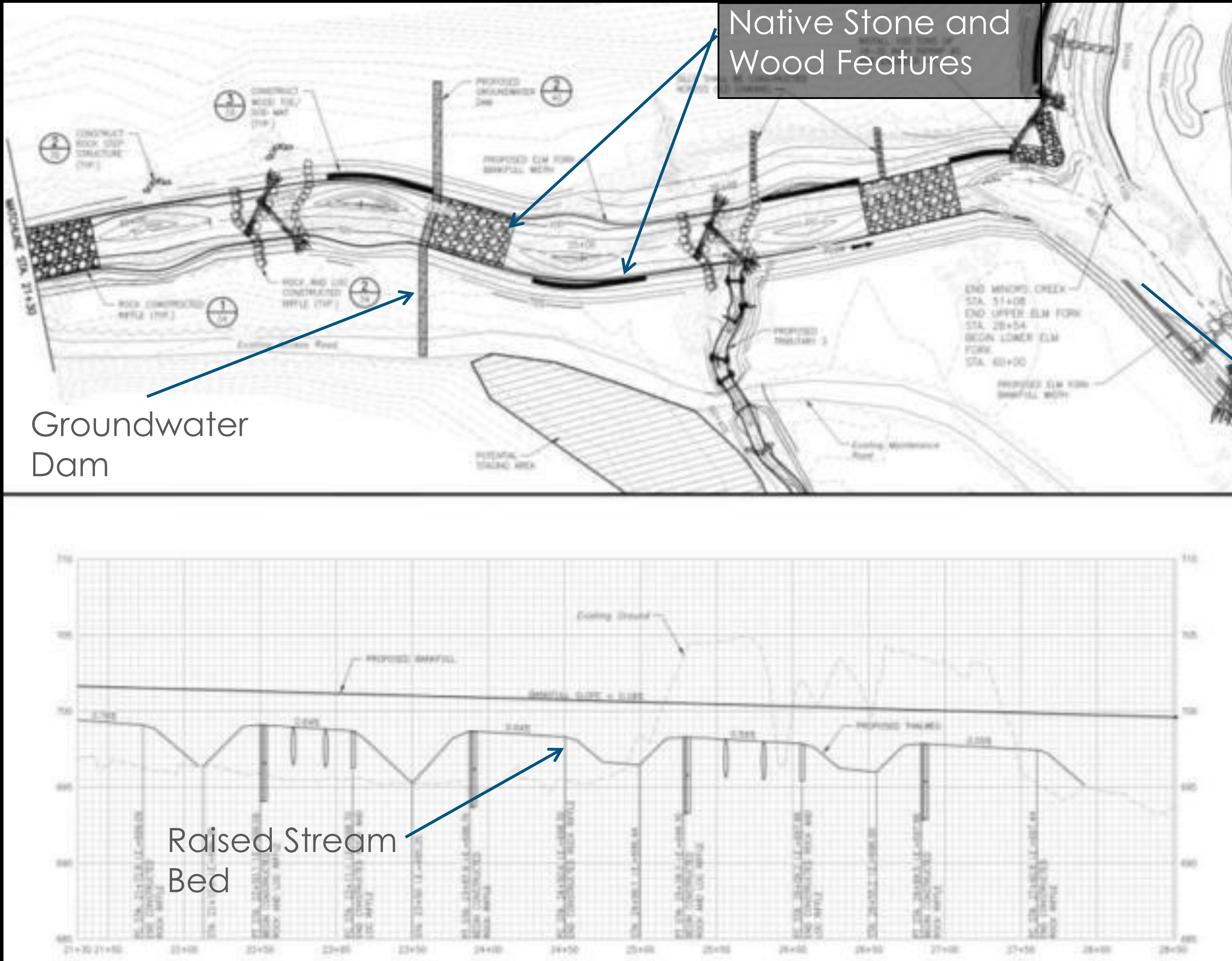
Elm Fork Restoration Case Study

- Entrenched Stream
- Minimal Riffle Habitat
- Significant Erosion


01/27/2010

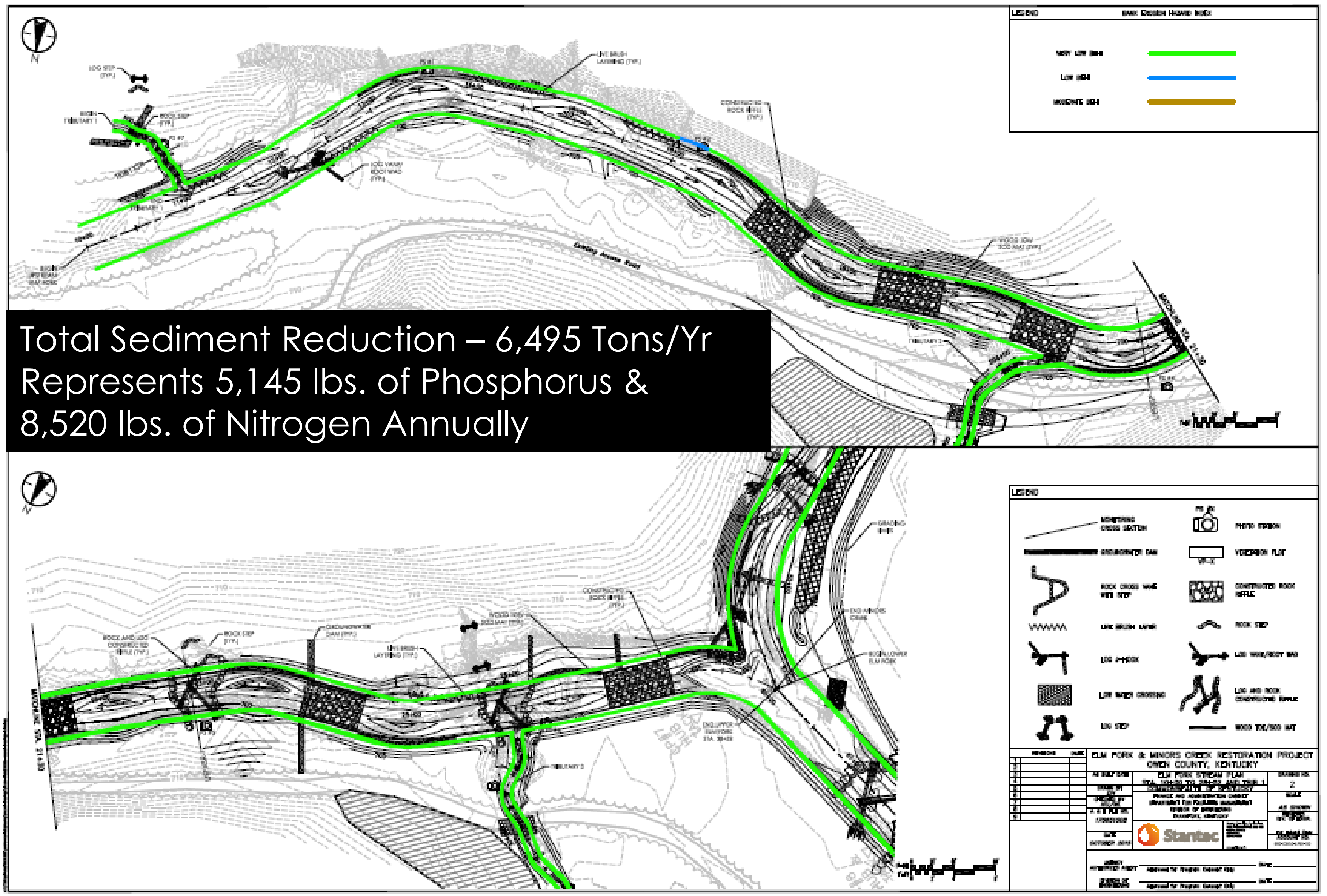
Design Approach

- Raised Channel Bed
- Established Floodplain Access
- Increased Riffle/Pool Habitat
- Project Encompasses 8,500 Feet of Restoration


Native Stone and Wood Features
Groundwater Dam
Raised Stream Bed

Pre-Restoration BANCS Model

Post Restoration BANCS Model



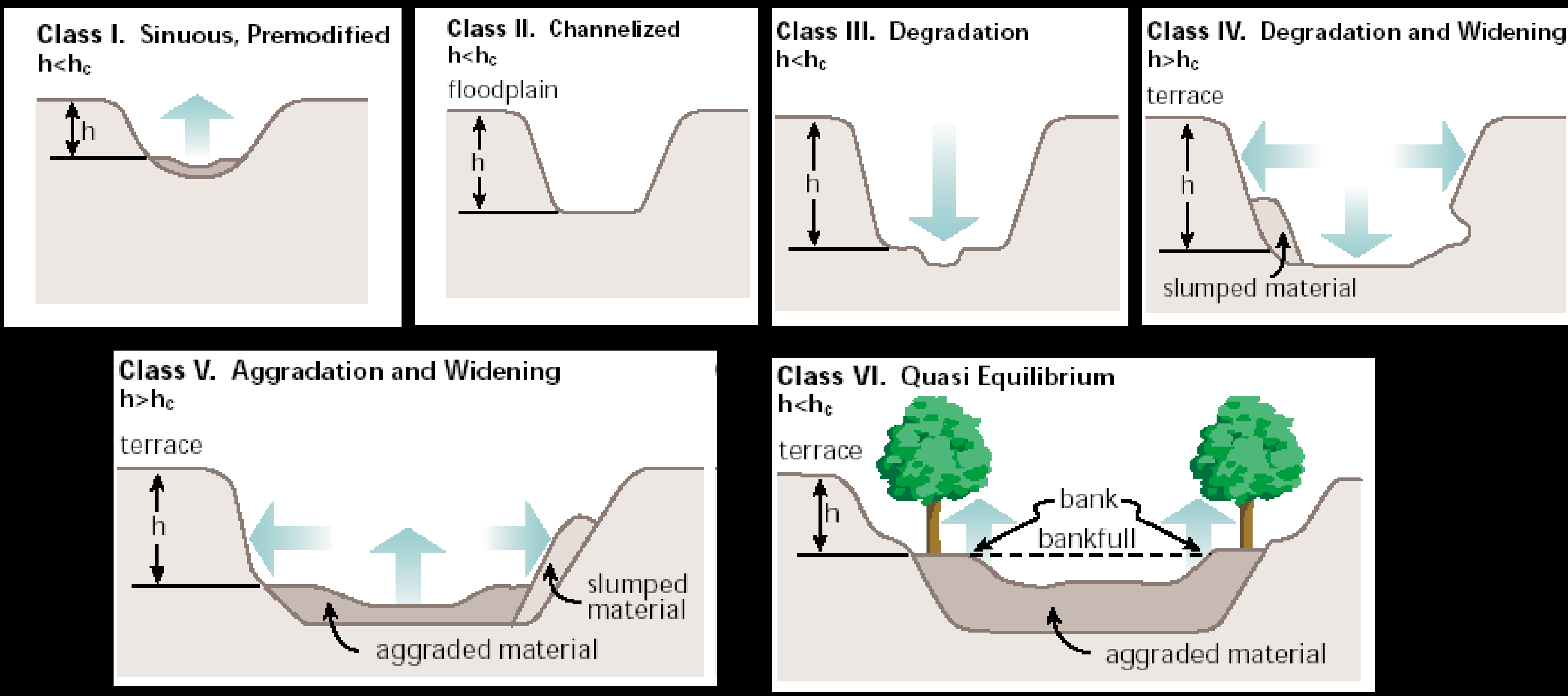
Total Sediment Reduction – 6,495 Tons/Yr
Represents 5,145 lbs. of Phosphorus &
8,520 lbs. of Nitrogen Annually


After 2 Growing Season

Use of Stream Restoration for Resiliency

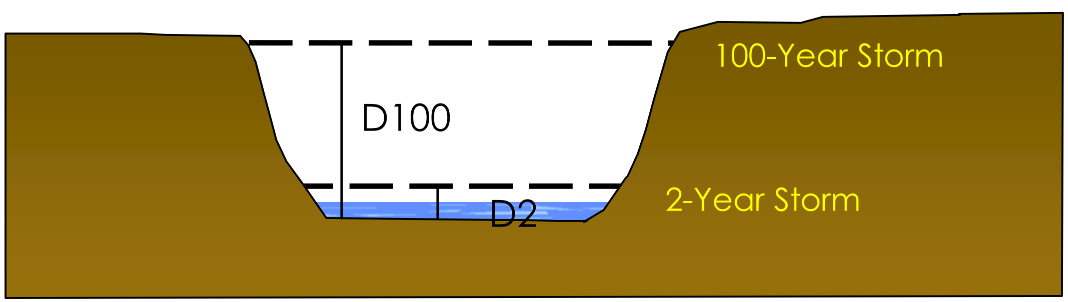
- Properly Restored Stream Inherently Resilient
- Importance of Floodplain Access
- Need for Buffers
- Increase in Funding Related to Resiliency

Simon's Modification of Schumm's Model

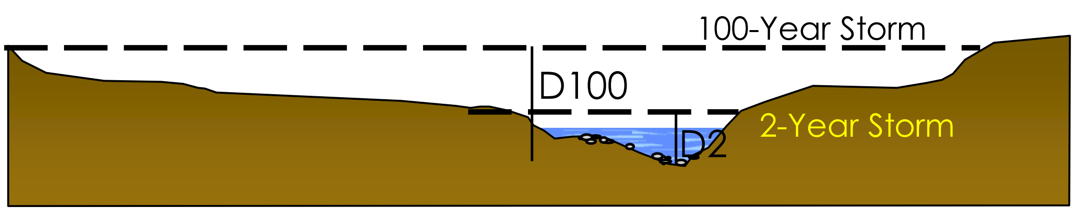


Shear Stresses in Streams

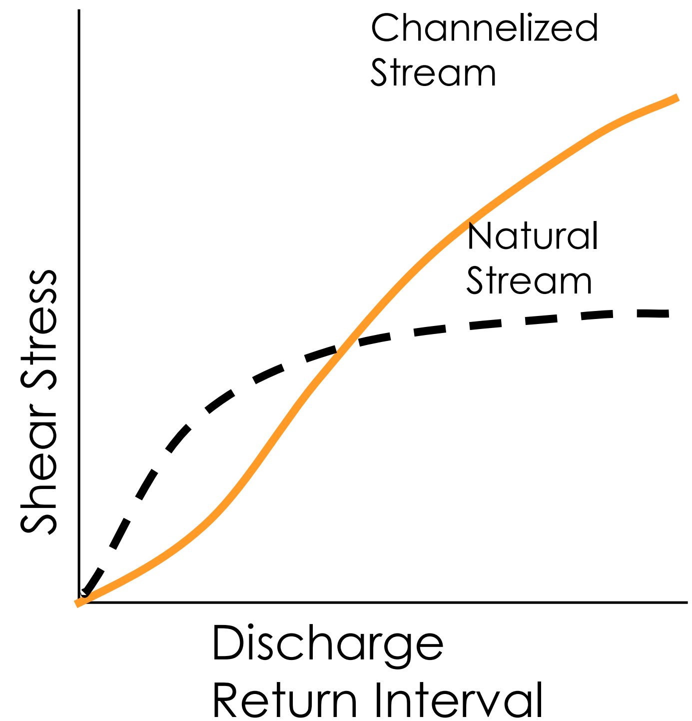
$$\text{Shear Stress} = \gamma \, R \, S$$



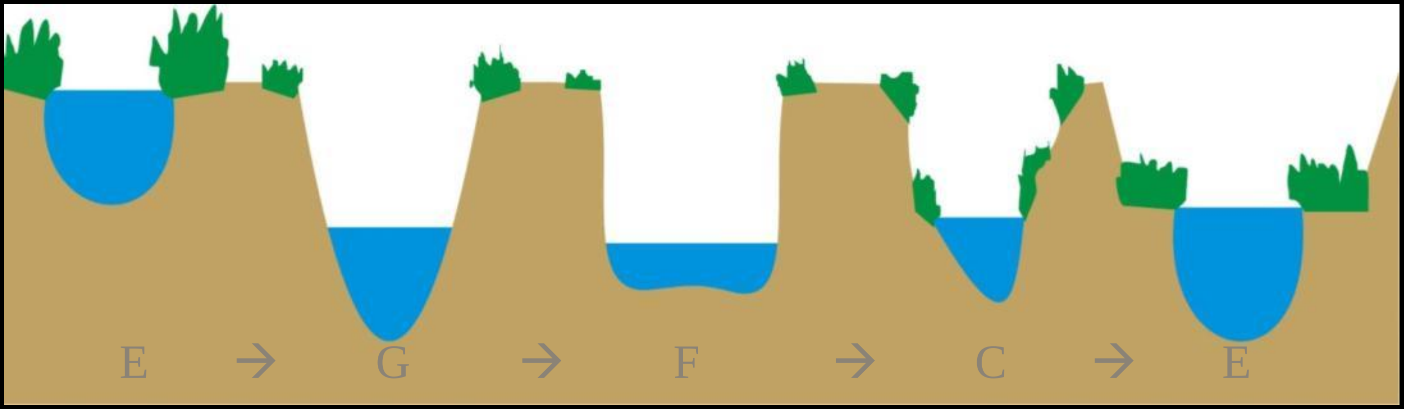
Channelized Stream



Natural Stream



Use of Rosgen's Classification System to Predict Channel Evolution



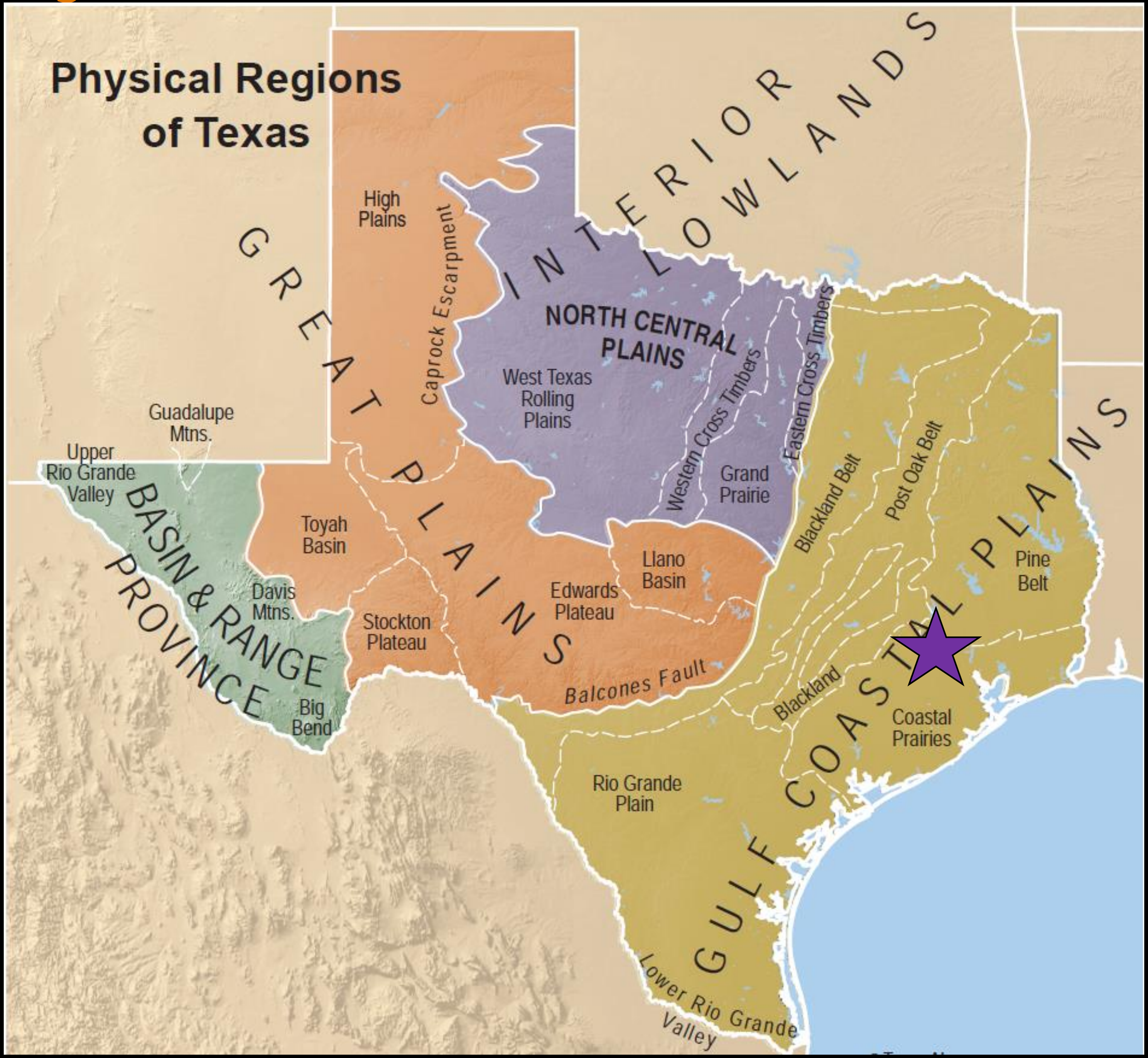
Katy Prairie Stream Restoration Case Study

- Stream Mitigation Bank & PRM
- Poor Floodplain Access
- Poor Habitat

Project Goals

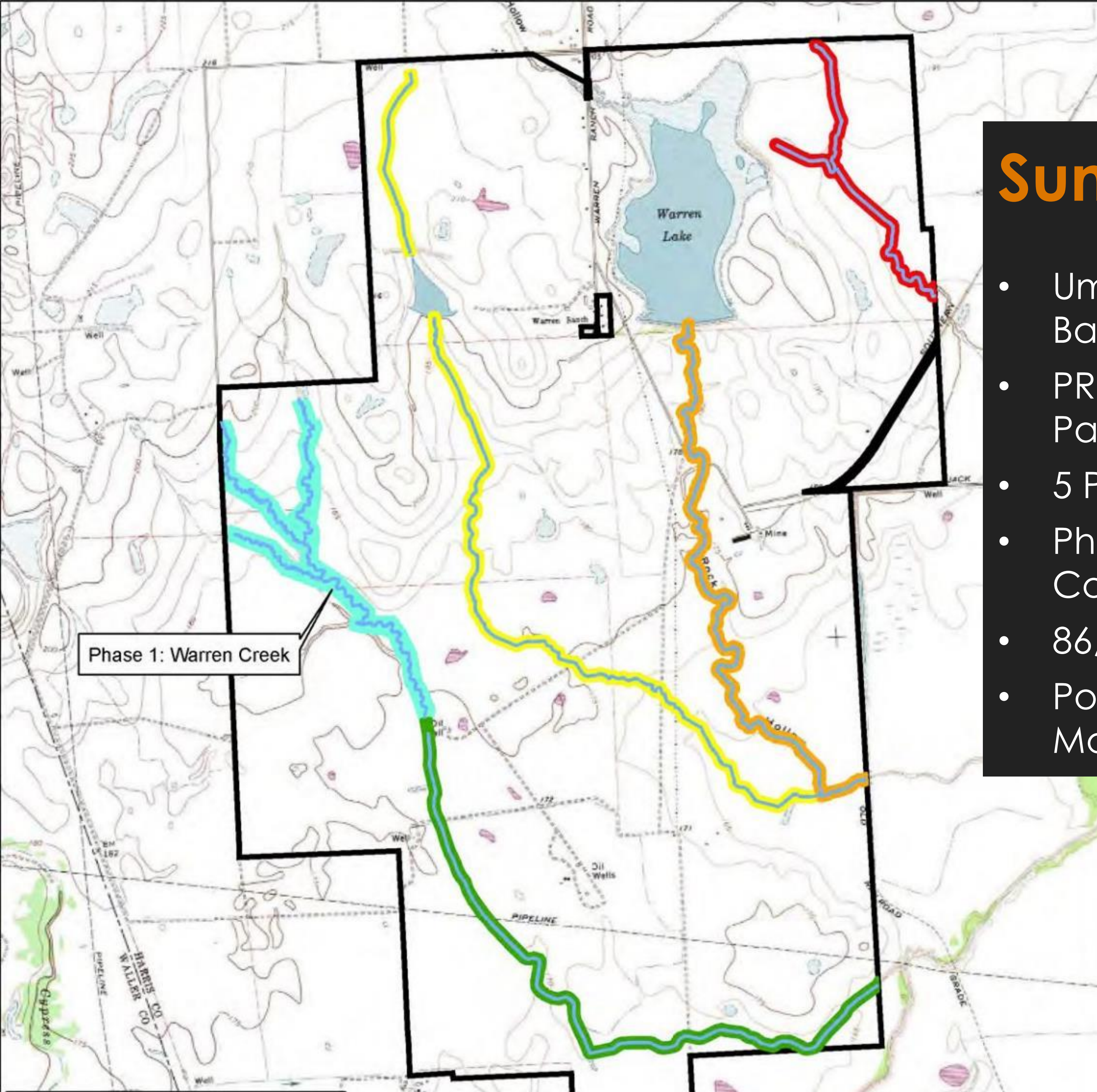
1. **Generate Stream Mitigation Credits**
2. **Stable Stream**
   - Dimension – Pattern - Profile
   - 100-Year Flood Event
3. **Restore Habitat**

Project Location



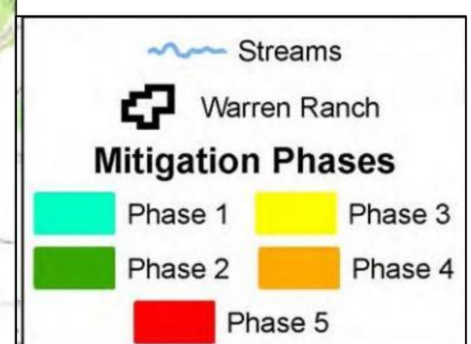
Project Partners

- Restoration Systems LLC
- Warren Ranch
- Katy Prairie Conservancy
- Stantec
- Forbes Consultancy
- Land Mechanics
- Wright Contracting
- Stuckey's Contract Services



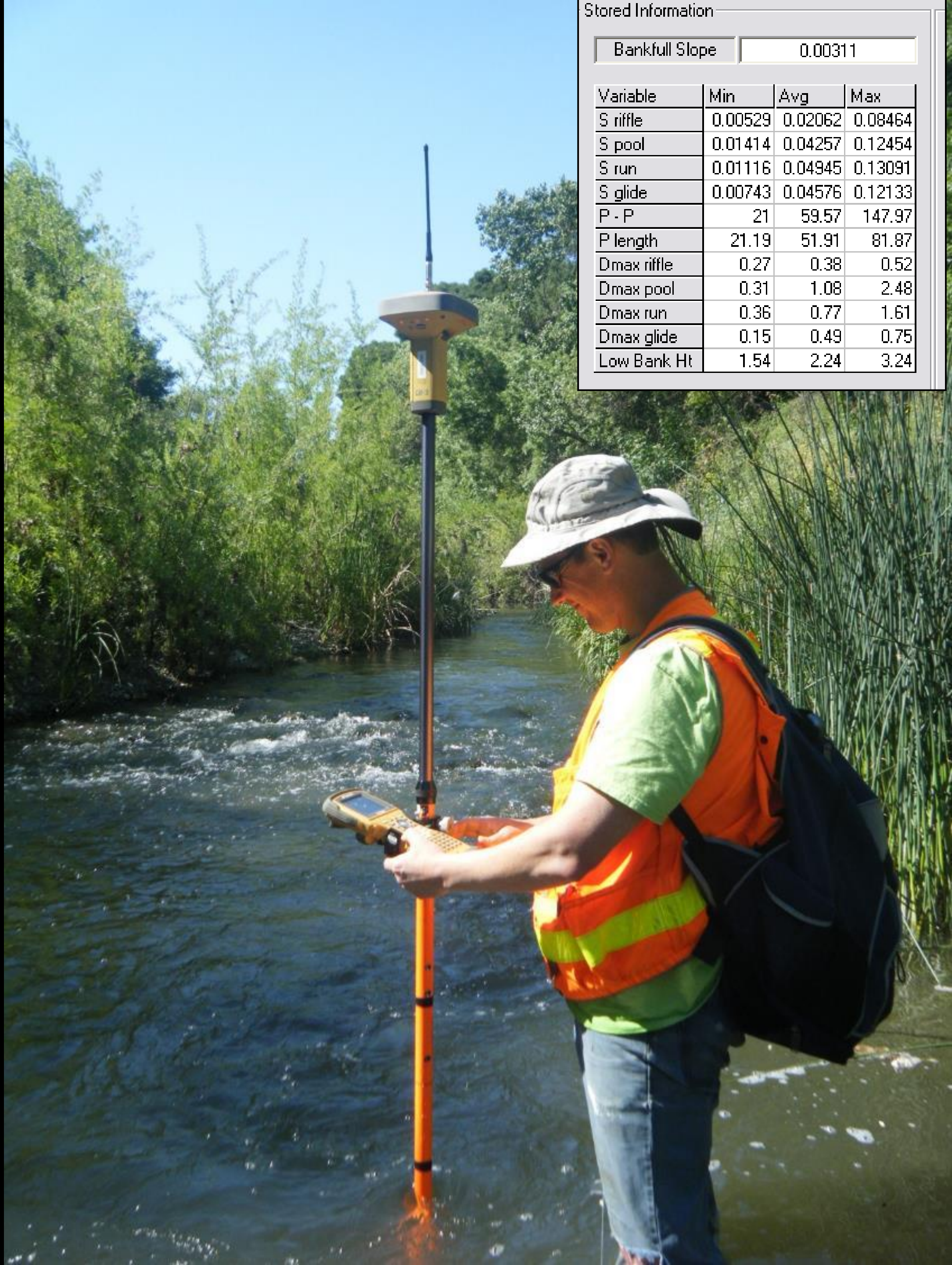
Summary

- Umbrella Mitigation Bank
- PRM for the Grand Parkway
- 5 Phases
- Phases 1 – 4 Constructed
- 86,000 Total Feet
- Post Construction Monitoring



Design Process

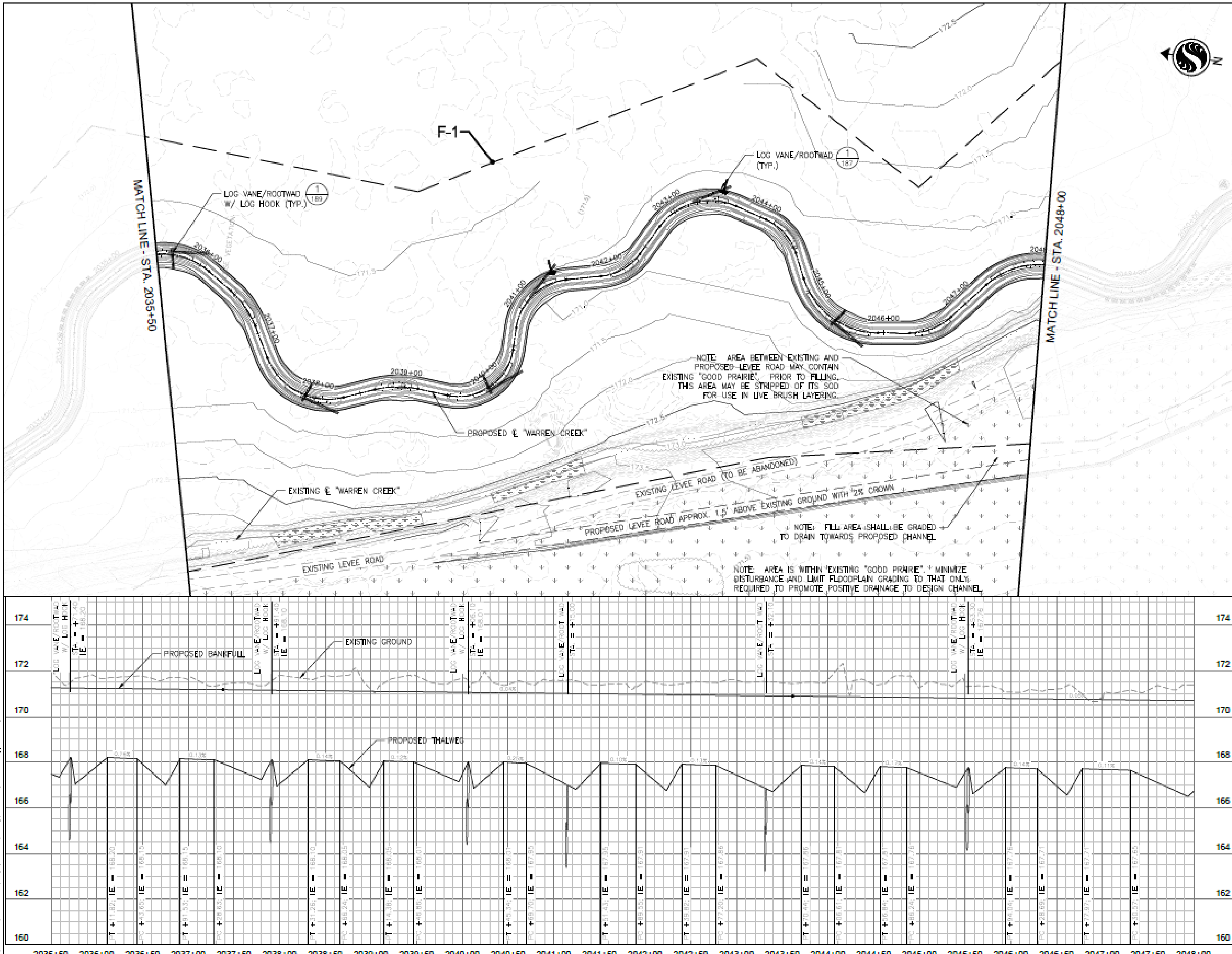
- Review of Watershed
- Overview of Site (Toothpick Survey)
- Gage Analysis/Region Geomorphic Relationships
- Geomorphic Data Collection
  - Cross Sections
  - Longitudinal Profile
  - Pebble Counts
  - Bar Samples
- Sediment Transport Analysis



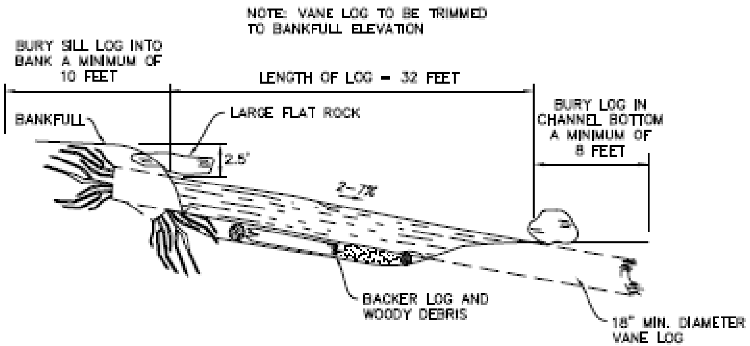
Stored Information

Bankfull Slope	0.00311

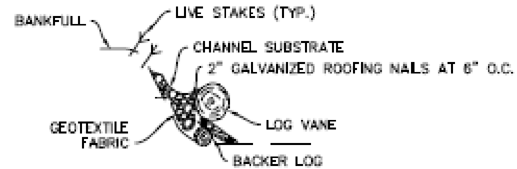
Variable	Min	Avg	Max
S riffle	0.00529	0.02062	0.08464
S pool	0.01414	0.04257	0.12454
S run	0.01116	0.04945	0.13091
S glide	0.00743	0.04576	0.12133
P - P	21	59.57	147.97
P length	21.19	51.91	81.87
Dmax riffle	0.27	0.38	0.52
Dmax pool	0.31	1.08	2.48
Dmax run	0.36	0.77	1.61
Dmax glide	0.15	0.49	0.75
Low Bank Ht	1.54	2.24	3.24



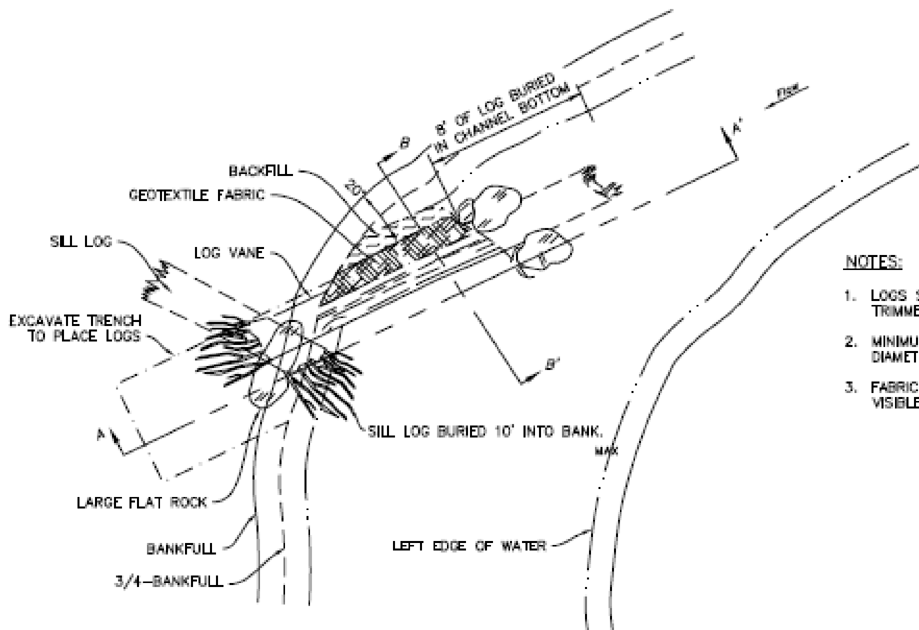
F-1
LOG VANE/ROOTWAD W/ LOG HOOK (TYP.) 1/189
LOG VANE/ROOTWAD (TYP.) 1/187
MATCH LINE - STA. 2035+50
MATCH LINE - STA. 2048+00
2036+00
2037+00
2038+00
2039+00
2040+00
2041+00
2042+00
2043+00
2044+00
2045+00
2046+00
2047+00
PROPOSED ℄ "WARREN CREEK"
EXISTING ℄ "WARREN CREEK"
NOTE: AREA BETWEEN EXISTING AND PROPOSED LEVEE ROAD MAY CONTAIN EXISTING "GOOD PRAIRIE". PRIOR TO FILLING, THIS AREA MAY BE STRIPPED OF ITS SOD FOR USE IN LIVE BRUSH LAYERING.
EXISTING LEVEE ROAD (TO BE ABANDONED)
PROPOSED LEVEE ROAD APPROX. 1.5' ABOVE EXISTING GROUND WITH 2% CROWN
NOTE: FILL AREA SHALL BE GRADED TO DRAIN TOWARDS PROPOSED CHANNEL
EXISTING LEVEE ROAD
NOTE: AREA IS WITHIN EXISTING "GOOD PRAIRIE". MINIMIZE DISTURBANCE AND LIMIT FLOODPLAIN GRADING TO THAT ONLY REQUIRED TO PROMOTE POSITIVE DRAINAGE TO DESIGN CHANNEL.
171.5
172.0
172.5
PROPOSED BANKFULL
EXISTING GROUND
PROPOSED THALWEG
LOG VANE/ROOTWAD W/ LOG HOOK
LOG VANE/ROOTWAD
174
172
170
168
166
164
162
160
2035+50
2036+00
2036+50
2037+00
2037+50
2038+00
2038+50
2039+00
2039+50
2040+00
2040+50
2041+00
2041+50
2042+00
2042+50
2043+00
2043+50
2044+00
2044+50
2045+00
2045+50
2046+00
2046+50
2047+00
2047+50
2048+00



SECTION A-A'



LOG VANE SECTION B-B'



LOG VANE PLAN

NOTES:

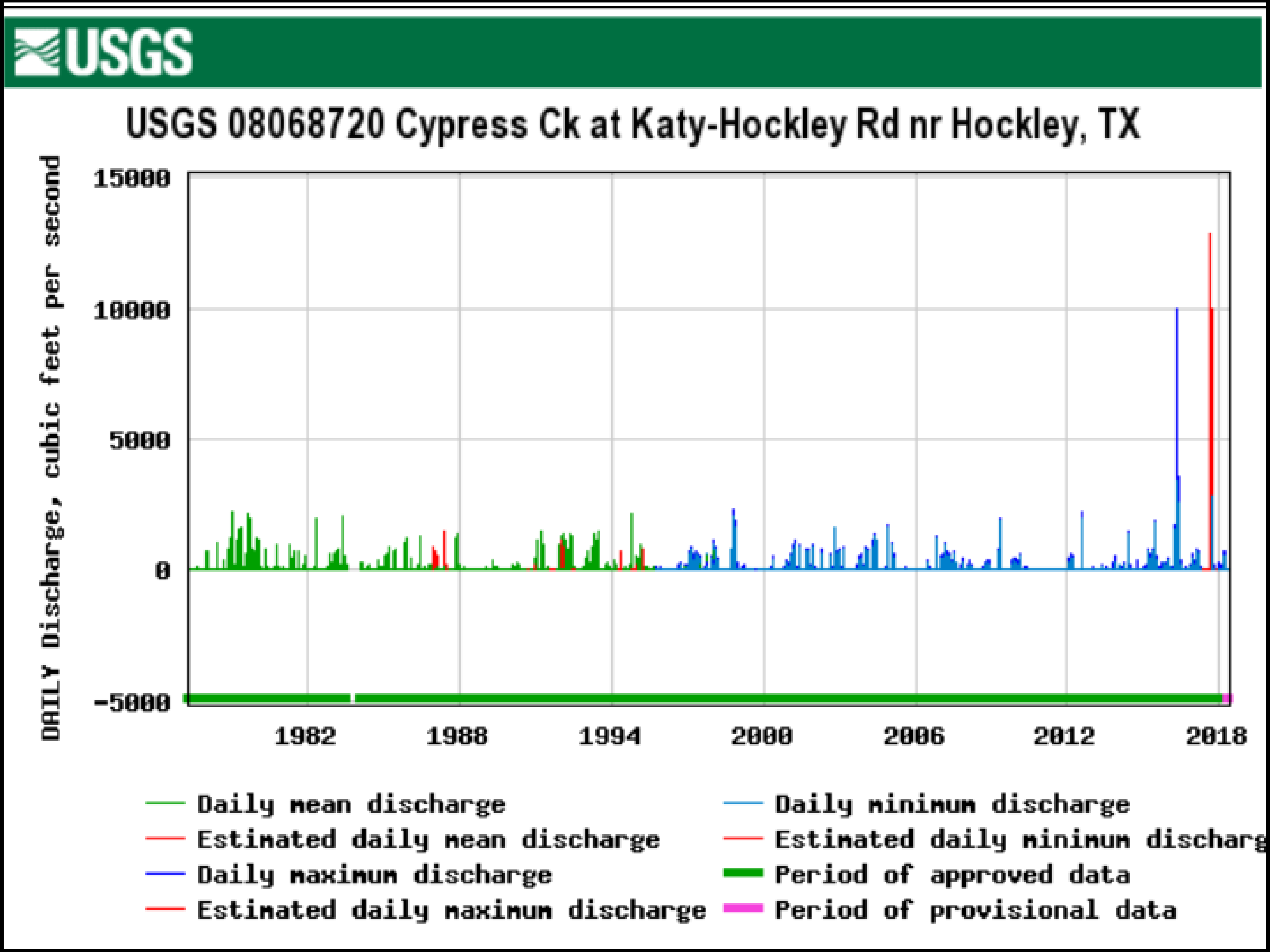
1. LOGS SHALL BE STRAIGHT AND LIMBS SHALL BE TRIMMED FLUSH.
2. MINIMUM LOG LENGTH IS 50 FEET AND MINIMUM DIAMETER IS 18 INCHES.
3. FABRIC SHALL BE COMPLETELY BURIED AND NOT VISIBLE.

2/13 DETAIL - LOG VANE
SCALE: NOT TO SCALE

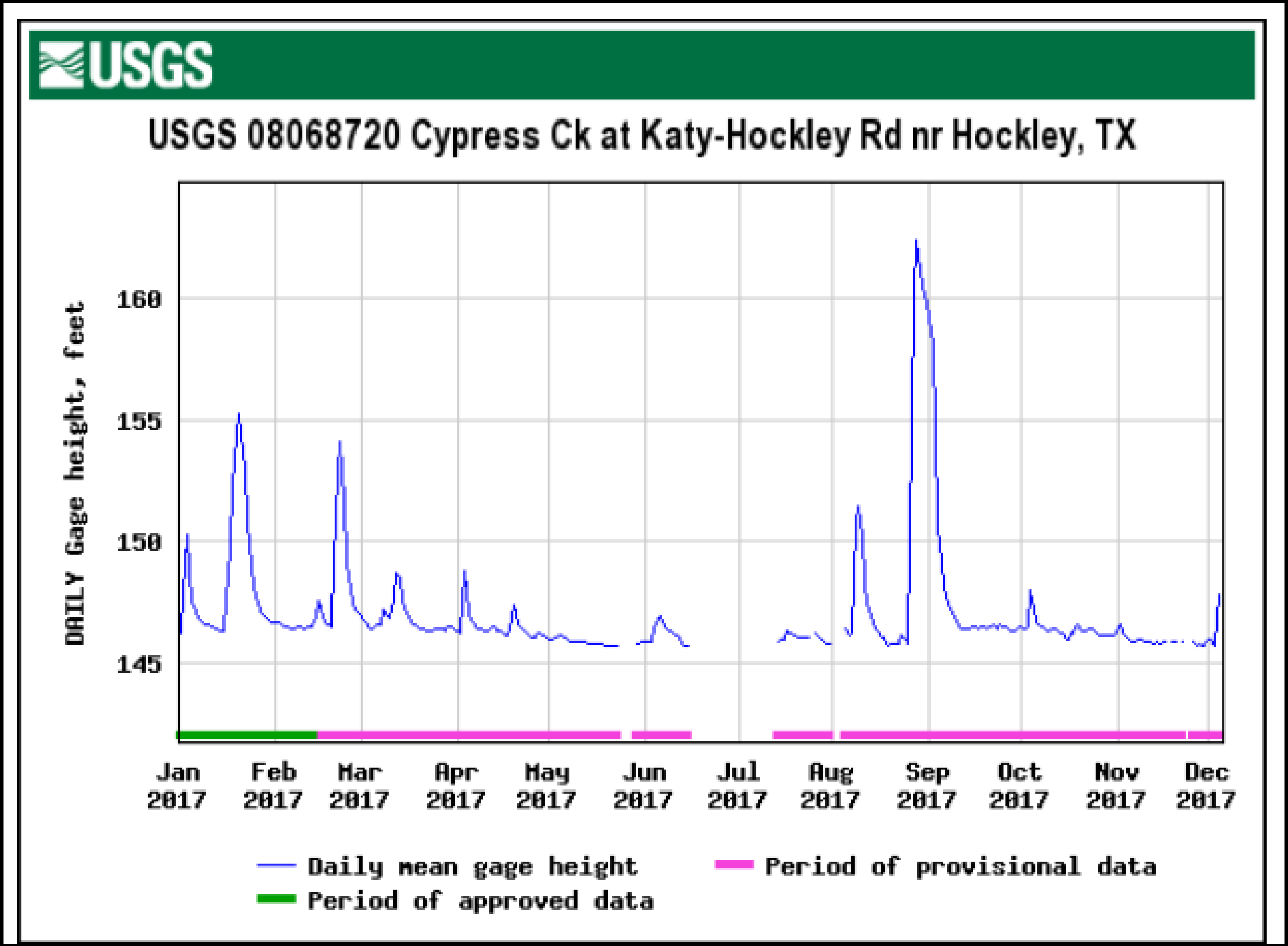

VOLVO

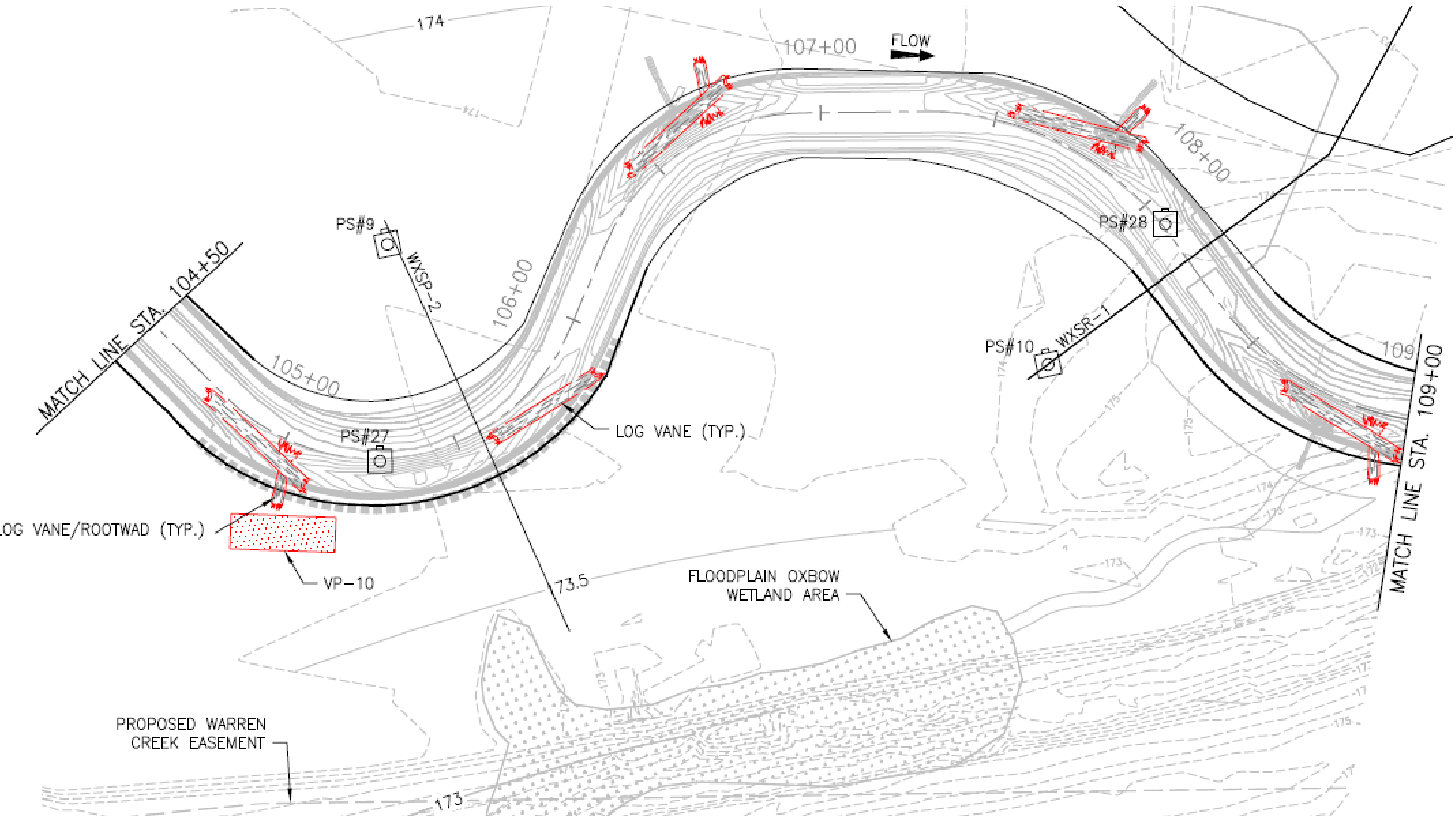

EC250DL

Daily Discharge 1976 - 2017



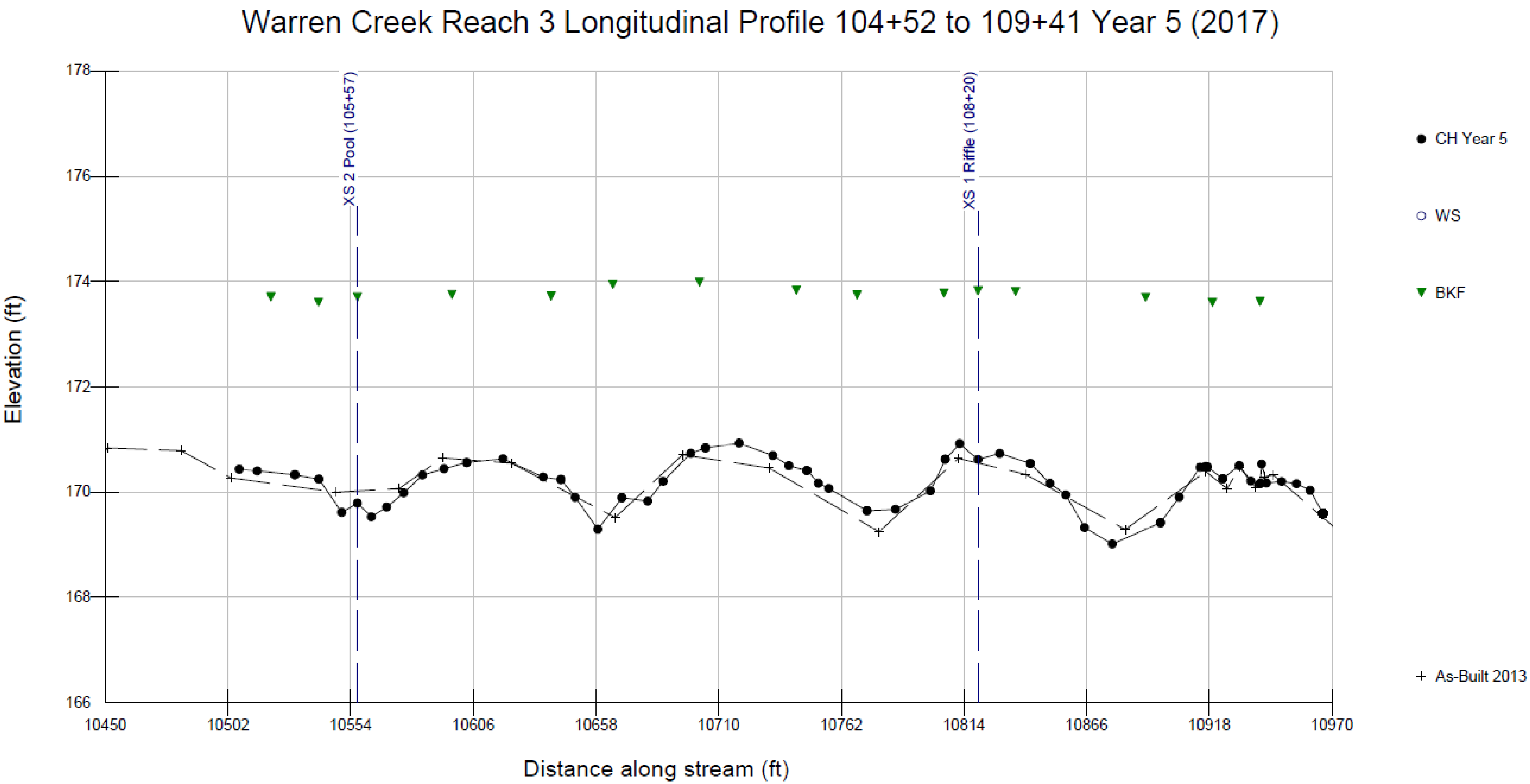
Daily Gage Height Jan. – Dec. 2017





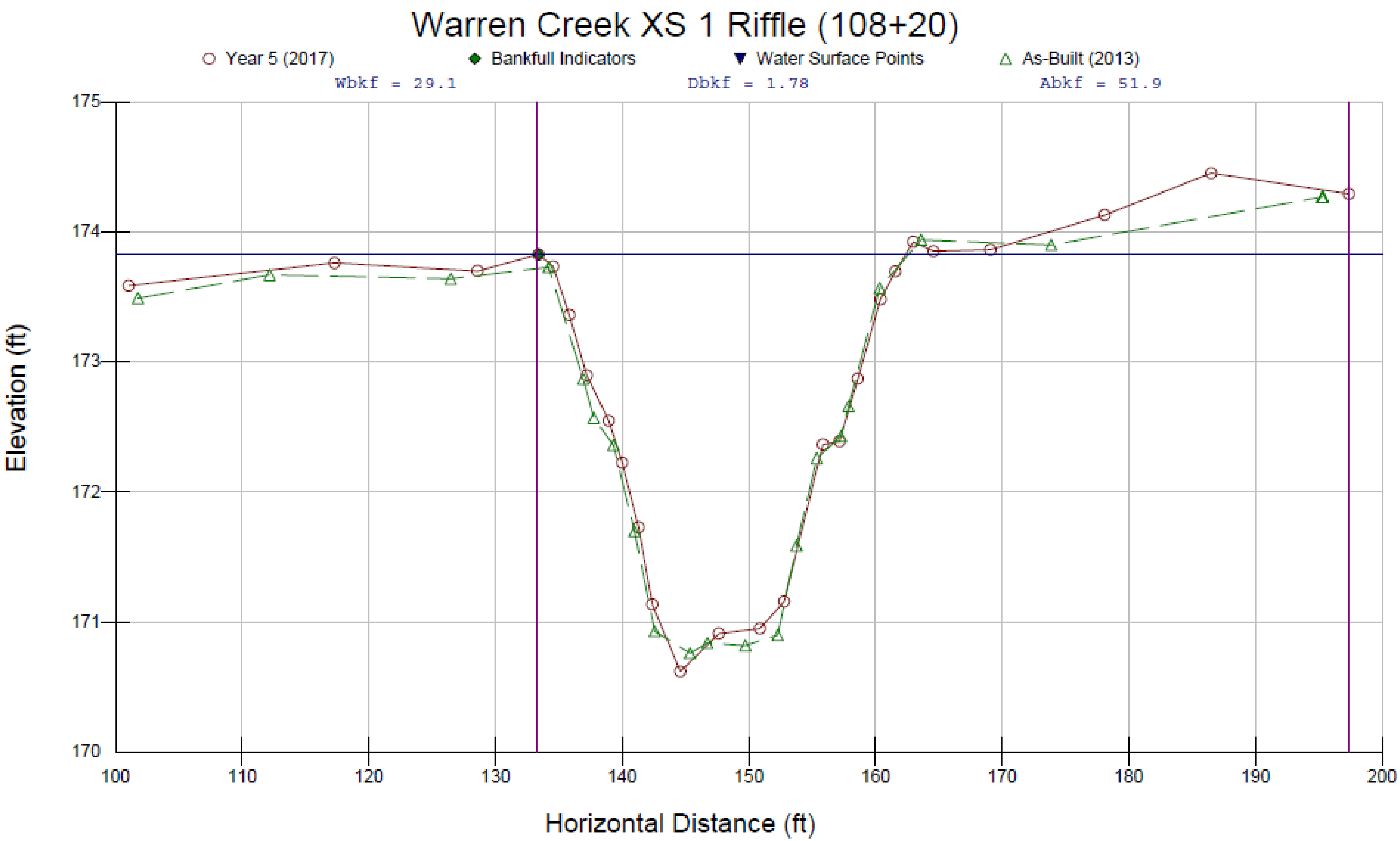
174
107+00
FLOW
108+00
MATCH LINE STA. 104+50
105+00
106+00
PS#9
WXSP-2
PS#28
PS#10
WXSR-1
109
109+00
MATCH LINE STA.
PS#27
LOG VANE (TYP.)
LOG VANE/ROOTWAD (TYP.)
VP-10
73.5
FLOODPLAIN OXBOW
WETLAND AREA
PROPOSED WARREN
CREEK EASEMENT
173

Stantec



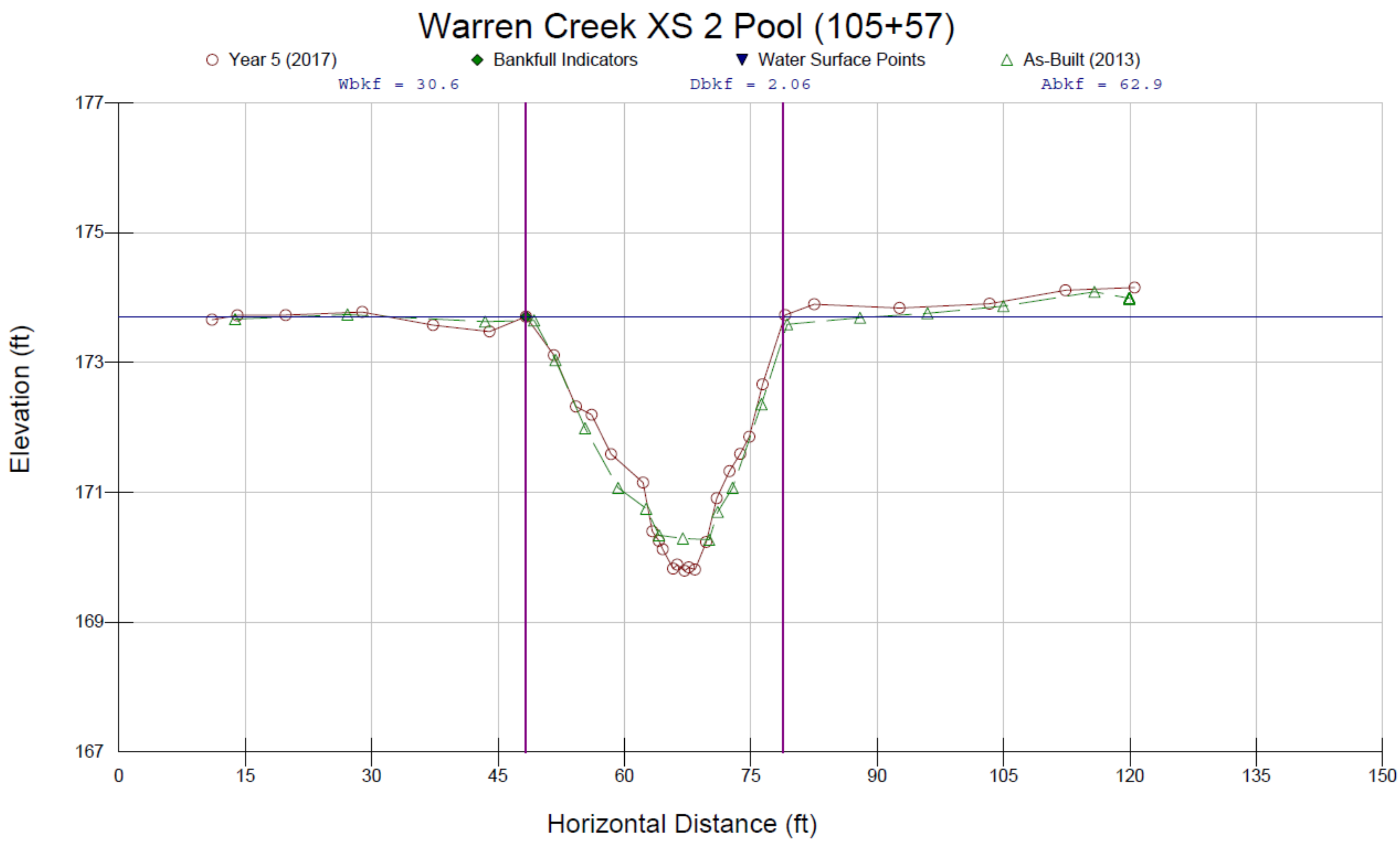
Warren Creek Reach 3 Longitudinal Profile 104+52 to 109+41 Year 5 (2017)
Elevation (ft)
178
176
174
172
170
168
166
10450
10502
10554
10606
10658
10710
10762
10814
10866
10918
10970
Distance along stream (ft)
XS 2 Pool (105+57)
XS 1 Riffle (108+20)
CH Year 5
WS
BKF
As-Built 2013

Stantec



Warren Creek XS 1 Riffle (108+20)
Year 5 (2017)
Bankfull Indicators
Water Surface Points
As-Built (2013)
Wbkf = 29.1
Dbkf = 1.78
Abkf = 51.9
Elevation (ft)
175
174
173
172
171
170
100
110
120
130
140
150
160
170
180
190
200
Horizontal Distance (ft)

Stantec


Warren Creek XS 2 Pool (105+57)
Year 5 (2017)
Bankfull Indicators
Water Surface Points
As-Built (2013)
Wbkf = 30.6
Dbkf = 2.06
Abkf = 62.9
Elevation (ft)
177
175
173
171
169
167
0
15
30
45
60
75
90
105
120
135
150
Horizontal Distance (ft)

Stantec

Photos Station 1 – As-Built Survey

Photos Station 1 – 2013

Photos Station 1 – 2014

Photos Station 1 – 2015

Photos Station 1 – 2016

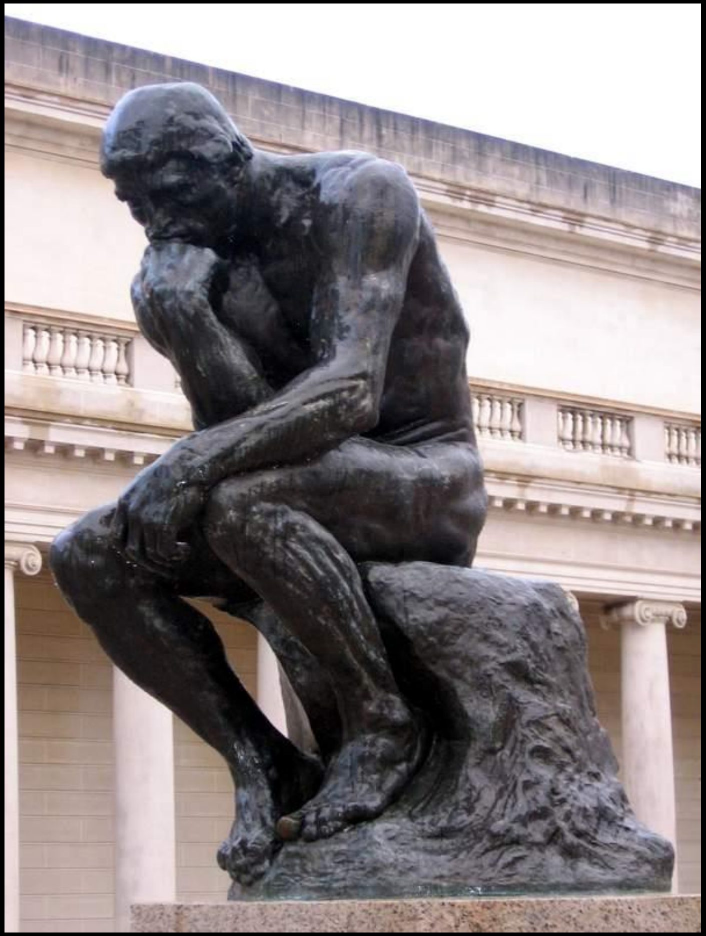
Photos Station 1 – 2017

Adaptive Management of Profession

- Funding Sources
- Certification/Licensure
- Movement Towards Functional Uplift

Certification/Licensure

- Positives & Negatives
- Must Make Sure Program Does not Exclude Approaches
- Certification of Teams vs Individuals
- Need to be Careful What We Wish For…



Best Ways to Stop Bad Projects from Happening

- Strong Procurement Process
- Focus on Preventing Misapplication of Methods
- Need Documented Standards of Care for Viable Methods
- Educated Reviewers
- Informed Clients

Movement Towards Functional Uplift

- Need Best Ecologically Based Science
- Robust Monitoring
- Measure (Currency) for Mitigation (Function versus Foot)
- Continuous Cycle

Stantec

The Growing & Evolving Benefits of Stream Restoration

From Resiliency to Stormwater BMPs – How Will the Industry Continue to Adapt?

J. George Athanasakes
October 30, 2018