A Case Study in Collaborative Stewardship, or “How Crane Creek got Her Groove Back”

Joshua B. Gilman, PE, D.WRE (Stantec)

SCDOT

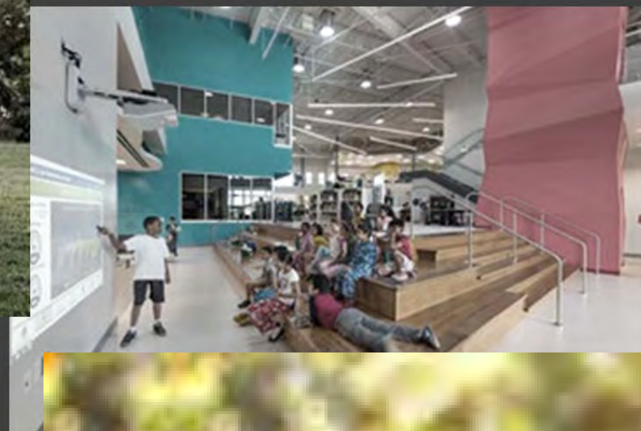
dhec

LE ESTATES, LLC

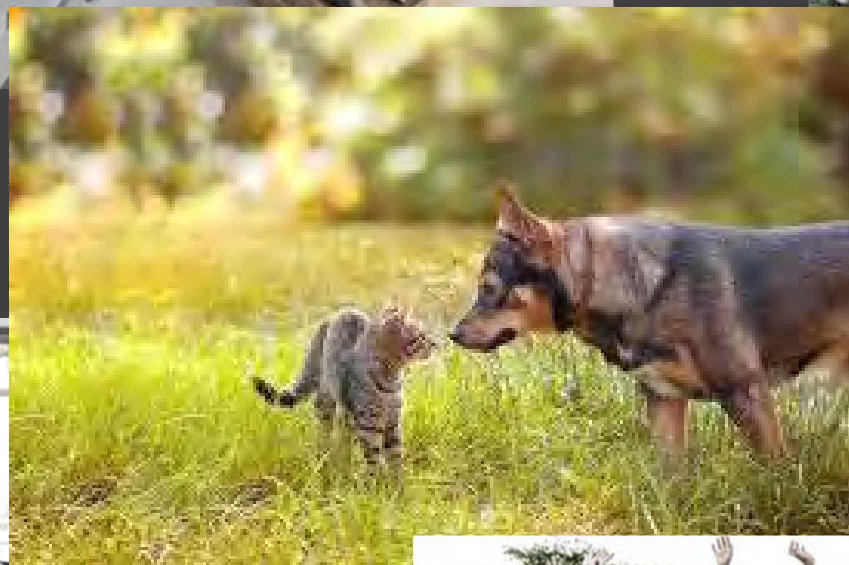
Stantec

SAFETY MOMENT

LAKE ELIZABETH EMBANKMENT BREACH AND DAM REMOVAL *Richland County, SC*



LAKE ELIZABETH EMBANKMENT BREACH AND DAM REMOVAL *Richland County, SC*

Tillie rendezvous with the hostage takers.

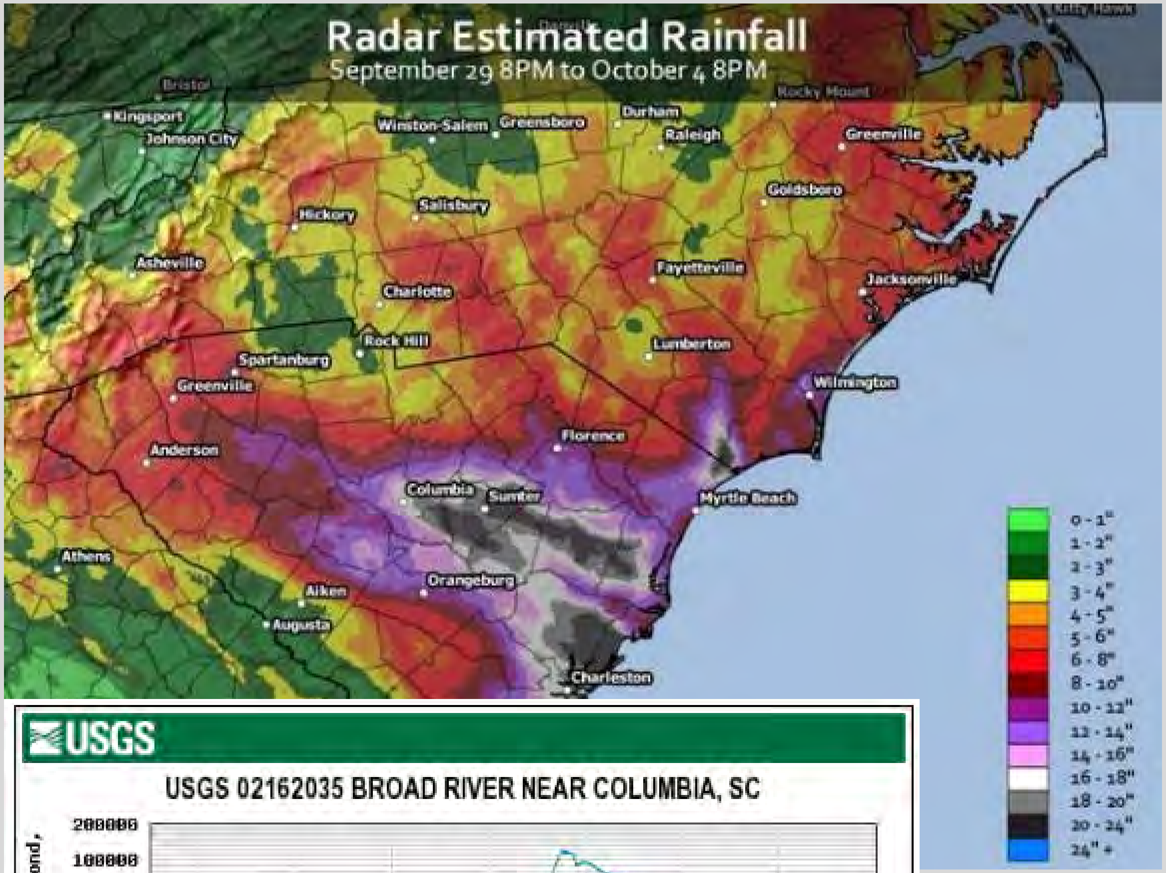
Agenda

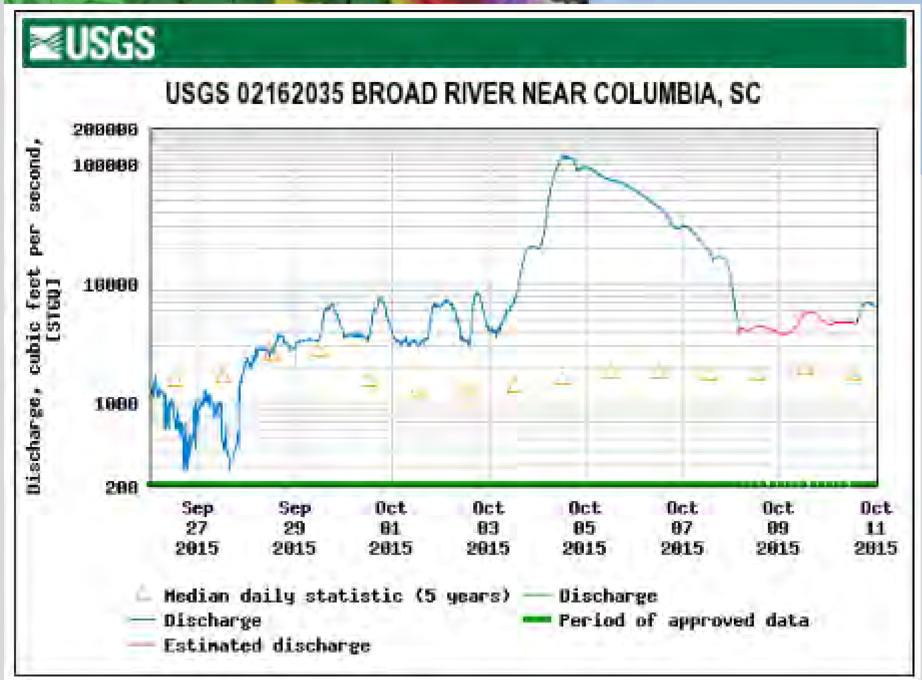
1. **Disaster Summary**
   - Event of record
   - Resultant damage
2. **Moment of Truth**
3. **Initial Reaction**
4. **New Ideas**
   - Onboarding major stakeholders through knowledge sharing
5. **Design Iteration**
6. **Summary of Success**
   - Expanded knowledge of Good Stewardship
   - A Win for Ecosystem is a Win for Everyone

Event of Record

Hurricane Joaquin

- Over 18” of rain
- 500-YR event
- Record Flooding





Resultant Damage


Resultant Damage

*“**SCDOT** explained construction cannot begin on Wilson Blvd. until the dam is repaired.”*

SCDOT

According to **DHEC**, “ in order for the dam to be repaired, the HOA's engineers must meet DHEC's regulations before given a permit to rebuild”

dhec

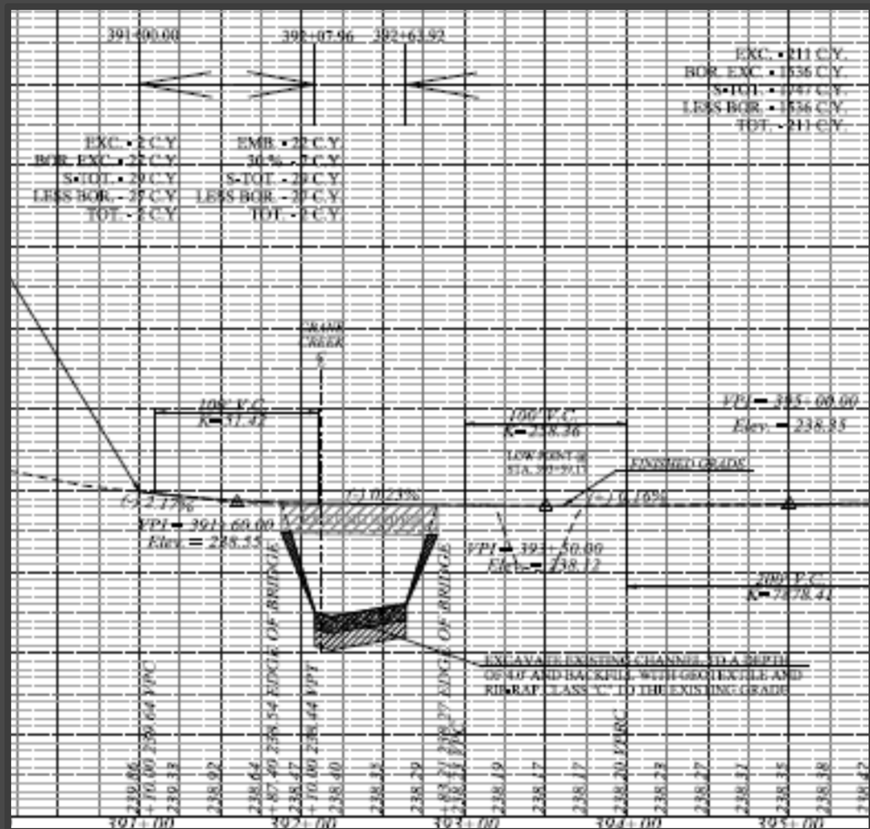
LE “**HOA** engineers project it will cost at least 500-thousand dollars to repair the dam...”

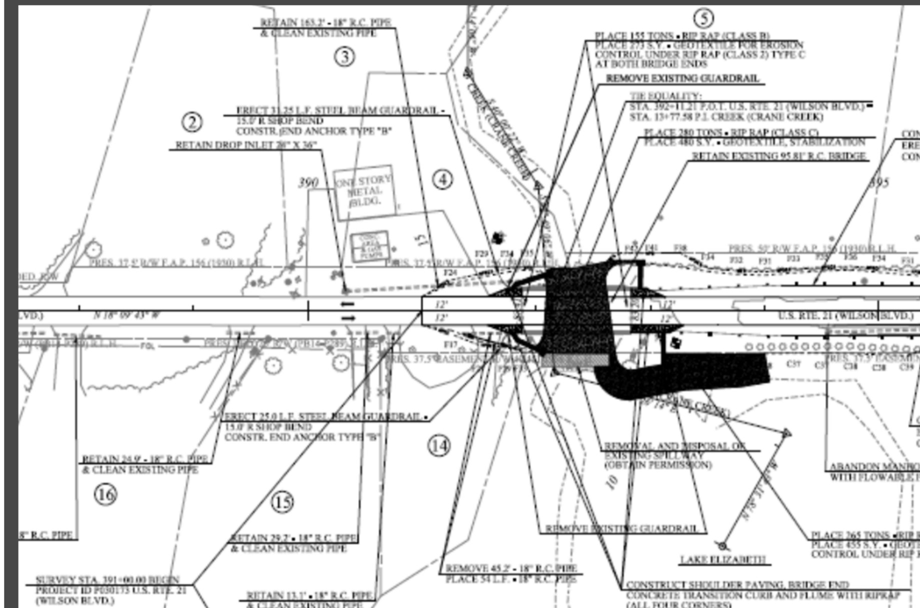
LE ESTATES, LLC

"We can't pay for it, that's a half a million dollars.”

“This is a small community and we don't have that type of stash."

“Lake Elizabeth homeowners worried neighborhood may remain in shambles after flood” *(WIS News, November 20, 2015)*





Initial Reaction – Traditional Roadway Hydraulics

STREAM MECHANICS

http://serc.carleton.edu/details/files/19080.html

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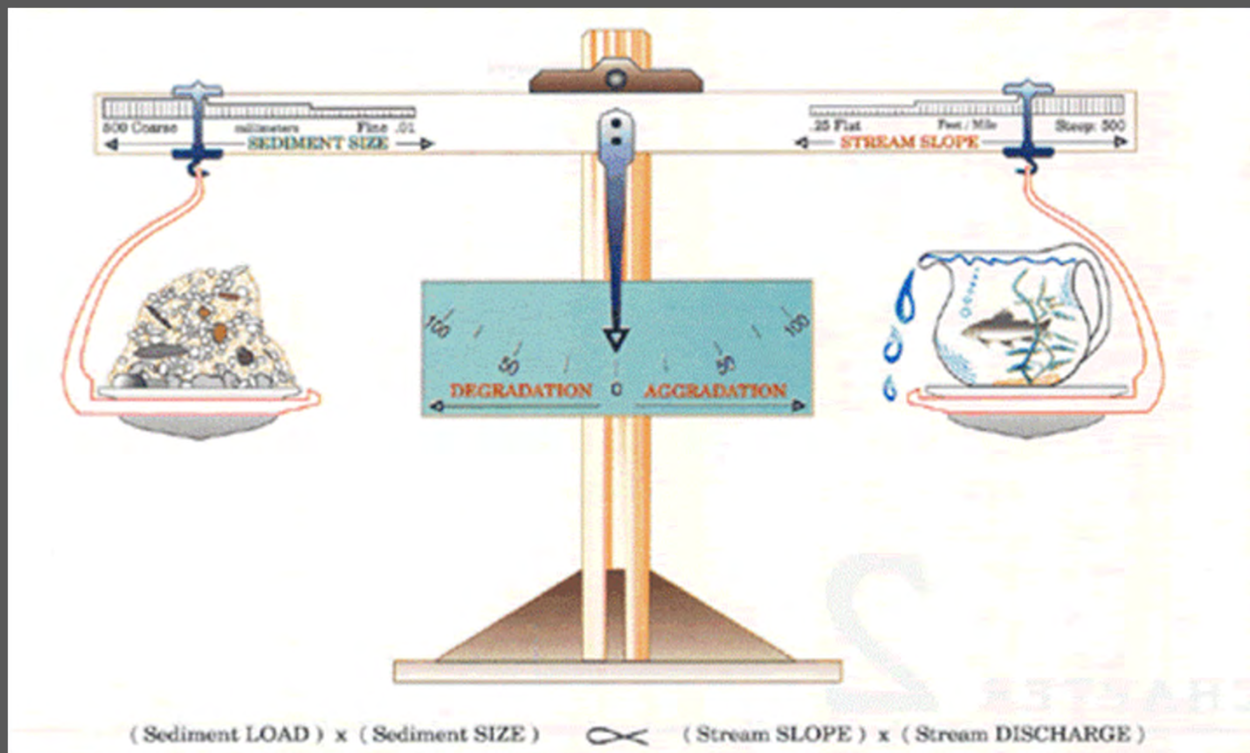
Dynamic Equilibrium

STREAM MECHANICS



Lane's Diagram

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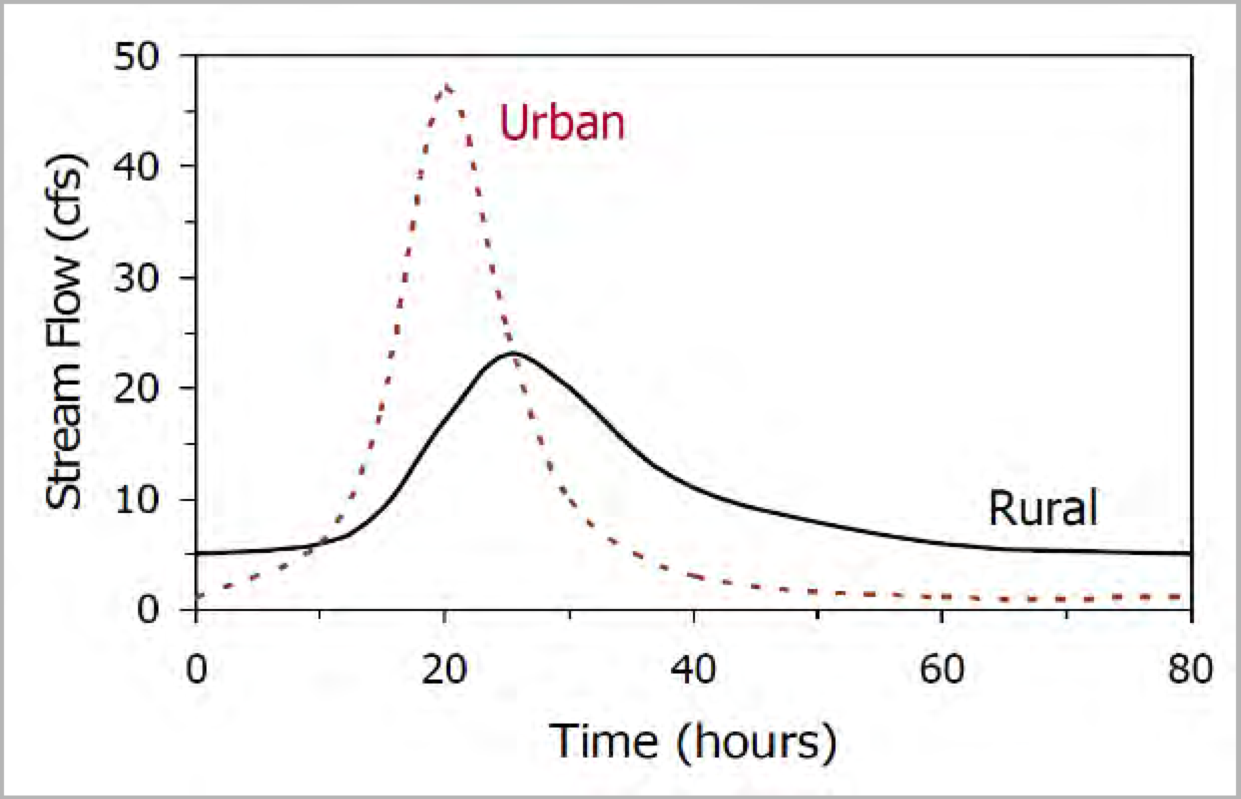
STREAM MECHANICS



Rural vs. Urban Hydrograph

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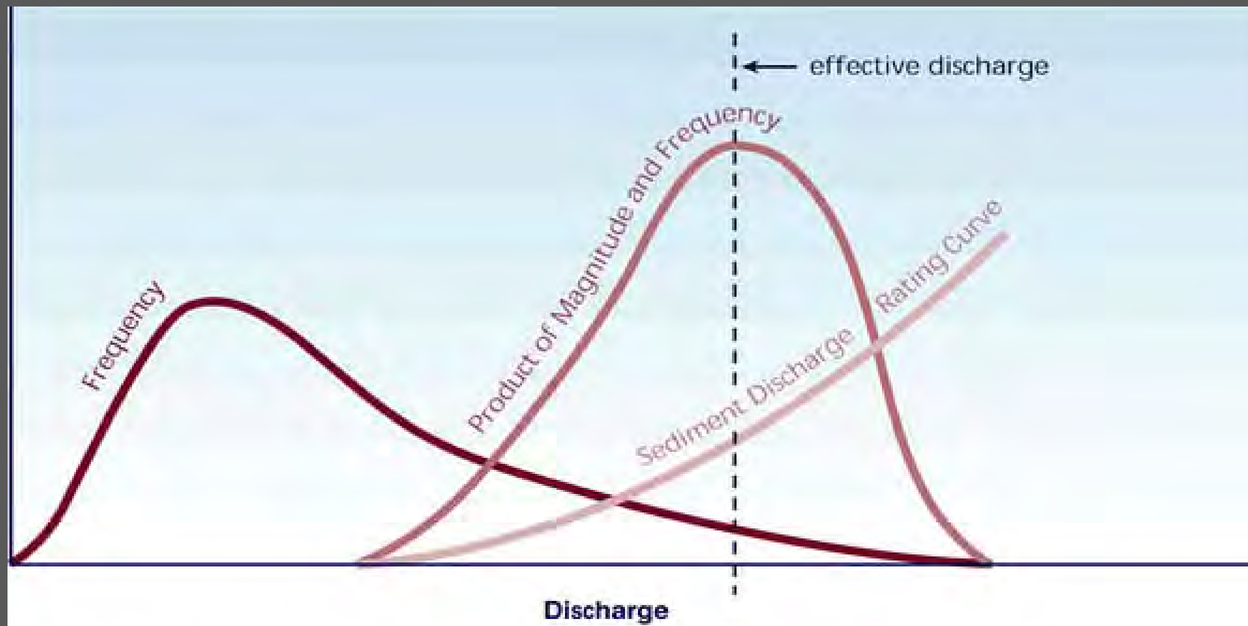
ENGINEERING DESIGN FUNDAMENTALS



From Wolman and Miller, 1960.

Fig. 7.5 – Effective discharge determination from sediment rating and flow duration curves.
In Stream Corridor Restoration: Principles, Processes, and Practices, 10/98.
Interagency Stream Restoration Working Group (FISRWG)(15 Federal agencies of the US).

Effective Discharge

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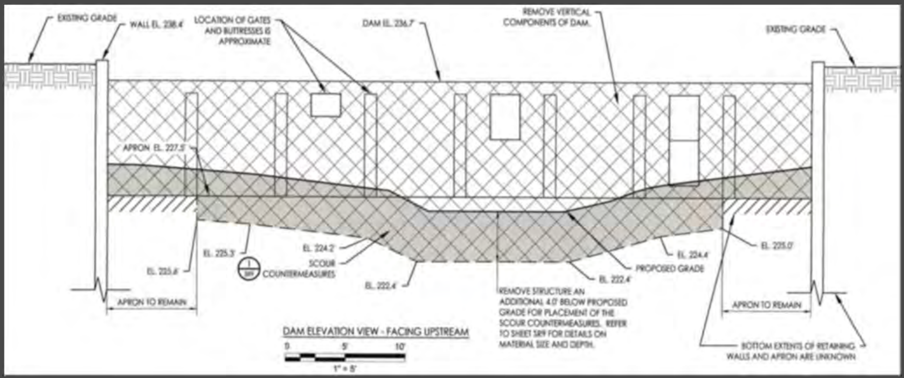

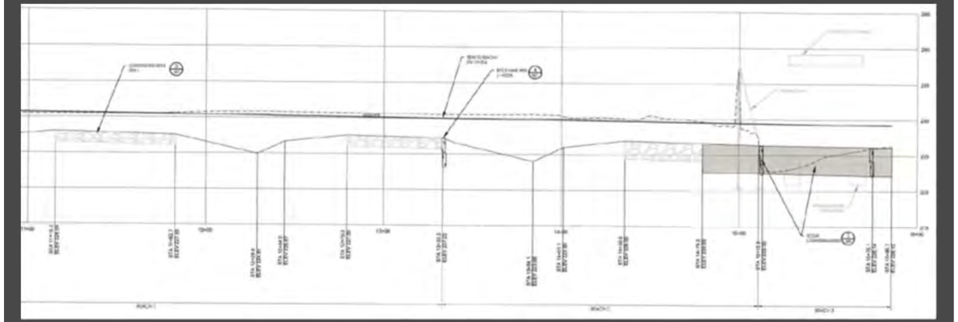

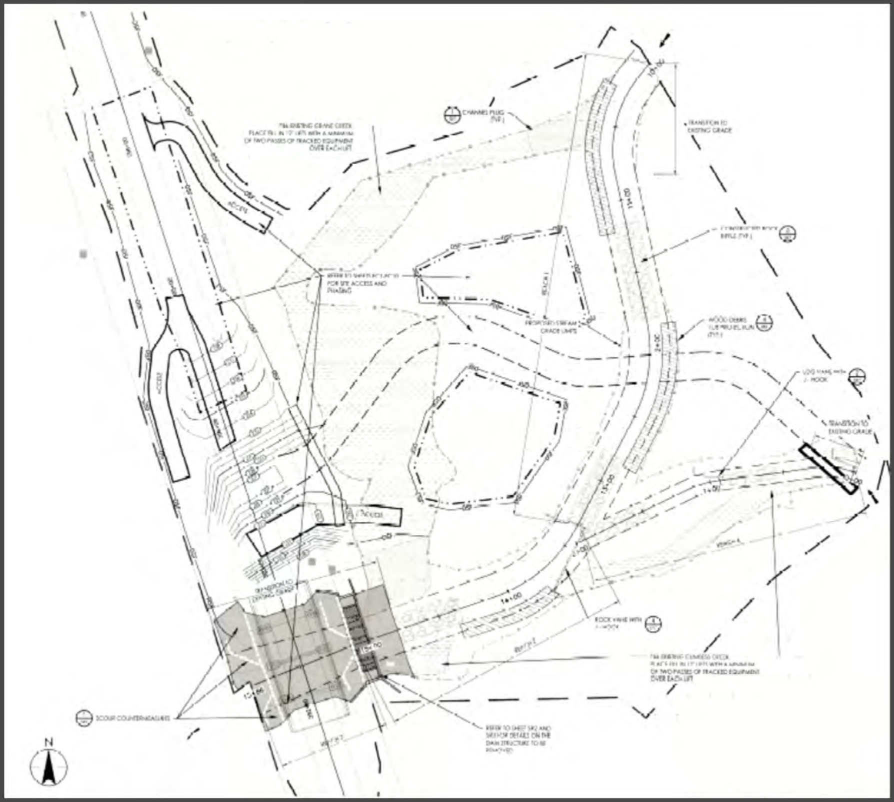

Design Iteration:

Incorporate Natural Channel Function

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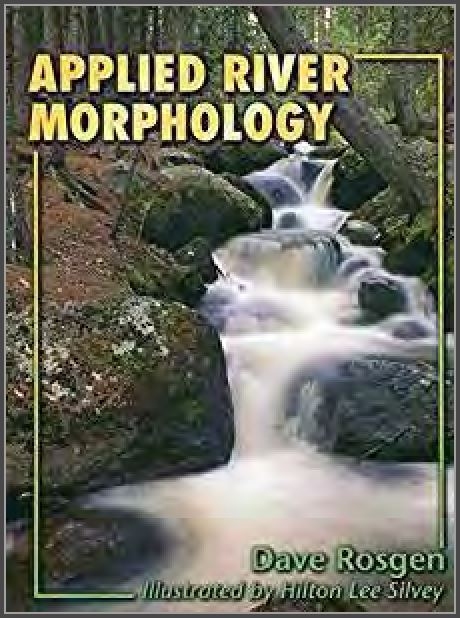

Design Iteration

Variables	Main Stem mean	UT01 mean	Dam mean	Confluence mean
Stream type	C 4	C 4	B4	C 4
Drainage area (sq. mi.)	19	3	22	22
Bankfull width (Wbkf)	27.4	13.4	30.5	30.5
Bankfull mean depth (Dbkf)	1.83	0.89	2.03	2.03
Max Depth/Mean Depth	1.55	1.56	1.55	1.55
Width/depth ratio (Wbkf/Dbkf)	15.0	15.1	15.0	15.0
Bankfull cross-sectional area (Abkf)	50.0	11.9	61.9	61.9
Manning's N (n)	0.035	0.035	0.054	0.035
Bankfull mean velocity (Vbkf)	3.5	4.8	2.4	3.7
Bankfull discharge, cfs (Qbkf)	174.2	57.3	150.1	231.5
Bankfull max depth (dmax)	2.8	1.4	3.1	3.1
Width of Floop Prone Area (Wfpa)	300.00	560.00	60.00	300.00
Entrenchment ratio (Wfpa/Wbkf)	11.0	41.8	2.0	9.8
Low-flow cross-sectional area (Abkf)	25	6	31	31
Low-flow width (Wbkf)	17.5	8.3	19.4	19.4
Low-flow mean depth (Dbkf)	1.431	0.684	1.593	1.593
Low-flow width/depth ratio (Wbkf/Dbkf)	12.2	12.2	12.2	12.2
Low-flow max depth (dmax)	1.804	0.862	2.007	2.007
Low-flow Max Depth/Mean Depth	1.3	1.3	1.3	1.3
Manning's N (n)	0.04	0.03	0.05	0.03
Low-flow mean velocity (Vbkf)	5.4	4.6	3.8	8.1
Low-flow discharge, cfs (Qbkf)	135	26	116	252
Ratio of Low-flow area to BKF area (Alf/Abkf)	0.50	0.48	0.50	0.50
Stream Meander Length (Lm)	323	210	n/a	0
Ratio of Stream meander length to bankfull width (Lm/Wbkf)	11.8	15.7	n/a	0.0
Linear Wave Length (λ)	300	195	n/a	0
Ratio of linear meander length to bankfull width (λ/Wbkf)	11.0	14.5	n/a	0.0
Radius of curvature (Rc)	89.4	66.6	n/a	99.8
Ratio of the radius of curvature to bankfull width (Rc/Wbkf)	3.3	5.0	n/a	3.3
Belt Width (Wbkf)	100.0	46.0	n/a	152.4
Meander width ratio (Wblt/Wbkf)	3.7	3.4	n/a	5.0
Sinuosity (stream length/valley distance) (K)	1.10	1.10	1.00	1.00
Valley slope (ft/ft)	0.000	0.000	0.003	0.000
Average slope (Savg) = (Svalley/K)	0.003	0.015	0.003	0.003
Riffle slope (Srif)	0.005	0.013	0.009	0.005
Ratio of riffle slope to bankfull slope (Srif/Sbkf)	1.7	0.9	3.0	1.8
Riffle Length (Lr)	90.785	66.285	50.410	50.410
Riffle Length to Riffle Width (Lr/Wbkf)	3.3	4.9	1.7	1.7
Pool slope (Spool)	0.000	0.000	0.000	0.000
Ratio of pool slope to bankfull slope (Spool/Sbkf)	0.000	0.000	0.000	0.000
Pool Length (Lp)	70.3	25.1	25.1	76.2
Pool Length to Riffle Width (Lp/Wbkf)	2.6	1.9	0.8	2.5
Maximum pool depth (Dpool)	5.5	2.7	5.1	6.1
Ratio of pool depth to average bankfull depth (Dpool/Dbkf)	3.0	3.0	2.5	3.0
Pool width (Wpool)	30.1	14.7	30.5	33.5
Ratio of pool width to bankfull width (Wpool/Wbkf)	1.1	1.1	1.0	1.1
Pool Area (Apool)	86.5	18.2	144.5	107.1
Ratio of pool area to bankfull area	1.7	1.5	2.3	1.7
Point Bar Slopes (H:1)	8	6	5	8
Pool to pool spacing (p-p)	162	90	0	151
Ratio of p-p spacing to bankfull width (p-p/Wbkf)	5.9	6.7	0.0	5.0

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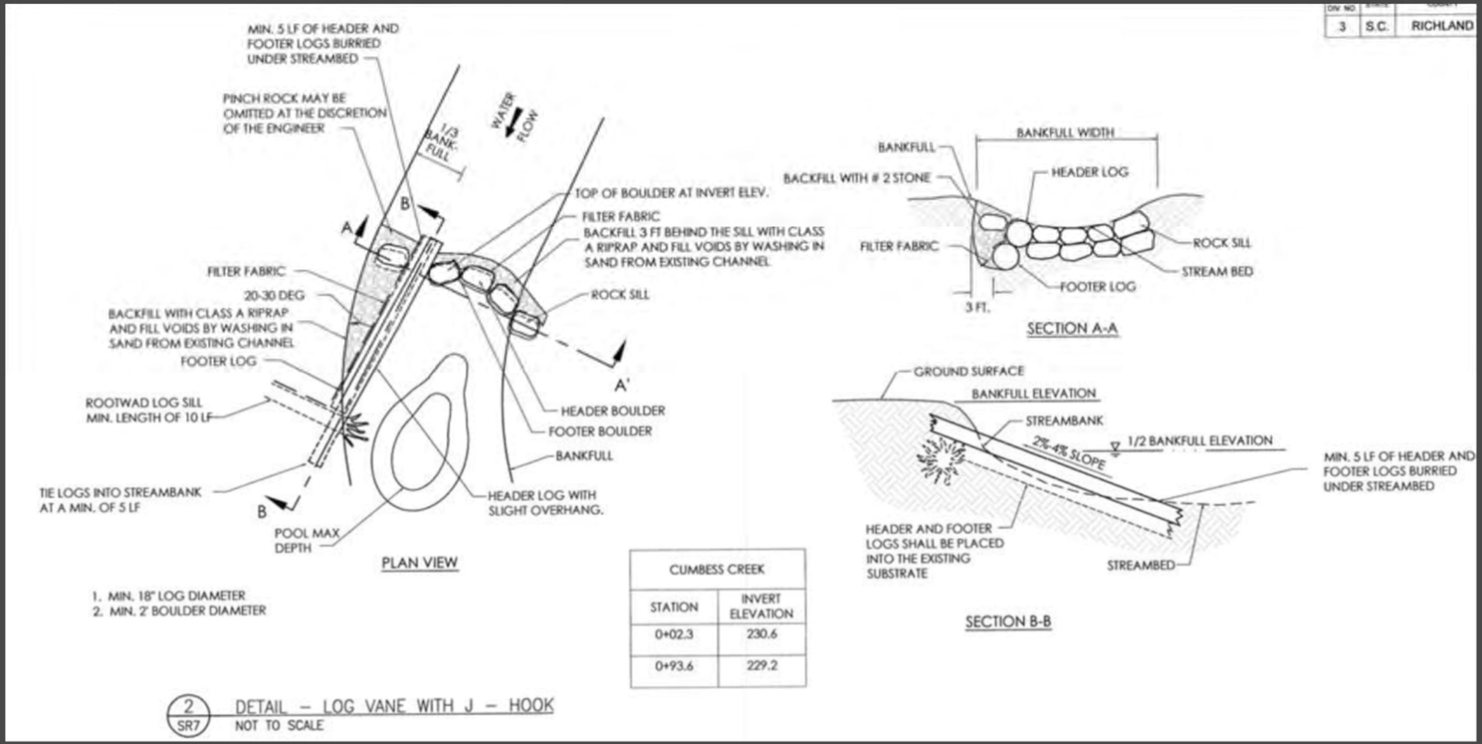

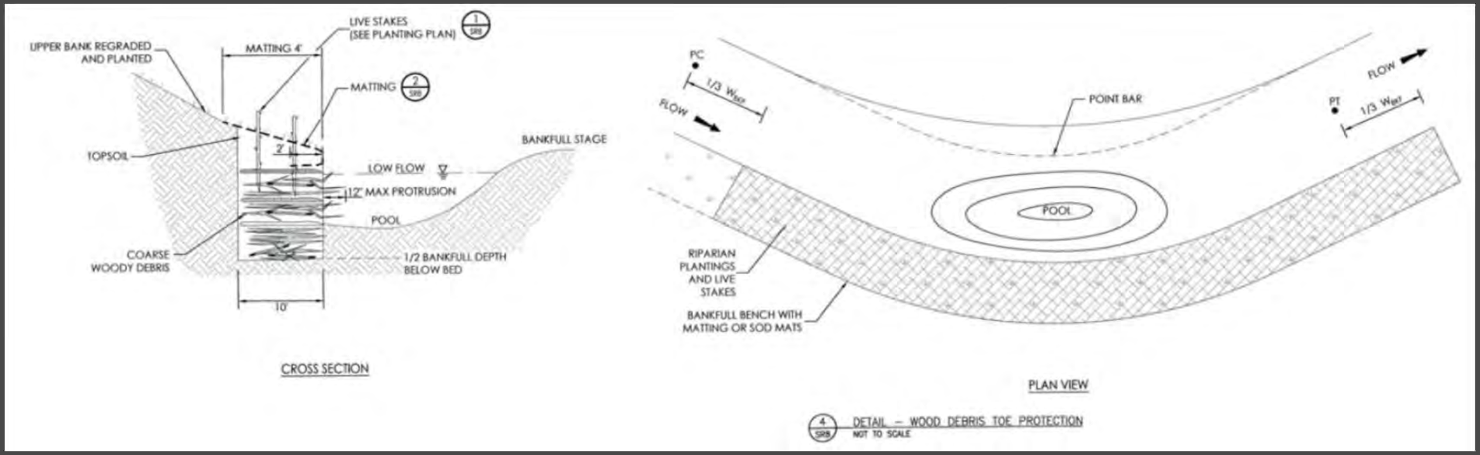

Design Iteration

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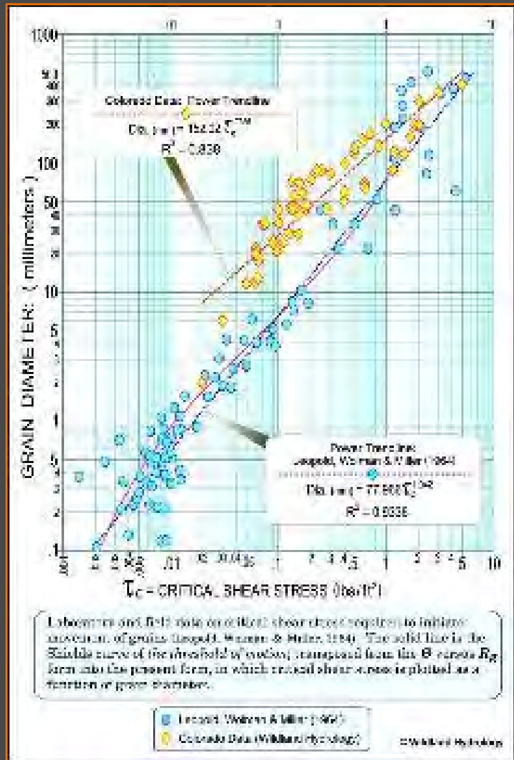

Technical Note

Shields versus Isbash

A. Recking[1] and J. Pitlick[2]

Abstract: The Shields and the Isbash equations for predicting the stability of rocks exposed to a turbulent flow were both proposed in 1936, and since then, both equations have been used widely in the analysis of transport thresholds for coarse sediment. These two equations were obtained using two very different approaches, but as demonstrated in this paper, the equation developed by Isbash is consistent with the relation formulated by Shields for predicting the motion of sediments either in the flume or in the field. Comparison of the two equations suggests that standard approaches tend to oversize riprap in mountain streams. **DOI:** 10.1061/(ASCE)HY.1943-7900.0000647. *© 2013 American Society of Civil Engineers.*

CE Database subject headings: Rocks; Stability; Turbulent flow; Predictions; Sediment transport; Riprap.

Author keywords: Bedload transport; Critical shields stress; Isbash parameter; Riprap.

September 2009
Publication No. FHWA-NHI-09-111

Hydraulic Engineering Circular No. 23

Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance-Third Edition

Volume 1

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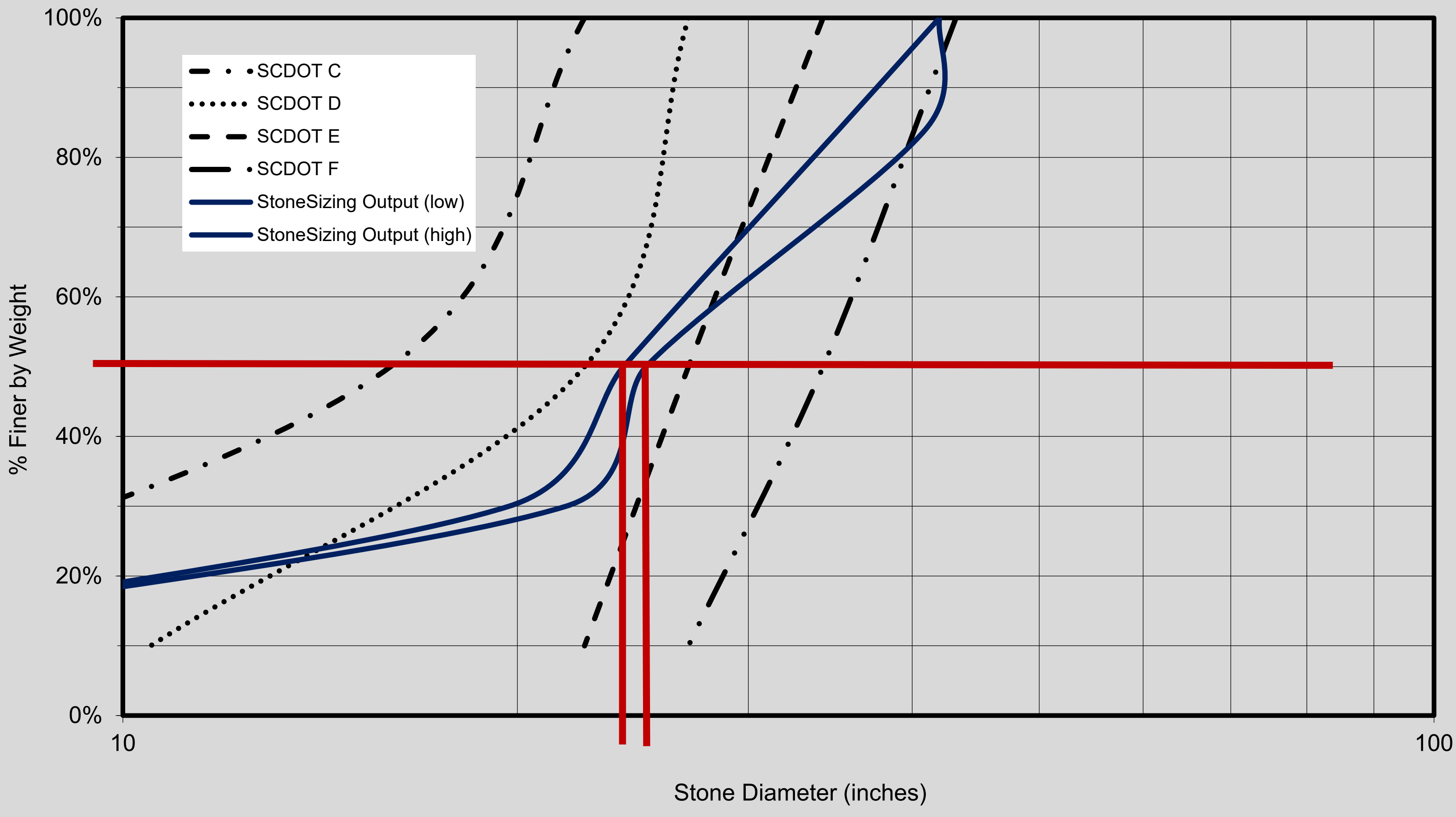
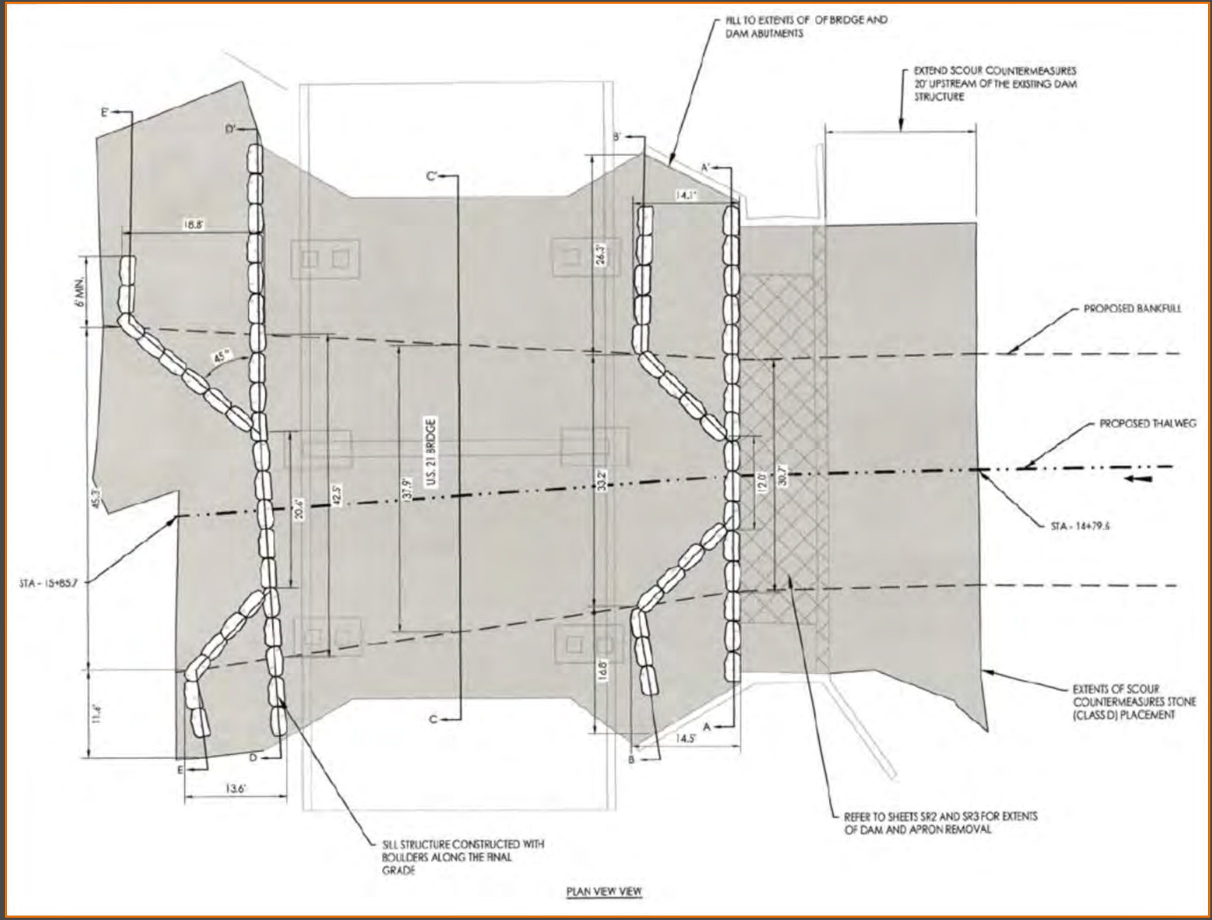
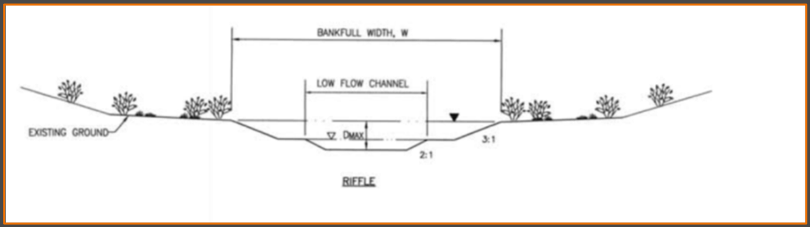
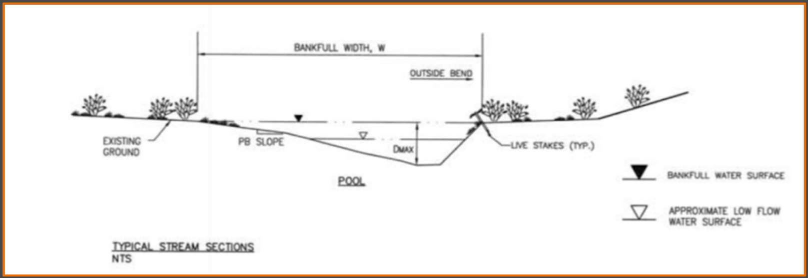


Figure 1: Grain size analysis for a really big sample

Design Iteration







Design Iteration

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Dec 14, 2016


October 31, 2017


May 8, 2018
October 18, 2018
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March 2020

March 2020

March 2020

2019 SC ACEC Award Winner

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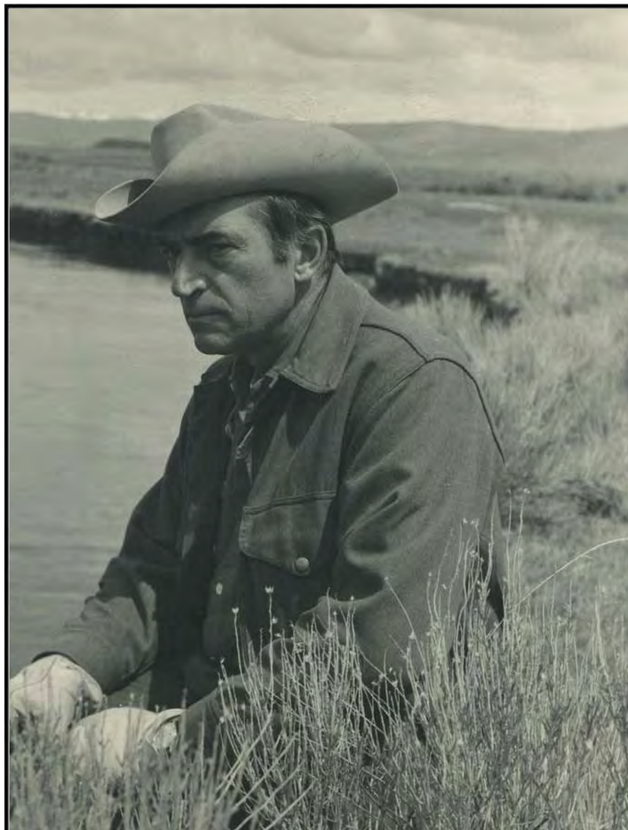

Water is the most critical resource issue of our lifetime and our children's lifetime. The health of our waters is the principal measure of how we live on the land.

— Luna Leopold —

Our Motivation