# Floods, Fish and Debris – 10-Year Perspective in South Central Alaska


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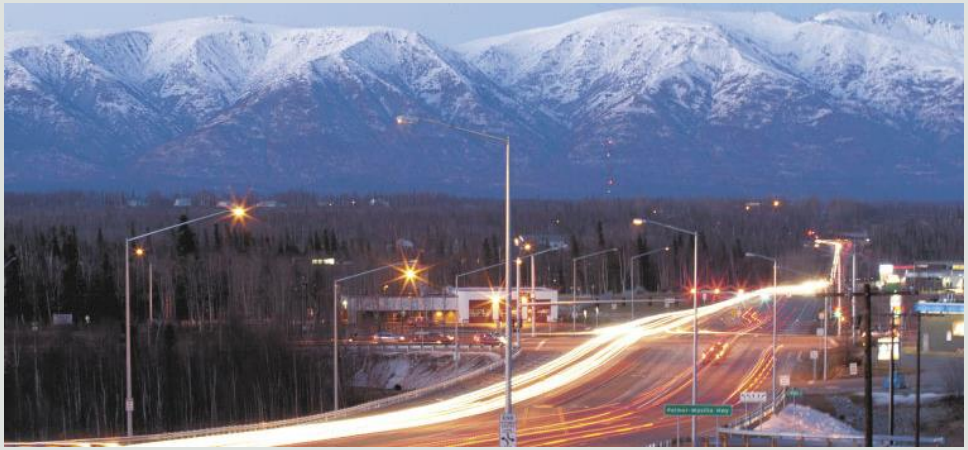
# Why Mainly South Central

- Fastest growing human population in Alaska
- 75% of Population
- Most of the Stocks of Concern
- (MatSu Alone)
  - 1960: 5000
  - 2012: 90,000
  - 2030: 160,000

- About 20% of all barriers in the state are South Central.

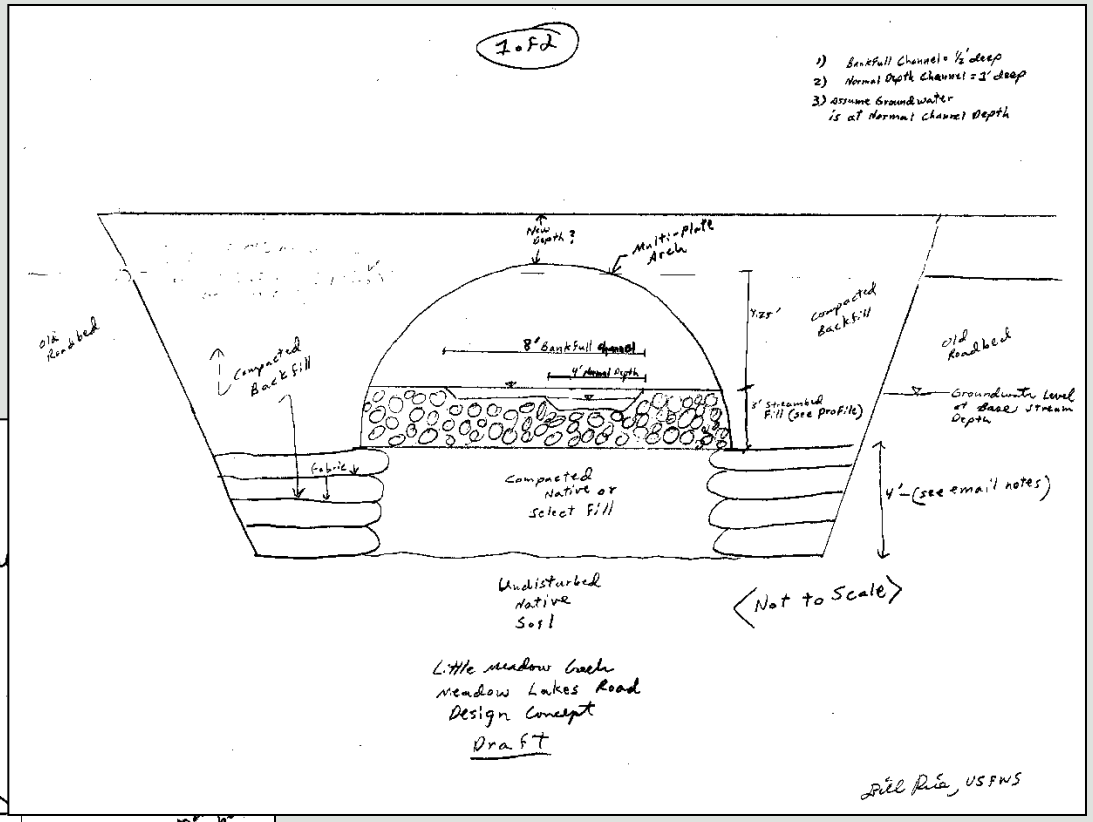
**Mat-Su's fast developing Wasilla-Palmer core area ("the Valley")**

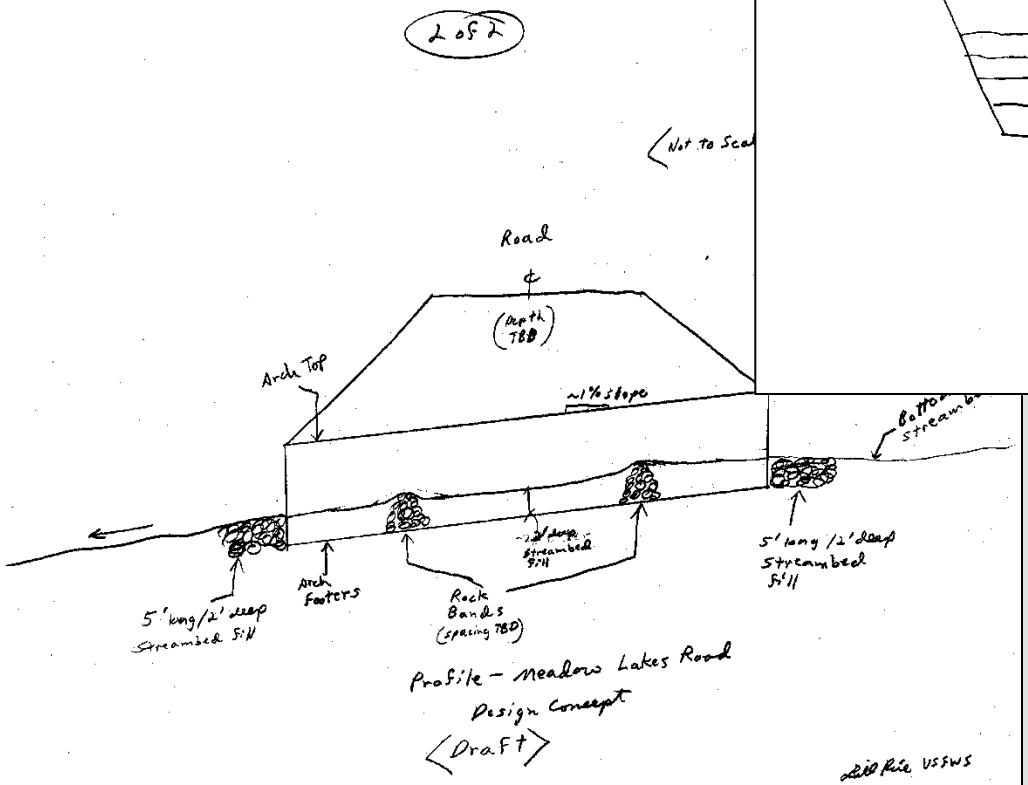


# The Years 1999-2005

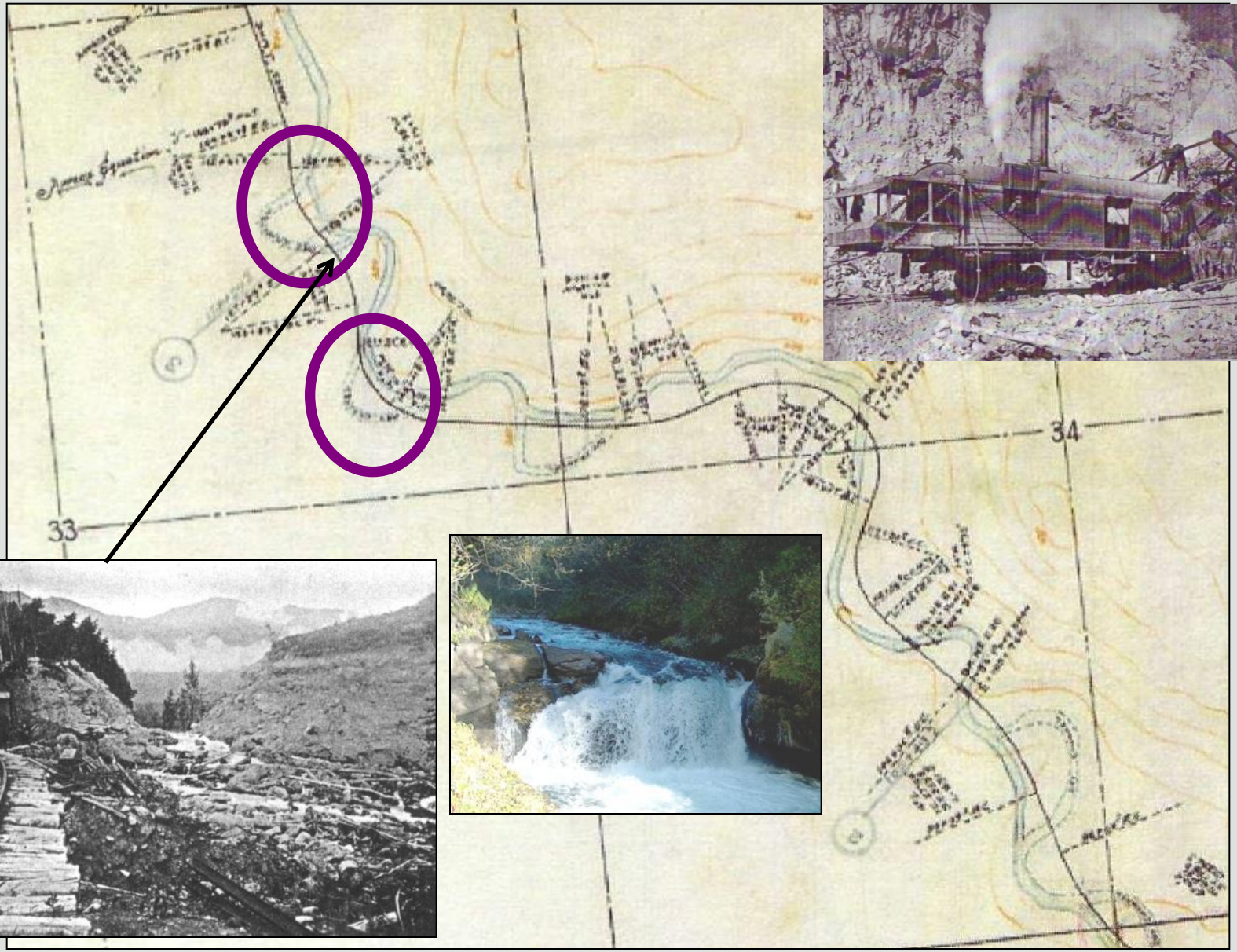
- ADFG Began Fish Passage Assessments
- Rise of Fish Passage Restoration
- Mainly Opportunistic/Capacity Building Projects
- Mostly Back-Of-The-Envelope Designs (but we were trained in AOP matters)

# Back-Of-The-Envelope Designs



# Moose Creek Falls



# Moose Creek


# 2005-Present (South Central)

- Restoration Capacity Increased Exponentially (est.)
  - SSSF Earmark to Anchorage ($10 million)
  - Salmon in the City ($7-$8 million)
  - $8 million in MatSu
  - $4-5 million in Kenai
  - $7 million EVOS in Kenai (2015)
  - $1.5 million Tyonek (2013-2015)
- Sophistication Increased
- Policy Created for “No New Barriers” with the help of multiple and expensive flood events
- New Prioritizations Created for Remaining Culverts
- About 210 culverts installed…..

**What Did We Do?**

**Lessons Learned?**

**What Did We Try?**

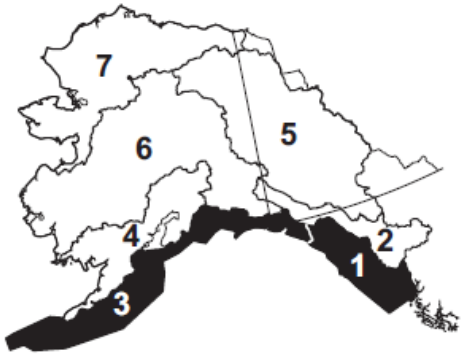
**What Worked?**

**How Did Our Perspectives Change?**

# Geomorphic Approach Is Key

# Ungaged Statistics


| Regression equation for specified recurrence interval $Q_T$ | Average standard error of prediction (log units) | Average standard error of prediction (percent) | Average equivalent years of record |
|---|---|---|---|
| **Region 1, Region 3 (93 gaging stations)** | | | |
| **Applicable range of variables:** | | | |
| ***A*: 0.720–571; *ST*: 0–26; *P*: 70–300; *J*: 0–32** | | | |
| $Q_2 = 0.004119\ A^{0.8361}\ (ST+1)^{-0.3590}\ P^{0.9110}\ (J+32)^{1.635}$ | 0.158 | 38 | 0.88 |
| $Q_5 = 0.009024\ A^{0.8322}\ (ST+1)^{-0.3670}\ P^{0.8128}\ (J+32)^{1.640}$ | .156 | 37 | 1.3 |
| $Q_{10} = 0.01450\ A^{0.8306}\ (ST+1)^{-0.3691}\ P^{0.7655}\ (J+32)^{1.622}$ | .157 | 37 | 1.8 |
| $Q_{25} = 0.02522\ A^{0.8292}\ (ST+1)^{-0.3697}\ P^{0.7165}\ (J+32)^{1.588}$ | .161 | 38 | 2.4 |
| $Q_{50} = 0.03711\ A^{0.8286}\ (ST+1)^{-0.3693}\ P^{0.6847}\ (J+32)^{1.559}$ | .166 | 40 | 2.8 |
| $Q_{100} = 0.05364\ A^{0.8281}\ (ST+1)^{-0.3683}\ P^{0.6556}\ (J+32)^{1.527}$ | .171 | 41 | 3.1 |
| $Q_{200} = 0.07658\ A^{0.8276}\ (ST+1)^{-0.3669}\ P^{0.6284}\ (J+32)^{1.495}$ | .178 | 43 | 3.4 |
| $Q_{500} = 0.1209\ A^{0.8272}\ (ST+1)^{-0.3646}\ P^{0.5948}\ (J+32)^{1.449}$ | .188 | 45 | 3.6 |



# Get The Substrate Right

**Mixing Matrix of Large Rock and Fines**

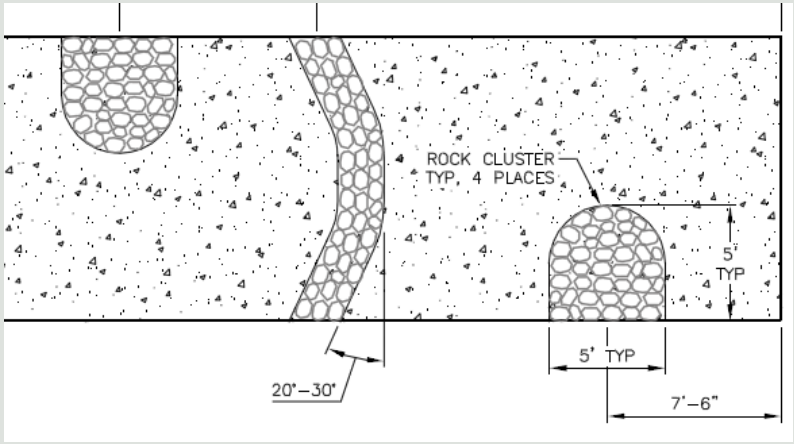
**Bed with Low Flow Channel and Random Rock Placement – Any Issues?**

# Bed Material Size and Arrangement

**Step-Pool: rigid, forcing features, little movement**


**Plane-Bed: sediment movement, rockband forcing feature**

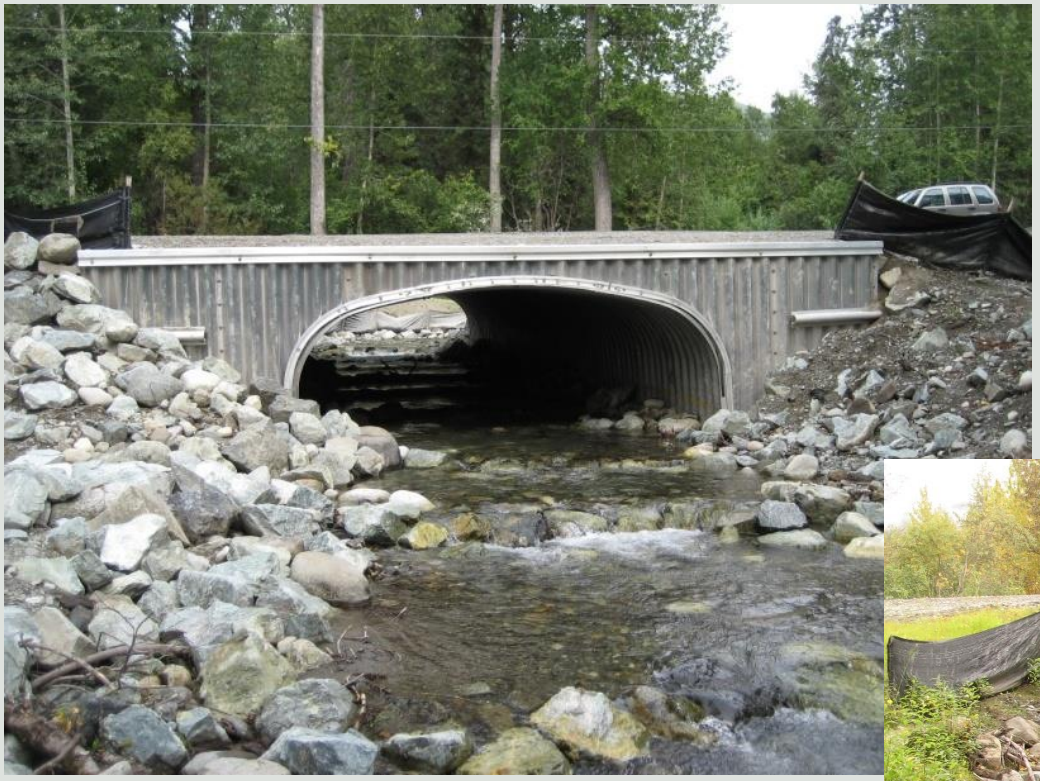

**Roughened Riffle: some sediment movement, single/cluster forcing features**




**Rough Riffle: some sediment movement, cluster and rockband forcing features**

# Riffle with Low Flow Channel

# Step-Pools



**Edgerton Parks Road at Government Creek - Matanuska-Susitna Borough**

**Jonesville Road at Eska Creek - Matanuska-Susitna Borough**

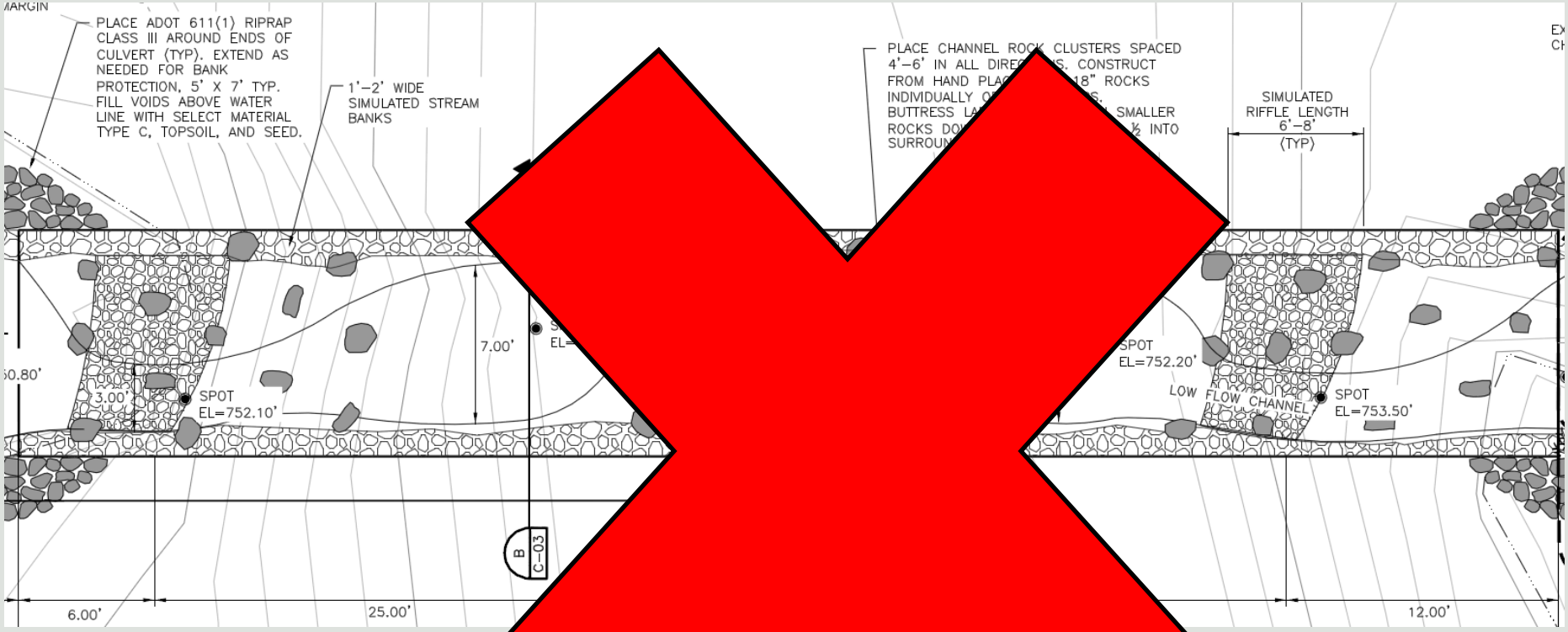
# Roughened Channel

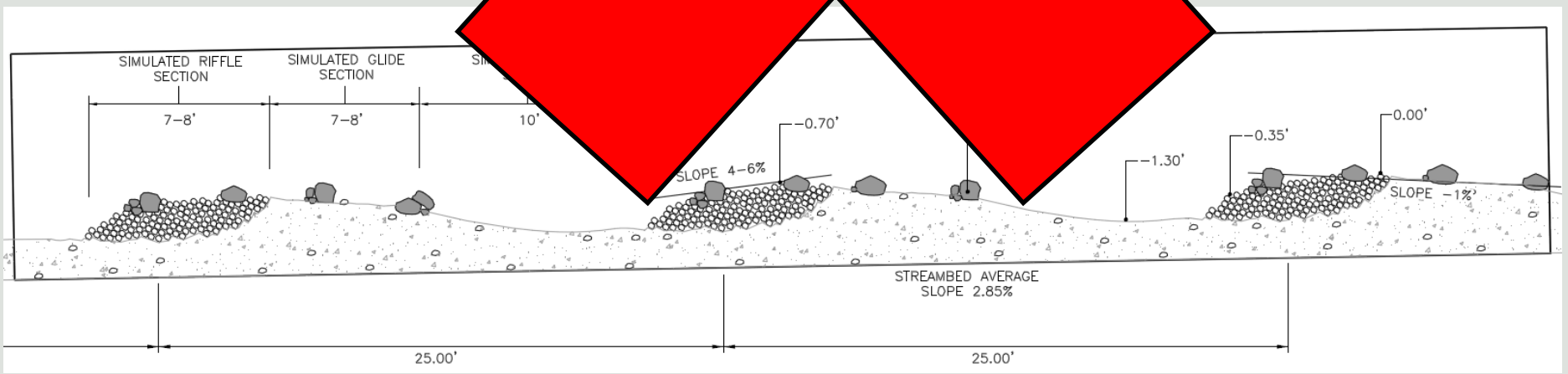
**Jonesville Road at Eska Creek**
**- Matanuska-Susitna Borough**

# Riffle-Pool


**Edgerton Parks Road, Elk Creek - Matanuska-Susitna Borough**

# Riffle-Pool Design



# Don’t Get Too Narrow

# Don’t Get Too Wide

## 1.0-1.2 Bankfull

# Too Wide?
# 1.5 BKF

**Coyote Creek**
**(8 foot channel in 16 foot culvert)**

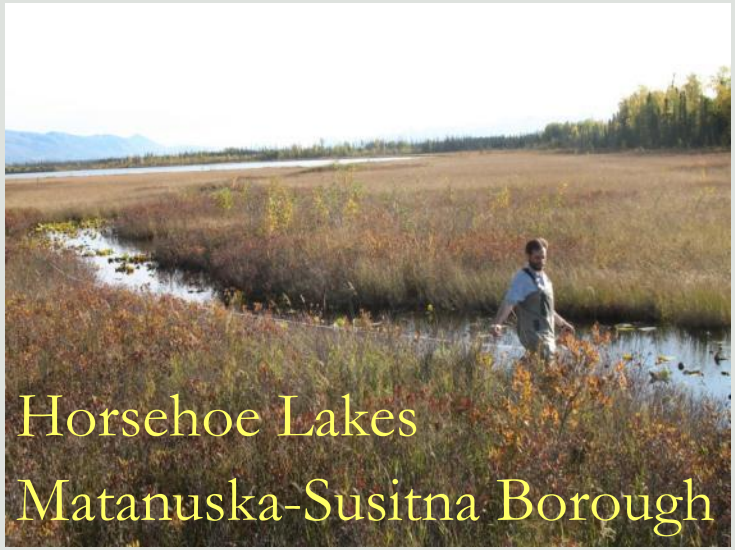
# Streambanks

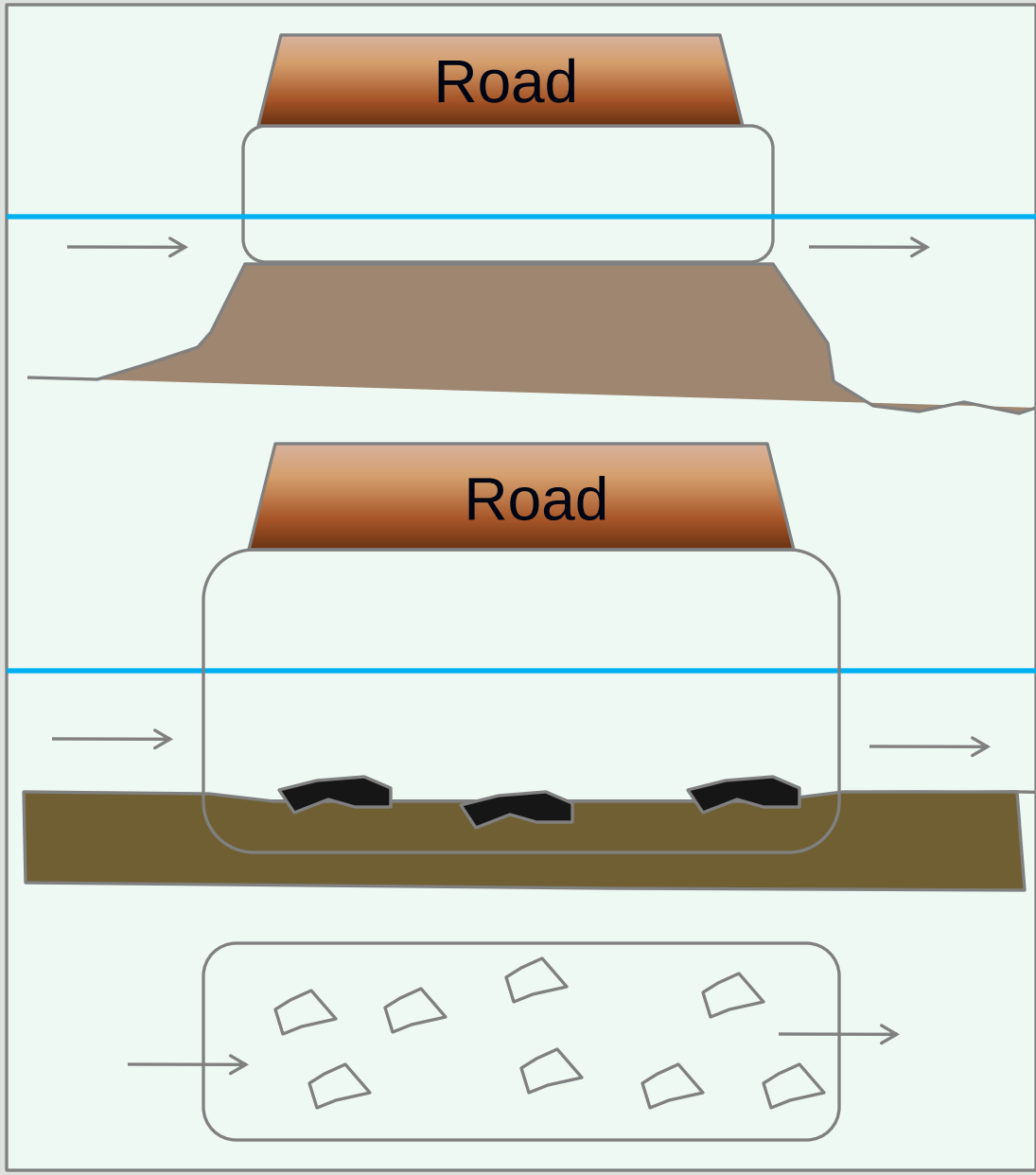
Duncan Drive, Kenai
(6 foot channel)

Coal Creek, Kenai
(12 foot channel in 18 ft. pipe)

**Streambanks are to be immovable at design flows – consider in low entrenched environments!**

# Lacustrine Systems

# Baffles/Hydraulic Method

# Transition Zones


Rosie Creek, Northern Region

**Remember to transition to natural banks and stream!**

Streambank Transition from Rock to Rootwads, Coal Creek, Kenai

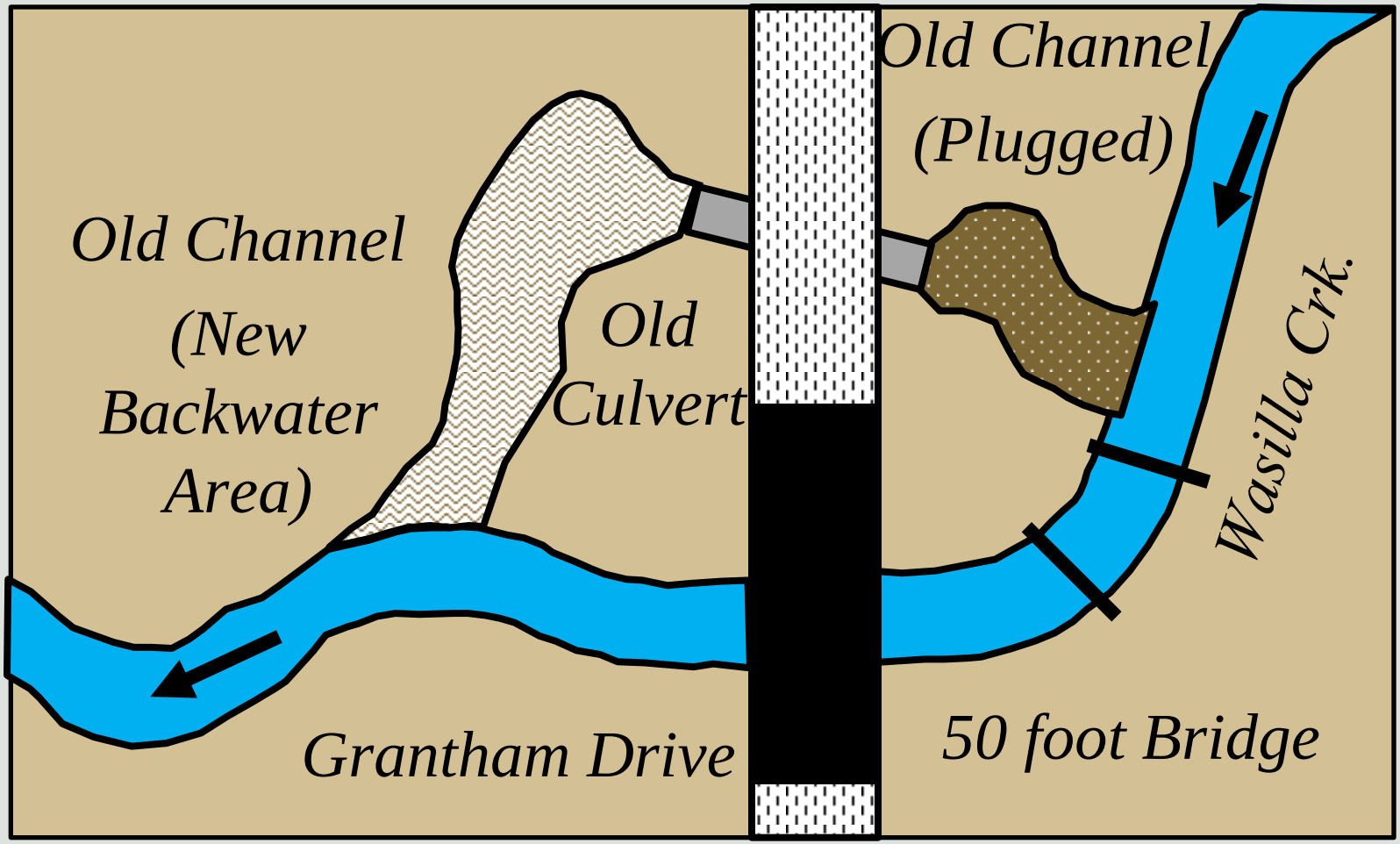
# Streambanks

**Brushlayering on Wrong Stream Type**

**Rootwad Applications**

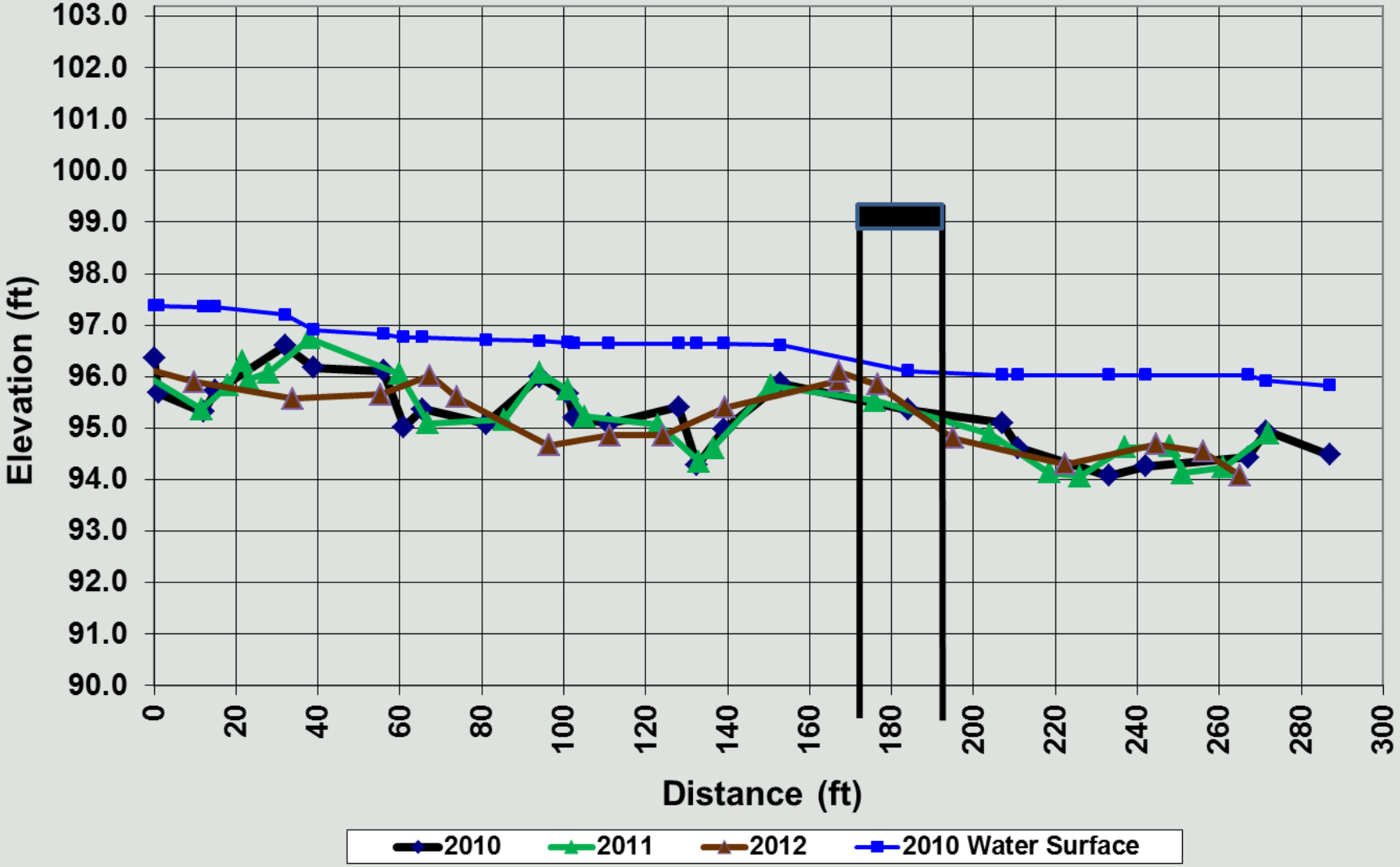
# Lake Outlets

# Meander Flip




*Plan View of Project (Wasilla Creek)*

# Wasilla Creek



# Perspectives

- ✓ Geomorphic Approach for Resiliency
- ✓ Primarily Fish Passage – Not  Habitat
- ✓ Bankfull Width
- ✓ Roughened Riffles
- ✓ Bottomless = Bottomed Pipes
- ✓ Consider Aluminum
- ✓ Beware of Plastic Pipes

# Points to Remember

- **What are your objectives?**
- **Emulate the stream type in your culvert and make bed features that reflect it.**
- **Size your stream banks to reflect stability at large flow events,  not to a set standard.**
- **Culverts are not bridges. Consider risk, design conservatively.**

# Future?

Montana Creek at Kalispell Street, 2012

Colter Creek, 2006

MatSu, 2012


Kenai, 2012

- Meander Flipping
- Lake Outlets
- Varous Bedforms – What Learned?
- Debris – Does Bankfull Width Really Work?
- Rocky Ramp and Streambed Design
- Lacustrine Culvert Design
- Designing for Less than 100-year on certain streams
- When wide may be too wide for Streambanks
- Approach Tie-Ins to Culvert Streambanks
- Power Creek Road – Importance of Sediment Transport
- Does moving creek for crossing to keep old culvert as diversion really work?
- Contractors and the Lessons Learned.