Clarks Creek TMDL Implementation
Tribal Role

1. Continue Tribal Council's Directive to change "status quo"
    1. Elodea Hand Pull
    2. "Dash Project – elodea suction
    3. Specialty Monitoring
    4. Sediment Reduction Project

2. Continue success of securing state and federal dollars with TMDL stakeholders to get projects built.

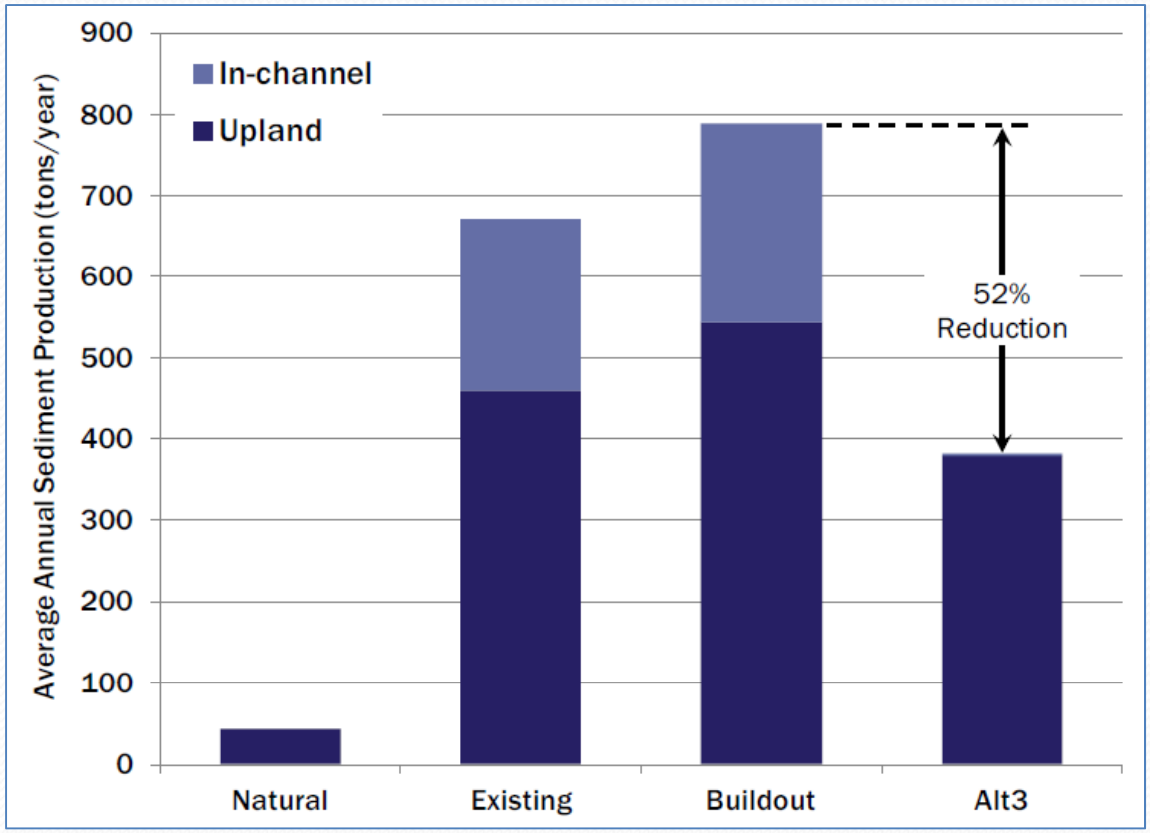
3. Use federal grant funding to "kick start" projects identified in the TMDL process and Tribe's Sediment Reduction Plan - designing, specifications, cost estimates, and permitting

4. Tribal Hatchery Monitoring to meet Dissolved Oxygen Deficit (DOD) Load Allocation

Compliance with DOD Load Allocation at Tribal Hatcheries

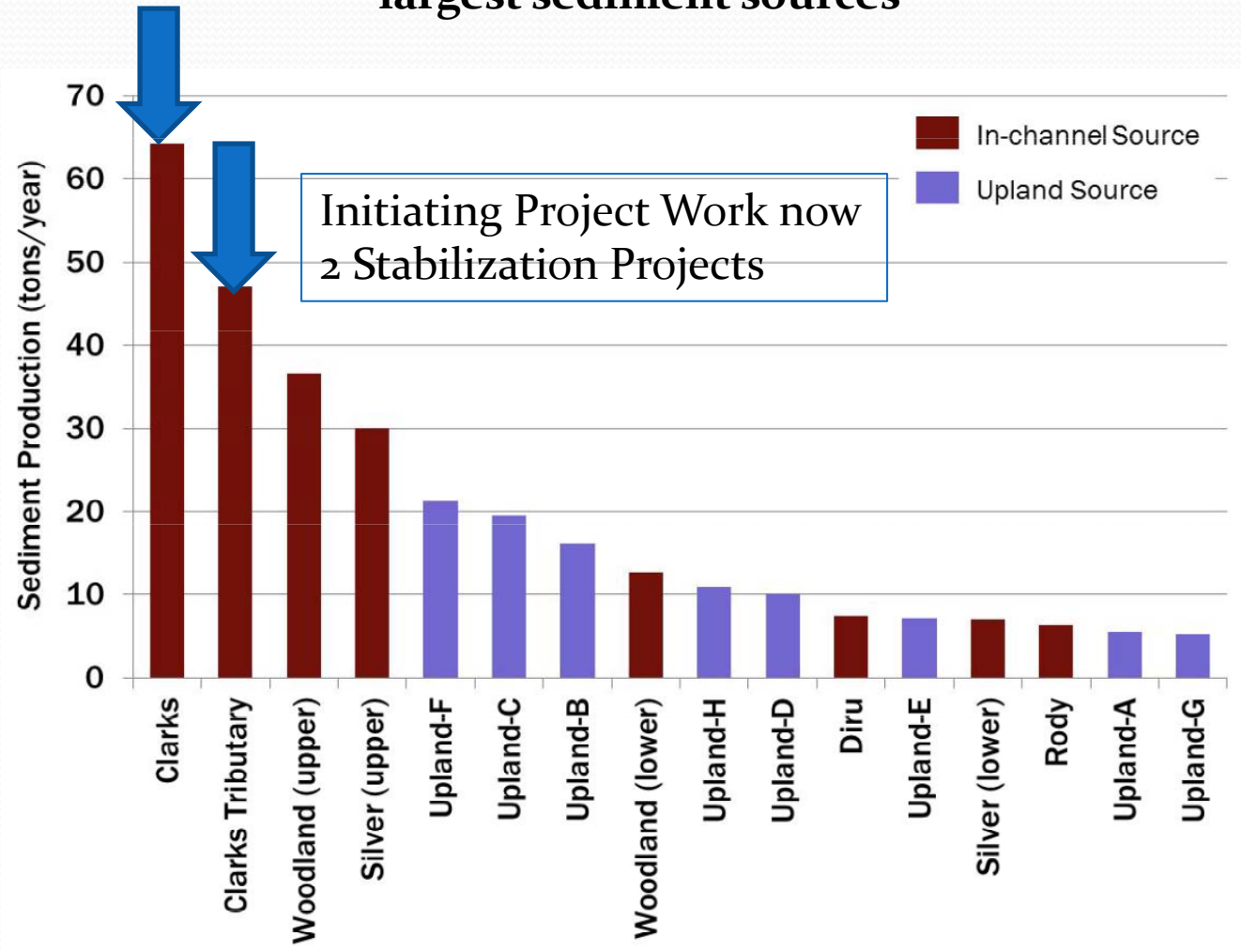
- Conduct monitoring at hatcheries for nutrients, solids, and flow when fish are on-station and during periods of continuous discharge
- Best Management Practices will be implemented at the hatcheries to reduce solids and nutrients discharged.
- An annual report of monitoring results and BMPs implemented will be submitted to Ecology at the end of each calendar year.

Sediment Plan Project Implementation Focus – Annual Sediment Reduction in Clarks Creek Basin



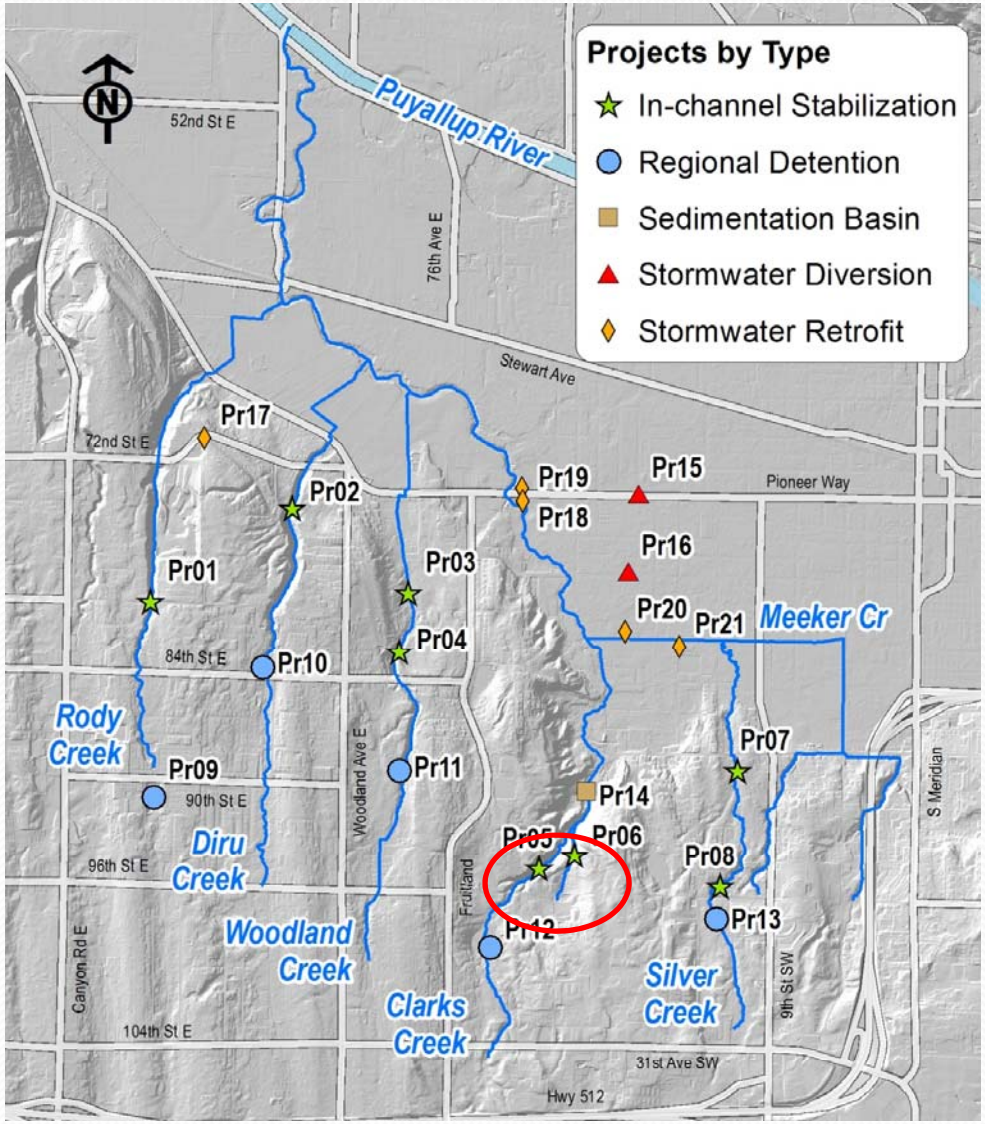
Alt 3 - full implementation of all 23 projects identified in the Tribe's Sediment Action Plan

Annual Sediment Loading in Clarks Creek Basin for 16 largest sediment sources



Project Types and Locations

- In-channel Stabilization
- Regional Detention
- Sedimentation Basin
- Stormwater Diversion
- Stormwater Retrofit
- Distributed Stormwater (LID)



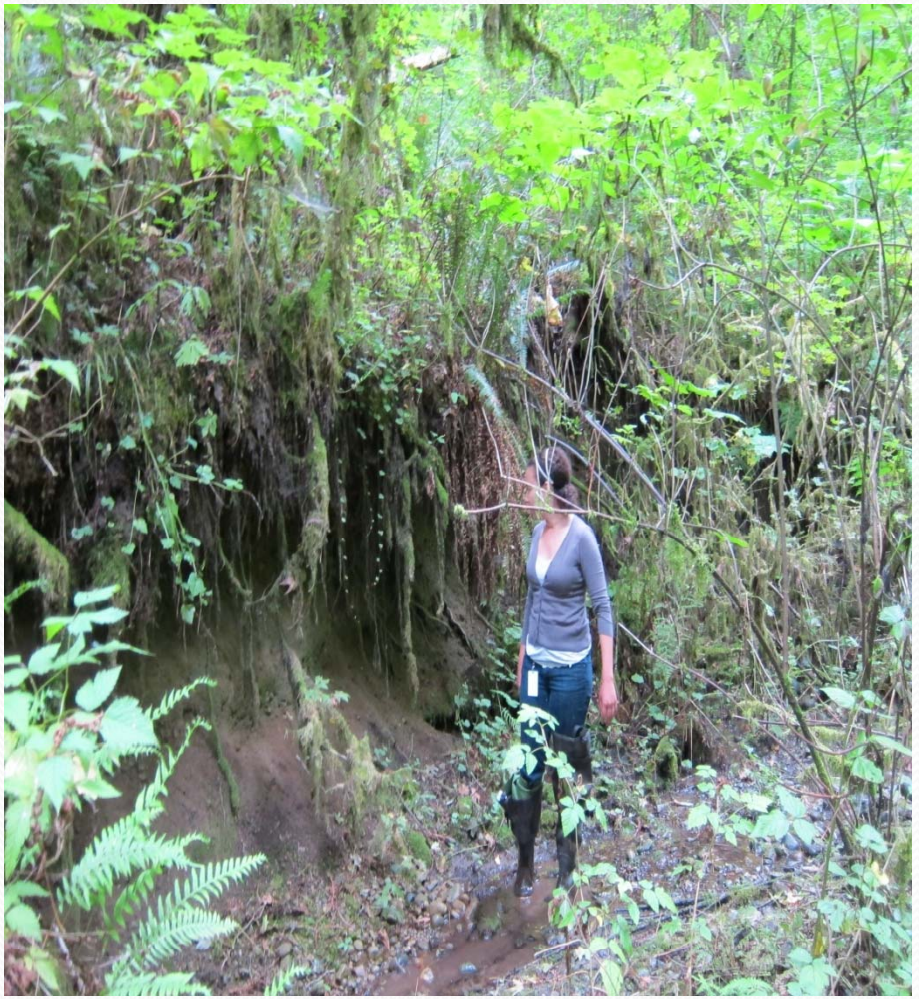
Note: 2 more upland projects were included in final plan, not depicted on map bioretention on roadways and porous pavement for arterials.

Sediment Plan Implementation

23 Sediment Reduction Projects

Reduce about 400 tons/yr of sediment or about 52% of annual avg sediment load produced in basin

Tribe currently starting design, engineering of Pro5 and Pro6 in Upper Clarks Creek Ravine Area



Sediment Sources

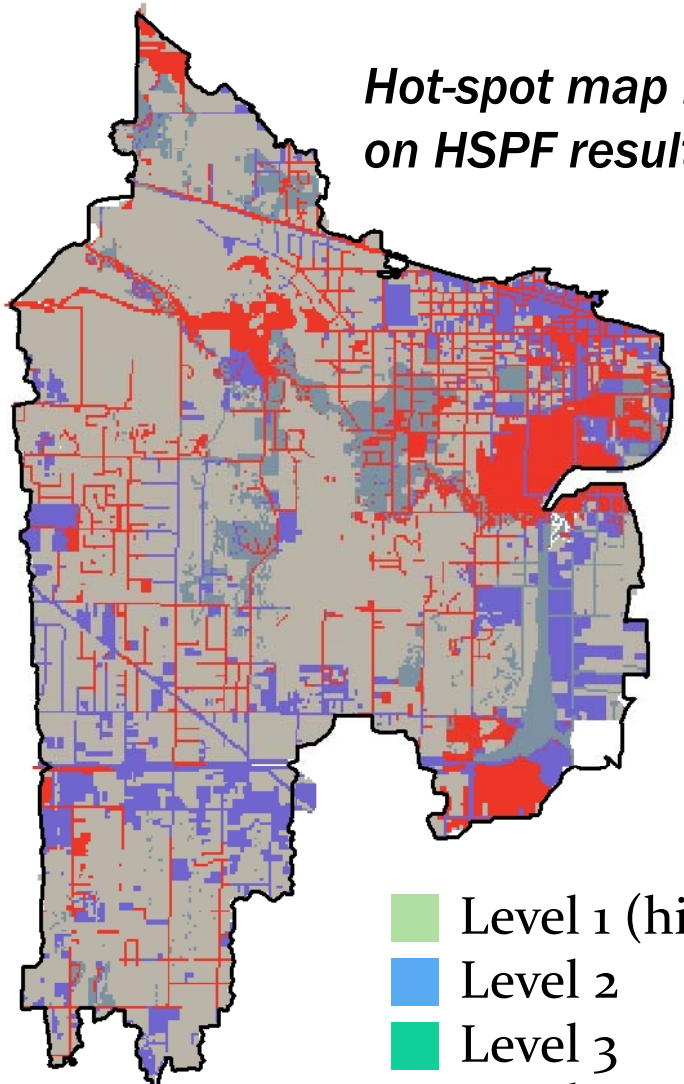
Two major types:

- **In-channel:** bed degradation, bank failures
- **Upland:** sediment production from surfaces and small drainages

Silver Creek

Diru Creek Runoff

Sediment Source Hotspots

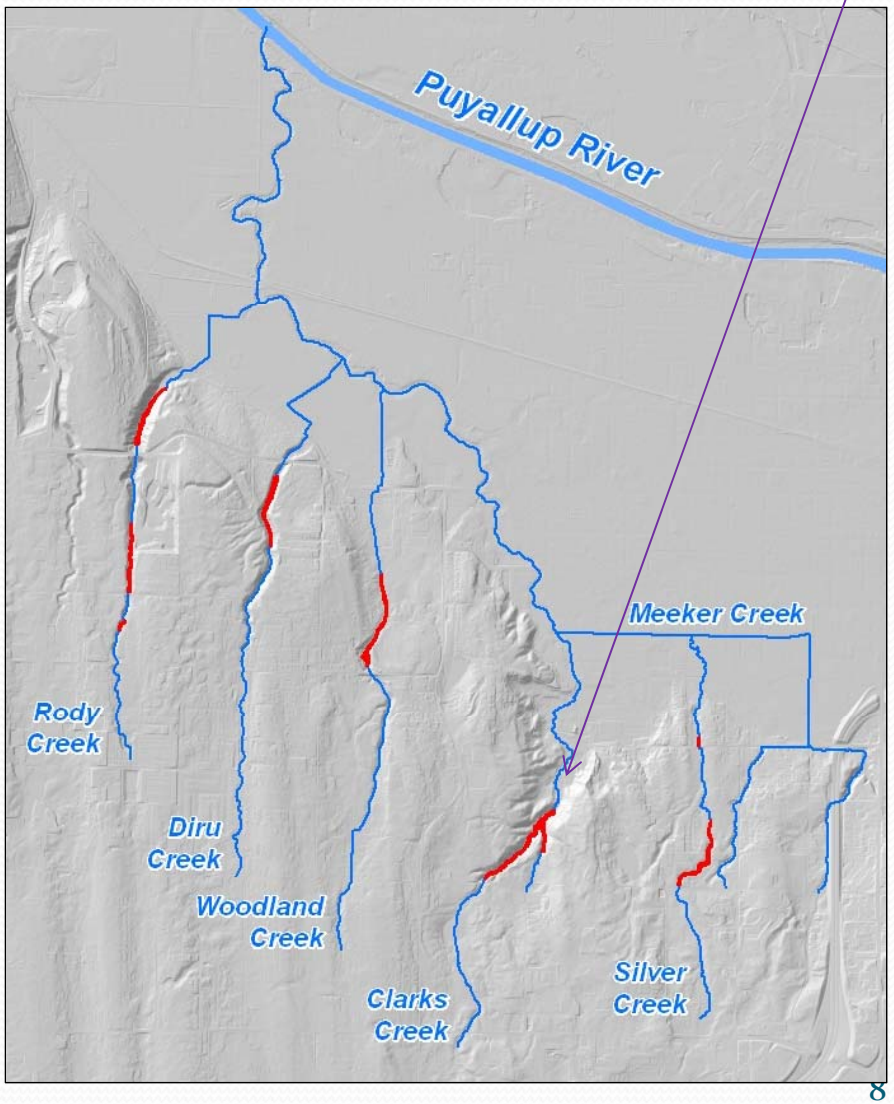


Hot-spot map based on HSPF results

- Level 1 (highest)
- Level 2
- Level 3
- Level 4

Brown and Caldwell 2013

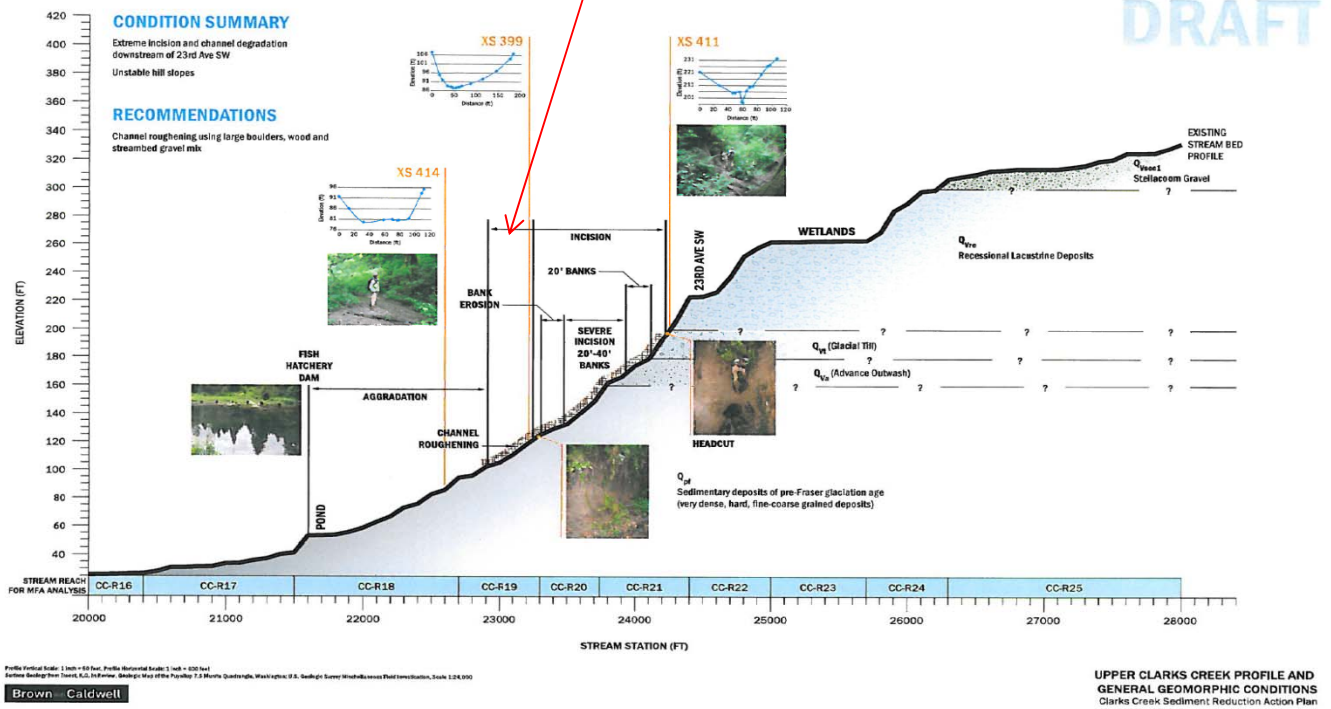
Targeted In-Channel Projects
-Upper Clarks Creek (Pro5 and Pro6)



Extreme Incision & Channel Degradation – Upper Clarks Creek (Pr05)

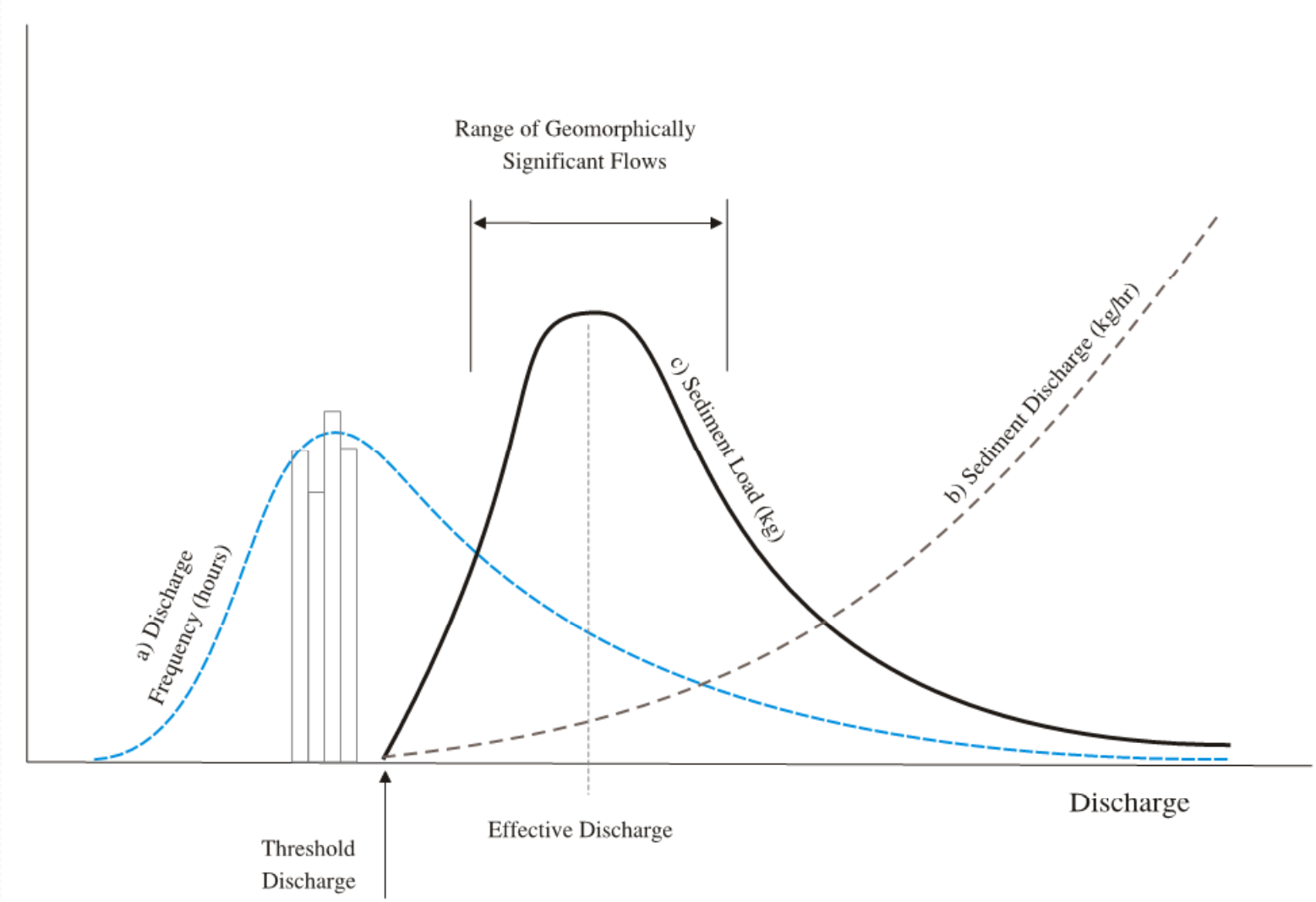
20-40 ft banks

Roughen Channel, change slope



Brown & Caldwell 2013

Effective Work Analysis



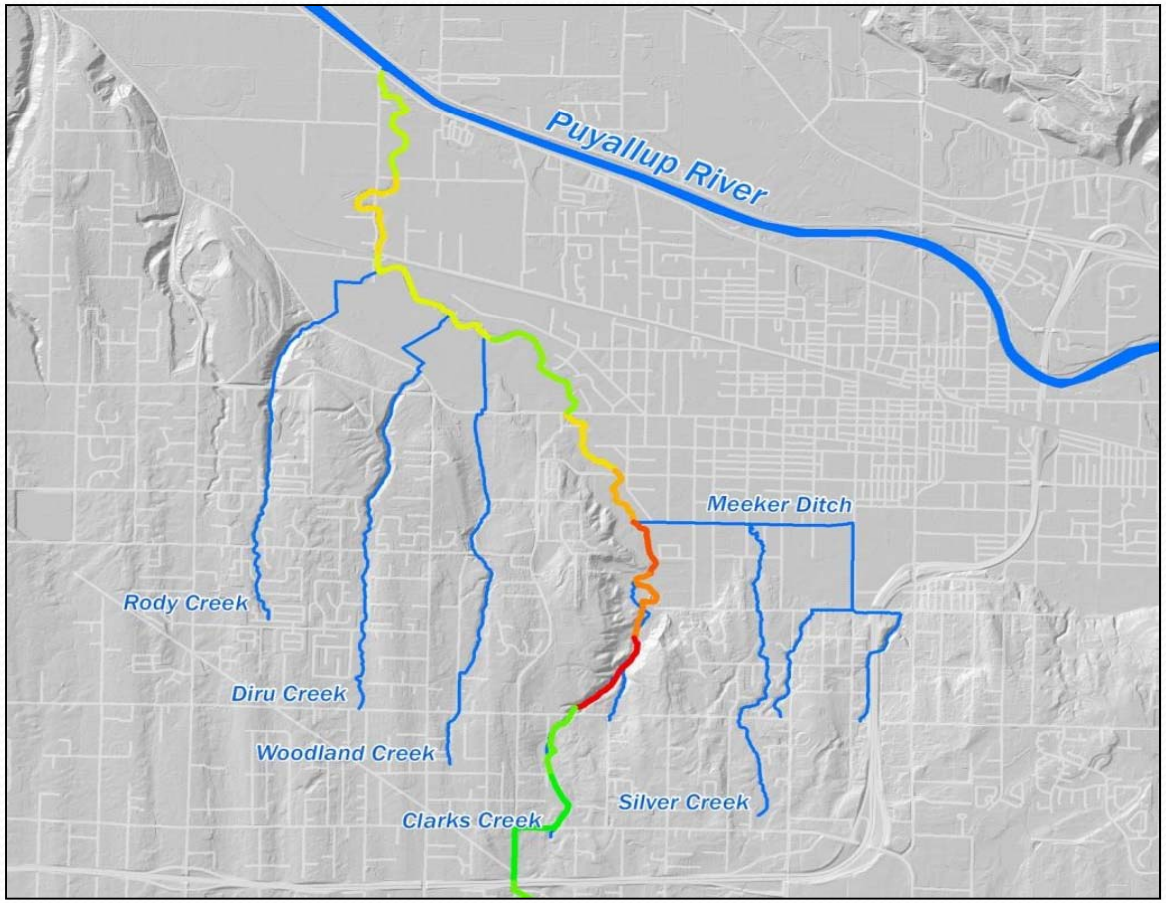
Brown and Caldwell 2013

Effective Work Analysis

MAP LEGEND

Effective Work

- Low
- Moderate
- High



Note: Clarks Creek Tributary work analysis not shown here

Geomorphically Significant Flow Analysis
Cross –Section DS of 23rd Ave SW (Upper Clarks Creek)

Existing 2-Year flow:
17.21 cfs

Natural 2-Year flow:
1.88 cfs

Upper flow bound for sediment loading:
18.75 cfs

Lower flow bound for sediment loading:
0.14 cfs

MFA Inputs	
Reach:	CC-R21
Flow location:	CC-Q09
Cross-section:	XS411
Channel Slope:	11.5%
Sediment sample:	Class 1
Flow scenario:	Existing

Low-flow Hydrology

Parameter	Natural	Existing	% Change
Median (50% exceedence)	0.33	0.38	16%
2-year Flow, Q_2	1.88	17.21	816%
50-year Flow, Q_{50}	7.58	60.24	694%
MR#7 Threshold, $0.5Q_2$	0.94	8.60	–
MR#5 Threshold, $0.08Q_2$	0.15	1.38	–

Incipient Motion of Sediments

Parameter	Incipient Motion		
	D_{16}	D_{50}	D_{84}
Flow rate (cfs)	0.00	0.01	0.03
Depth of flow (ft)	0.00	0.08	0.16
Fraction of natural Q_2	0.0000	0.003	0.02

Geomorphically Significant Flows

Total area under sediment loading curve (t/yr):	81,496
Desired level of control (percent of loading curve):	98%
Upper flow bound for sediment loading (cfs):	18.75
Lower flow bound for sediment loading (cfs):	0.14
Upper flow bound as a fraction of 50-year flow*:	2.47
Lower flow bound as a fraction of 2-year flow*:	0.072

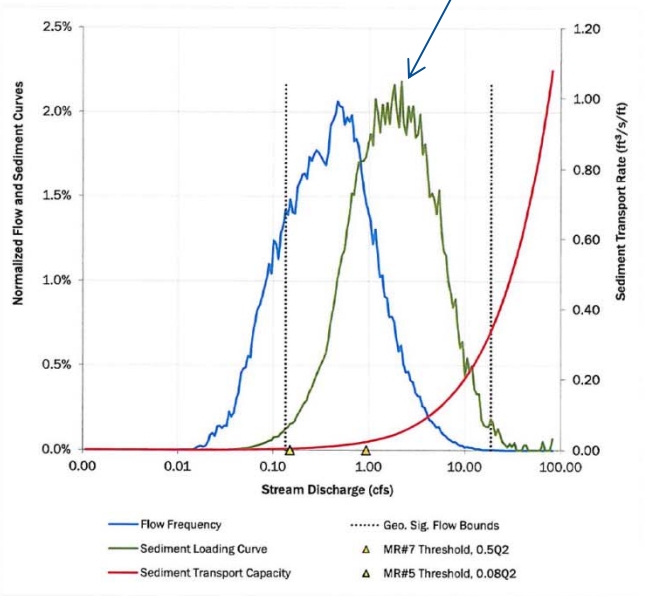
*Flows based on "Natural" conditions

Effective Discharge Conditions

Flow at the peak rate of sediment loading (cfs):	2.17
Flow depth at effective discharge (ft):	0.77
Shear Stress at effective discharge (lb/ft^2):	1.90
Average flow velocity at effective discharge (ft/s):	3.8
Shear velocity at effective discharge (ft/s):	1.0
Effective width at effective discharge (ft):	2.1
Largest mobilized sediment:	*Very coarse gravel*
Largest fully suspended sediment:	*Very fine gravel*
Sediment beginning to settle out:	*Fine gravel*

Use or disclosure of data contained on this sheet is subject to the restriction specified at the beginning of this document.

DRAFT This is a draft version of the spreadsheet and is not intended to be a final representation of the work done or recommendations made by Brown and Caldwell. It should not be relied upon; consult the final version.



Brown & Caldwell 2013

The Upper Clarks Creek projects will reduce over 130 tons/yr of sediment.