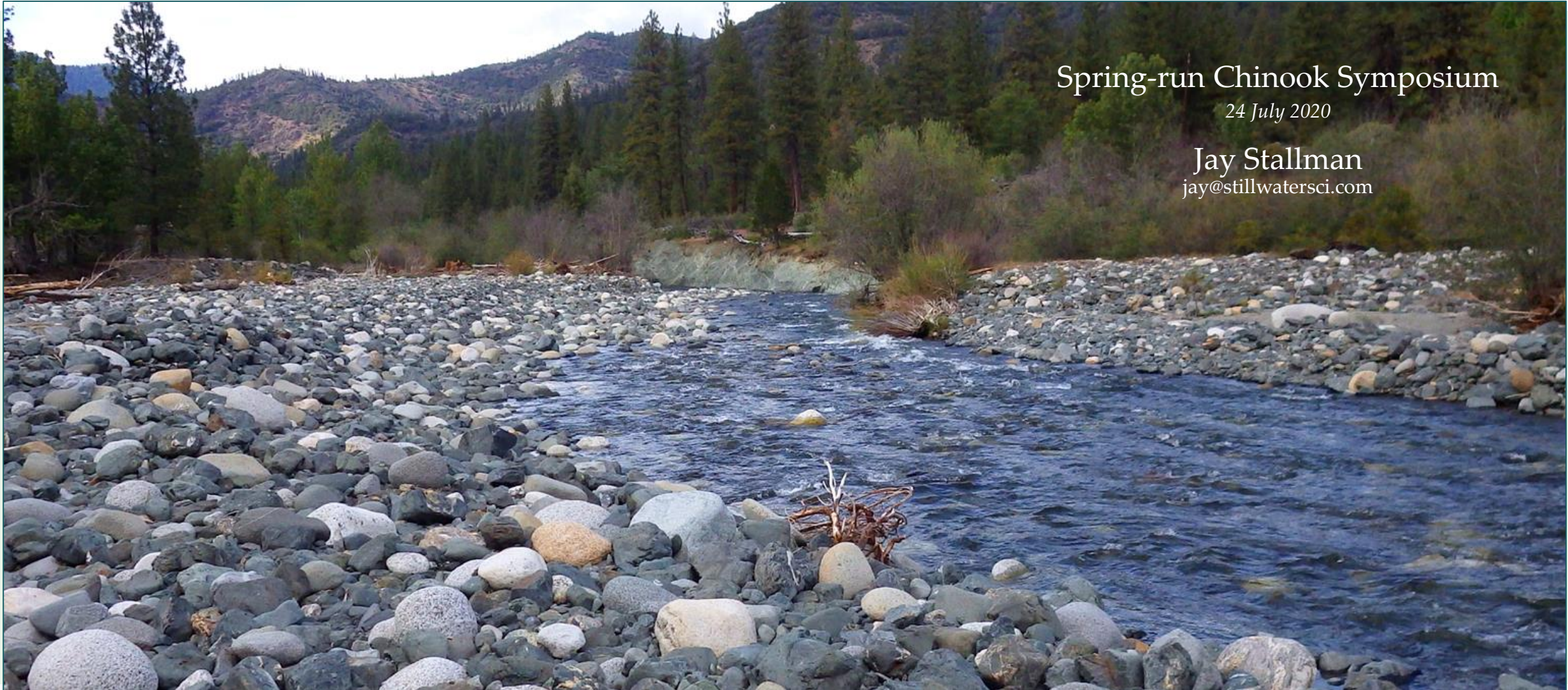


EFFORTS TO ADDRESS HABITAT IMPAIRMENTS FROM LEGACY PLACER MINING IN THE MIDDLE KLAMATH

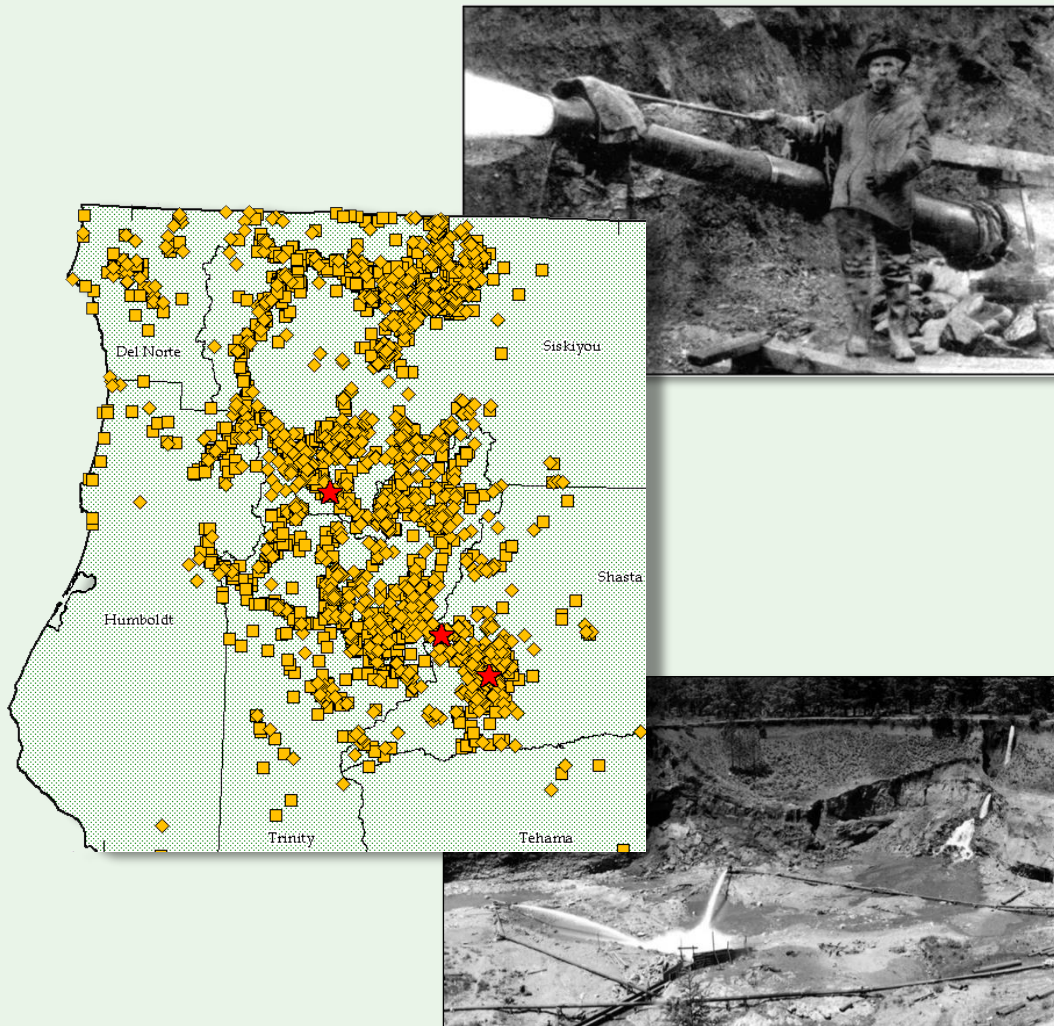


Spring-run Chinook Symposium

24 July 2020

Jay Stallman
jay@stillwatersci.com

PLACER MINING IN THE MID-KLAMATH BASIN



Basin	Sluice & Hydraulic	Dredge
Trinity	1860s-1900s	1887-1959
Salmon	1870s-1950s	1930s
Scott	1856	1934-1950
Sacramento	1860s	1905-1915
Sierra Nevada	1853	late 1890s

1884 Sawyer Decision in Woodruff v. North Bloomfield Mining and Gravel
Prohibited discharging hydraulic mining debris to Sierra Nevada rivers

1893 Caminetti Act
Prohibited hydraulic mining in the Sacramento River Basin

1936 Quin Bill
Prohibited hydraulic mining in the Klamath Basin July–November

1942 War Production Board Order L-208
Halted gold mining

LEGACY IMPACTS

- Mining established present-day physical template
- Unique legacy in each river system
 - Methods, timing, and intensity
 - Valley and channel geometry
 - Sediment mass balance
 - Climate

- Denuded slopes and valley bottoms
- Aggraded channels and floodplains
- Reduced channel complexity
- Coarsened bed, reduced mobility
- Reduced floodplain inundation
- Elevated summer water temperatures
- Degraded riparian functions



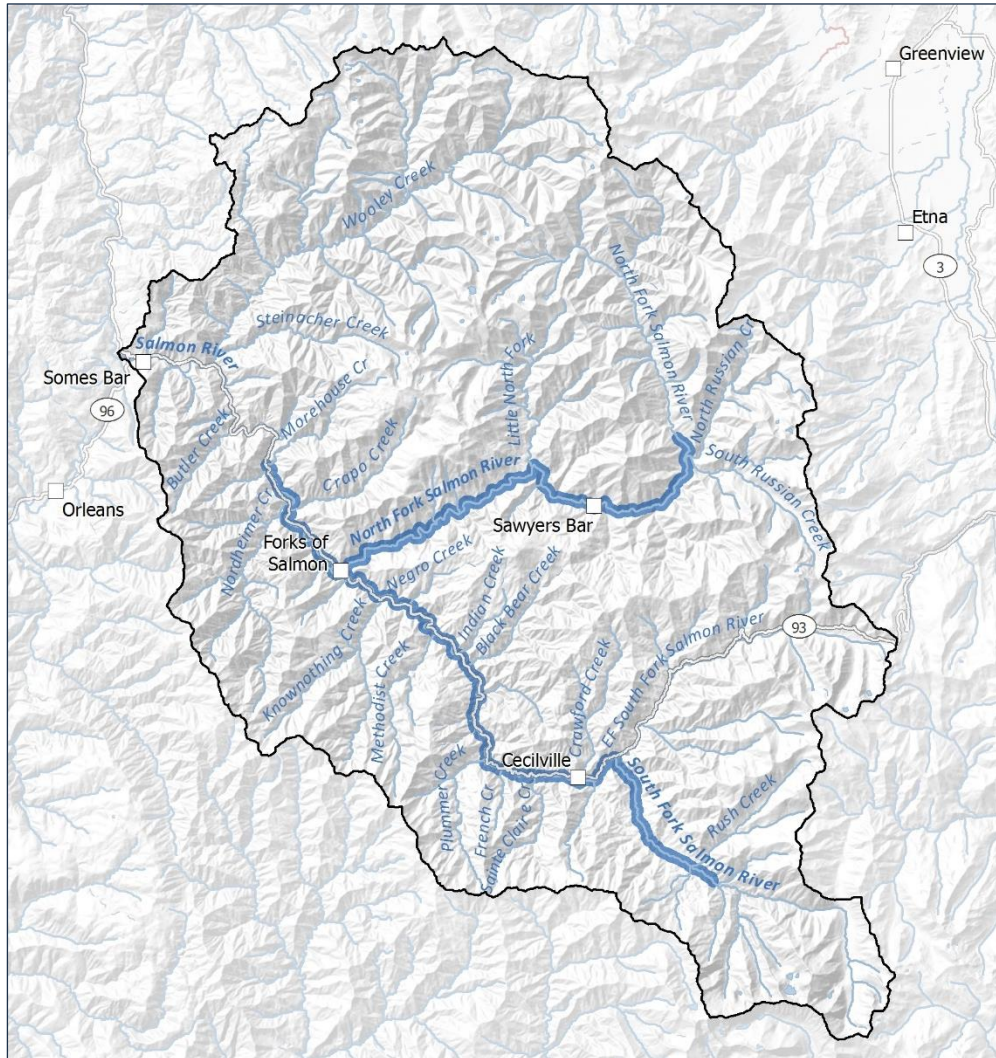


SALMON RIVER FLOODPLAIN HABITAT ENHANCEMENT AND MINE TAILING REMEDIATION

- SRRC initiated science-based planning process in 2014
- Goals:
 - Increase long-term salmonid productivity
 - Ensure Salmon River remains refuge for cold-water dependent species
- Objectives:
 - Increase over-wintering, over-summering, and spawning habitat
 - Improve riparian functions
 - Improve hydrologic functions
 - Protect and enhance thermally suitable habitats



PROJECT AREA AND PHASES



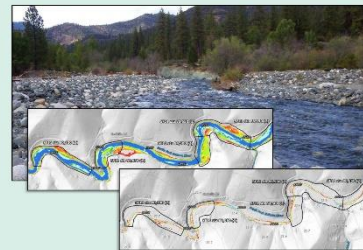
Phase 1 - Opportunities and constraints

Phase 2 - Conceptual design

Phase 3 - State and Federal environmental review

Phase 4 - Engineering design and implementation

TECHNICAL MEMORANDUM - JANUARY 2018
Salmon River Floodplain Habitat Enhancement
and Mine Tailing Remediation Project
Phase 1: Technical Analysis of Opportunities and Constraints



PREPARED FOR
Salmon River Restoration Council
25631 Sawyers Bar Road
Sawyers Bar, CA 96027

PREPARED BY
Stillwater Sciences
850 G Street, Suite K
Arcata, CA 95521

Stillwater Sciences

DRAFT TECHNICAL MEMORANDUM - MARCH 2020
Salmon River Floodplain Habitat Enhancement
and Mine Tailing Remediation Project
Phase 2: Conceptual Design



PREPARED FOR
Salmon River Restoration Council
25631 Sawyers Bar Road
Sawyers Bar, CA 96027

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Stillwater Sciences

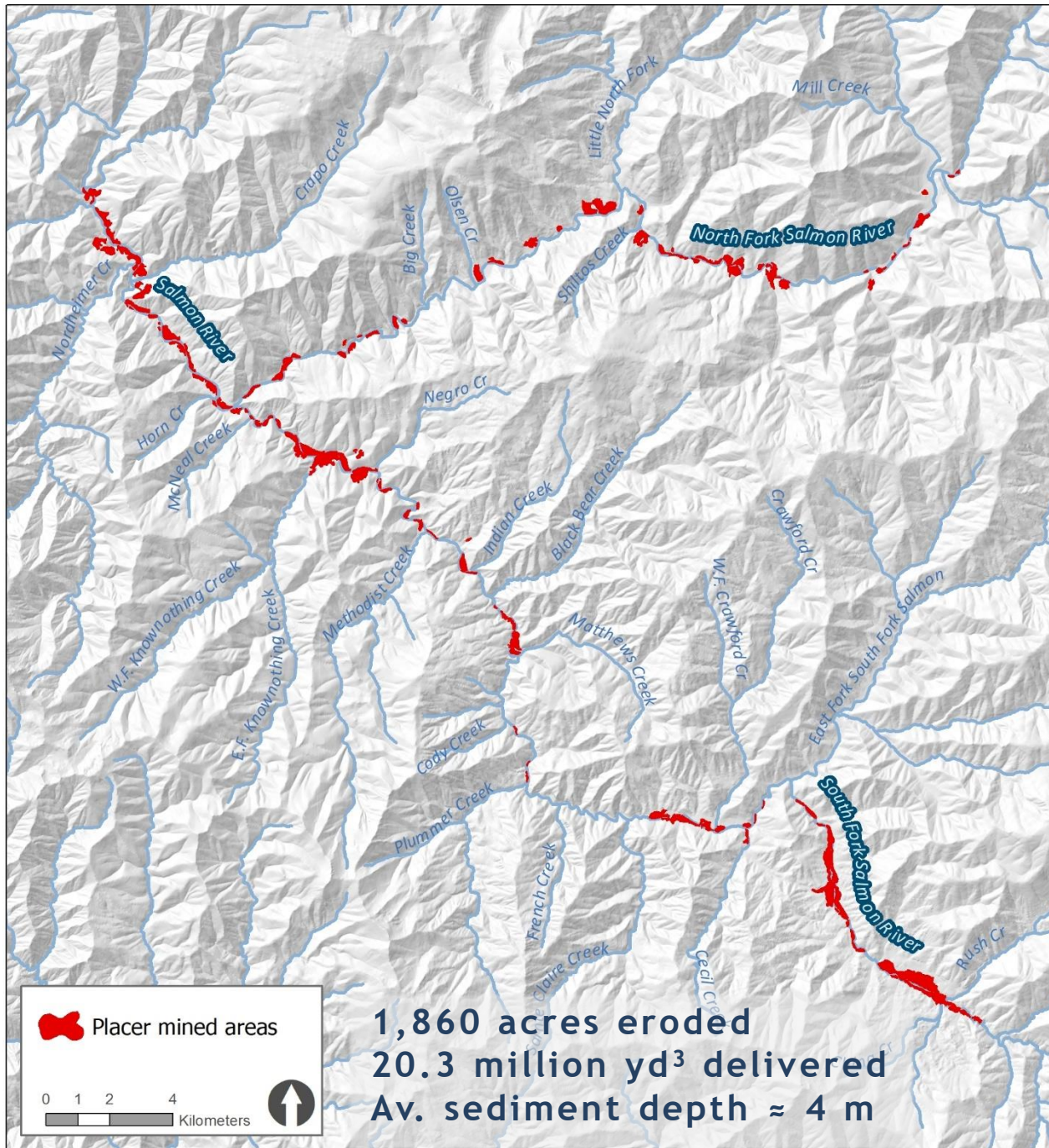
TECHNICAL MEMORANDUM - DECEMBER 2019
Salmon River Floodplain Habitat Enhancement
and Mine Tailing Remediation Project:
Fisheries Resources Report



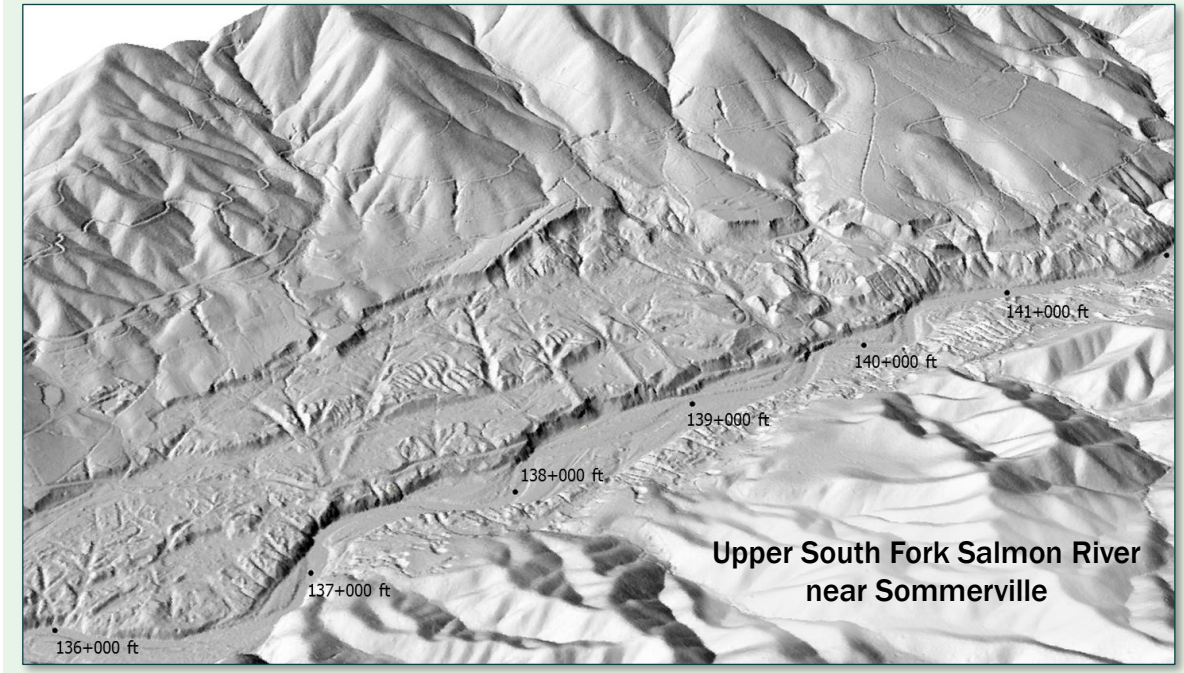
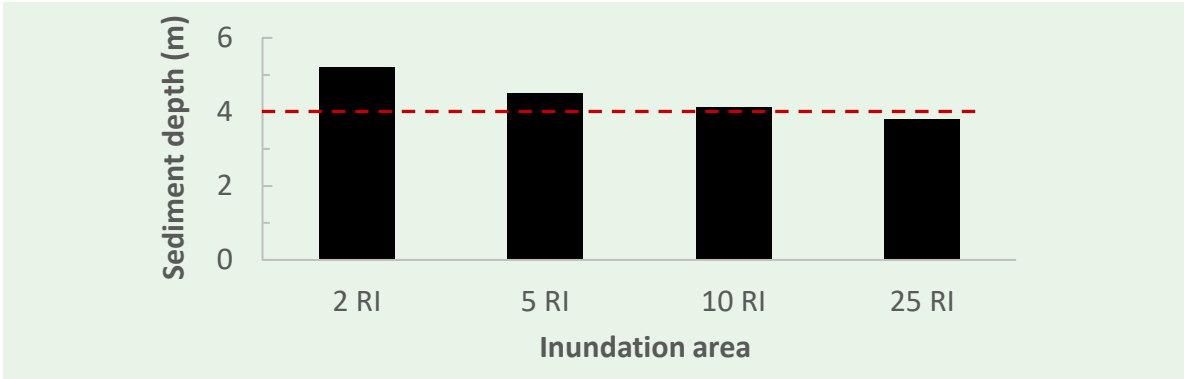
PREPARED FOR
Salmon River Restoration Council
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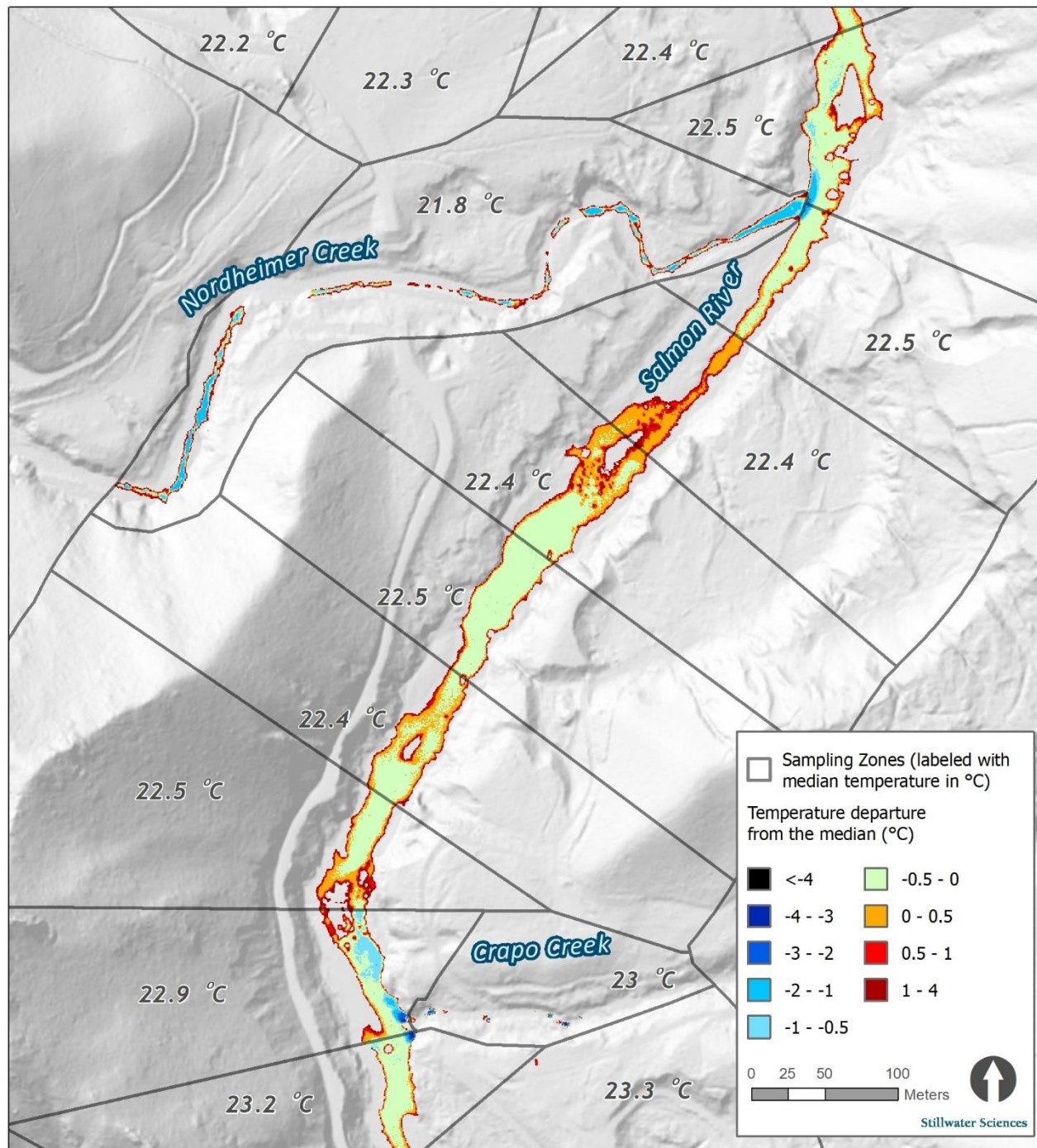
MINING DISTURBANCE

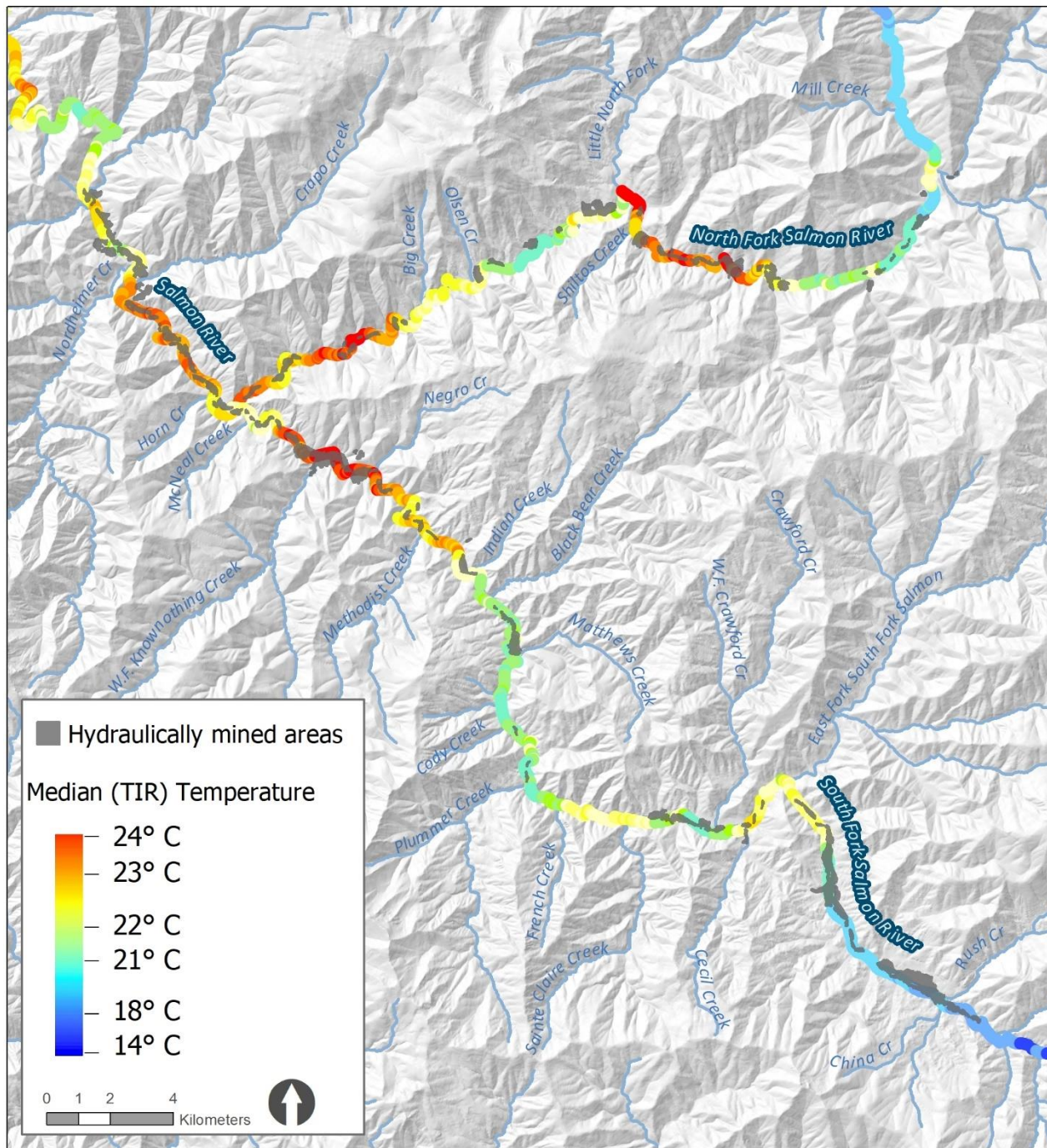


THERMALLY SUITABLE HABITAT BASED ON TIR IMAGERY

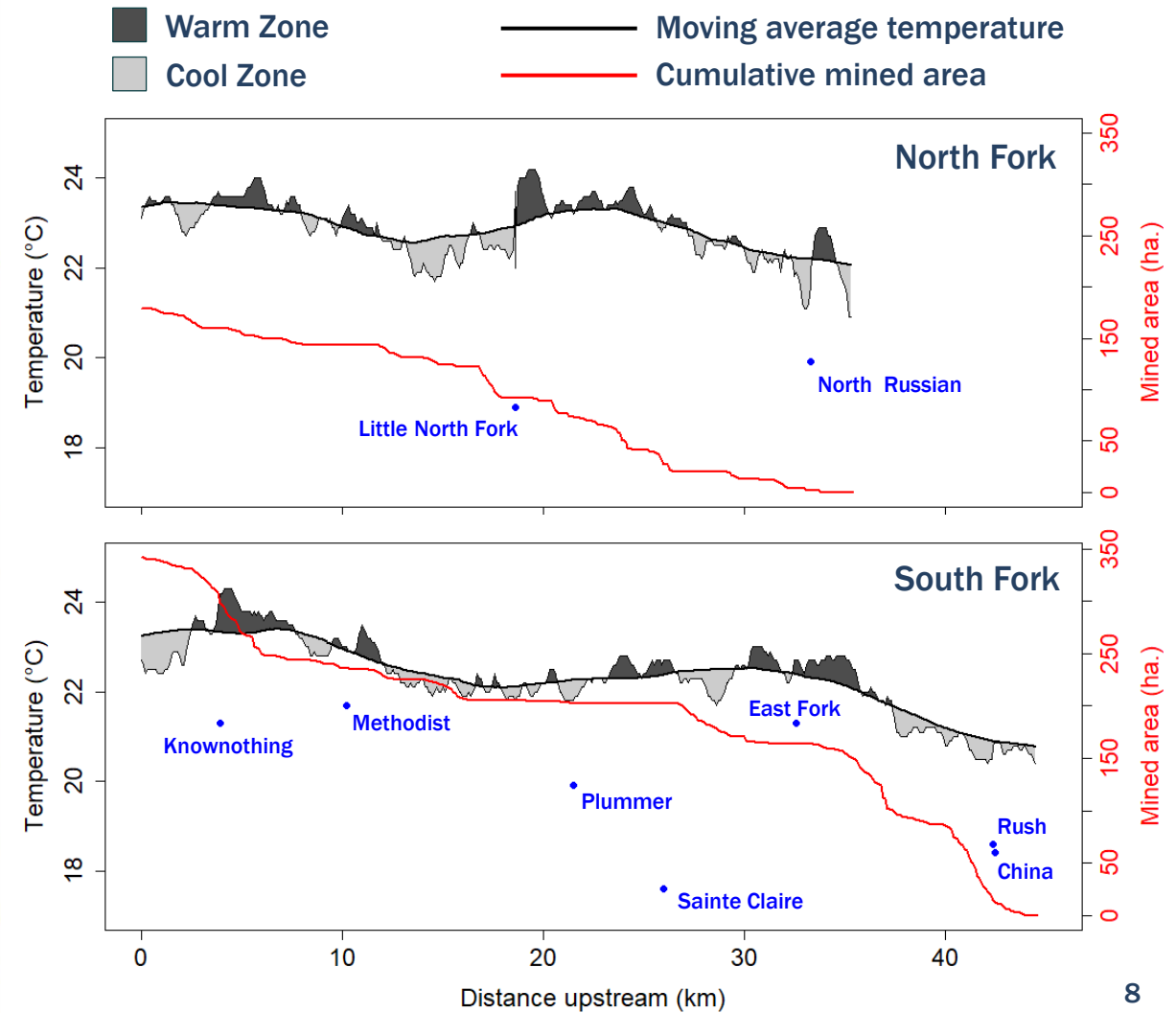
Approach:

- TIR imagery acquired for 85 mi
July 22-23, 2009
- 100 m sampling zones
- Moving median temperatures over 500 m
channel length
- Reach-scale thermal zones and thermal
refuges defined by temp departures =
median zone temp – observed TIR temp

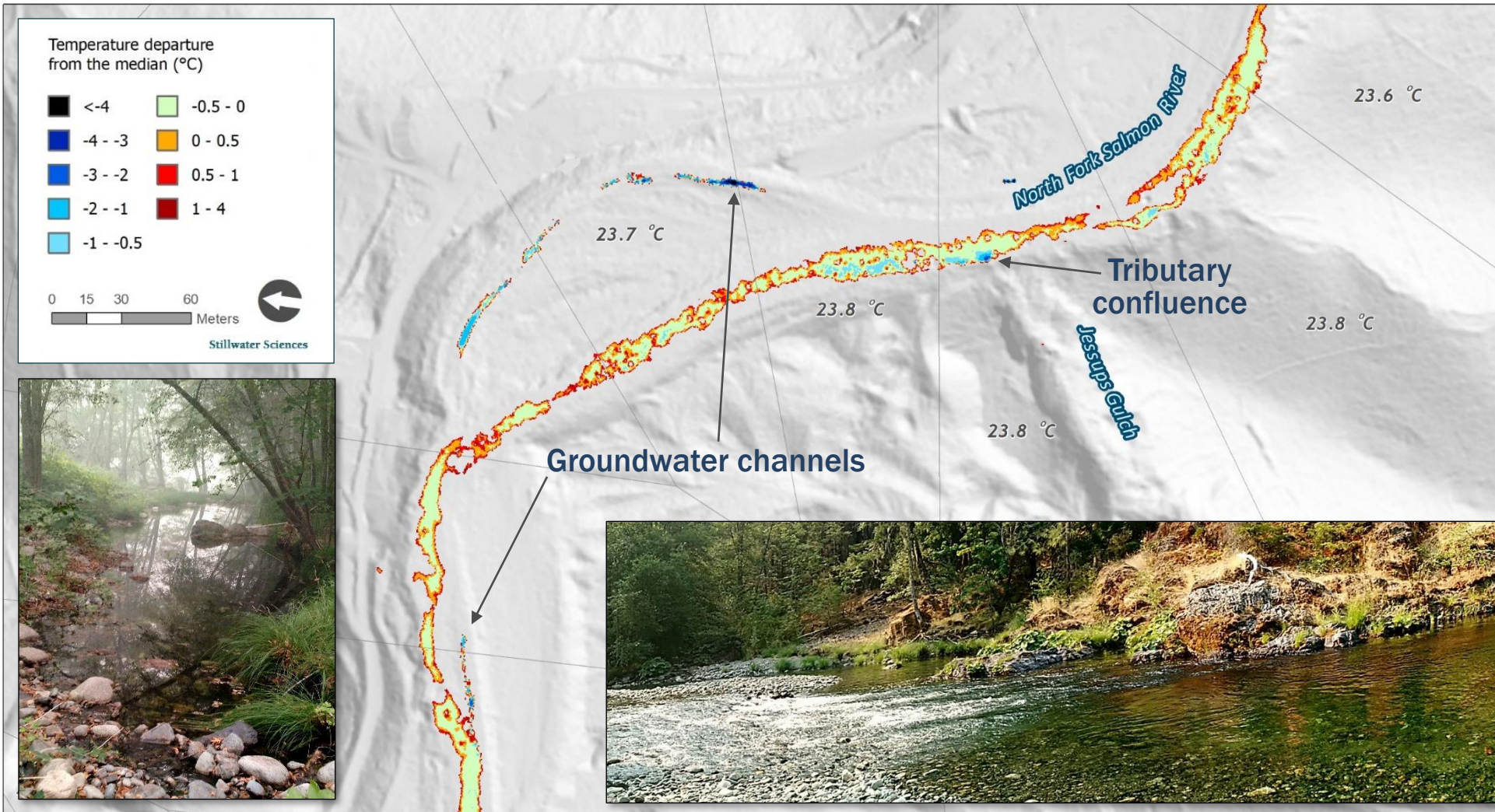




REACH-SCALE THERMAL ZONES

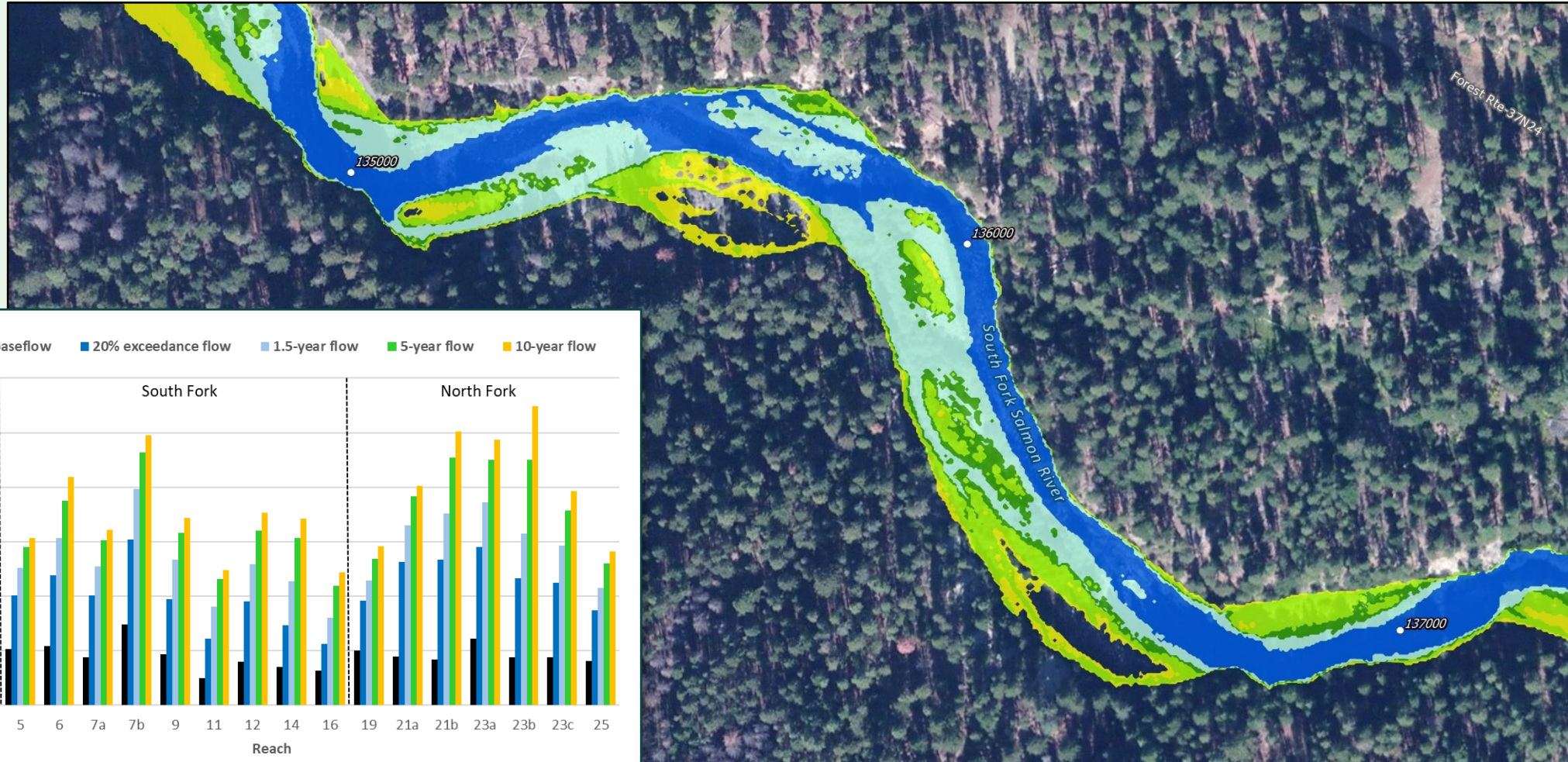


THERMAL REFUGES

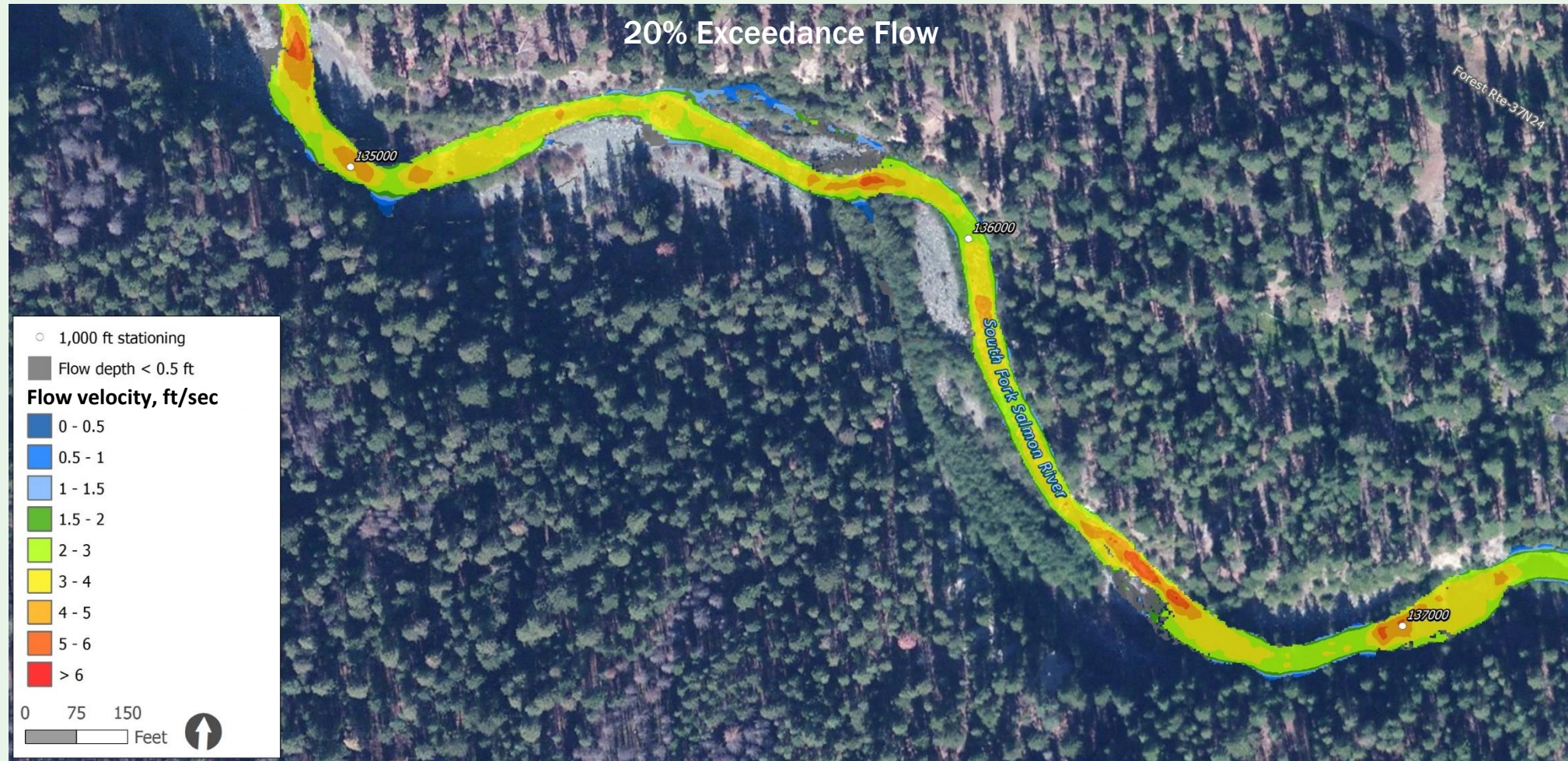


- Tributary Confluences
- Groundwater Channels
- Trailing bar edge
- Valley pinch points
- Pools

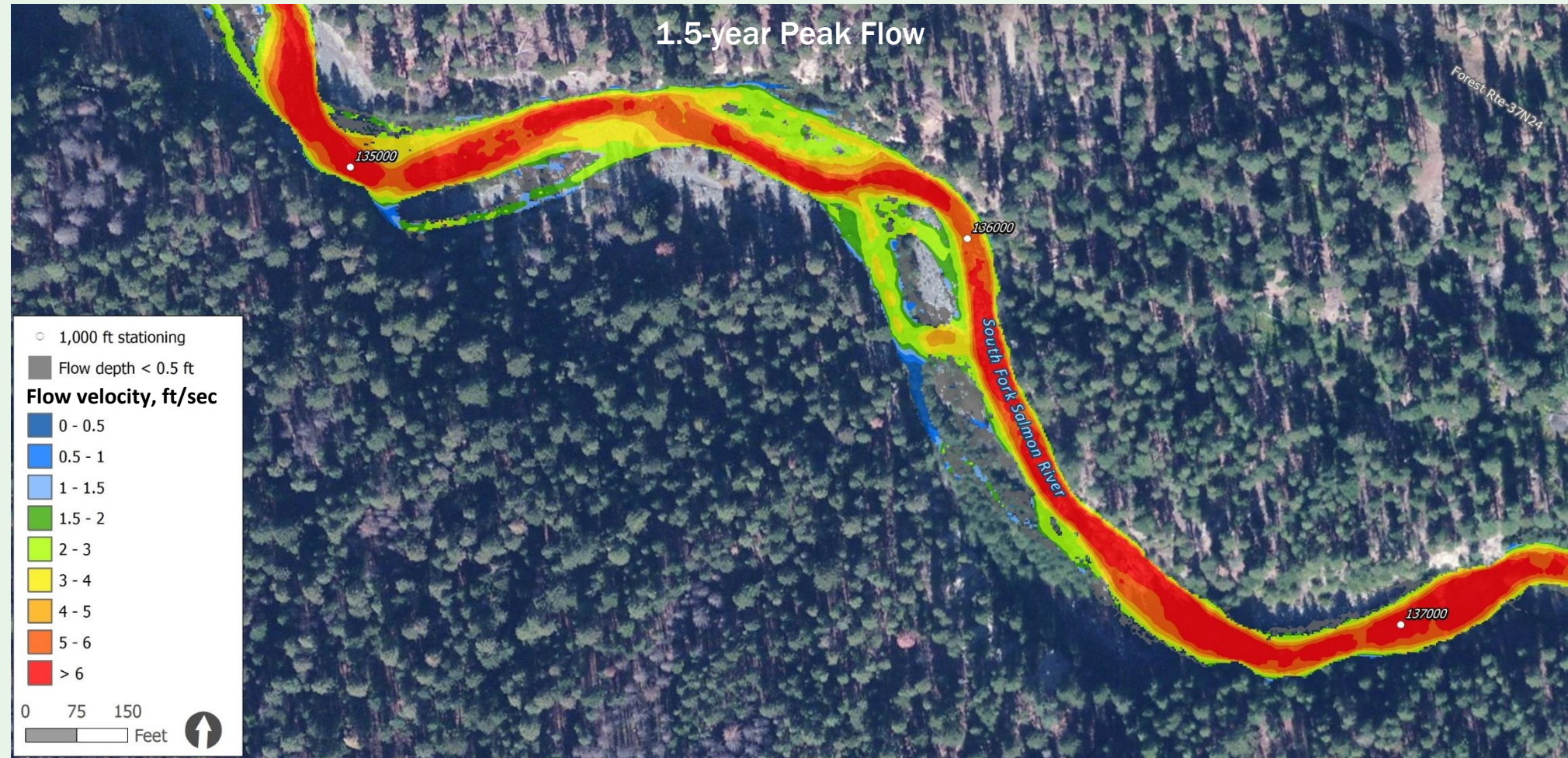
HYDRODYNAMIC MODELING: FLOW INUNDATION



HYDRODYNAMIC MODELING: FLOW VELOCITIES

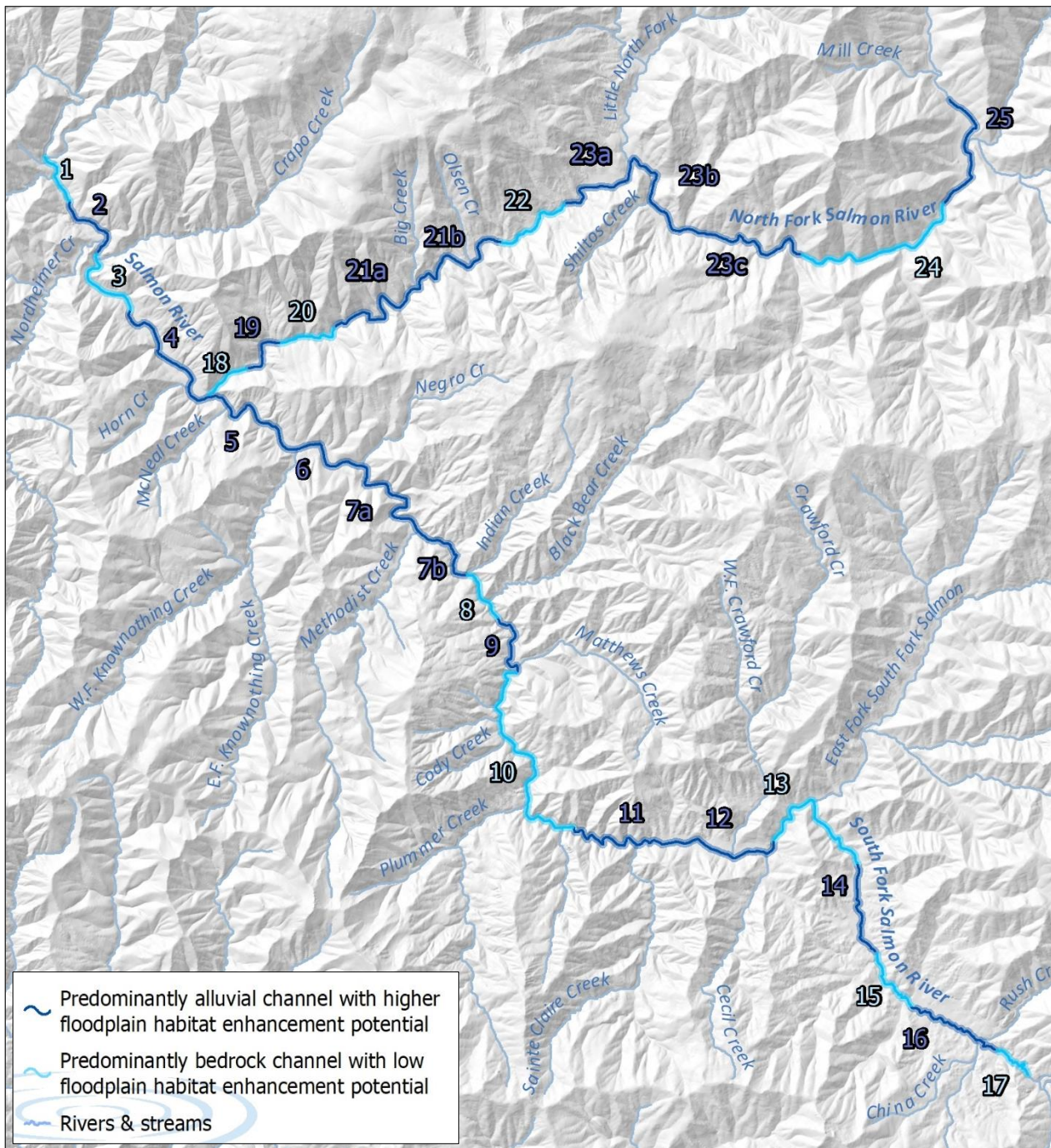
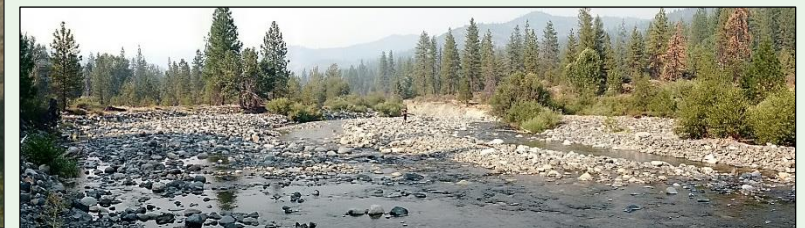
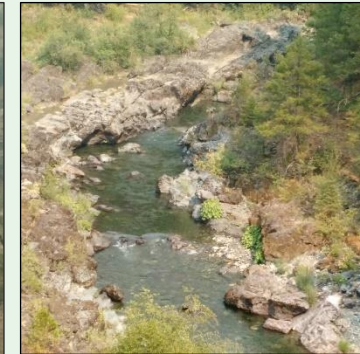


HYDRODYNAMIC MODELING: FLOW VELOCITIES



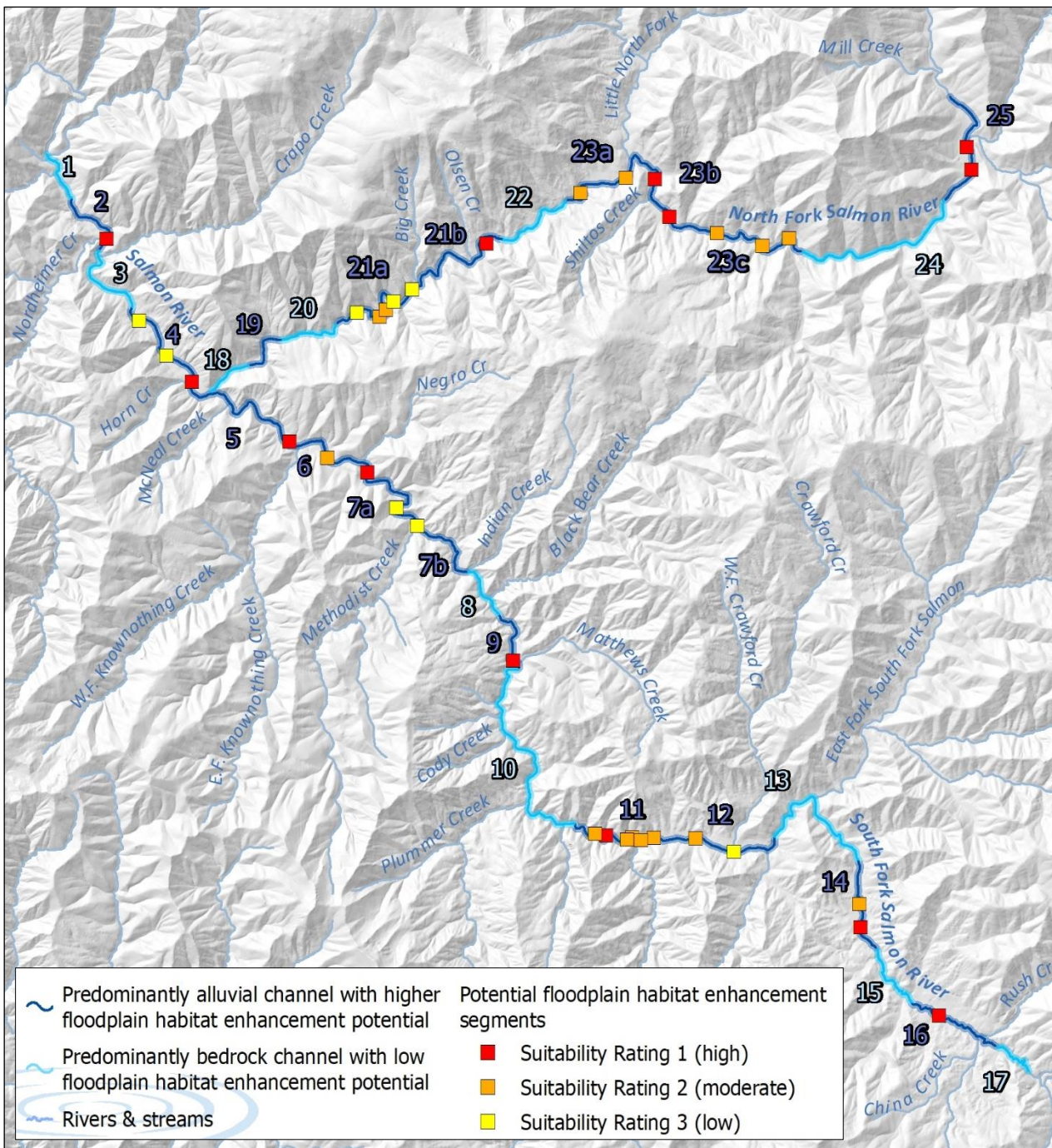
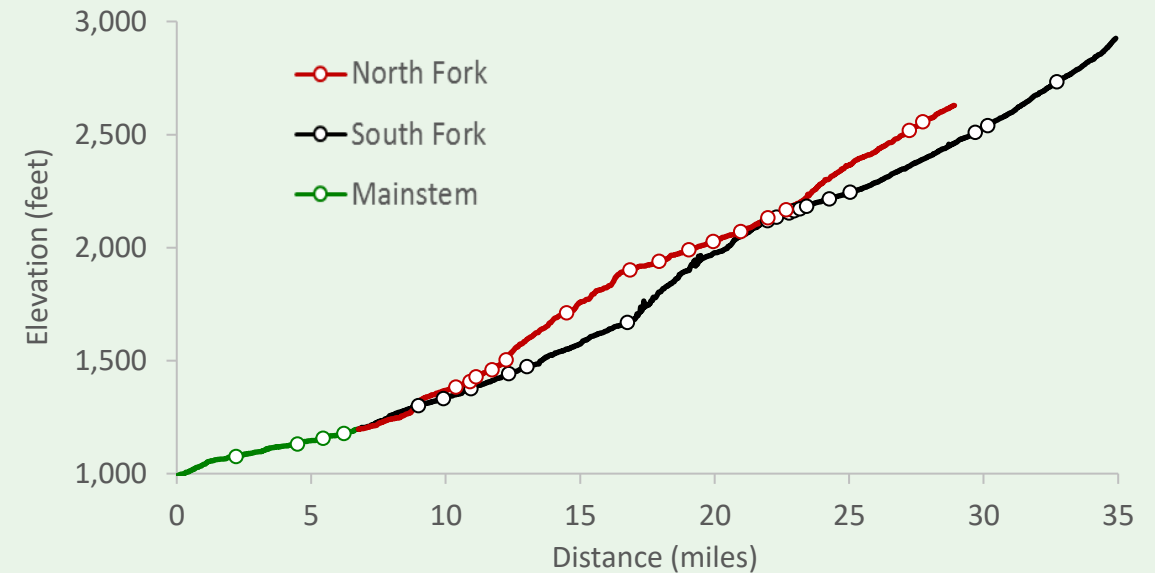
REACH MORPHOLOGY

- Channel gradient
- Valley width
- Channel confinement
- Resistant channel boundaries
- Alluvial channel features

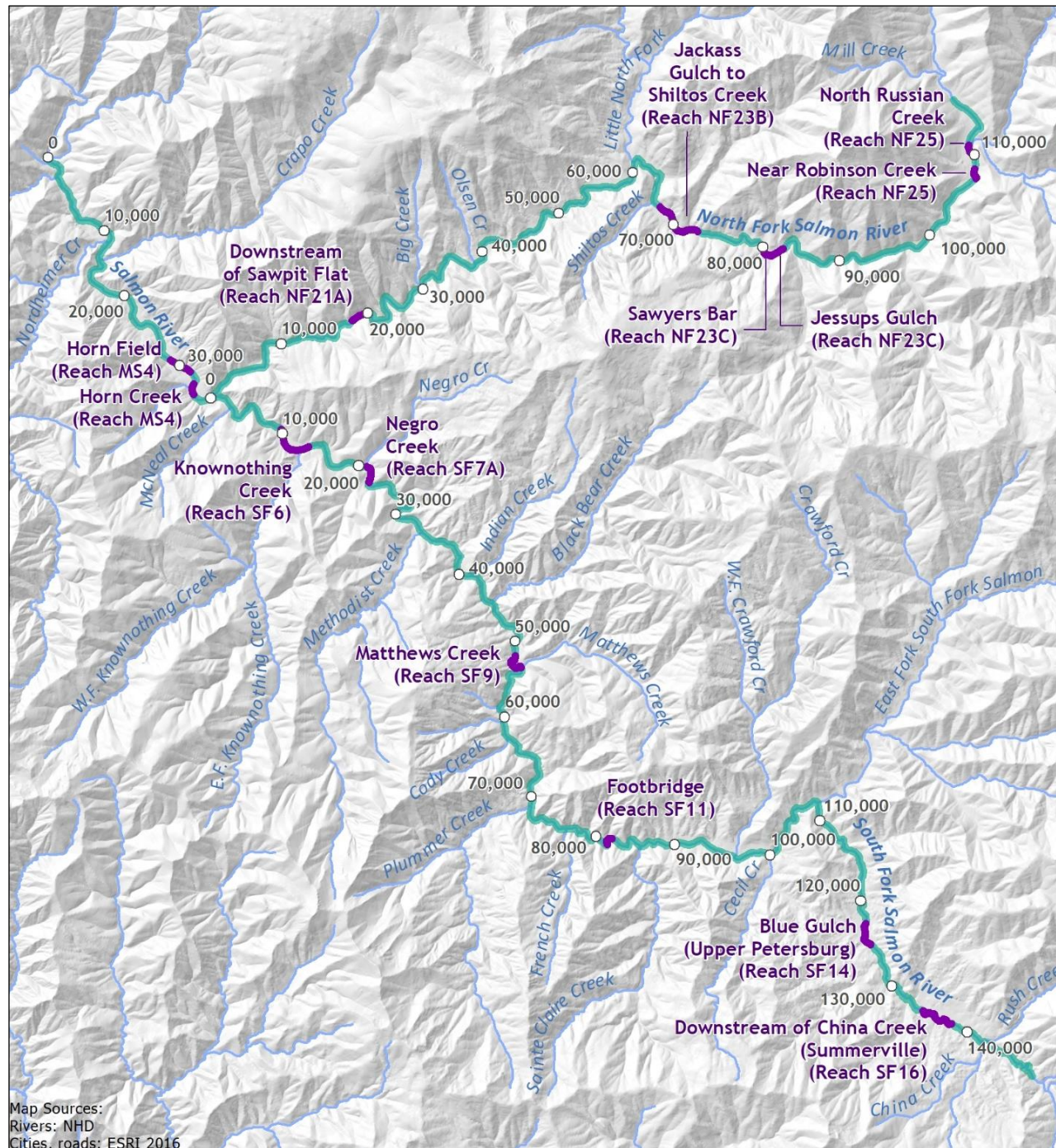


POTENTIAL ENHANCEMENT SEGMENTS

- Reach morphology
- Flow inundation
- Thermal conditions
- Riparian vegetation cover
- Spawning and rearing habitat conditions
- In-stream restoration priorities identified by TAC

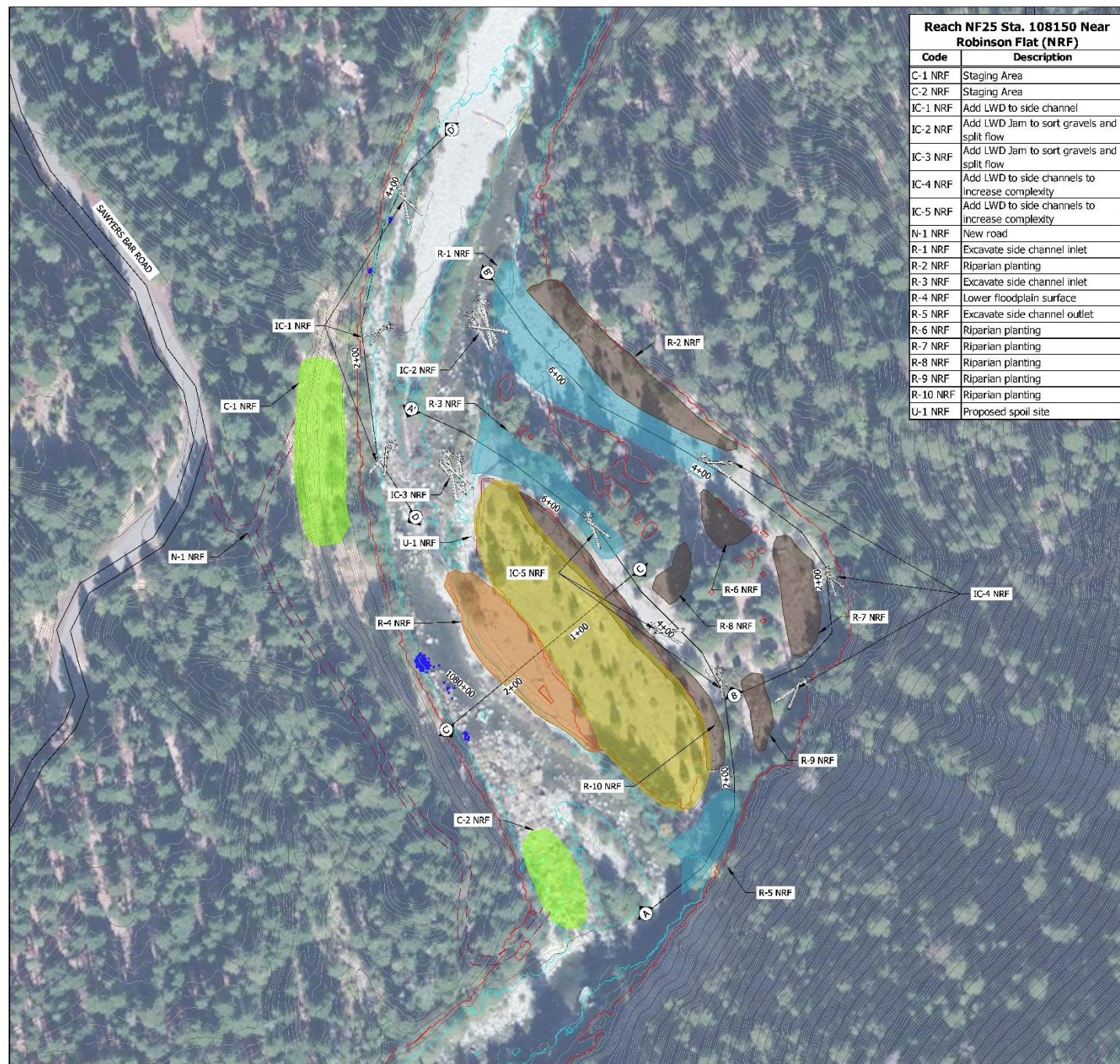


DESIGN SITES



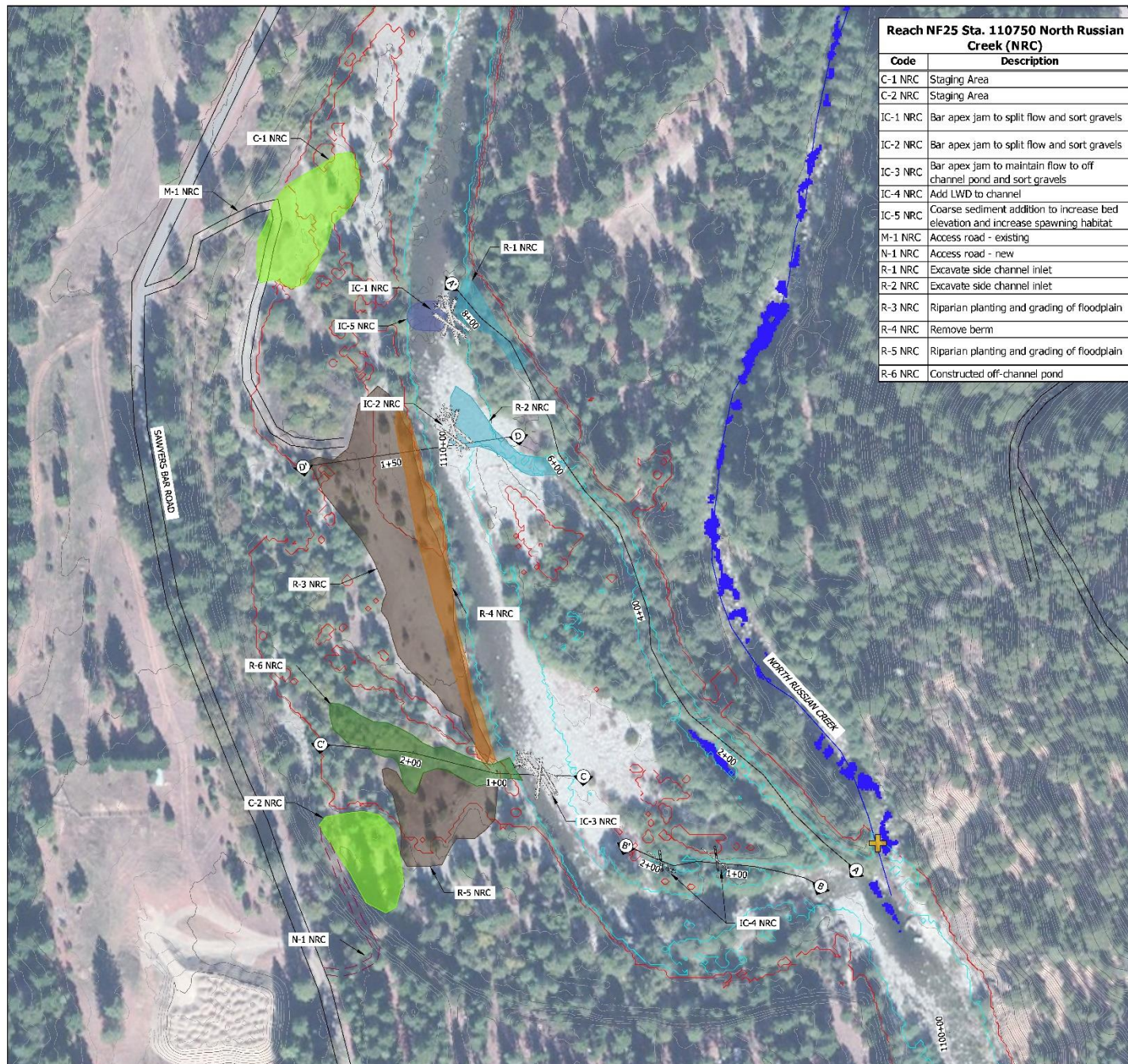
Design site	Reach
Horn Field	Mainstem 4
Horn Creek	Mainstem 4
Knownothing Creek	South Fork 6
Matthews Creek	South Fork 9
Negro Creek	South Fork 7A
Footbridge	South Fork 11
Blue Gulch (Upper Petersburg)	South Fork 14
Downstream of China Creek (Summerville)	South Fork 16
Downstream of Sawpit Flat	North Fork 21A
Jackass Gulch to Shiltos Creek	North Fork 23B
Jessups Gulch	North Fork 23C
Sawyers Bar	North Fork 23C
Near Robinson Creek	North Fork 25
North Russian Creek	North Fork 25

CONCEPTUAL DESIGN



- Increase inundation frequency, improve connectivity
- Add complexity to side-channels and channel margins
- Create in-channel structures that promote sorting, depth, and cover
- Revegetate floodplains and tailings

CONCEPTUAL DESIGN



- Enhance thermal refugia
- Create, enhance, and connect off-channel ponds and wetlands
- Revegetate floodplains and tailings
- Add complexity to side-channels and channel margins
- Create in-channel structures that promote sorting, depth, and cover
- Increase inundation frequency, improve connectivity

CONCEPTUAL DESIGN

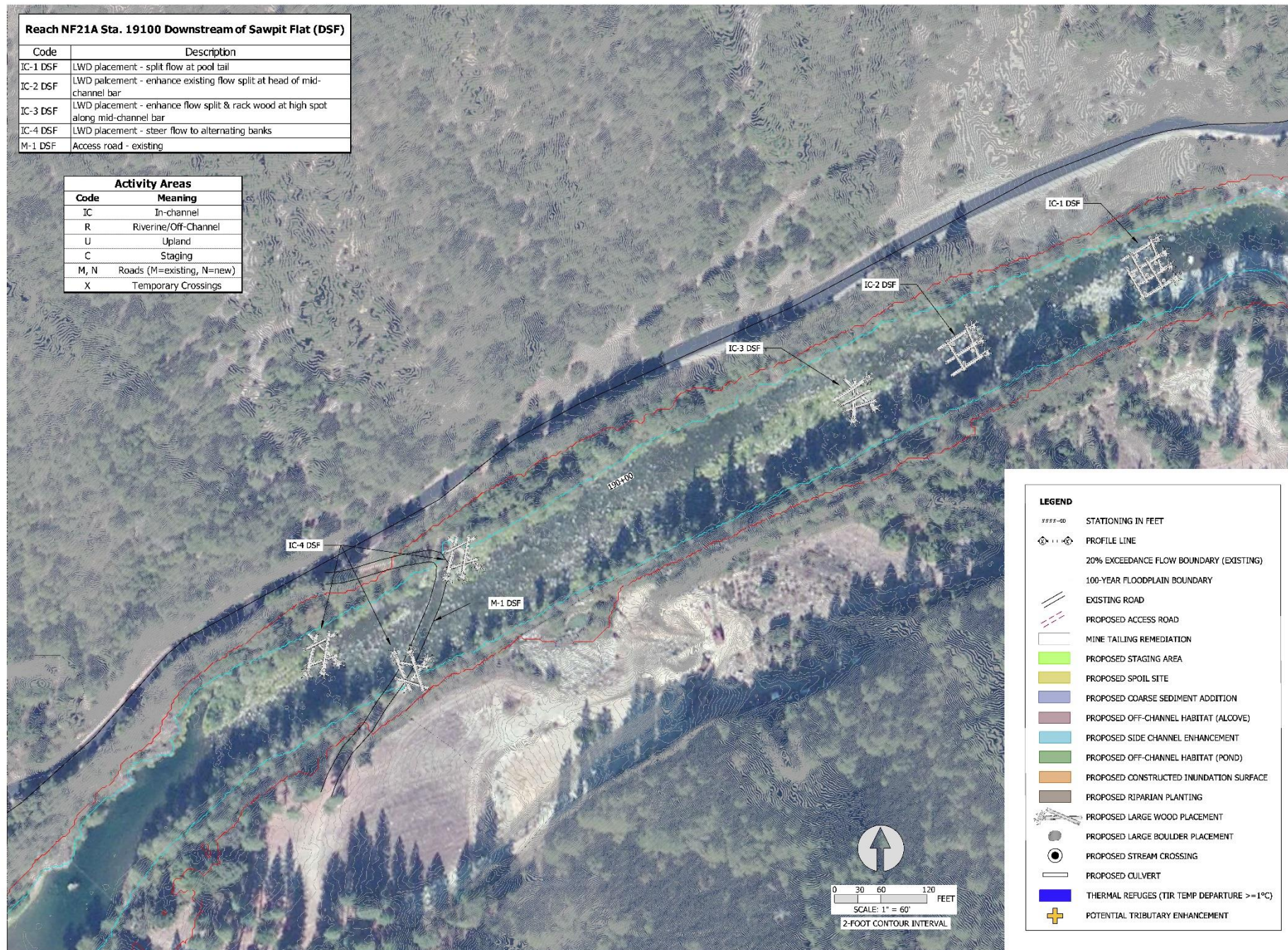
- Create in-channel structures that promote:

✓ Channel complexity

✓ Sorting

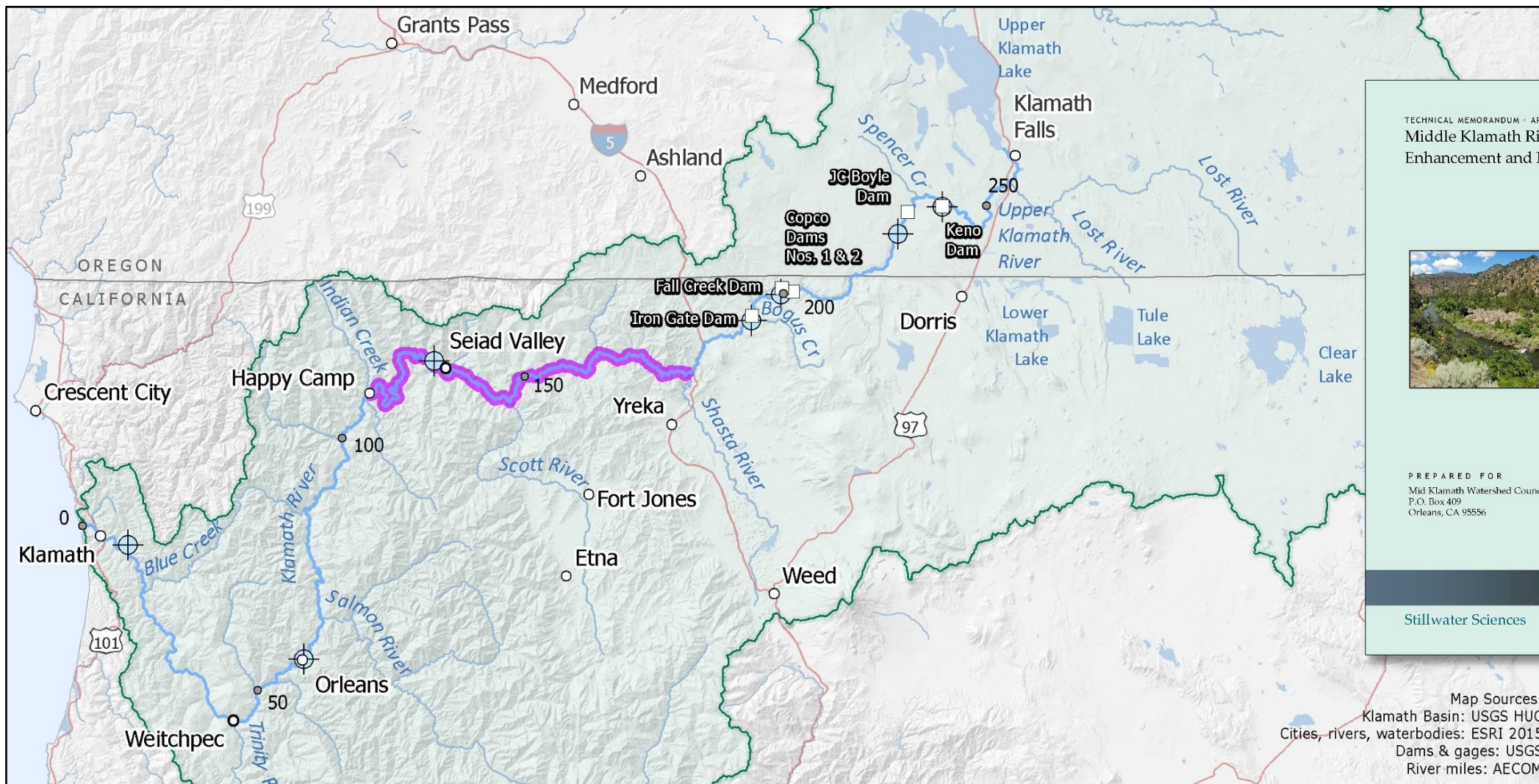
✓ Depth

✓ Cover

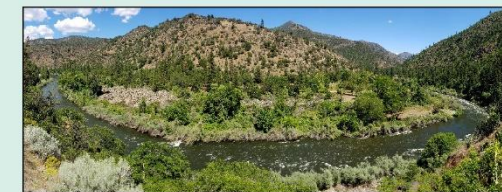




MIDDLE KLAMATH RIVER FLOODPLAIN HABITAT ENHANCEMENT AND MINE TAILING REMEDIATION



TECHNICAL MEMORANDUM - APRIL 2019
Middle Klamath River Floodplain Habitat
Enhancement and Mine Tailing Remediation



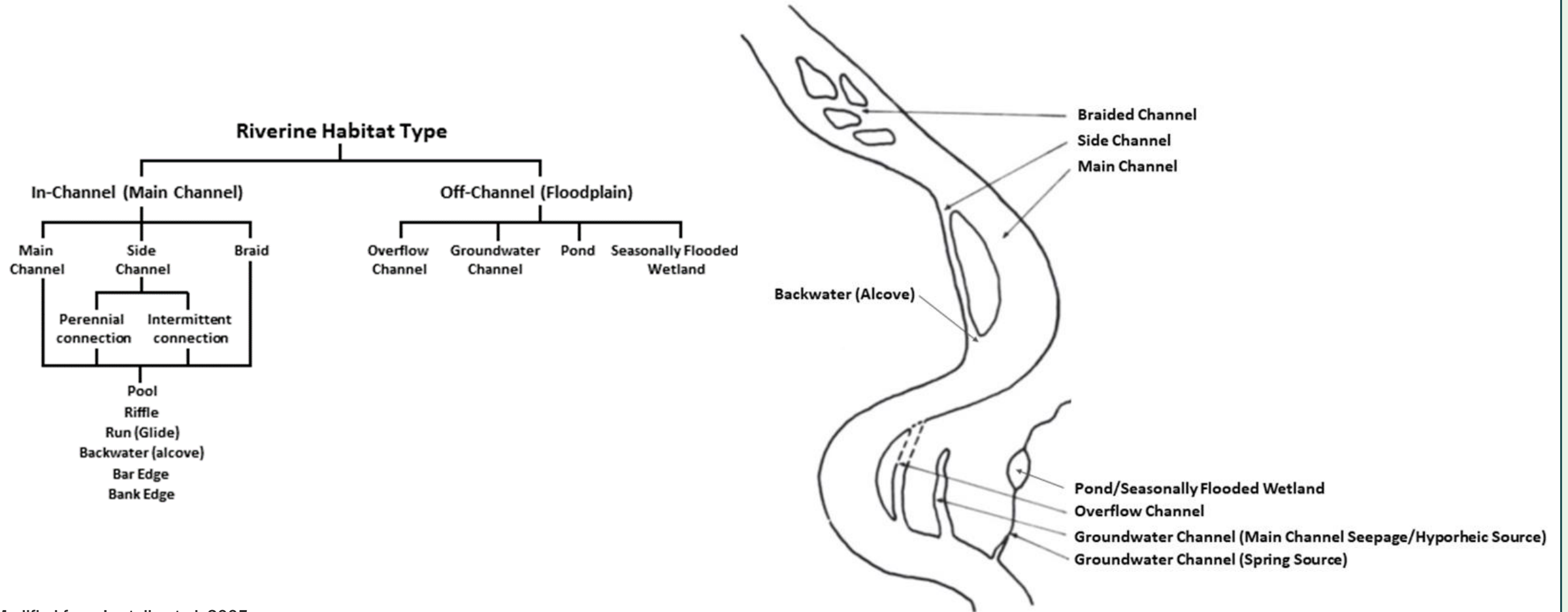
PREPARED FOR
Mid Klamath Watershed Council
P.O. Box 409
Orleans, CA 95556

PREPARED BY
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850 G Street, Suite K
Arcata, CA 95521

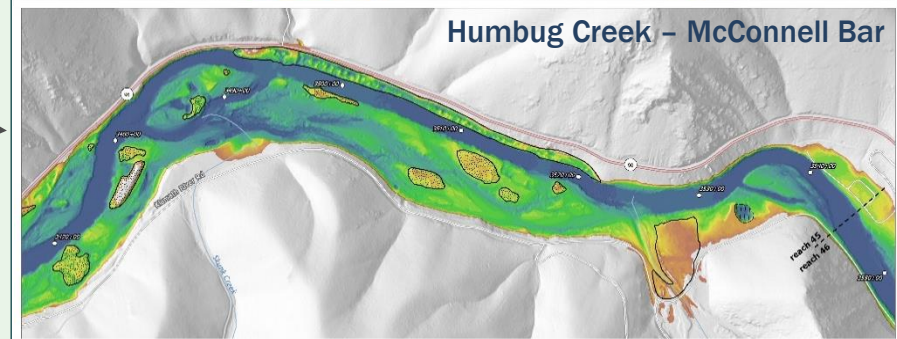
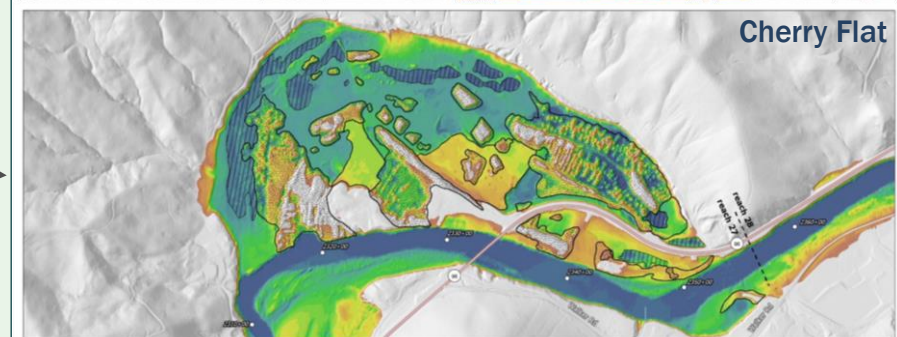
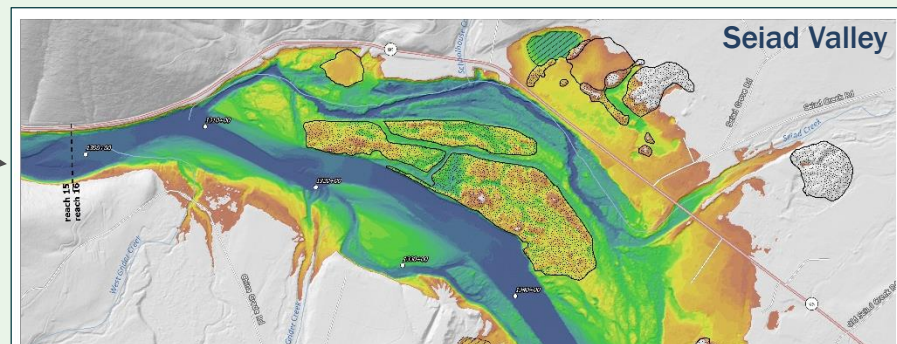
Stillwater Sciences

Map Sources:
Klamath Basin: USGS HUC
Cities, rivers, waterbodies: ESRI 2015
Dams & gages: USGS
River miles: AECOM

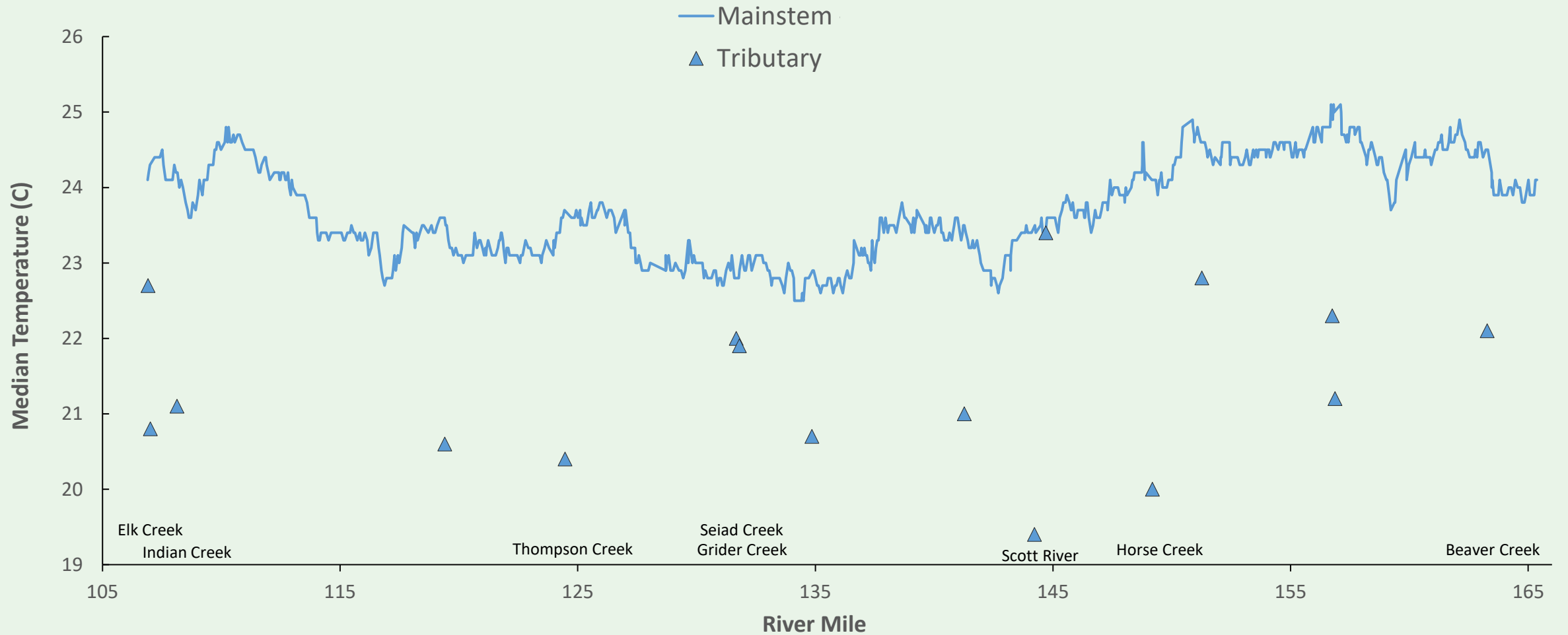
RIVERINE HABITAT TYPES



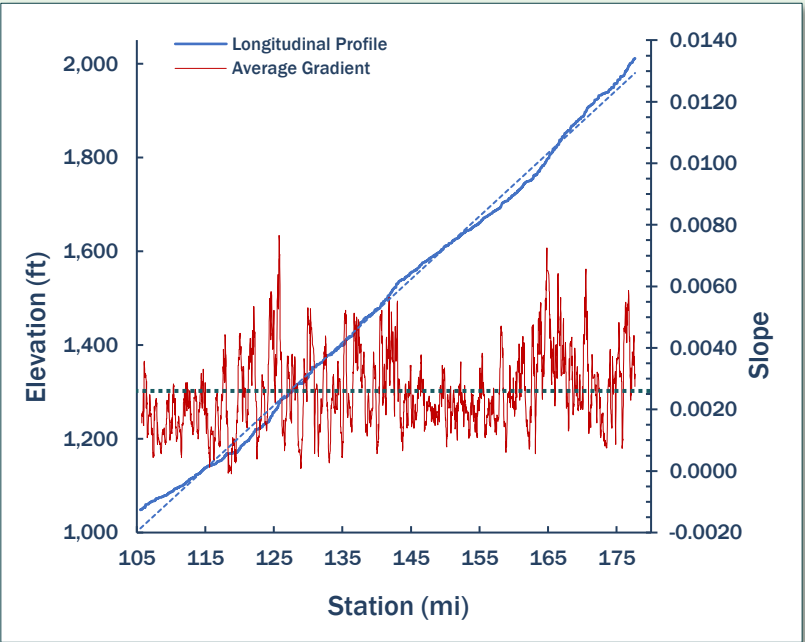
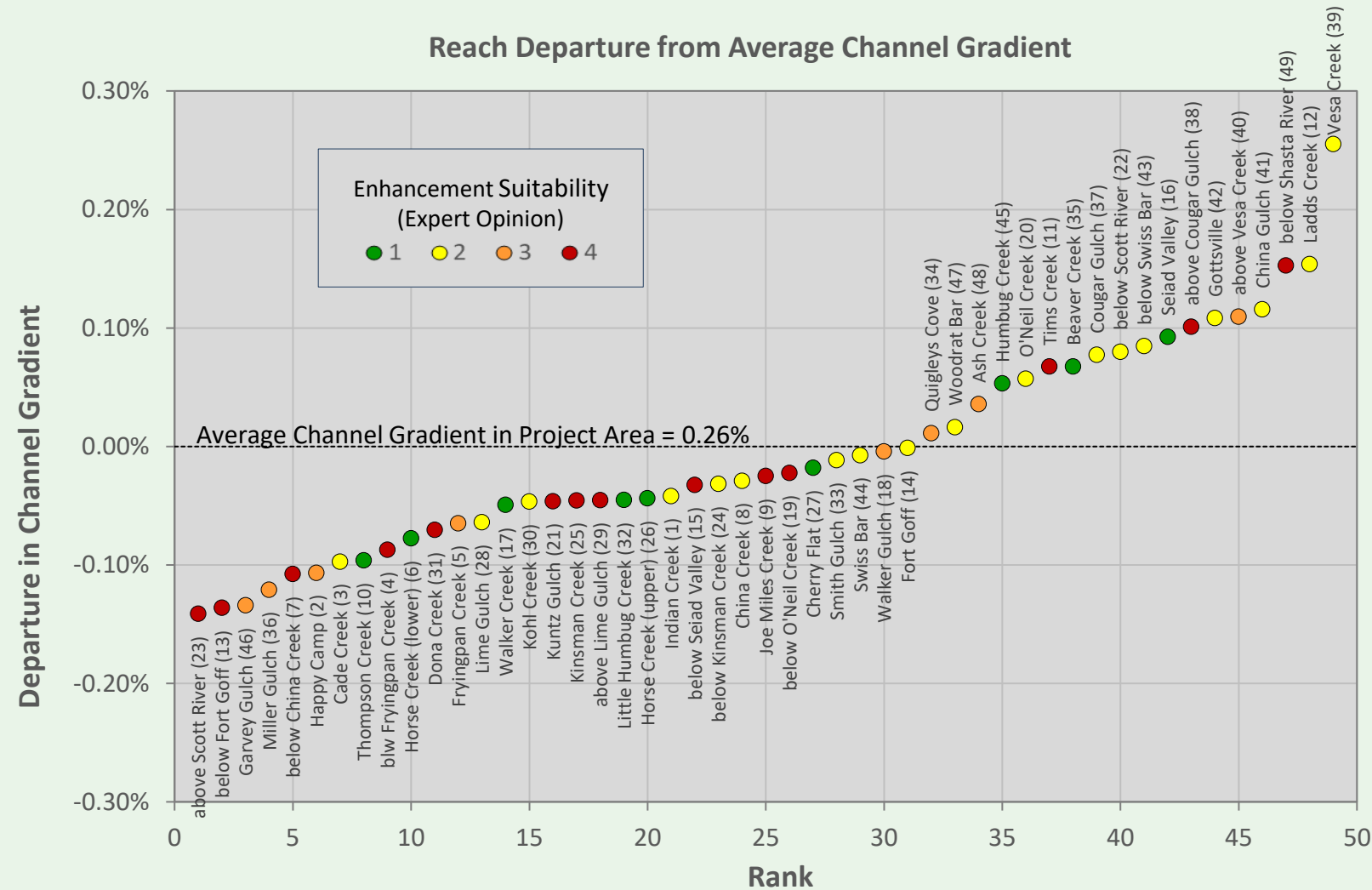
MINING DISTURBANCE



THERMAL REFUGES

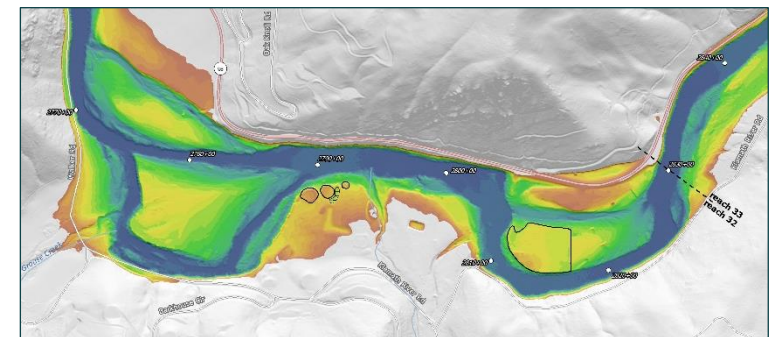
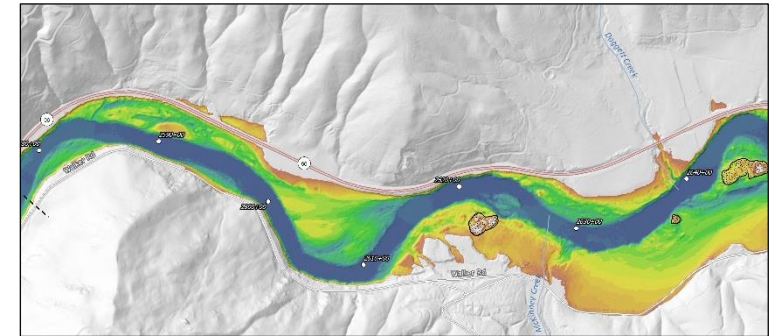
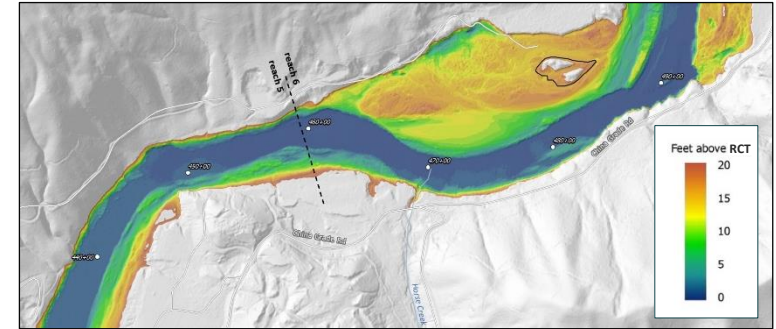
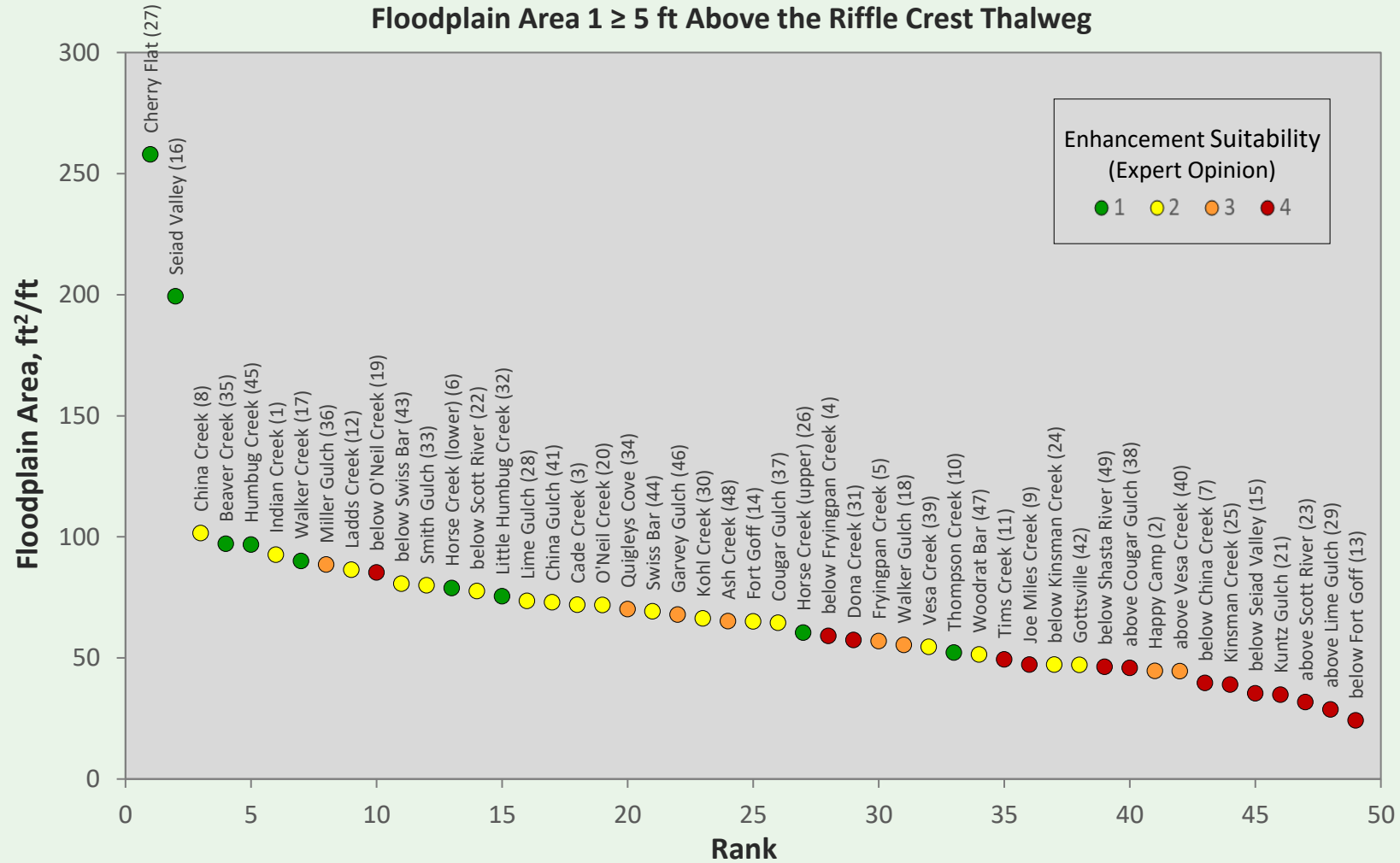


CHANNEL GRADIENT

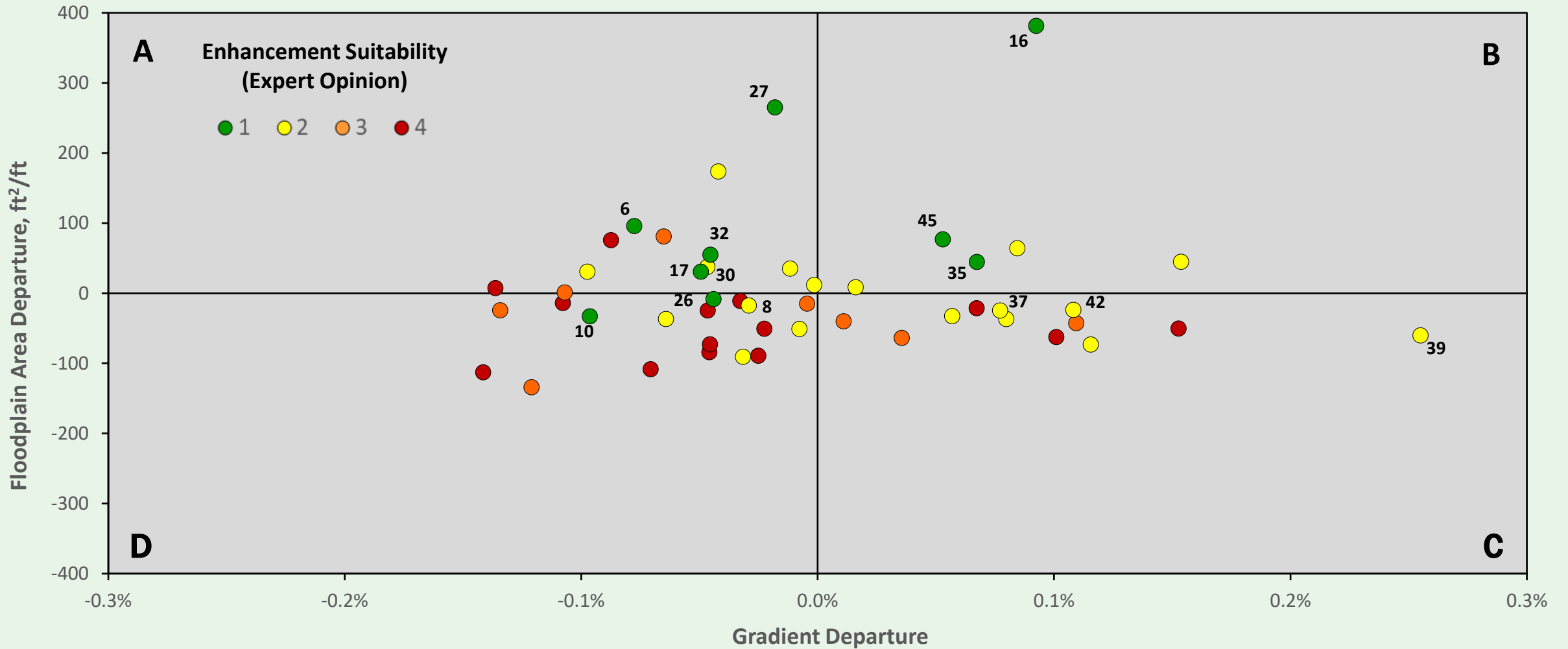


RELATIVE ELEVATION

Floodplain Area 1 $\geq$ 5 ft Above the Riffle Crest Thalweg



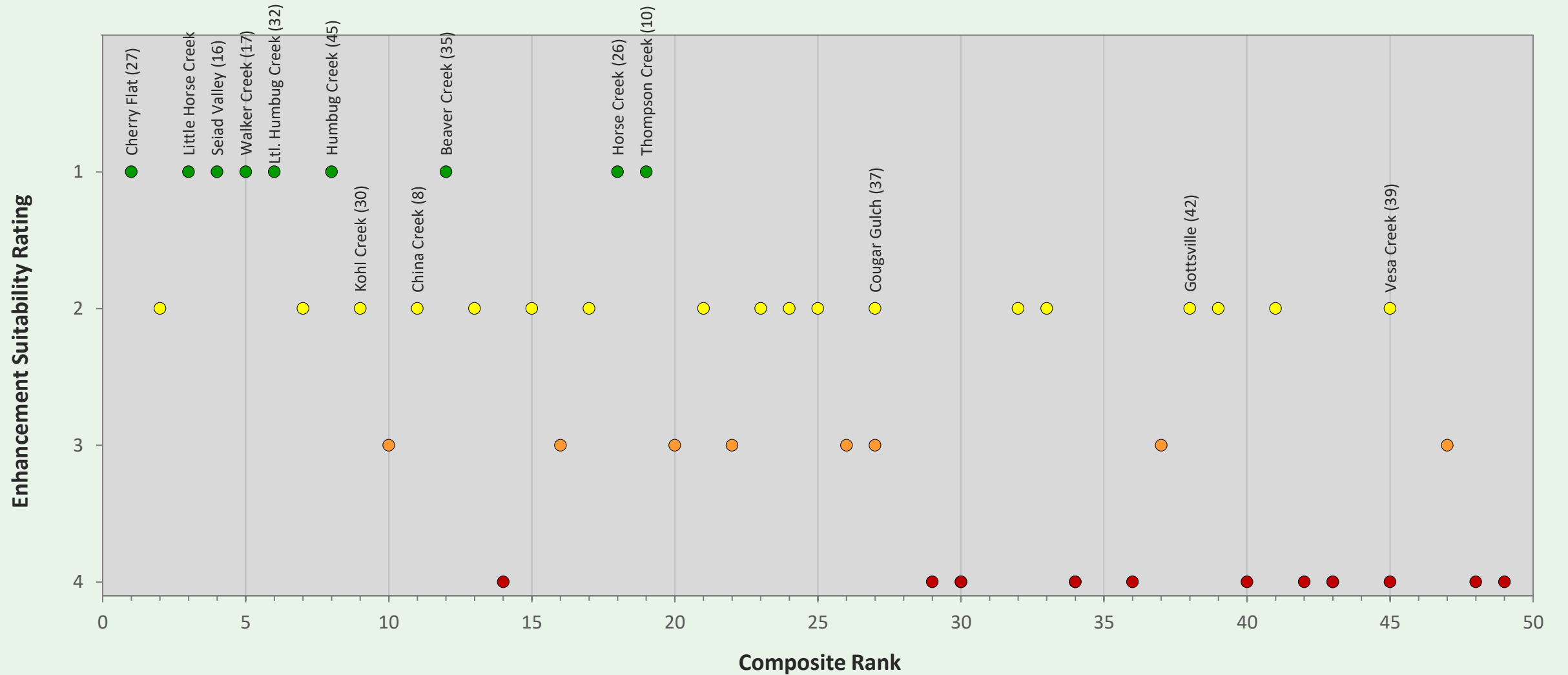
POTENTIAL ENHANCEMENT DOMAINS



COMPOSITE



DESIGN SITES

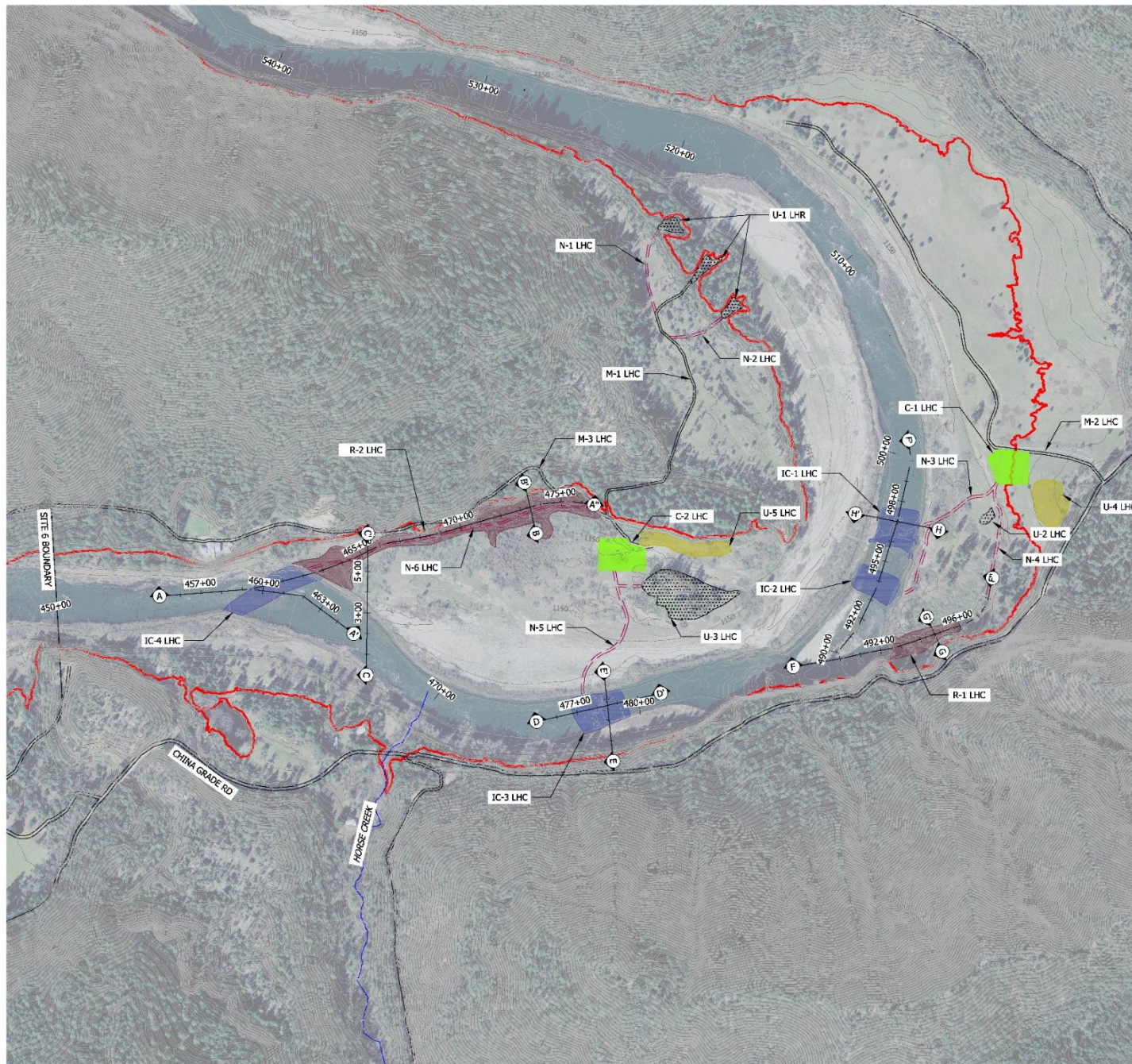


DESIGN SITES



Reach No	Reach Name
6	Little Horse Creek
8	China Creek
10	Thompson Creek
16	Seiad Valley
17	Walker Creek
26	Horse Creek (upper)
27	Cherry Flat
30	Kohl Creek
32	Little Humbug Creek
35	Beaver Creek
37	Cougar Gulch
39	Vesa Creek
42	Gottsville
45	Humbug Creek

CONCEPTUAL DESIGN



LEGEND

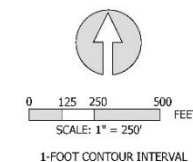
###+00	STATIONING IN FEET
—+—+—	PROFILE LINE
—	100-YEAR FLOODPLAIN BOUNDARY
—	EXISTING ROAD
▨	EXISTING MINE TAILINGS
- - -	PROPOSED ACCESS ROAD
■	PROPOSED STAGING AREA
■	PROPOSED SPOIL PILES
■	PROPOSED COARSE SEDIMENT ADDITION
■	PROPOSED OFF-CHANNEL HABITAT (ALCOVE)

Site 6 Little Horse Creek (LHC)

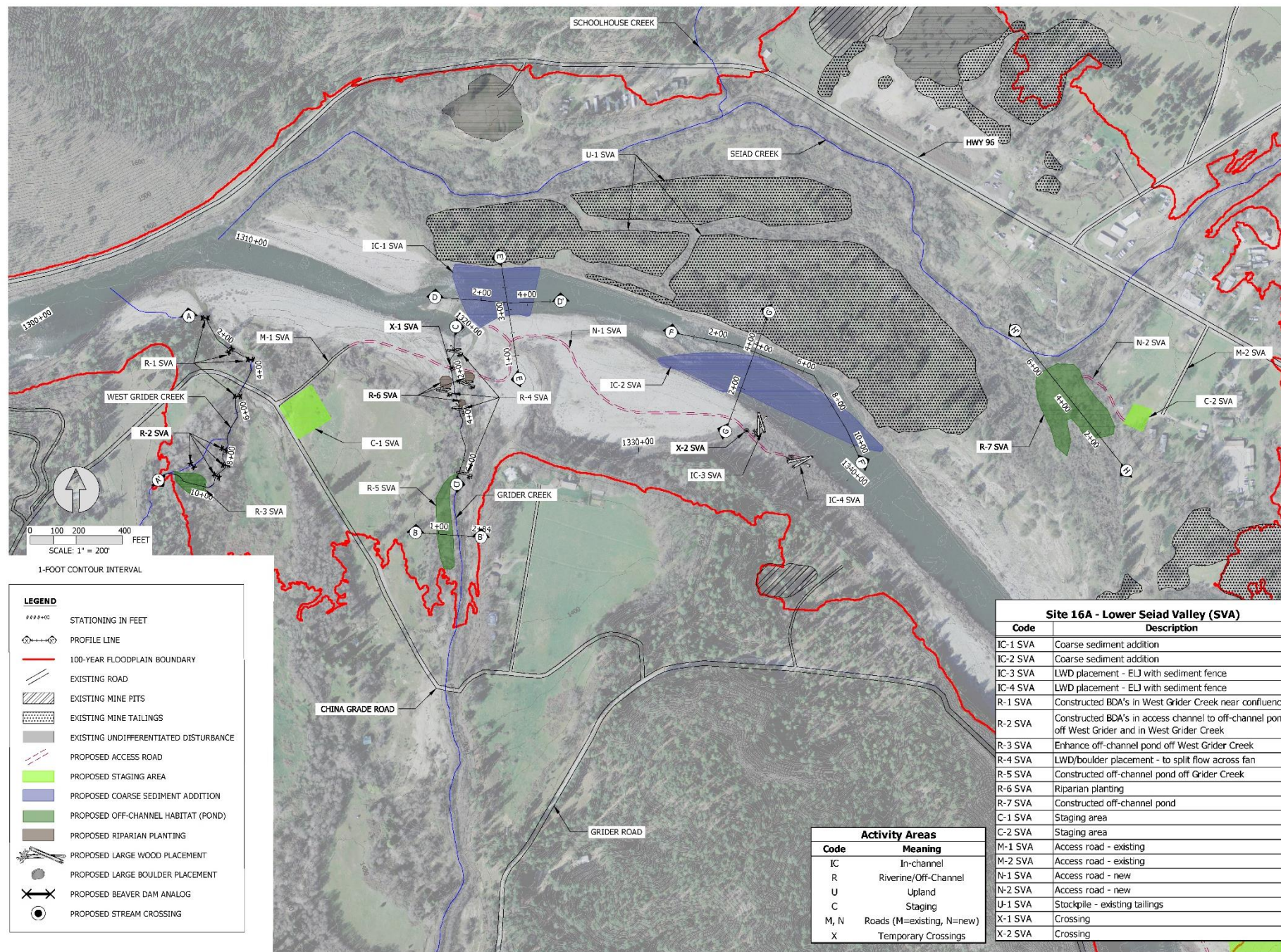
Code	Description
IC-1 LHC	Coarse sediment addition
IC-2 LHC	Coarse sediment addition
IC-3 LHC	Coarse sediment addition
IC-4 LHC	Coarse sediment addition
R-1 LHC	Expansion of alcove/backwater
R-2 LHC	Constructed alcove/backwater
U-1 LHC	Stockpile - existing tailings
U-2 LHC	Stockpile - existing tailings
U-3 LHC	Stockpile - existing tailings
U-4 LHC	Proposed spoil pile
U-5 LHC	Proposed spoil pile
C-1 LHC	Staging area
C-2 LHC	Staging area
M-1 LHC	Access road - existing
M-2 LHC	Access road - existing
M-3 LHC	Access road - existing
N-1 LHC	Access road - new
N-2 LHC	Access road - new
N-3 LHC	Access road - new
N-4 LHC	Access road - new
N-5 LHC	Access road - new
N-6 LHC	Access road - new

Activity Areas

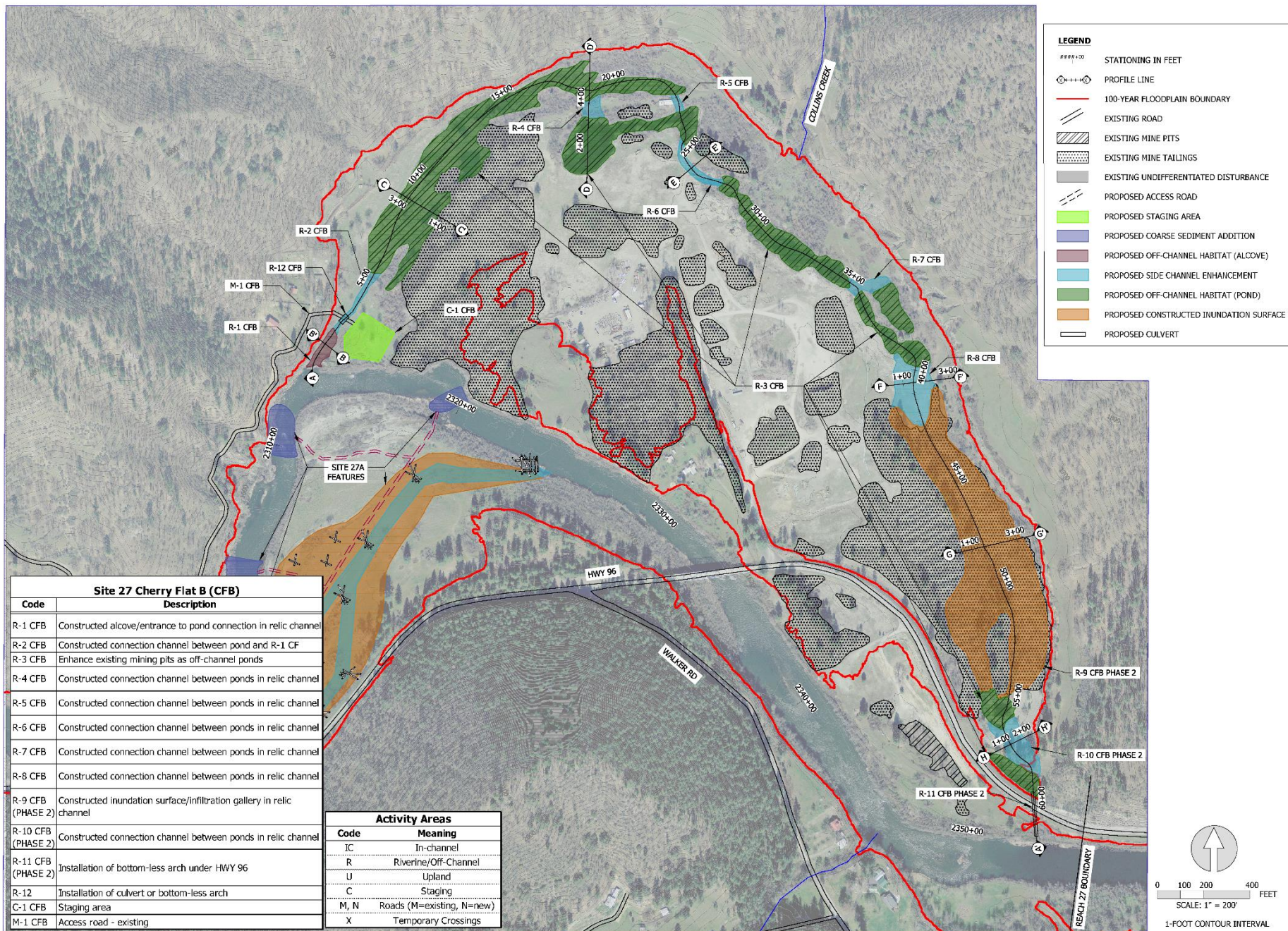
Code	Meaning
IC	In-channel
R	Riverine/Off-Channel
U	Upland
C	Staging
M, N	Roads (M=existing, N=new)
X	Temporary Crossings



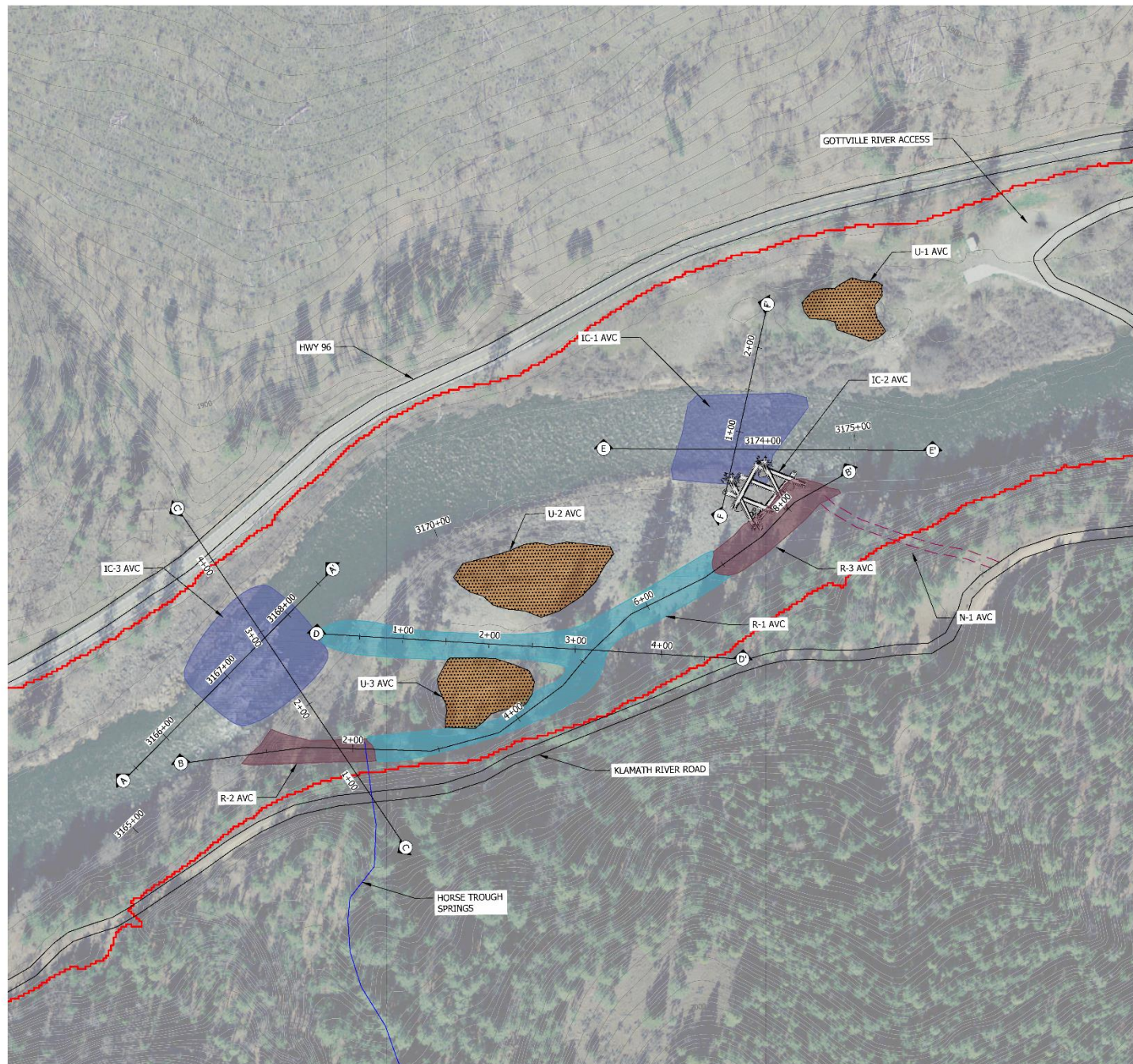
CONCEPTUAL DESIGN



CONCEPTUAL DESIGN



CONCEPTUAL DESIGN



LEGEND

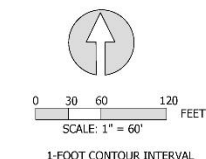
----	STATIONING IN FEET
—○—	PROFILE LINE
---	100-YEAR FLOODPLAIN BOUNDARY
---	EXISTING ROAD
---	EXISTING MINE TAILINGS
---	PROPOSED ACCESS ROAD
---	PROPOSED COARSE SEDIMENT ADDITION
---	PROPOSED OFF-CHANNEL (ALCOVE)
---	PROPOSED SIDE CHANNEL ENHANCEMENT
---	PROPOSED CONSTRUCTED INUNDATION SURFACE
---	PROPOSED LARGE WOOD PLACEMENT
---	PROPOSED LARGE BOULDER PLACEMENT

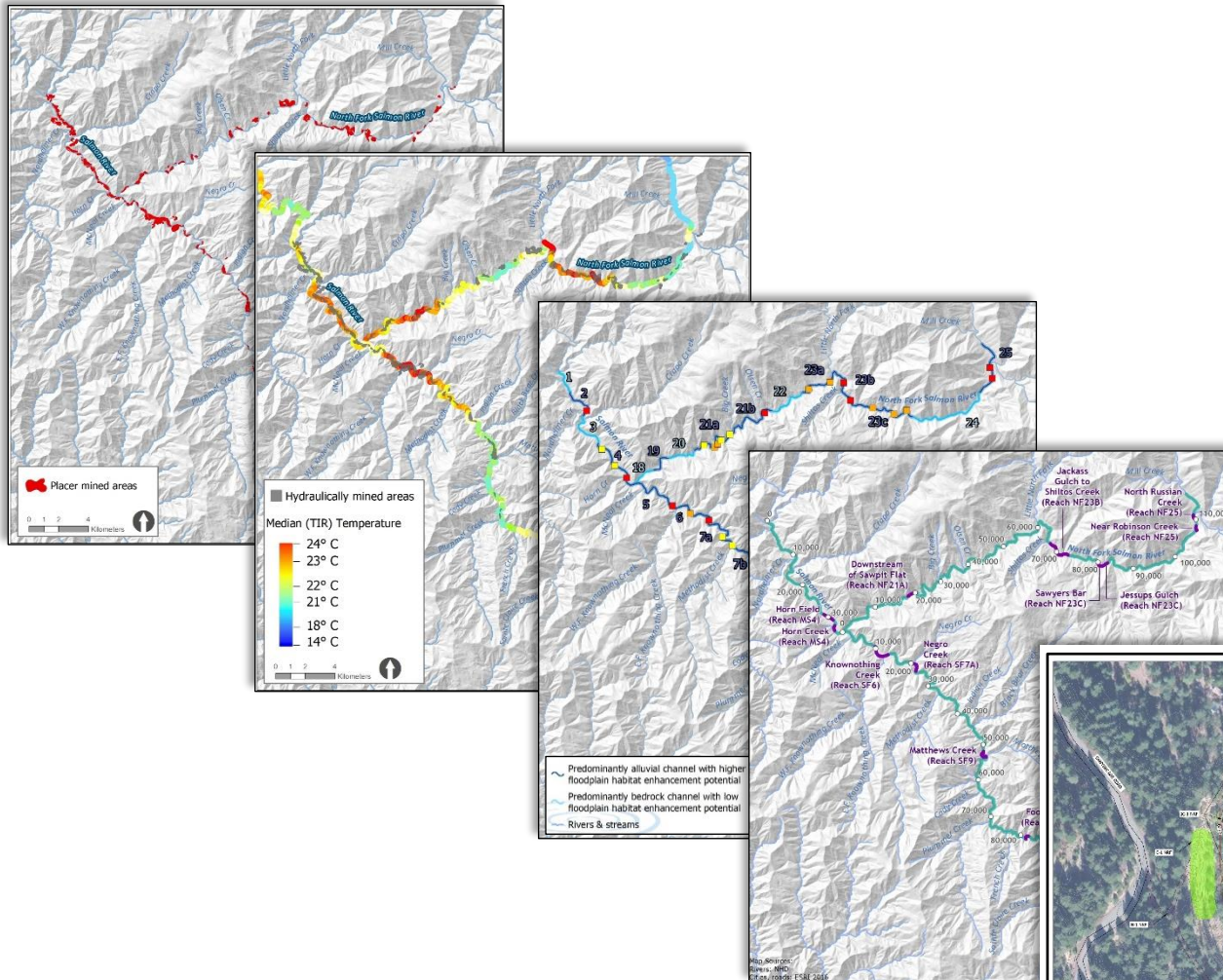
Site 40 Above Vesa Creek (AVC)

Code	Description
IC-1 AVC	Coarse sediment addition
IC-2 AVC	LWD placement - ELJ with sediment fence
IC-3 AVC	Coarse sediment addition
R-1 AVC	Constructed side channel
R-2 AVC	Constructed alcove
R-3 AVC	Constructed alcove
N-1 AVC	Access road - new
U-1 AVC	Mine tailing removal/graded floodplain
U-2 AVC	Mine tailing removal/graded floodplain
U-3 AVC	Mine tailing removal/graded floodplain

Activity Areas

Code	Meaning
IC	In-channel
R	Riverine/Off-Channel
U	Upland
C	Staging
M, N	Roads (M=existing, N=new)
X	Temporary Crossings





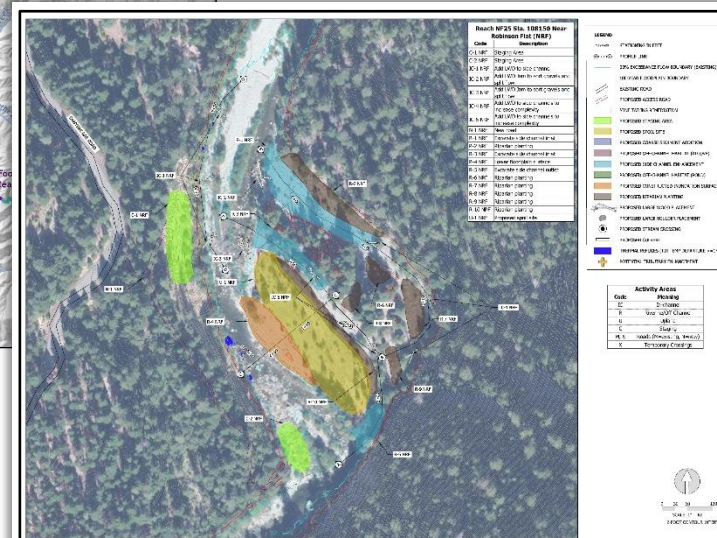
**Mid Klamath
Watershed Council**

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