Assessing Localized Habitat Changes

An Alternative to Habitat Suitability Index Models

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Localized Habitat Changes

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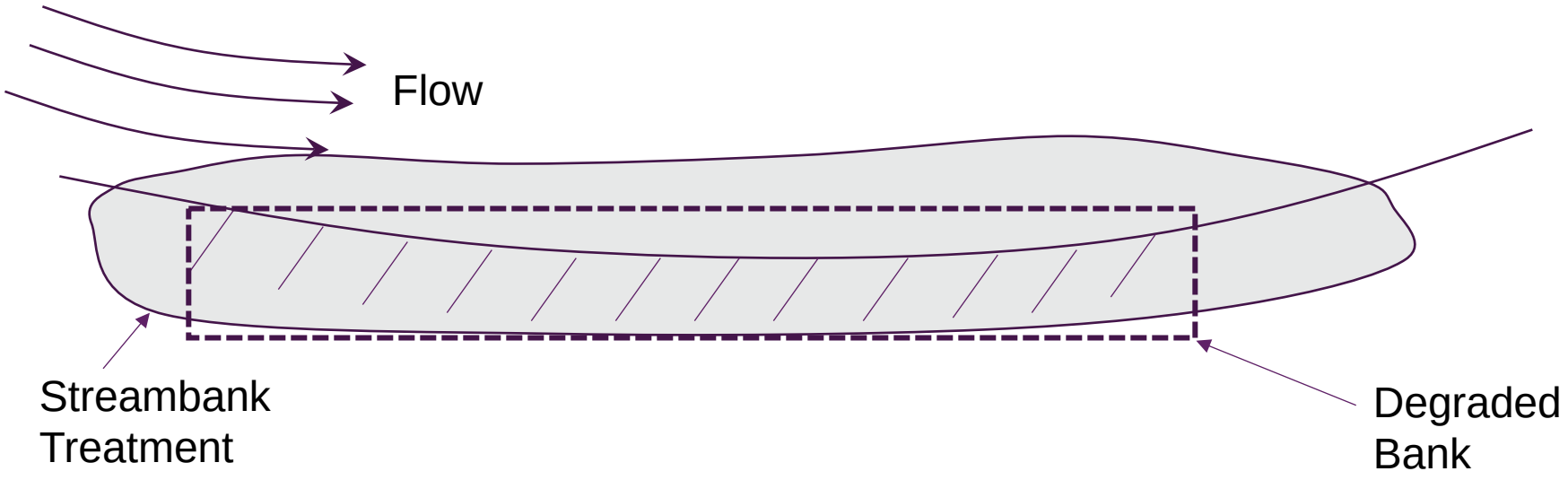
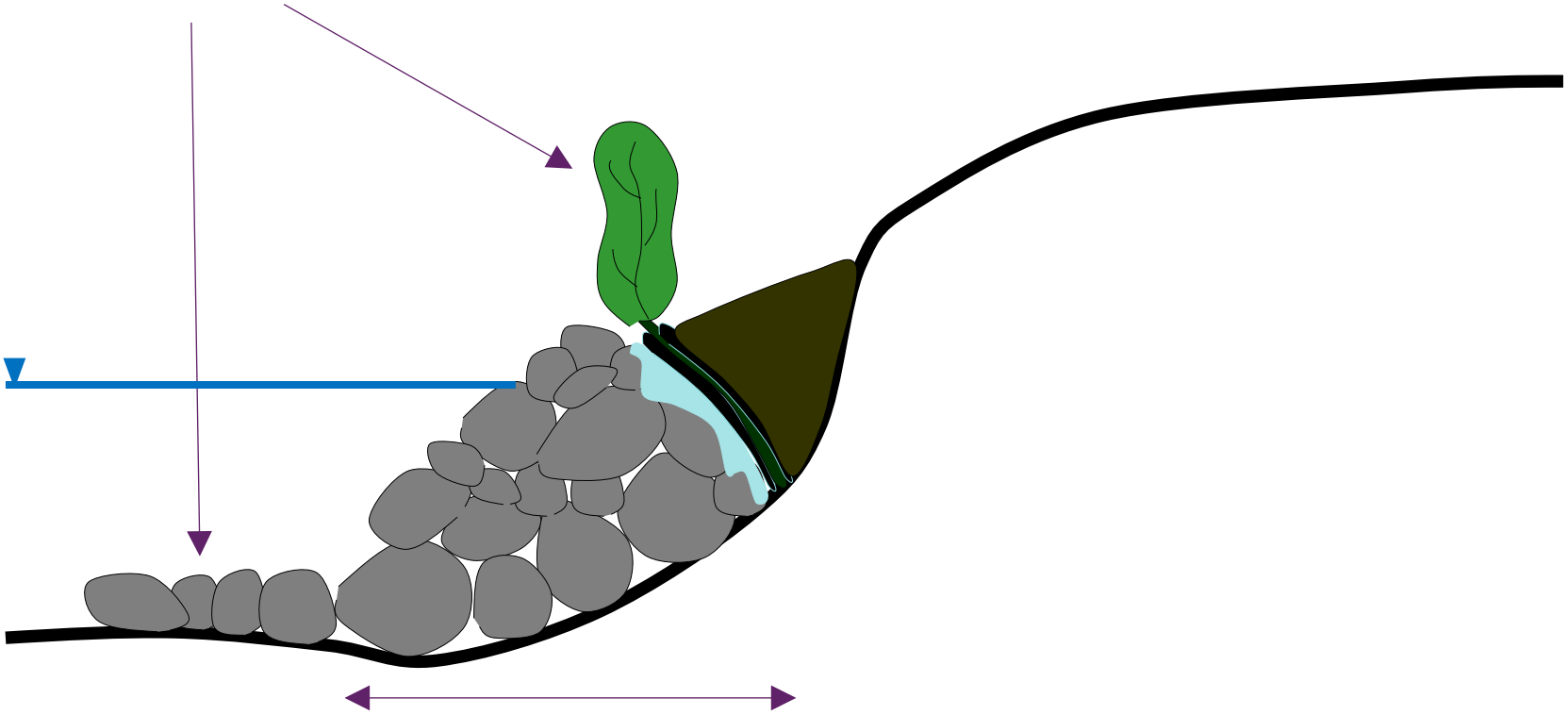


Hydraulic and Habitat Assessments

Habitat Enhancements = habitat gained or quality improvement



Encroachment into channel = habitat lost

Localized Habitat Changes

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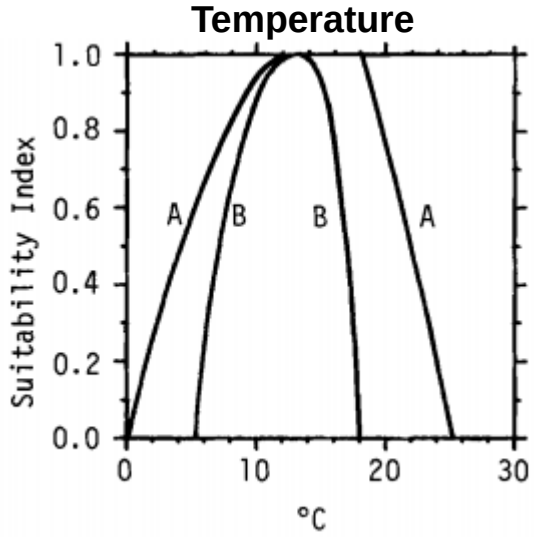
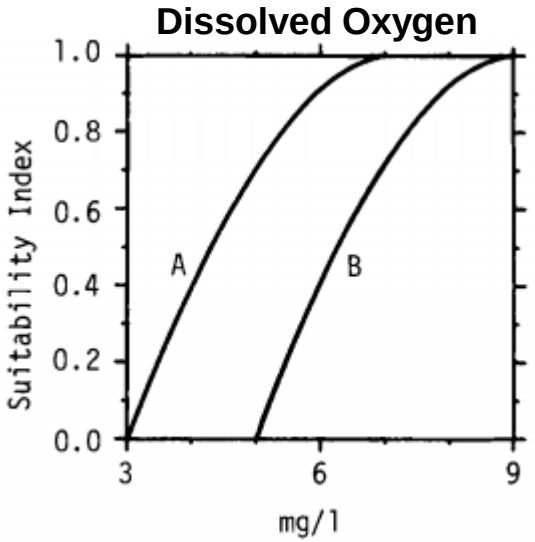
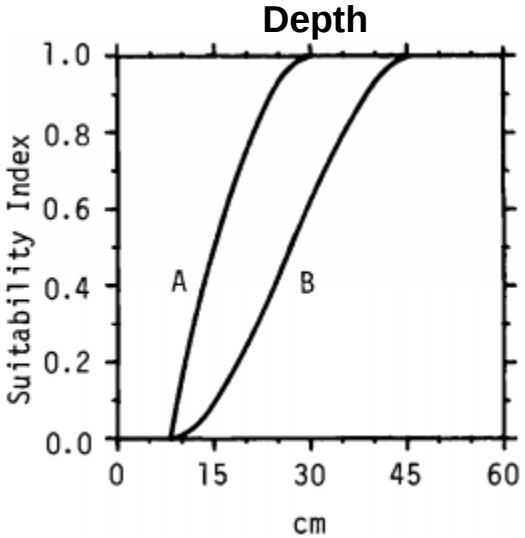
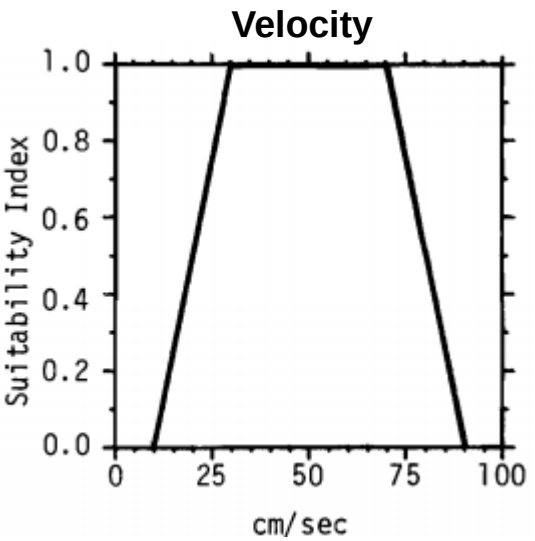
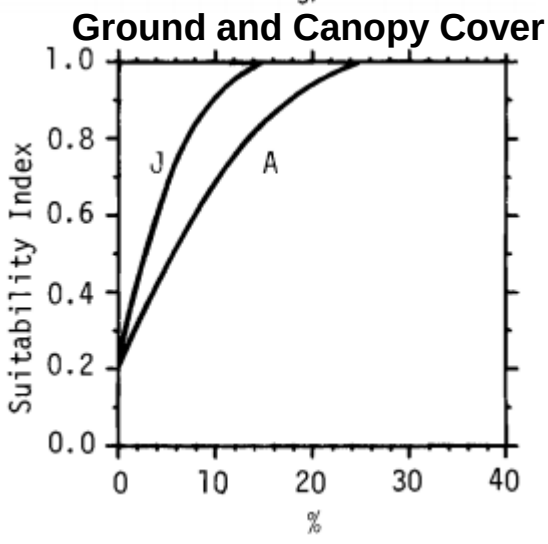
Hydraulic and Habitat Assessments - HSI Rainbow Trout (*Oncorhynchus mykiss*)[1]

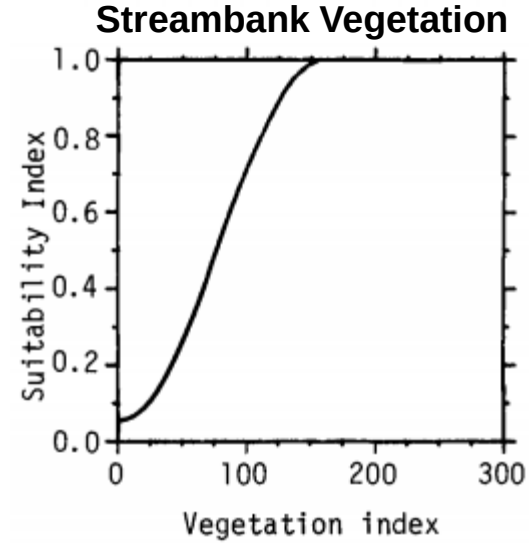






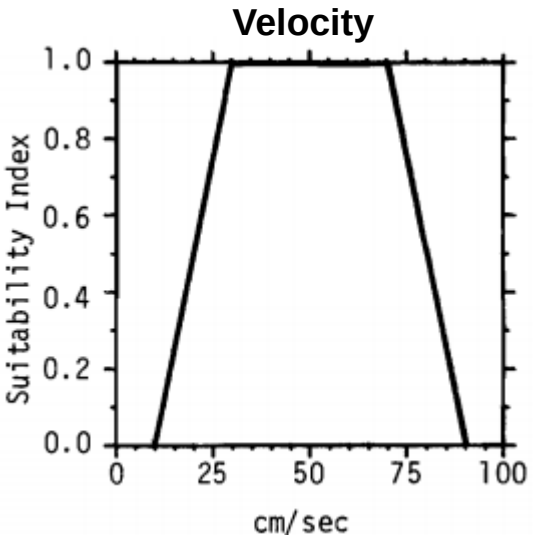






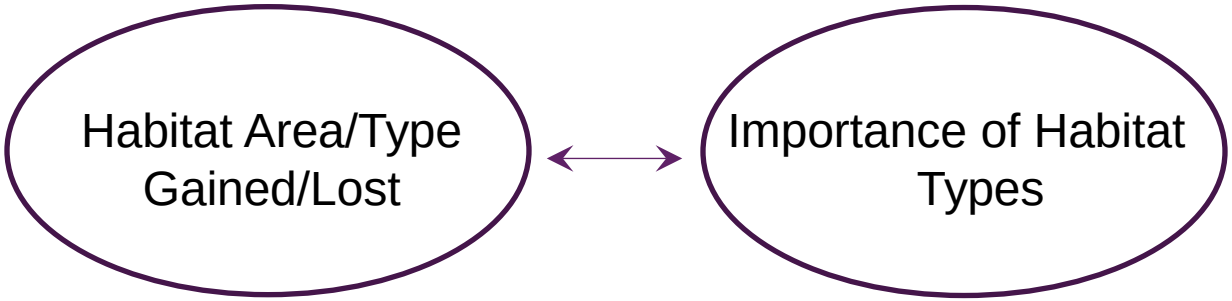
[1]Raleigh, R. F., T. Hickman, R. C. Solomon, and P. C. Nelson. 1984. Habitat suitability information: Rainbow trout. U.S. Fish Wildl. Servo FWS/OBS-82/10.60. 64 pp.

Hydraulic and Habitat Assessments - HSI Rainbow Trout (*Oncorhynchus mykiss)*[1]



Hydraulic and Habitat Assessments

- Two aspects to quantifying habitat changes



- Objective
- Quantifiable
- Transparent
- Consistent

- Subjective
- Site-Specific
- Implications on productivity

- Two-component approach allows for consistency and transparency while ensuring a site-specific, subjective assessment conducted by qualified individuals

Hydraulic and Habitat Assessments

Habitat Lost: 200m^2

Debris Cluster Area of Influence: 30m^2

Debris Cluster Habitat Quality: 1.5 times greater than baseline

Debris Cluster Baseline-Equivalent Habitat Area: 45m^2

Baseline-Equivalent Habitat Changes:
200 – 45 = **155m^2 Loss**

Integrating Objective and Subjective Assessment Strategies

- Major habitat indices – substantial positive impacts to hydraulics, substrate, or channel characteristics
  - Rearing habitat
  - Cover
  - Improved pool-riffle ratio
  - Scour pools
  - Improved benthic invertebrate production
- Minor habitat indices – do not substantially influence hydraulics, substrate, or channel characteristics
  - Increased invertebrate drift
  - Reduction in downstream erosion
  - Improved turbulence characteristics
  - Silt catch

Integrating Objective and Subjective Assessment Strategies

Habitat Component	Major Habitat Enhancement Indices						Minor Habitat Enhancement Indices*				Total Habitat Index Score	Enhancement Factor, E_f
	Scour Pools	Provide Rearing Habitat	Cover	Preferential Heightened Velocity Zone	Improved Pool - Riffle Ratio	Improved Benthic Invertebrate Production	Increase Drift	Reduce Downstream Erosion	Improved Turbulence	Silt Catch		
Baseline	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**2**	**1**
~~Debris Cluster~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~1~~	~~1~~	~~0~~	~~1~~	~~1~~	~~3.5~~	~~1.5~~
Root Wad	0	0	1	0	0	1	1	0	1	1	**3.5**	**1.5**
~~Stream Barb / J Hook~~	~~1~~	~~1~~	~~1~~	~~1~~	~~1~~	~~0~~	~~0~~	~~1~~	~~1~~	~~0~~	~~6~~	~~2~~
J-Hook with Root Wad	1	1	1	1	1	1	1	1	1	1	**8**	**2.5**
~~Boulder Cluster~~	~~0~~	~~1~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~2.5~~	~~1.25~~
Brush Layer	0	0	1	0	0	1	0	0	0	1	**2.5**	**1.25**
Willow / Fascine Bundles	0	0	1	0	0	1	0	0	0	1	**2.5**	**1.25**
Riparian Zone Plantings (Direct Influence)	0	0	1	0	0	1	0	0	0	1	**2.5**	**1.25**
Riparian Zone Plantings** (Indirect Influence)	0	0	0.25	0	0	0.25	0	0	0	0.25	**0.625**	**0.25**
Log Crib Wall	0	1	0	0	0	1	0	1	0	0	**2.5**	**1.25**
Pool and Riffle Bed	1	1	1	1	1	0	0	0	1	1	**6**	**2**

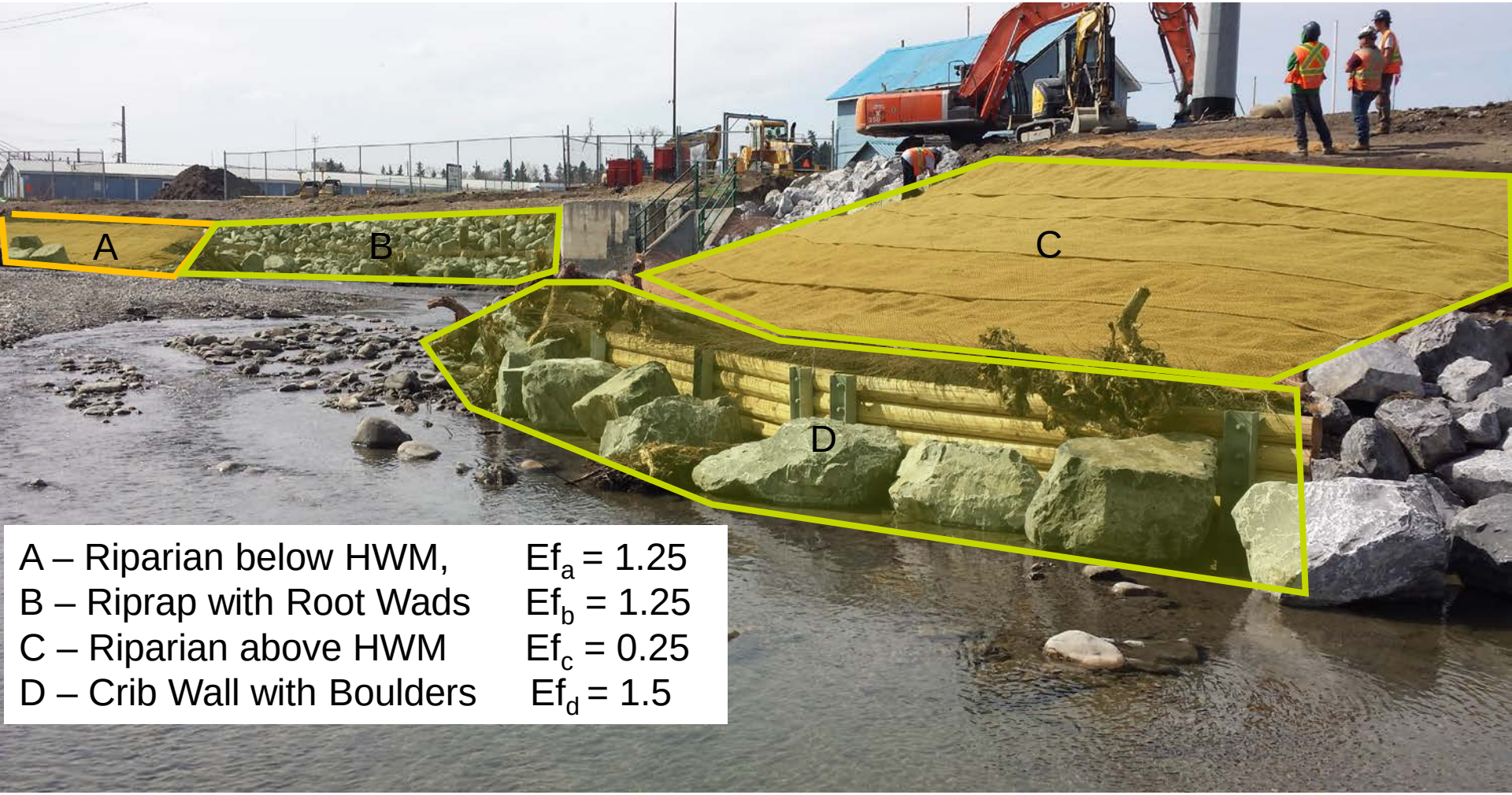
*Minor habitat enhancements are weighted half of major enhancements.

**Riparian Zone Plantings (Indirect Influence) are discounted by 75% as they indirectly impact fish habitat

J-Hook w/ Root Wad Enhancement Factor = 2.5

Integrating Objective and Subjective Assessment Strategies

Integrating Objective and Subjective Assessment Strategies



A – Riparian below HWM, $Ef_a = 1.25$
B – Riprap with Root Wads $Ef_b = 1.25$
C – Riparian above HWM $Ef_c = 0.25$
D – Crib Wall with Boulders $Ef_d = 1.5$

Integrating Objective and Subjective Assessment Strategies

- Component A – Riparian below HWM
  - Improved cover
  - Increased invertebrate production
  - Silt Catch in floods
  - Habitat value 25% better than baseline, $Ef_a = 1.25$
  - Area of Influence = $100m^2$
  - **Baseline-equivalent area** = $100m^2 x 1.25$ = **$125m^2$**

- Component B – Riprap with Root Wads
  - Riprap similar quality to baseline degraded bank
  - Root wads provide cover, increased benthic drift, improved turbulence characteristics
  - Habitat value 50% better than baseline, $Ef_b = 1.50$
  - Area of Influence = $150m^2$
  - **Baseline-equivalent area** = $150m^2 x 1.50$ = **$225m^2$**

Integrating Objective and Subjective Assessment Strategies

- Component C – Riparian above HWM
  - Improved Cover
  - Increased invertebrate production
  - Silt Catch in Floods
  - Habitat value discounted by 75% for being above HWM, $Ef_a = 0.25$
  - Area of Influence = $200m^2$
  - **Baseline-equivalent area** = $200m^2 x 0.25$ = **$50m^2$**

- Component D – Crib Wall with Boulders
  - Crib wall provides reduction in erosion
  - Boulders provide cover, rearing habitat, improved turbulence characteristics
  - Habitat value 25% better than baseline, $Ef_b = 1.25$
  - Area of Influence = $50m^2$
  - **Baseline-equivalent area** = $50m^2 x 1.25$ = **$62.5m^2$**

Integrating Objective and Subjective Assessment Strategies

- Baseline Habitat Lost = 450 m^2
- New Baseline-Equivalent Habitat Benefits:
  - A: 150m^2
  - B: 225m^2
  - C: 50m^2
  - D: 75m^2
  - **Total: 500 m^2**

- Net Habitat Change: **Additional benefit of ~50 m^2 above baseline conditions.**
  - It is likely that harm has been avoided based on the habitat characteristics deemed important for this site as agreed upon between government and proponent.

Integrating Objective and Subjective Assessment Strategies

Table 3.1 - Net Fish Habitat Footprint Calculator

Site: Stampede

As-Built In-Stream Footprint (m^2)	2967

Habitat Component	Quantity of Component	Component Dimensions		Unmodified Component Influence Area		Total Offset Area, A_{offset} (m^2)
Root Wad	24	Perpendicular length into channel, L (m)	2	Area of hydraulic influence, A_{hyd} (m^2)	192	432
				Area of cover, A_{cover} (m^2)	96	
		Component width, W (m)	2	Total area of enhancement, $A_{Enhanced}$ (m^2)	288	
Boulder Cluster (Area 1A)	3	Width of cluster, W (m) (perpendicular to flow)	3	Area of cluster, $A_{cluster}$ (m^2)	27	83.25
		Length of cluster, L (m) (parallel to flow)	3	Area of wake, A_{wake} (m^2)	39.6	
		Height of boulder, h_b (m) (0.5m for Class II)	1.1	Total area of enhancement, $A_{Enhanced}$ (m^2)	66.6	
Brush Layer	N/A	Crown width, w (m) (from supplier)	2	Total area of enhancement, $A_{Enhanced}$ (m^2)	130	162.5
		Width of influence, w_i (m) (half of crown width)	1			
		Length of brush layer parallel to bank, L (m)	130			
Willow Bundles	20	Crown width, w (m) (from supplier)	2	Total area of enhancement, $A_{Enhanced}$ (m^2)	40	50
		Width of influence, w_i (m) (half of crown width)	1			
		Crown length of willow bundle parallel to bank, L (m)	2			
Riparian Plantings Zone 1	N/A	Slope length, S (m) (perpendicular to bank)	10	Total area below 2 year water levels, A_b (m^2)	72	90
		Portion of influencial slope length below 2 year levels, S_{ib} (m)	1			
		Portion of influencial slope length above 2 year levels, S_{ia} (m)	9	Total area above 2 year water levels, A_a (m^2)	648	162
		Riparian channel length, L (m) (parallel to bank)	72			
Log Crib Wall	N/A	Crib wall height, h (m)	1	Total area of enhancement, $A_{Enhanced}$ (m^2)	18	22.5
		Crib wall length, L (m)	18			
Junk / Debris Removal	N/A			Total area of enhancement, $A_{Enhanced}$ (m^2)	238	476
Bridge Pier Removal	N/A			Total area of enhancement, $A_{Enhanced}$ (m^2)	20	40

94% indicates serious harm has likely been avoided.

As-Built In-Stream Footprint (m^2)	-2967
Total Fish Habitat Enhancement Area, A (m^2)	2774.2
Percentage of Footprint Compensated	94%
Net Footprint (m^2)	-192.8

Simplifying Results for Effective Management Decisions

amec foster wheeler

DFO Footprints for MD of Foothills 2014 Projects

Site and DFO Authorization Number	Component	Design Length (m)	As-Built Length (m)	Component	Number of Design Items	Number of As-Built Items	Component	Design In-Stream Footprint* (m^2)	As-Built In-Stream Footprint* (m^2)	As-Built In-Stream Footprint (m^2)	Total Fish Habitat Enhancement Area, A (m^2)	Percentage of Footprint Compensated	Net Footprint (m^2)
Threepoint Creek 338 Ave ED-14-00902	U/S Revetment	11	11	J-Hook with Root Wad	3	3	LPSTP	1149	958	-958	631	66%	-327
	LPSTP	180	160				Total	1149	958				
	D/S Revetment	11	11	Debris Cluster	3	3							
	Out-of-Channel Revetment	0	55	Brush Layer (m)	180	160							
	In-Stream Total	180	160	Total	6	6							
	Total	202	237										
Threepoint Creek Beauchemin ED-14-00932	U/S Key-In	10	10	Stream Barb	9	3	LPSTP	888	345	-345	298	86%	-47
	LPSTP	295	110	Debris Cluster	4	2	Total	888	345				
	D/S Key-In	10	10	Root Wad	2	1							
	In-Stream Total	295	110	Brush Layer (m)	295	110							
	Total	315	130	Total	15	6							
Sheep River Country Lane ED-14-00844	Revetment	25	25	Brush Layer (m)	260	260	U/S Protection	1076	1076	-1289	325	25%	-964
	U/S Protection	210	210				D/S Protection	213	213				
	D/S Protection	50	50				Total	1289	1289				
	In-Stream Total	260	260										
	Total	285	285										
Threepoint Creek Racetrack ED-14-00904	U/S Key-In	25	25	Debris Cluster	4	4	LPSTP	1434	1434	-2378	1197.875	50%	-1180.125
	U/S LPSTP	60	60	J-Hook with Root Wad	4	4	Culvert Riprap	18	18				
	Culvert Outfall	11	11				Subtotal	1452	1452				
	D/S LPSTP	210	210	Brush Layer (m)	270	270							
	D/S Key-In	25	25	Subtotal	8	8							
	Subtotal	331	331										
Threepoint Creek Gaudet (Racetrack) ED-14-00904	U/S Key-In	15	15	Debris Cluster	2	2	LPSTP	926	926				
	LPSTP	95	95	Stream Barb	7	7	Subtotal	926	926				
	Subtotal	110	110	Root Wad	1	1	Total	2378	2378				
	In-Stream Total	376	376	Brush Layer (m)	95	95							
	Total	441	441	Subtotal	10	10							
				Total	18	18							
Bow River Waterski ED-14-00292	U/S Key-In	25	40	J-Hook with Root Wad	3	3	LPSTP	3250	3280	-3760	1433.75	[illegible]	-2326.25
	U/S LPSTP	450	450				Riprap Revetment	600	480				
	Riprap Revetment	100	80	Brush Layer (m)	650	635	Total	3850	3760				
	D/S LPSTP	100	105	Total	3	3							
	D/S Key-In	25	25										
	In-Stream Total	650	635										
	Total	700	700										
							Totals	9554	8730	-8730	3885.625	45%	-4844.375

* Footprint below 2 year flood level minus wet footprint (As calculated in DFO approvals)

Could be less based on high section of U/S Protection

Estimate based on Design Footprint/Design In-Stream Length

45% indicates serious harm will still likely occur, therefore more offsetting is needed, on the order of 5000 m^2.

Simplifying Results for Effective Management Decisions

- Simplify decisions while maintaining important ecosystem considerations
  - Create effective dialogue between government, proponent, and consultant through objective, transparent, and consistent evaluations
  - Incentivize proponents to seek eco-friendly design solutions
    - Self-management of ecosystem risks
- Optimize eco-friendly designs based on ecohydraulic relationships and habitat priorities to reduce risk
  - Maximize habitat benefits while minimizing project costs
  - Promote harm-avoidance through strategic on-site habitat enhancements rather than compensation measures

Thank you!