Salmonid Restoration Federation 2021
Large Wood Field School

One Approach to Assessing Risk for Large Wood Structures

A Case Study from the Albion River

Kelly Bar, North Fork Salmon River, California

Michael Love P.E.
Arcata, California
mlove@h2odesigns.com
707-822-2411

Michael Love & Associates
Hydrologic Solutions

Elias J. Steinbuck, CEG

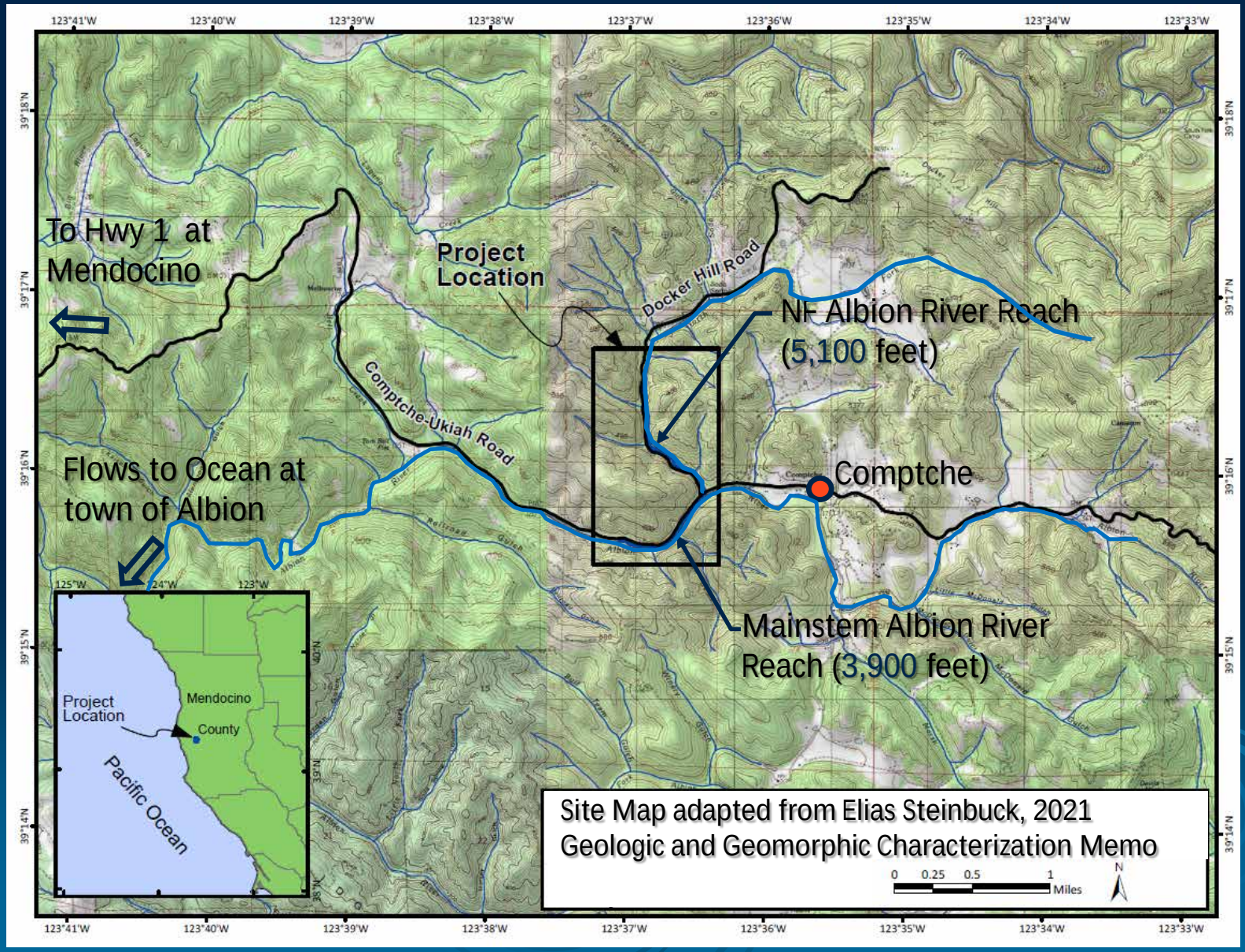
TROUT UNLIMITED

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

MENDOCINO

Albion River Wood Loading Project

Project Location



Albion River Wood Loading Project

Project Reaches Incised to Bedrock and Lack Large Wood Controls

Albion River

Massive Log Jam Along Comptche-Ukiah Road downstream of Project

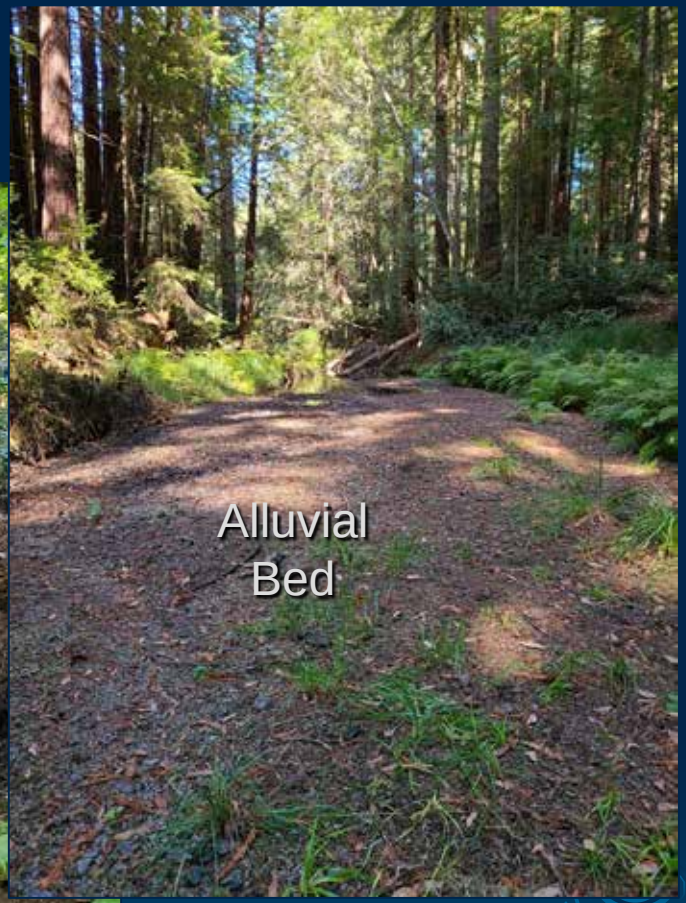
Alluvial Bed Extends Far Upstream of Jam – Bedrock Downstream

Bedrock Bank Saves Adjacent County Road from Lateral Scour

Mainstem Albion River LWD4

Where wood is present channel regains an alluvial bed

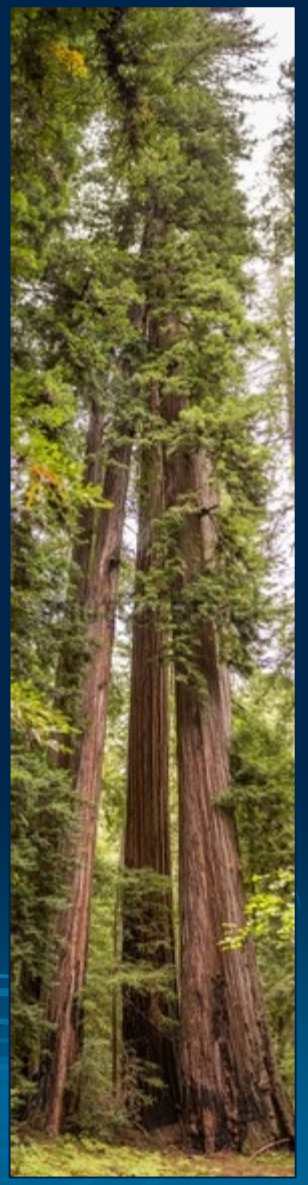
Looking upstream and Lage Wood Accumulation



Looking Upstream from Wood at Gravel Bedded River

Albion River Project

Trout Unlimited Project Lead - FRGP Funded



Project Goal

- Restore bedrock reaches to an alluvial-bed throughout much of the project length to improve salmonid habitat

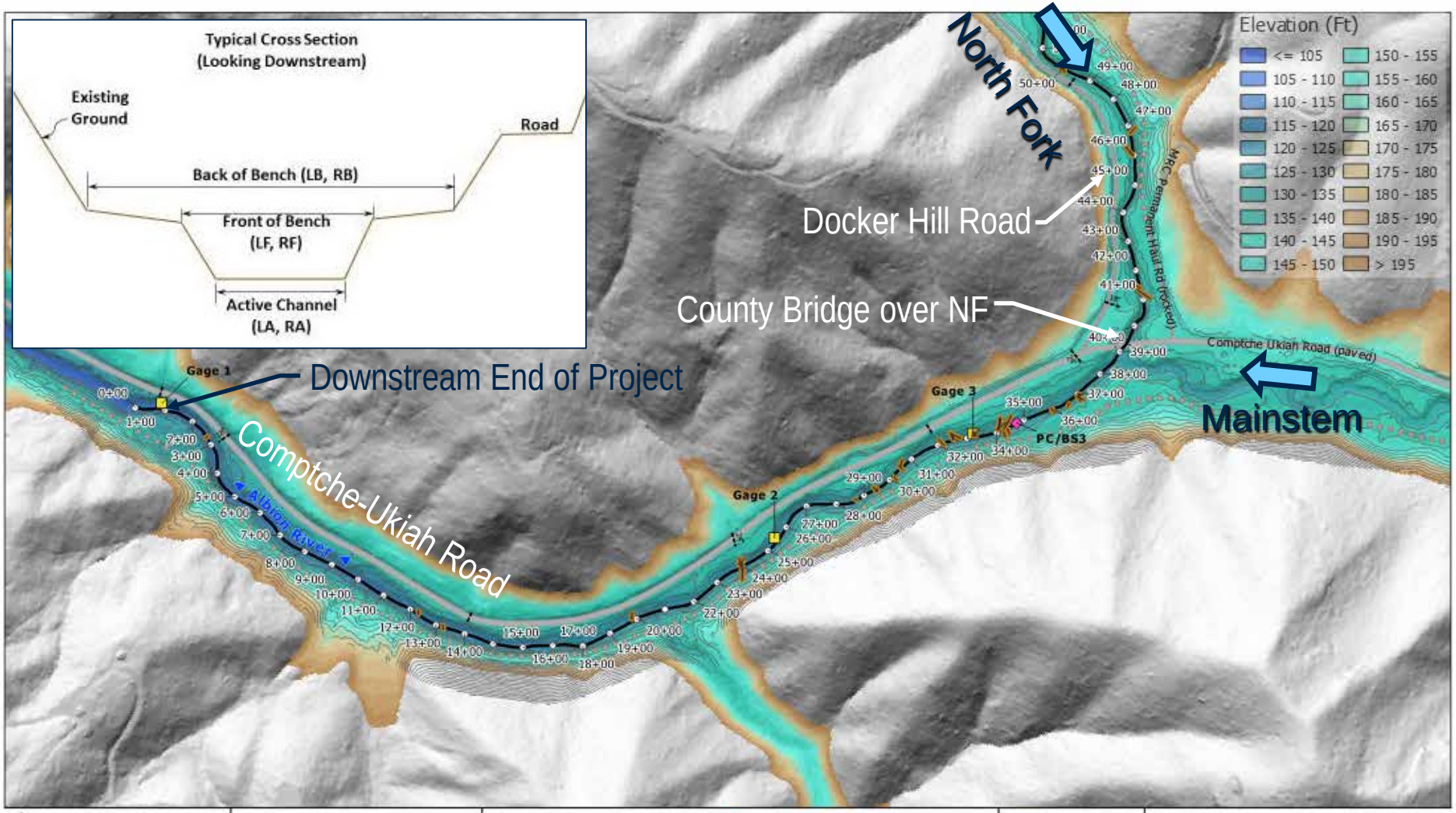
Project Objectives

- Install large wood structures to initiate process of in-channel alluvium accumulation and storage
- Meet NMFS SONCC recovery plan wood loading densities for “very good” (11 pieces/330 feet)

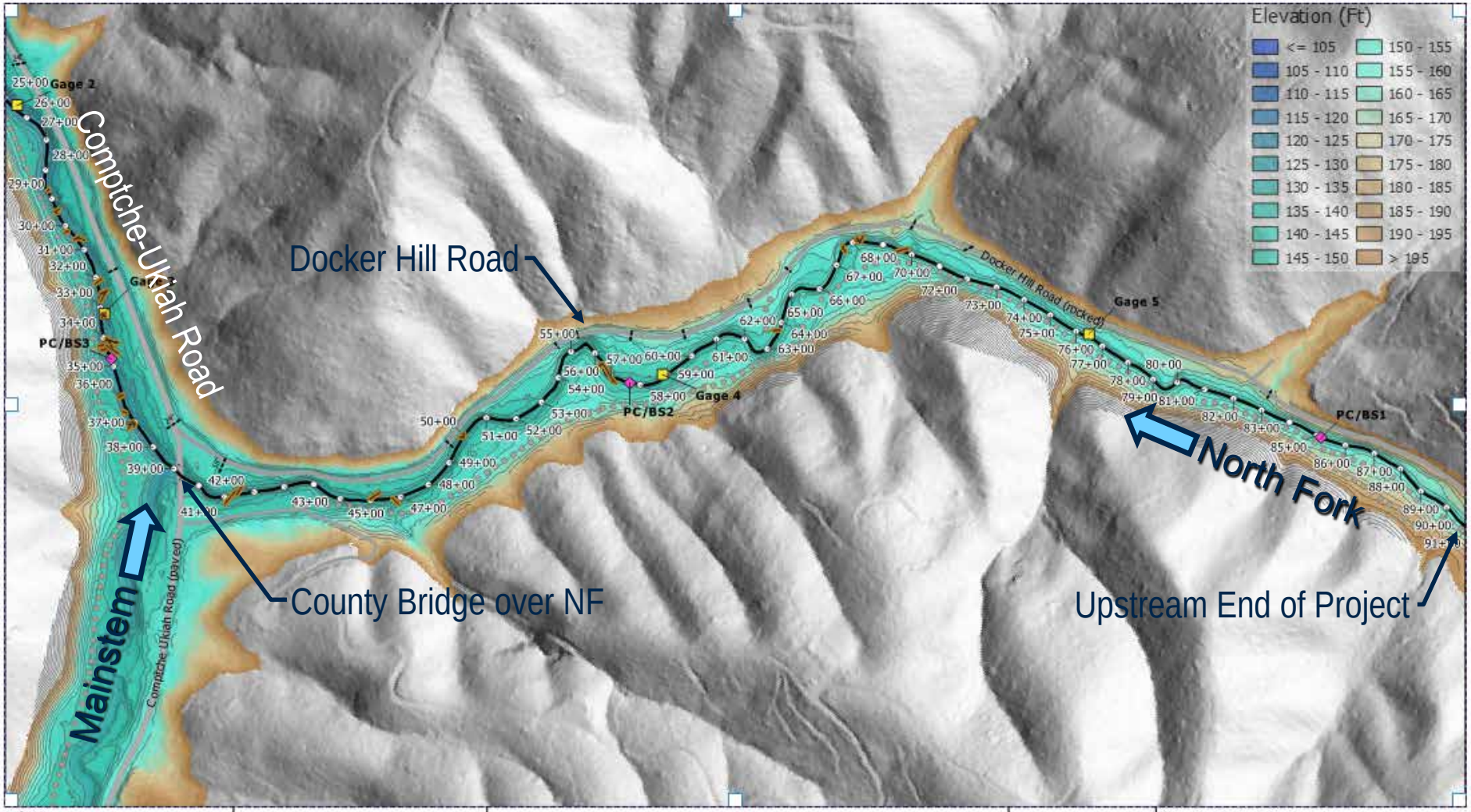
Potential Project Risks Identified During Scoping

- River reaches in close proximity to County and private roads and utilities
- County bridge pier in middle of channel

Mainstem Albion River Topo Basemap



North Fork Albion River Topo Basemap



Datums:
Horizontal: NAD83 State Plane CA Zone 2
Vertical: NAVD88

Sources:
Elevation: Mendocino County Lidar
Aerial Image: 2018 Google Satellite

Fisheries Restoration Grant Program
Grant Agreement Number: Q1910514

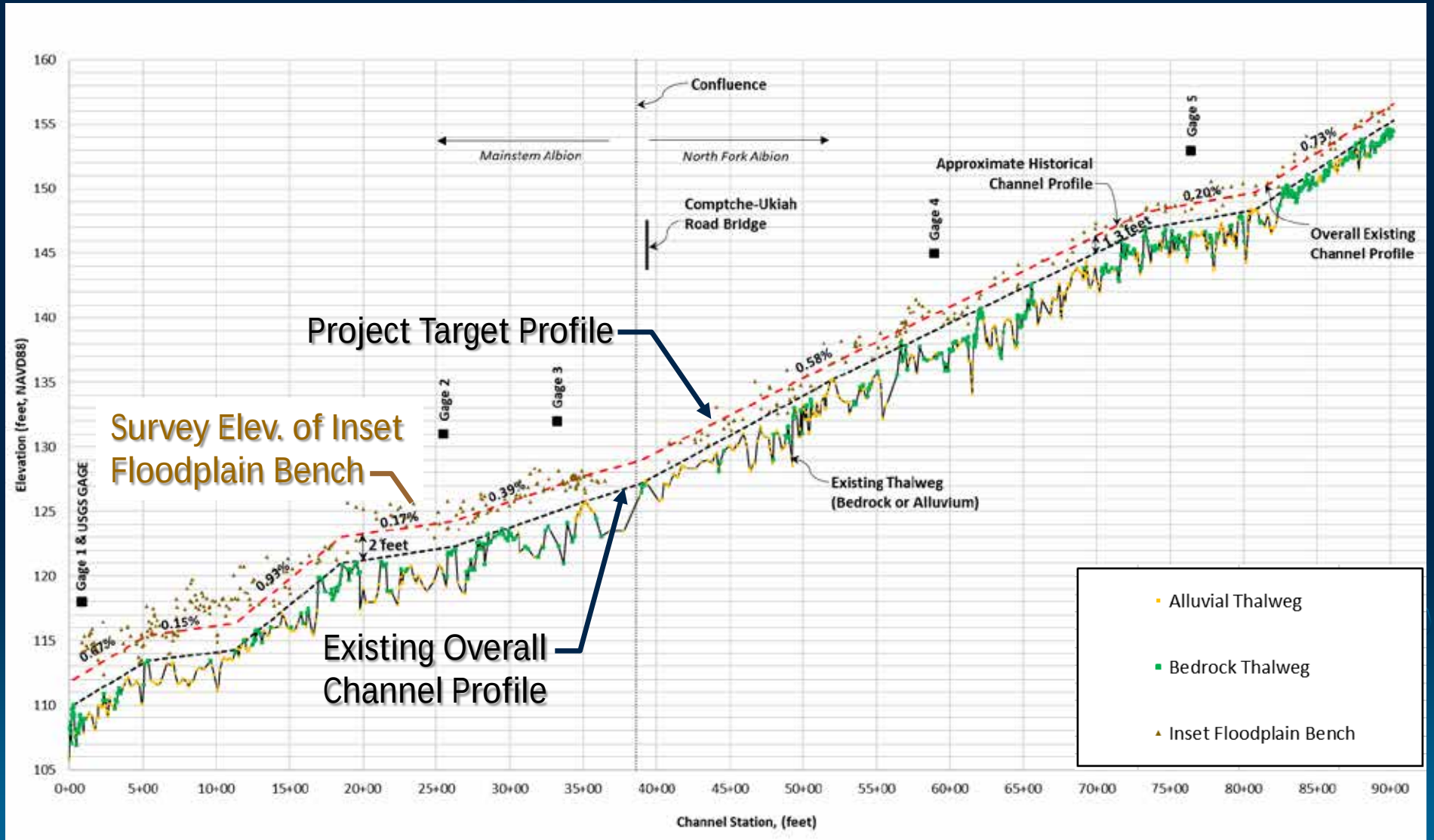
Albion River Instream Coho Habitat Enhancement Design Project

Figure 2 of 2
Albion River Risk Assessment

Filepath: Q:\Albion River LWD\7 CAD-GIS\QGIS\Working\Albion River LWD survey.qgs

Michael Love & Associates, Inc. P.O. Box 4477, Arcata, CA 95521 (707) 822-2411

Albion River Existing Profile and Target Aggraded Profile



Risk Assessment

The *process of detecting hazards and assessing associated risks*

Hazard – A condition or process with the potential to threaten public safety, property, or operations

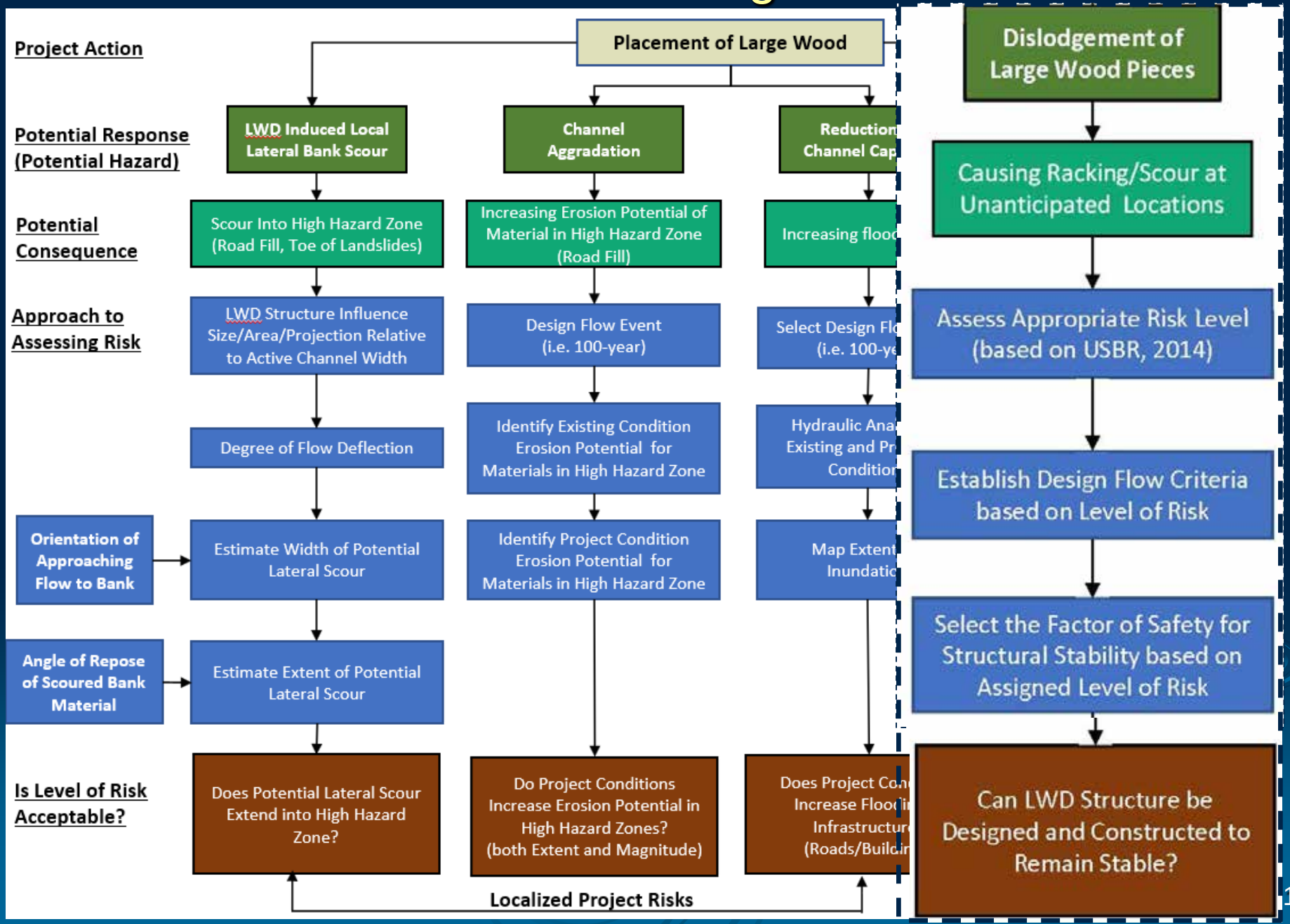
Risk –Combination (product) of the hazard's severity and probability

Severity – Consequences from the identified hazard when it occurs

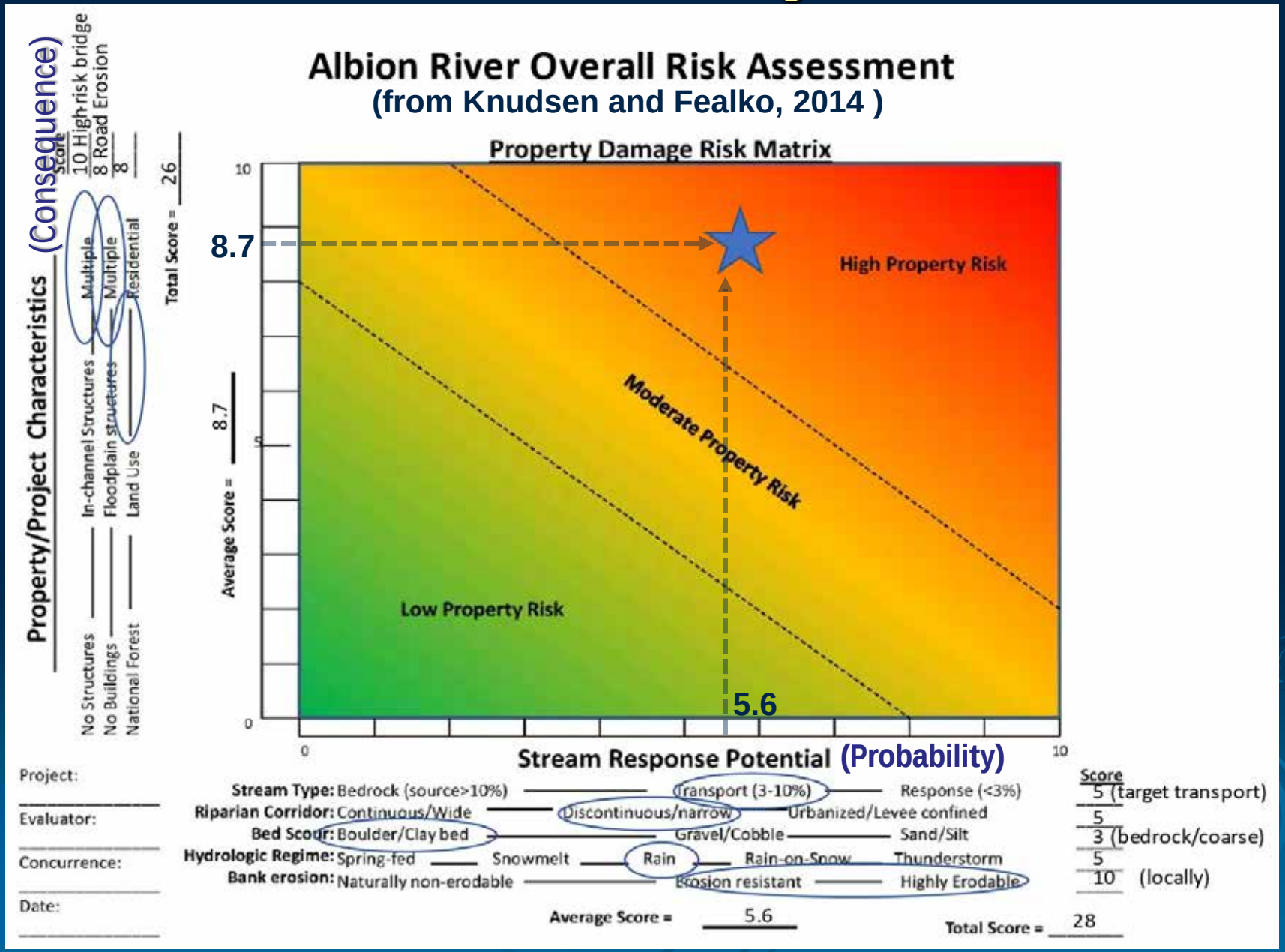
Probability – Likelihood of occurrence

Risk Management

Assessment of Risk from Large Wood Structures



Albion River Reach-Scale Risk Determination for Structure Dislogement



Albion River Reach-Scale Design Criteria based on Risk Determination

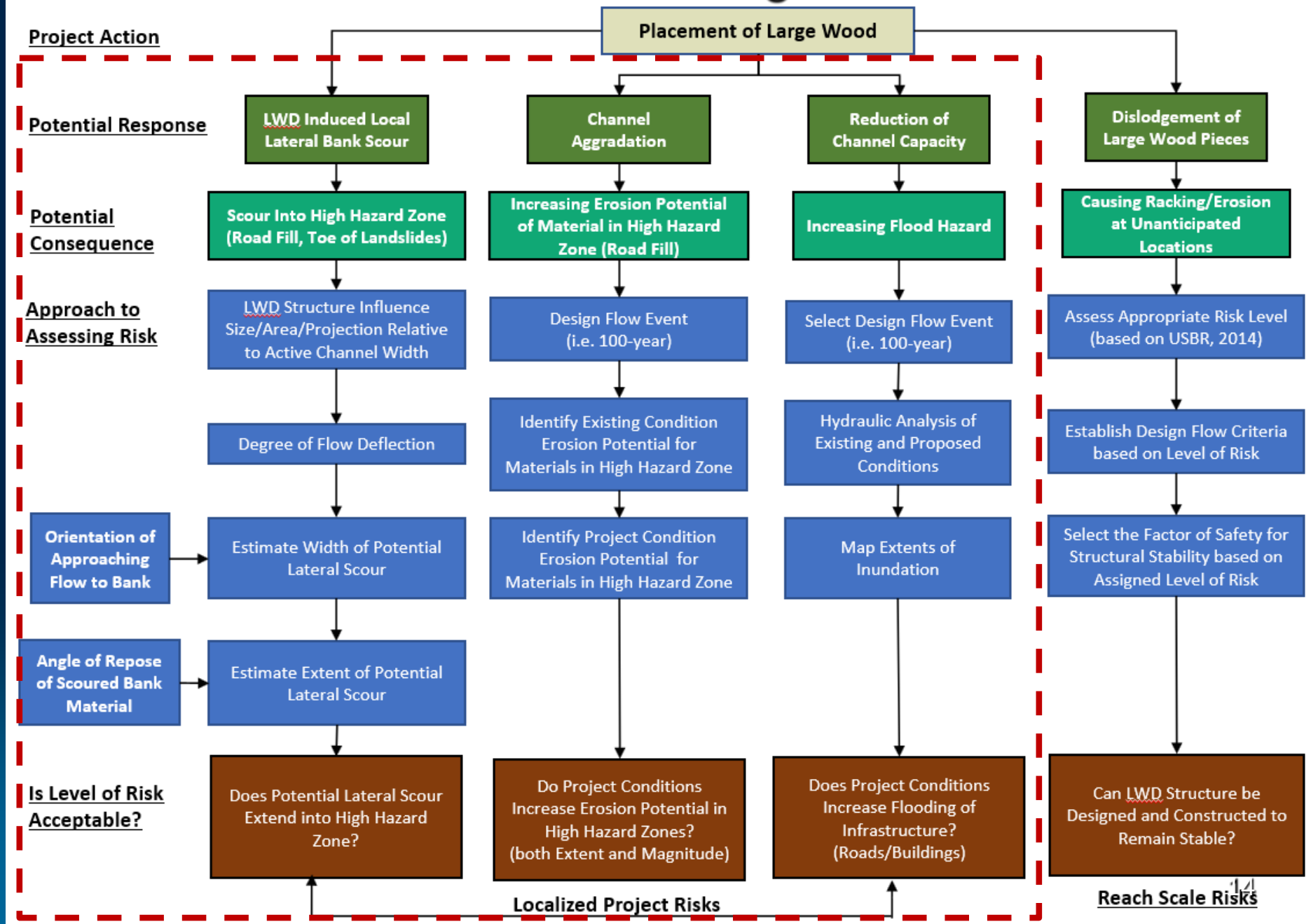
Table 4. Minimum recommended factors of safety.

Public Safety Risk	Property Damage Risk	Stability Design Flow Criteria	$FOS_{sliding}$	$FOS_{bouyancy}$	$FOS_{rotation}$ $FOS_{overturning}$
High	High	100-year	1.75	2.0	1.75
High	Moderate	50-year	1.5	1.75	1.5
High	Low	25-year	1.5	1.75	1.5
Low	High	100-year	1.75	2.0	1.75
Low	Moderate	25-year	1.5	1.75	1.5
Low	Low	10-year	1.25	1.5	1.25

(from Knudsen and Fealko, 2014)

Conclusion: All large wood structures need to be engineered to remain stable

Assessment of Risk from Large Wood Structures

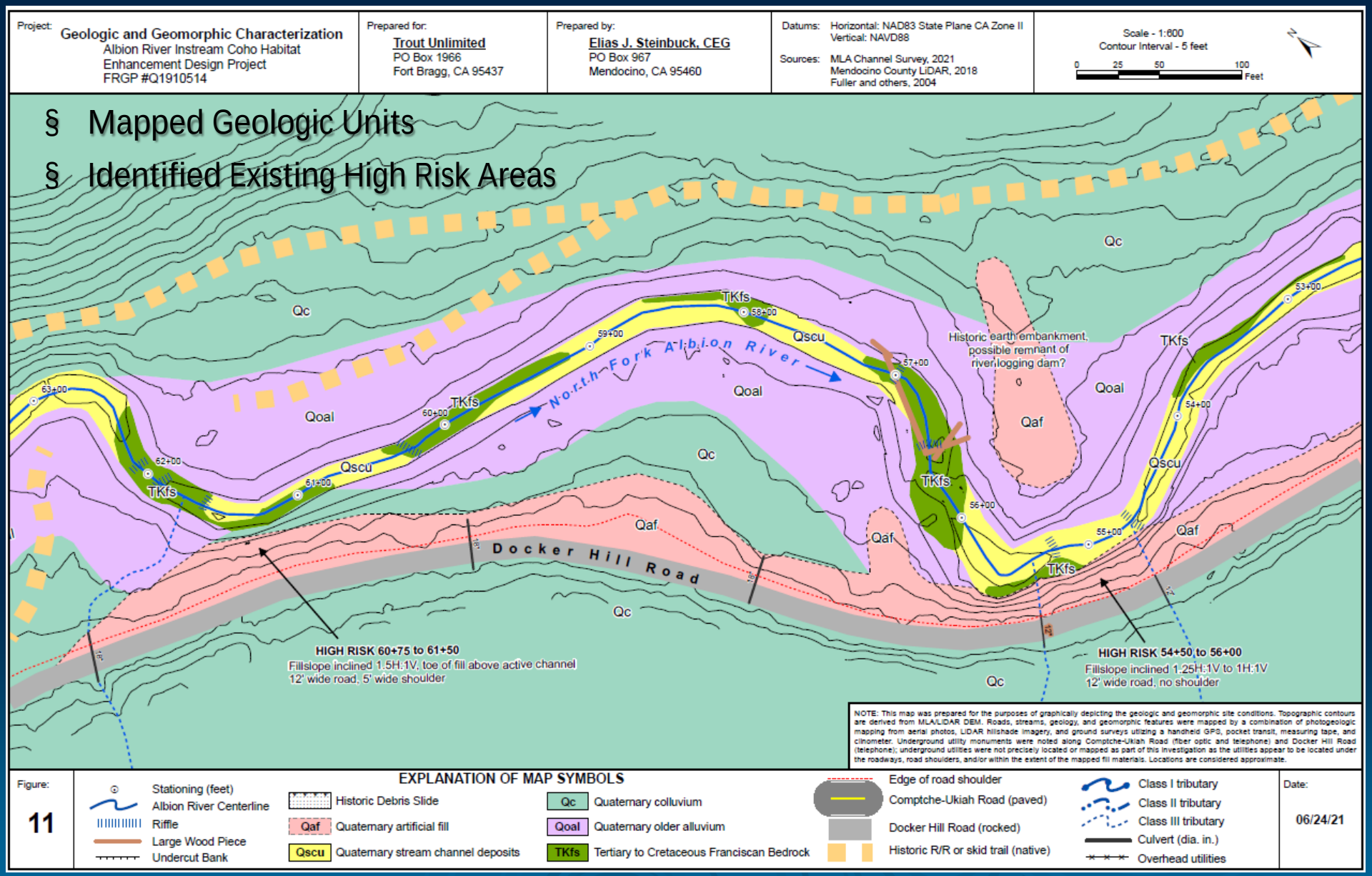


Lateral Scour Example

Price Creek
Tributary To Eel River

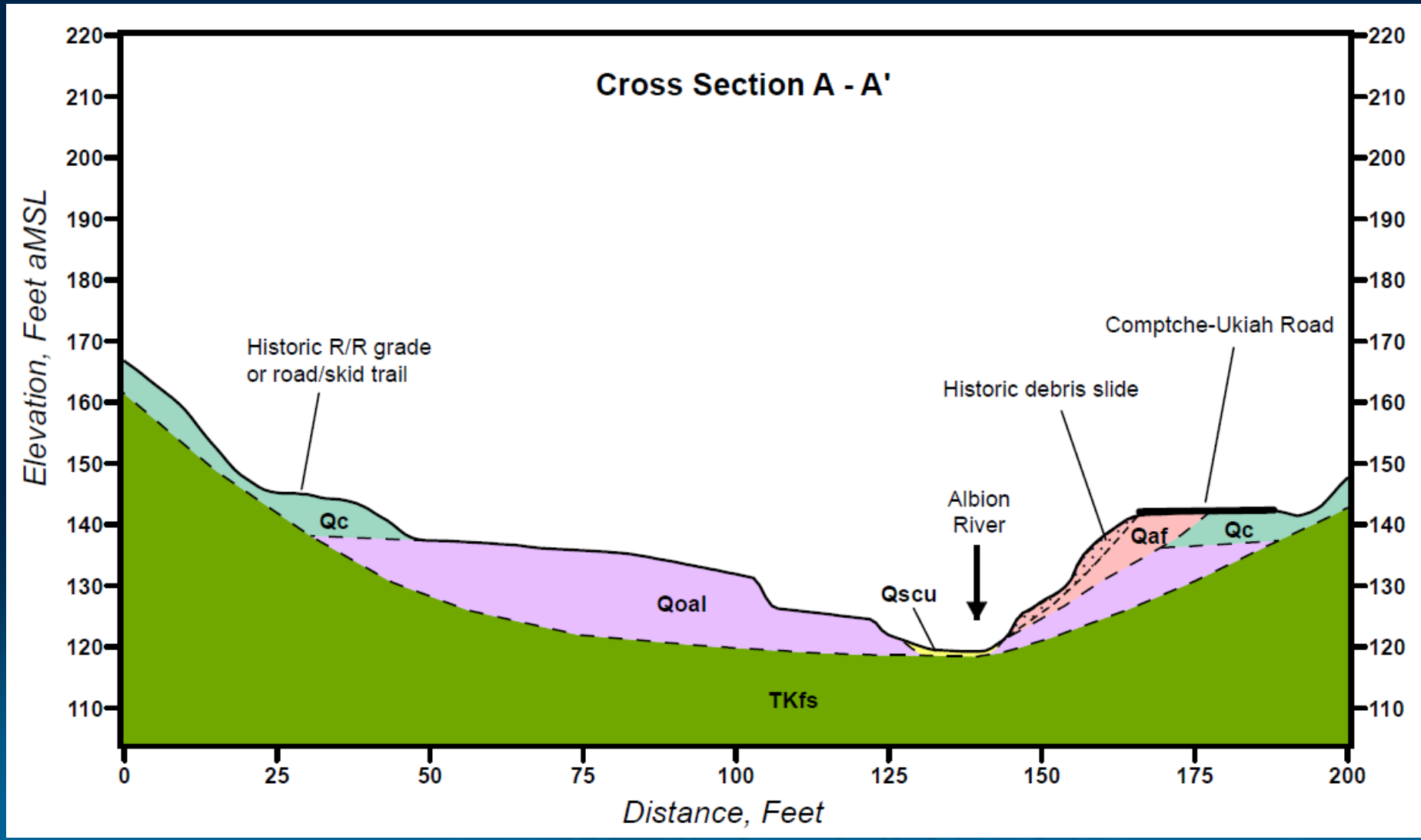
Racking on LWD Structure Causes Lateral Scour into County Road Embankment Leading to Emergency Repair

Geomorphic Mapping



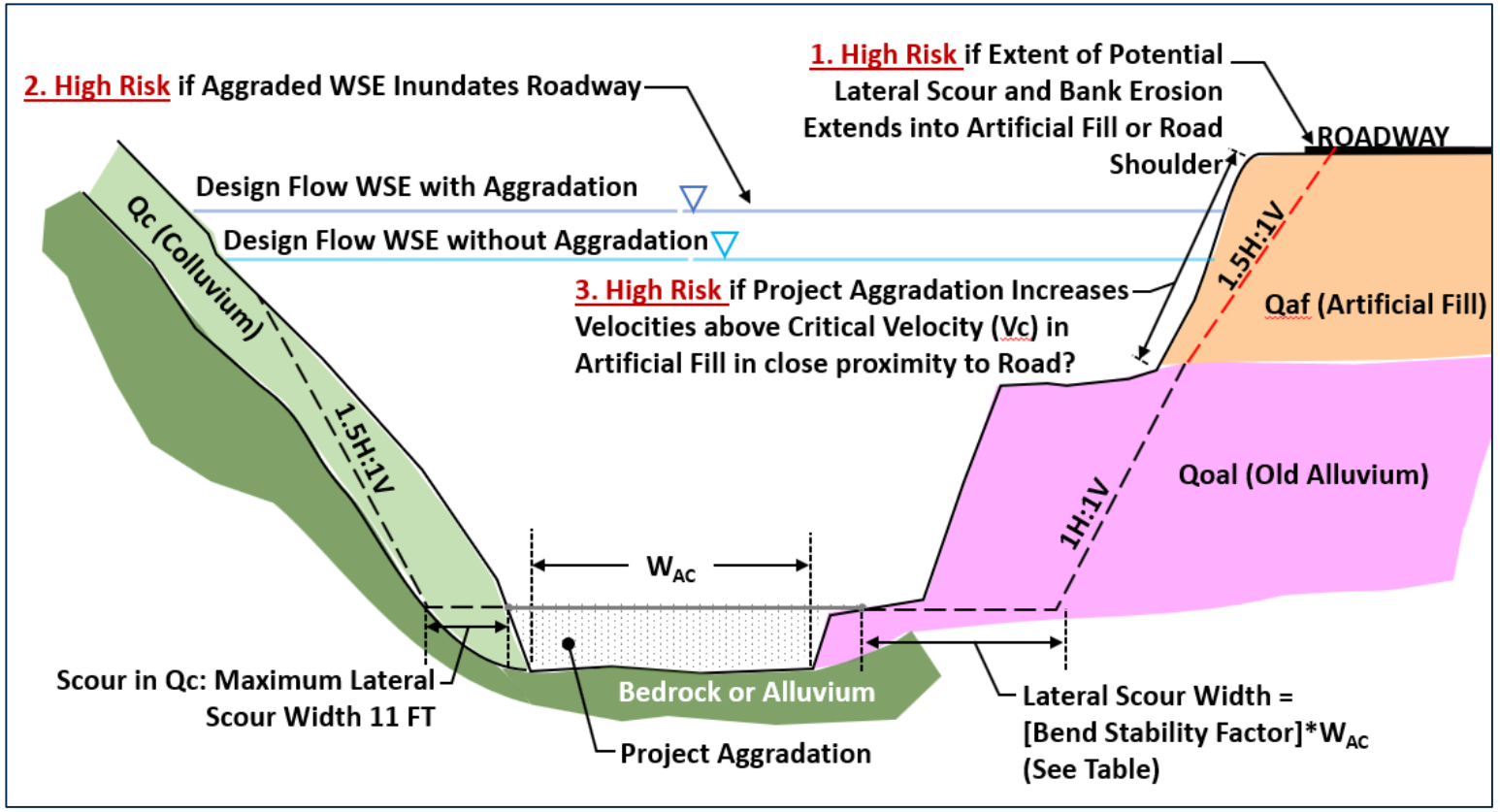
From Elias Steinbuck, 2021. Geologic and Geomorphic Characterization Memo

Using Geomorphic Cross Sections in Assessing Risk



From Elias Steinbuck, 2021. Geologic and Geomorphic Characterization Memo

Definitions for Assessing Risk of Wood Induced Lateral Scour and Increased Surface Erosion of Artificial Fill



Evaluation Criteria for Erosion Potential in Artificial Fil (Qaf)

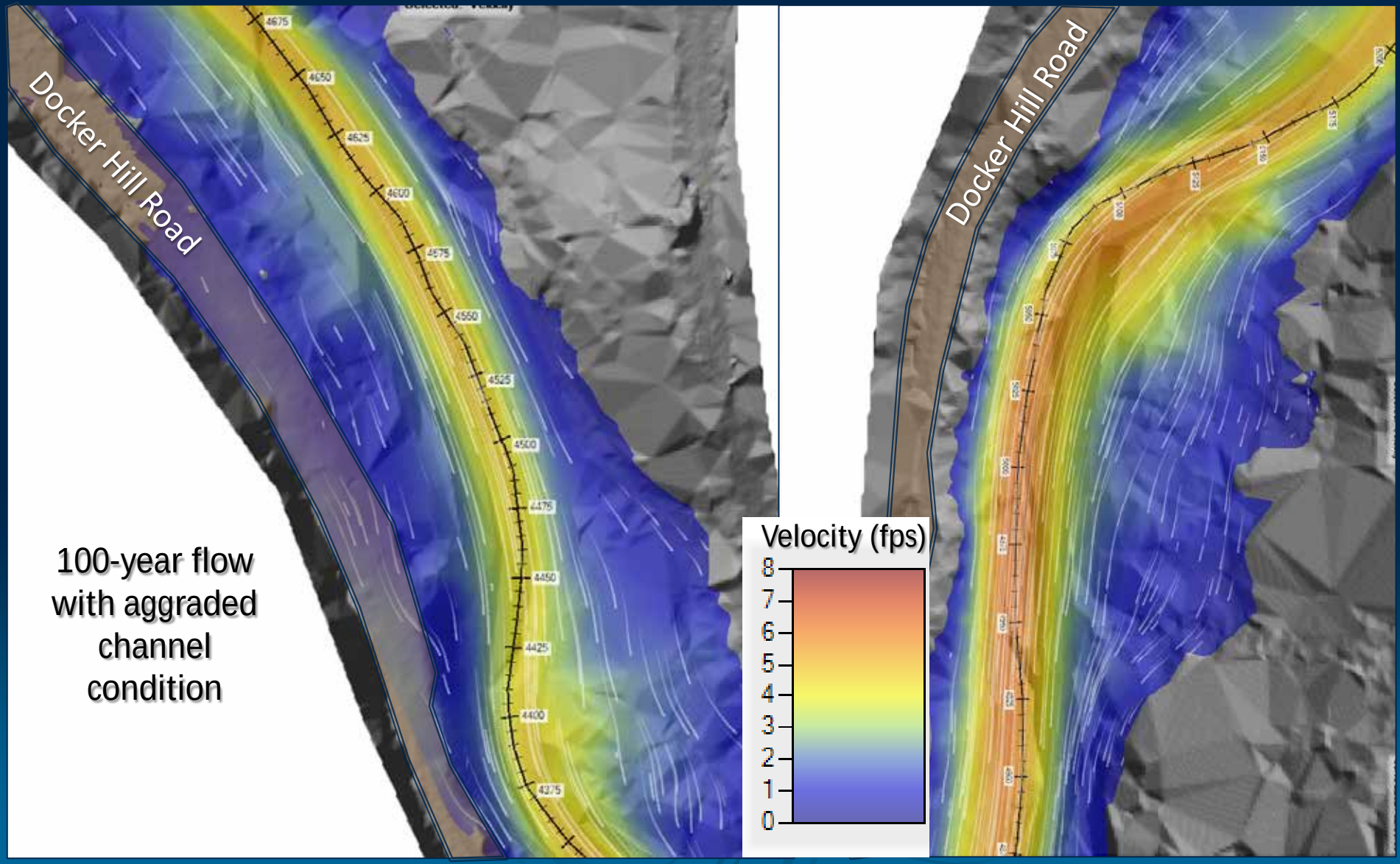
- 100-year return period flow velocities
- Applied Critical Velocity for Artificial Fill = 3.5 ft/s based on NRCS Threshold Channel Design (NRCS, 2007)

Values Applied to Assessment of Potential Lateral Scour/Bank Erosion Extents

Bank Position and Lateral Scour Potential Relative to Bend Stability	Later Scour Width (feet)
Straight or Inside of Bend (Low)	L =0.5*W_{AC}
Outside of Gentle Bend (Moderate)	L=0.75*W_{AC}
Outside of Tight Bend (High)	L=1.0*W_{AC}

Applied Active Channel Width (W_{AC}): Main Stem = 25 ft; North Fork = 16 ft

Albion River 2D Hydraulic Modeling for Existing and Aggraded Condition



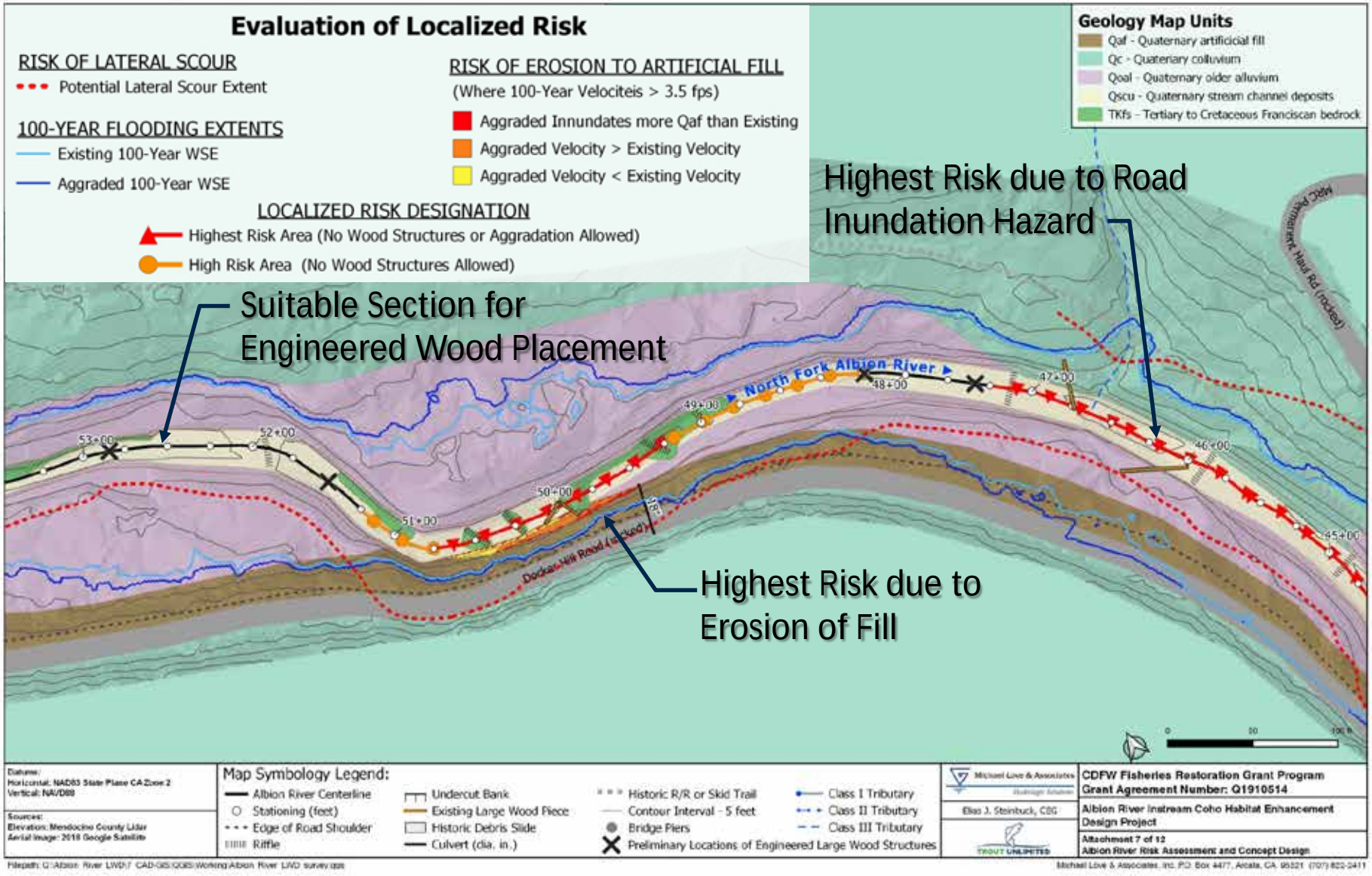
Levels of Risk and Mitigative Actions

Risk Level	Definition
Low	No Threats to Public Safety /Property Present
Moderate	Low Potential Risk to Public Safety/Property
High	High Potential Risk to Public Safety/Property

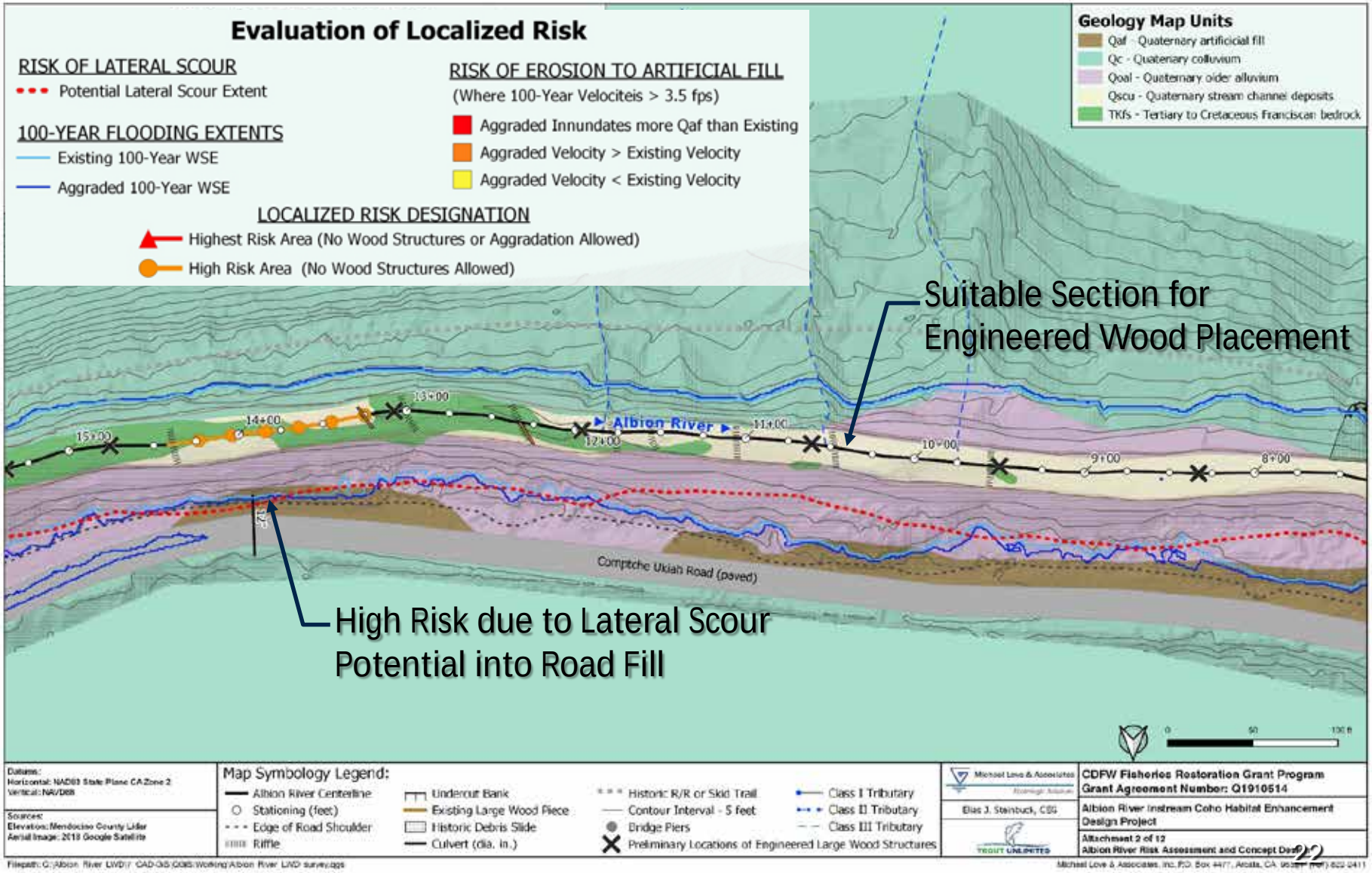
Mitigative Action for Identified Hazards based on Risk Level

Identified Hazards	Low Risk	Moderate Risk	High Risk
1. Reach Scale Hazards from Structure Dislodgement	Follow Standard Guidelines	Engineer Structures for Stability	• Engineer Structures for Stability
2. Potential Lateral Scour into Roadway			• No Structures In these Locations
3. Potential Increase of Erosion along Road Fill			• No Structures • No Structure-Induced Aggradation in these Locations
4. Roadway Inundation and Loss of Bridge Capacity			

Mapping of Risk Levels (North Fork)



Mapping of Risk Levels (Mainstem)

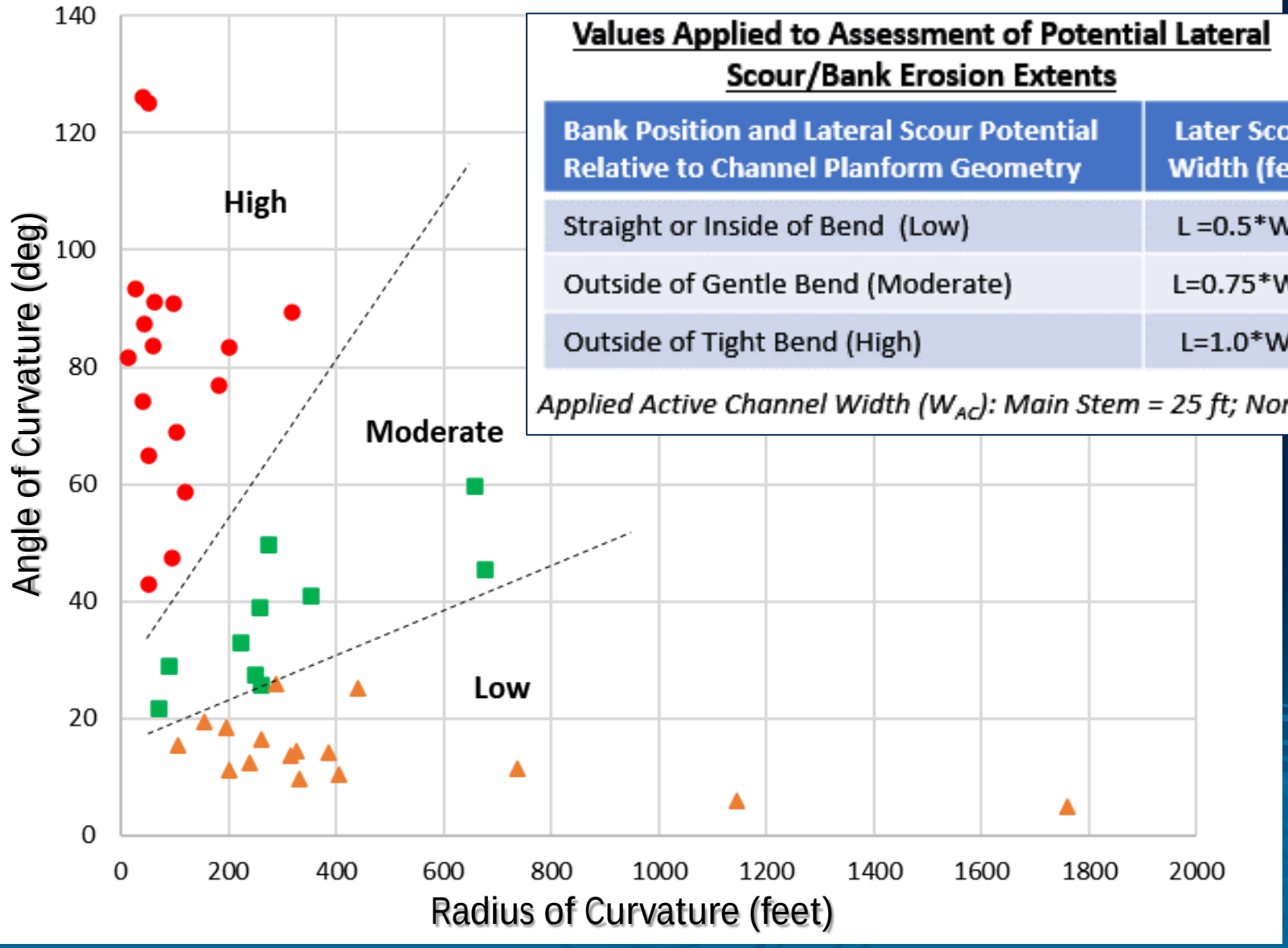


Summary

- This is one approach to assessing risk in a "risky reach"
  - Pilot study for large wood risk assessment
  - Tried a wide breath of analysis
  - Next step is to determine how the analysis can be simplified
- Need to identify each type of hazard associated with the project to
  - Determine consequence and likelihood of occurrence to assess risk
- If structure dislodgement pose downstream risk to property/safety due to unanticipated scour/racking
  - Structure must be engineered for stability

Questions?

Meanders Influence on Potential Lateral Migration Extent



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