

**Preliminary design proposal for treatment of the
Hazel and Goldbasin Landslides**

prepared by

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for

United States Army Corps of Engineers

and

The Stillaguamish Tribe of Indians

The proposed treatment of these landslides is a series of Large Wood Debris (LWD) revetments that will eliminate toe cutting of the landslides and prevent failure materials from being immediately transported downstream. These revetments will be similar in structural composition to the Phase I and II Engineered Log Jam (ELJ) projects that have been constructed on the North Fork Stillaguamish (NFS) river. The enclosed document includes preliminary plans for applications at each landslide, project specifications, and initial budgets.

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Estimated Cost

Hazel / Steelhead Haven Landslide:

The Hazel landslide is commonly known as the Steelhead Haven slide to the local community. Because of this and that other projects in the Hazel area have been constructed and/or are under consideration, I will refer to this landslide as Steelhead Haven from this point on. The series of revetments proposed at the Steelhead Haven landslide would eliminate toe cutting of the slide and create settling ponds for fine materials delivered to the mainstem from the multiple streams that drain the slide area. In addition, these structures will create adult Chinook holding habitat similar to that of the North Fork Stillaguamish (NFS) Engineered Log Jams (ELJs) and mainstem off-channel habitat currently lacking in the NFS. Revetment A would isolate the landslide from the mainstem NFS and eliminate the toe cutting which is considered a critical factor in the stability of the landslide as a whole. The structure will also create deep pools critical for adult Chinook holding. Revetments B, C, and D will create a series of settling ponds to help decrease the magnitude of fine sediments delivered to the mainstem NFS. These revetments will also create a pseudo beaver-pond network providing mainstem off-channel habitat. Initially the area created between the landslide and revetment A will be quite expansive and largely a habitat component. As the creeks drain the slide and deliver fine sediment, an increasing volume of this area will be converted to fine sediment storage. Over time it is possible that the entire area between revetment A and the landslide will be converted to fine sediment storage. It is also possible that stabilization of the landslide will occur prior to filling the entire storage area and that some off channel habitat will remain over time. Uncertainty remains with respect to the eventual equilibrium condition as well as the time frame of development. An additional habitat component that will develop is a log raft in the stagnation point that will be created by the interaction of the river and revetment A. This will result in an excellent feeding zone with cover for juveniles and adult stream fishes.

Log Specifications for revetment A

Key Members Stacked Members Racked materials

	Max	Min	Max	Min	Max	Min
D _R (ft)	16	8	12	6	8	2
D _B (in)	40	32	31	24	23	14
Total Length (ft)	80	60	60	35	40	20

Log Specifications for revetment B, C, and D

Key Members Stacked Members Racked materials

	Max	Min	Max	Min	Max	Min
D _R (ft)	12	6	12	6	8	2
D _B (in)	31	24	31	24	23	14
Total Length (ft)	80	60	60	35	40	20

Steelhead Haven / Hazel slide Cost Estimates

Material Costs:

Cost of Key members	2500	Cost of Stackers	2000	Cost of Rackers	250	Total Cost: Rackers
Length (ft)	# of Key members	# of Stackers	# of Rackers	Total Cost: Key members	Total Cost: Stackers	Total Cost: Rackers
Revetment #1	1200	80	240	800	200,000	200,000
Revetment #2	500	100	100	250	0	62,500
Revetment #3	500	100	100	250	0	62,500
Revetment #4	100	20	20	50	40,000	12,500
					200,000	337,500
						1,457,500

Total Material Costs

Equipment and Labor:

Units	Cost per hour	Cost per month	Estimated Hours	Estimated Months	Cost	
D8 Dozer	1	145	360		52,200	
Track Grapple 1	1	140	360		50,400	
Track Grapple 2	1	140	360		50,400	
Track Grapple 3	1	100	360		36,000	
Track hoe	1	8600		2	17,200	
Skidder	1	8000		2	16,000	
Tubes	3	49	80		11,760	
Laborers	3	30	360		32,400	
					266,360	
					Total Equipment and labor costs	
					Total Project Costs	1,723,860

Goldbasin Landslide:

Slope failures that occurred in 1998 and 1999 filled the channel that was toe cutting the landslide. This has forced the river away from the landslide and has relocated the river in a desirable location. The objective of revetment A is to prevent the river from eroding its way back through these fines to the toe of the slope re-establishing undesirable conditions. Revetment B is positioned to increase the residence time of flows draining the slide by creating a settling pond for fines. The exact location of revetment B may change based upon optimal site conditions to achieve this goal.

The expected post project conditions would be the same as post construction conditions with the exception of scour pool development local to revetment A. Revetment construction, specifications, and log metrics for Goldbasin slide are the same as those presented for Steelhead Haven. The specifications for revetment A at both sites are identical. Similarly, the specifications for revetment B at Goldbasin are the same as the specifications for revetments B, C, and D at Steelhead Haven.

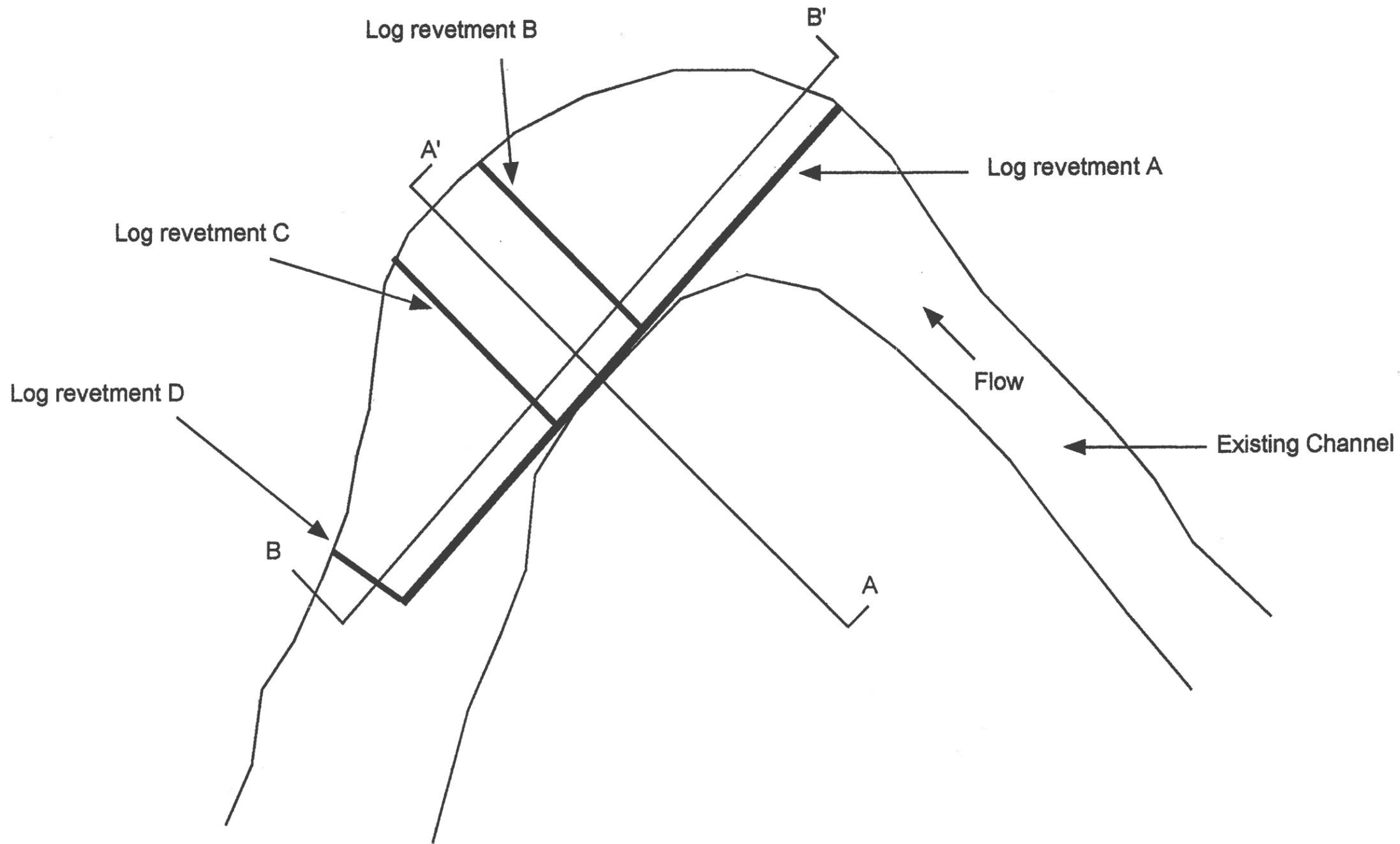
Goldbasin Cost Estimates

Material Costs:

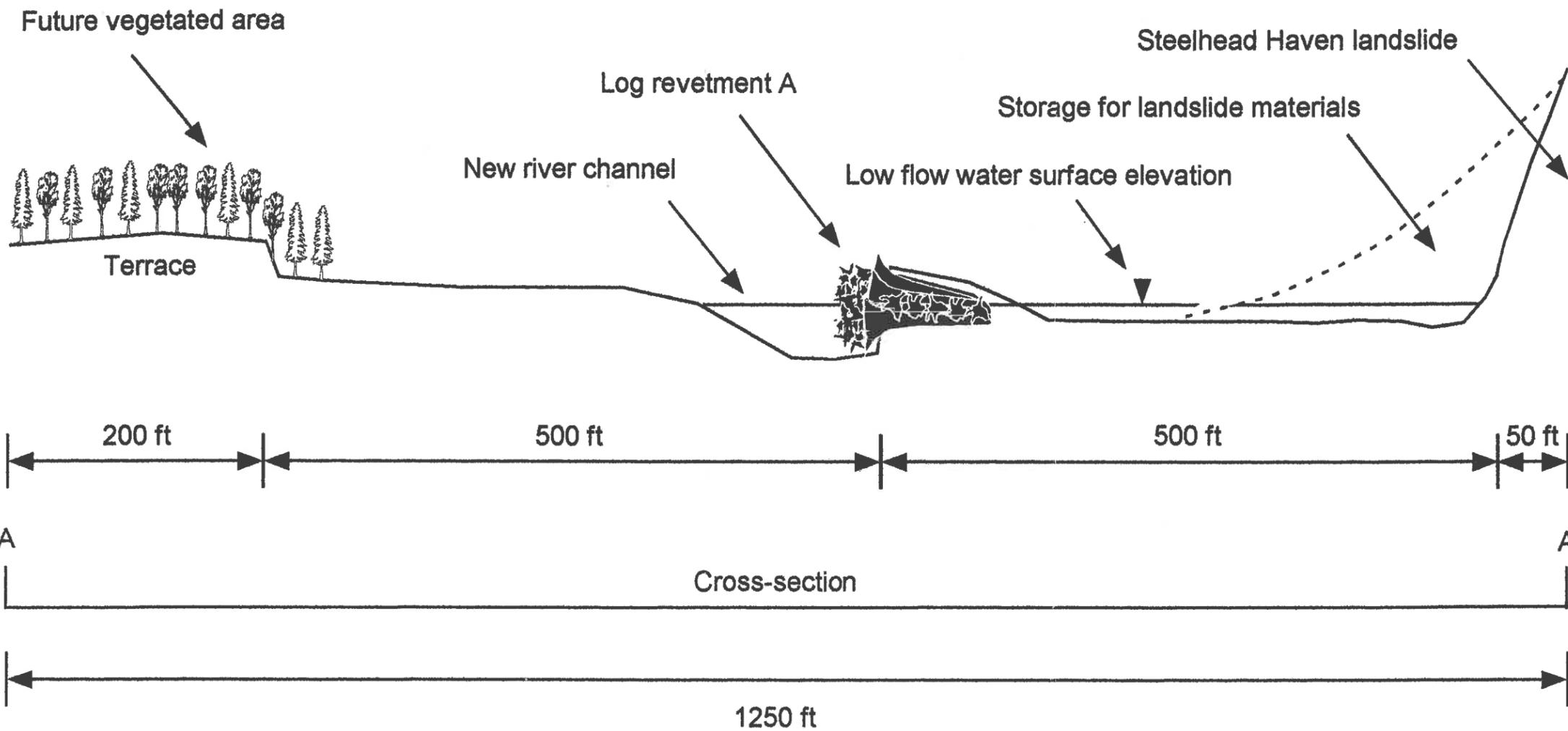
Cost of Key members	2500	Cost of Stackers	2000	Cost of Rackers	250	Total Cost: Key members	Total Cost: Stackers	Total Cost: Rackers	
Length (ft)	# of Key members	# of Stackers	# of Rackers	Total Cost: Key members	Total Cost: Stackers	Total Cost: Rackers			
Revetment #1	300	20	200	50,000	120,000	50,000			
Revetment #2	300	0	100	0	60,000	25,000			
				50,000	180,000	75,000			
				Total Material Costs			305,000		

Equipment and Labor:

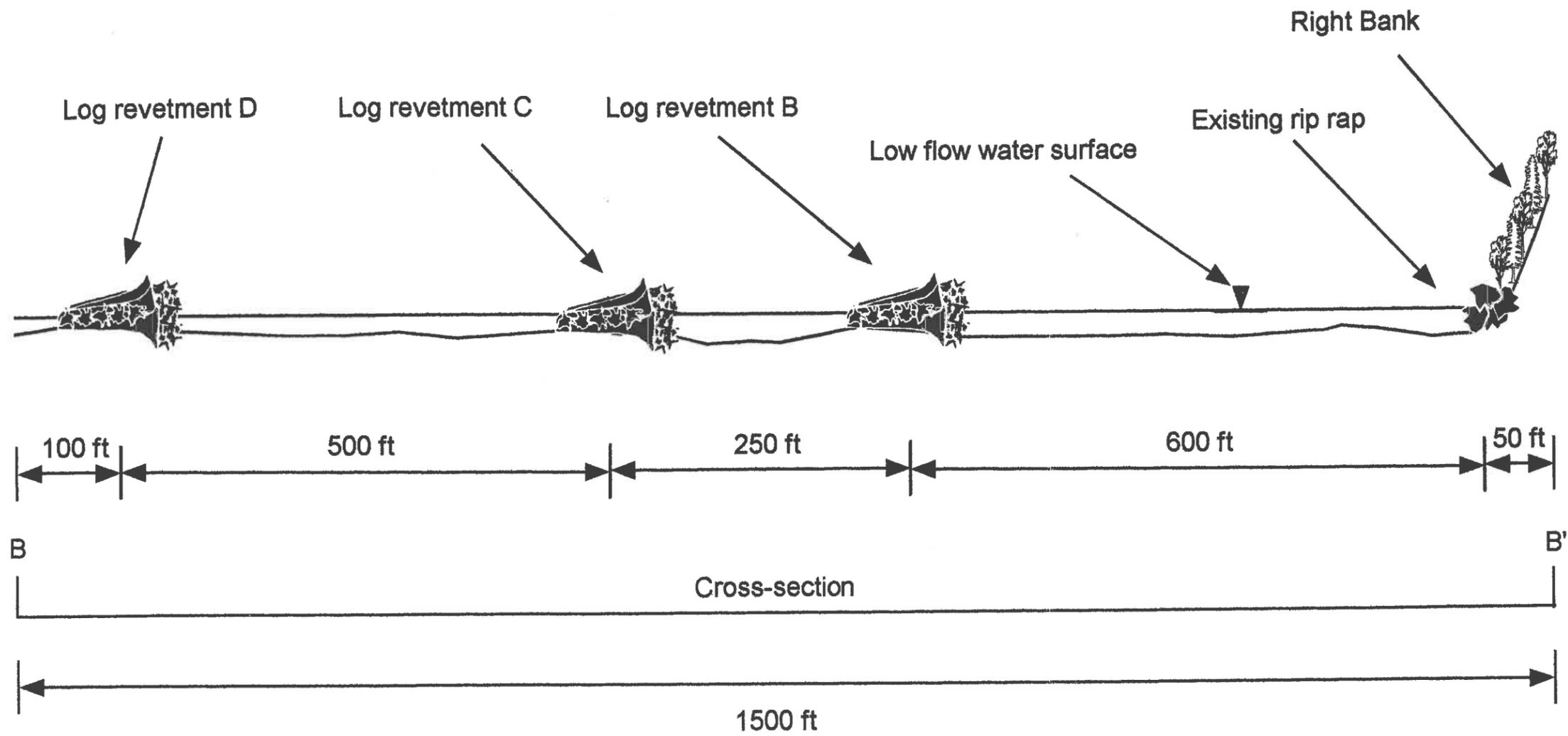
	Units	Cost per hour	Cost per month	Estimated Hours	Estimated Months	Cost
D8 Dozer	1	145		180		26,100
Track Grapple 1	1	140		180		25,200
Track Grapple 2	1	140		180		25,200
Track Grapple 3	1	100		180		18,000
Track hoe	1		8600		2	17,200
Skidder	1		8000		2	16,000
Tubes	3	49		80		11,760
Laborers	3	30		180		16,200
				Total Equipment and labor costs		155,660
				Total Project Costs		460,660



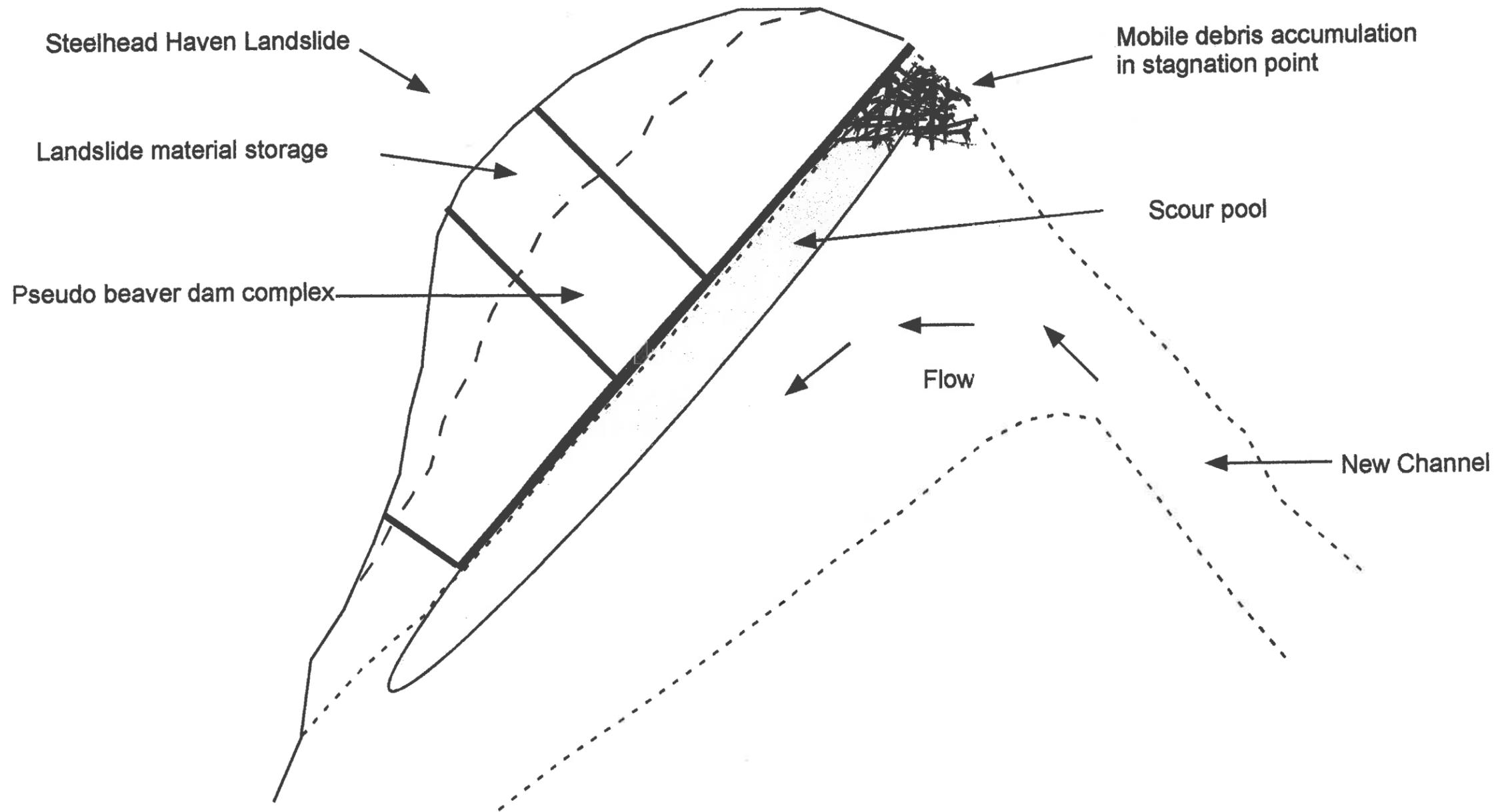
Project: Steelhead Haven Landslide, North Fork Stillaguamish river approximately RM 20.0			
Typical: Plan view of existing conditions and proposed project placement			
Design By	Tracy Drury	Notes	Date
Drawn By	Tracy Drury		1/19/00



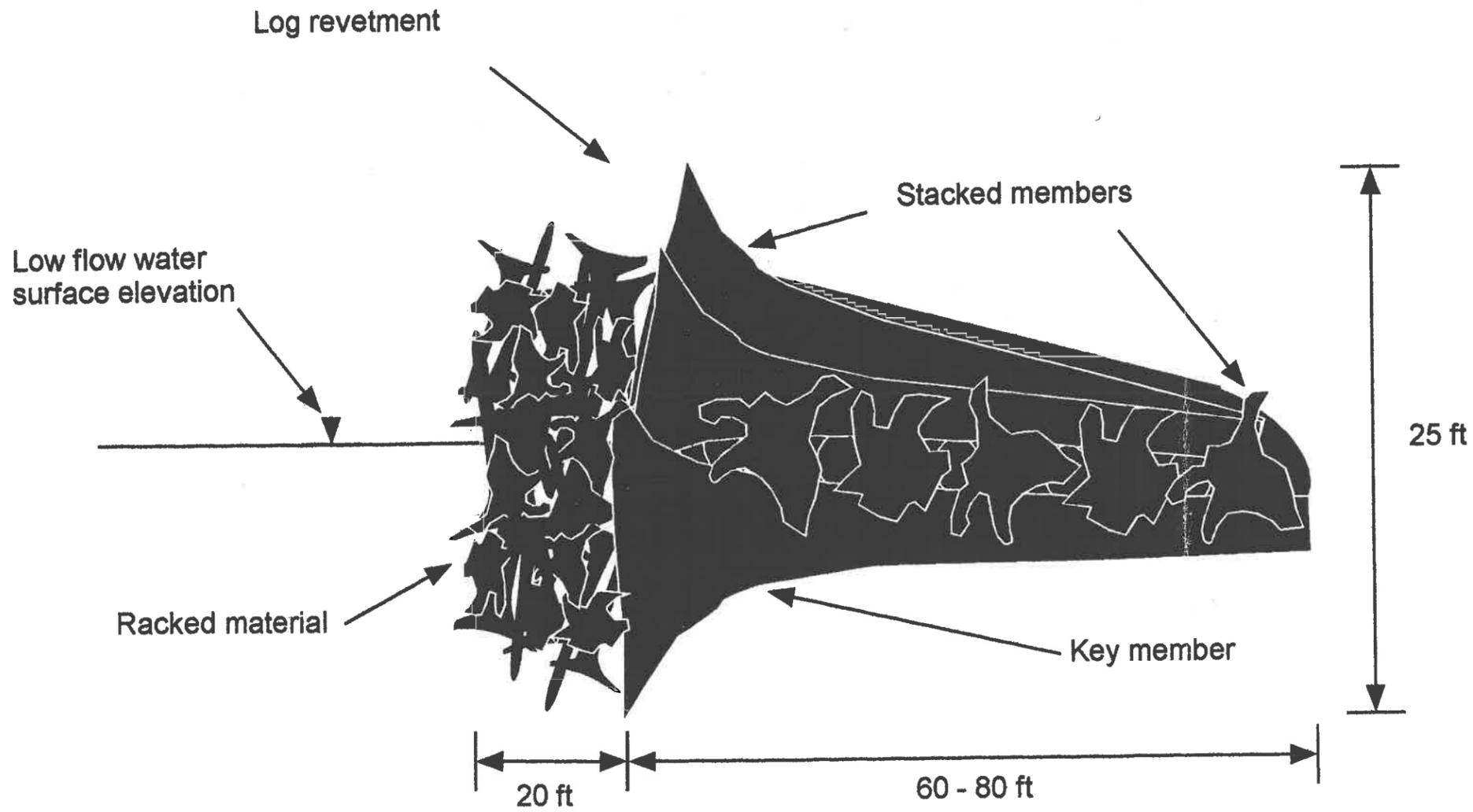
Project: Steelhead Haven Landslide, North Fork Stillaguamish river approximately RM 20.0			
Typical: Expected post project conditions for cross-section A - A'			
Design By	Tracy Drury	Notes	Date
Drawn By	Tracy Drury		1/19/00



Project: Steelhead Haven Landslide, North Fork Stillaguamish river approximately RM 20.0			
Typical: Placement of log revetments B, C, and D and expected conditions for cross-section B - B'			
Design By	Tracy Drury	Notes	Date
Drawn By	Tracy Drury		1/23/00

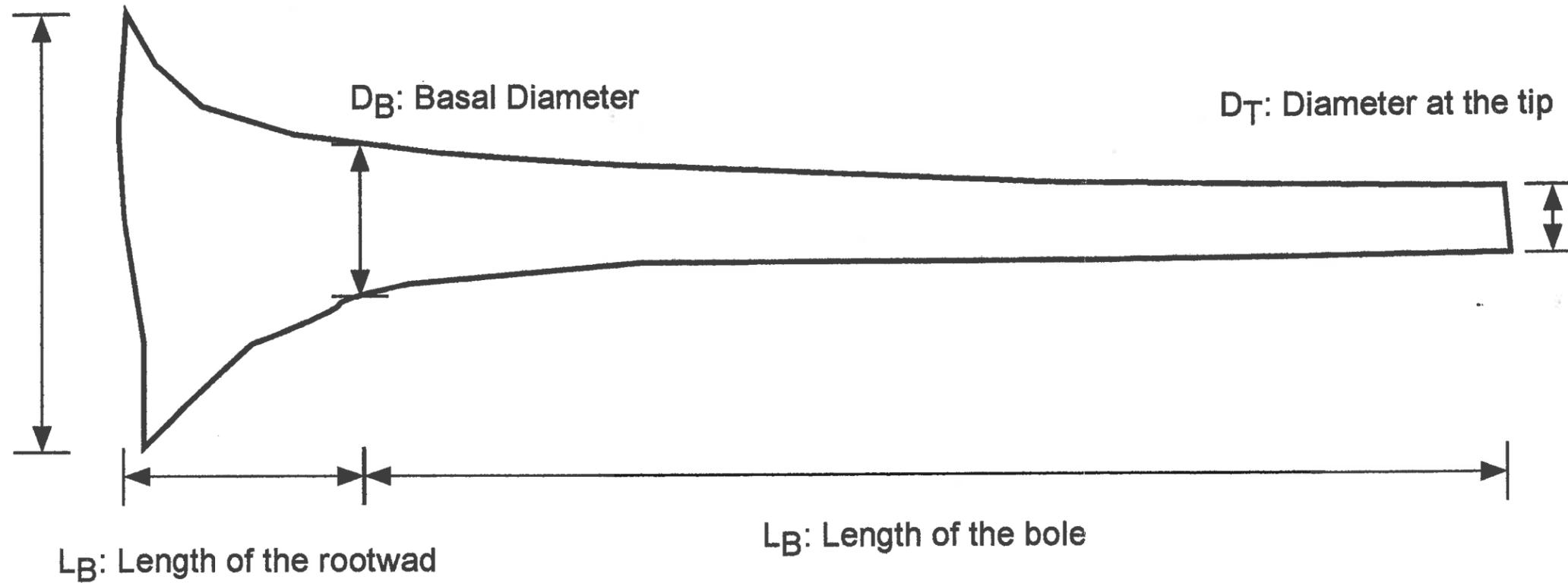


Project: Steelhead Haven Landslide, North Fork Stillaguamish river approximately RM 20.0			
Typical: Plan view of expected post project conditions			
Design By	Tracy Drury	Notes	Date
Drawn By	Tracy Drury		1/19/00

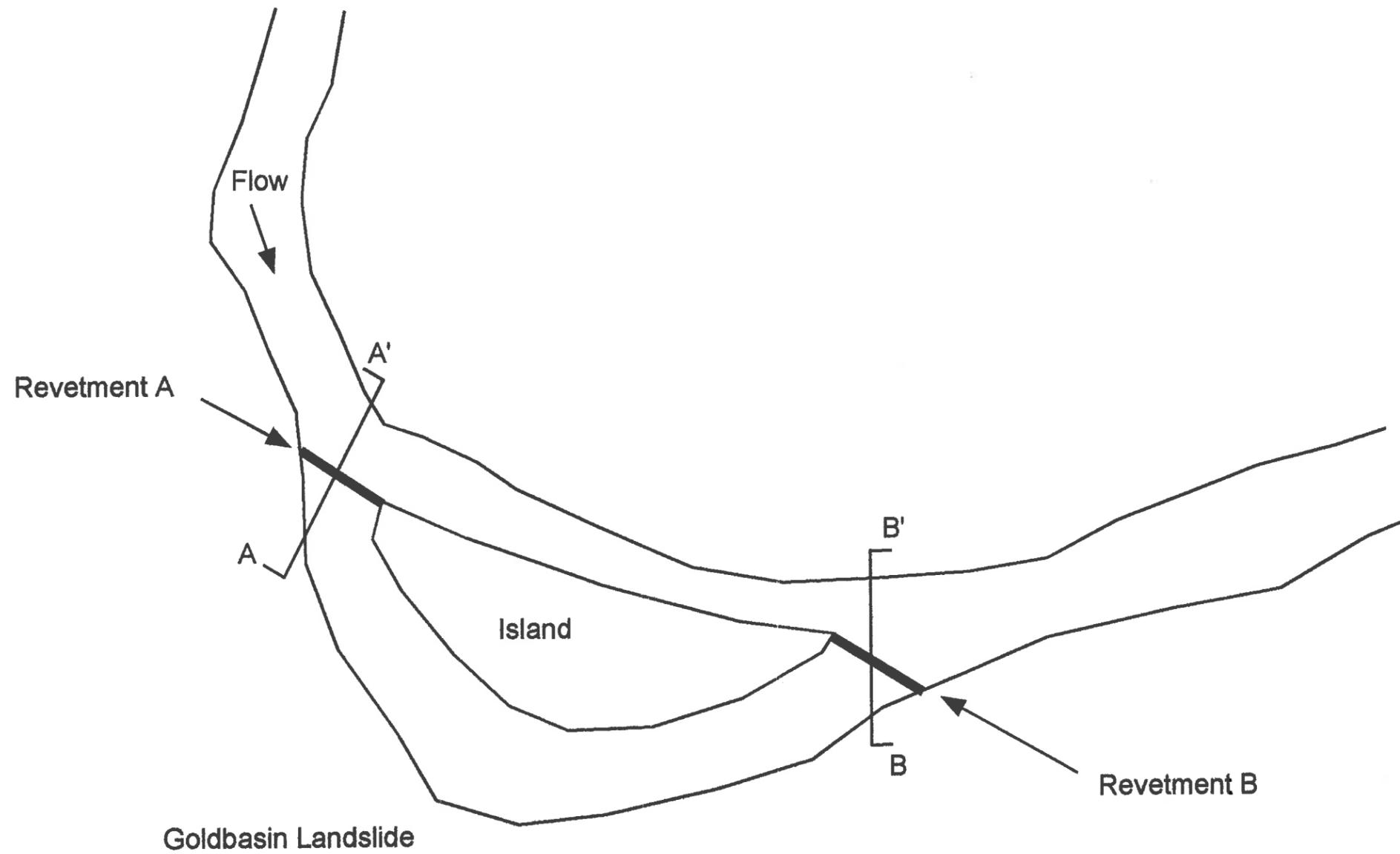


Project: Steelhead Haven Landslide, North Fork Stillaguamish river approximately RM 20.0			
Typical: Cross-section of revetment A			
Design By	Tracy Drury	Notes	Date
Drawn By	Tracy Drury		1/19/00

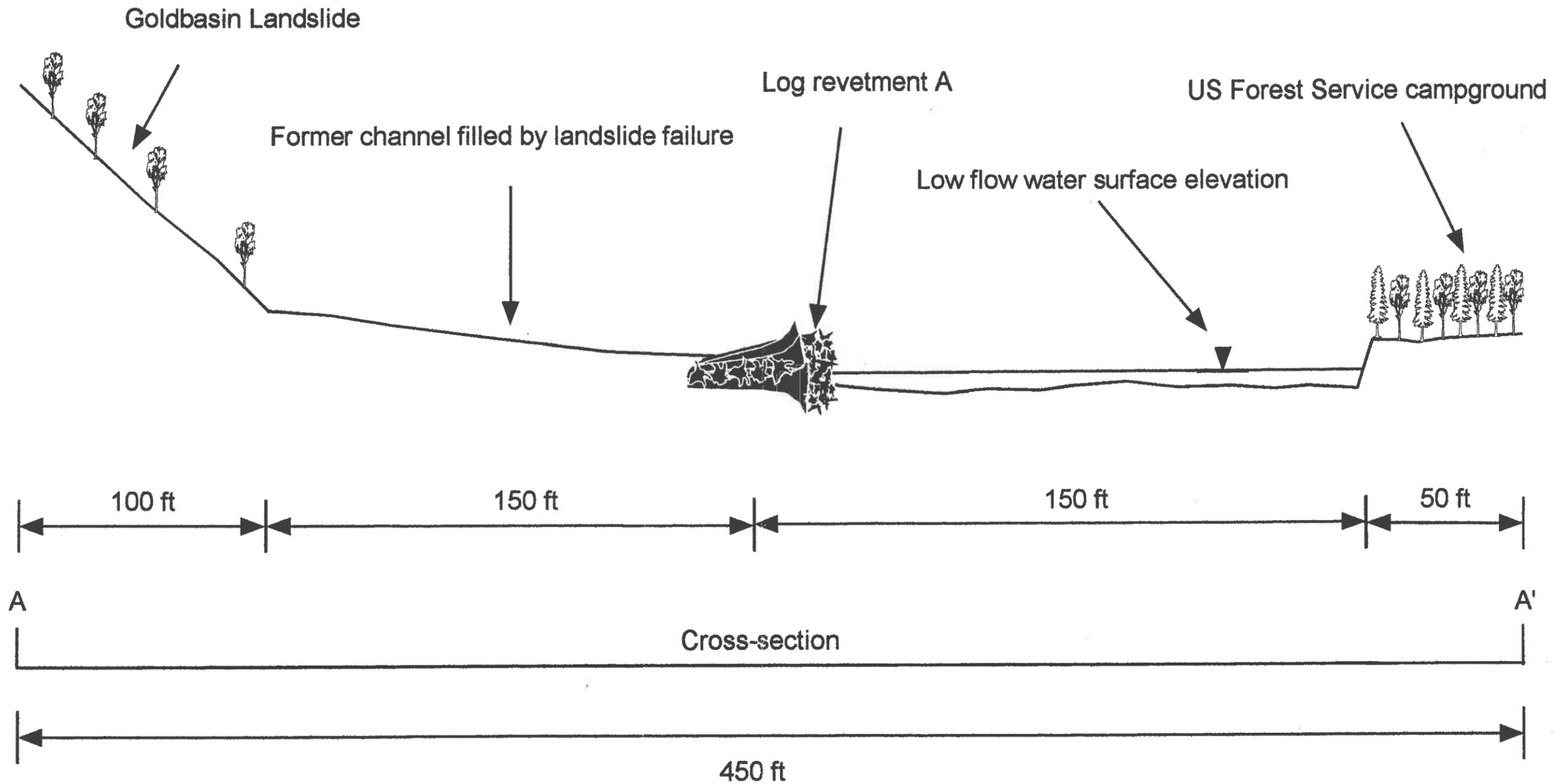
D_R : Diameter of Rootwad



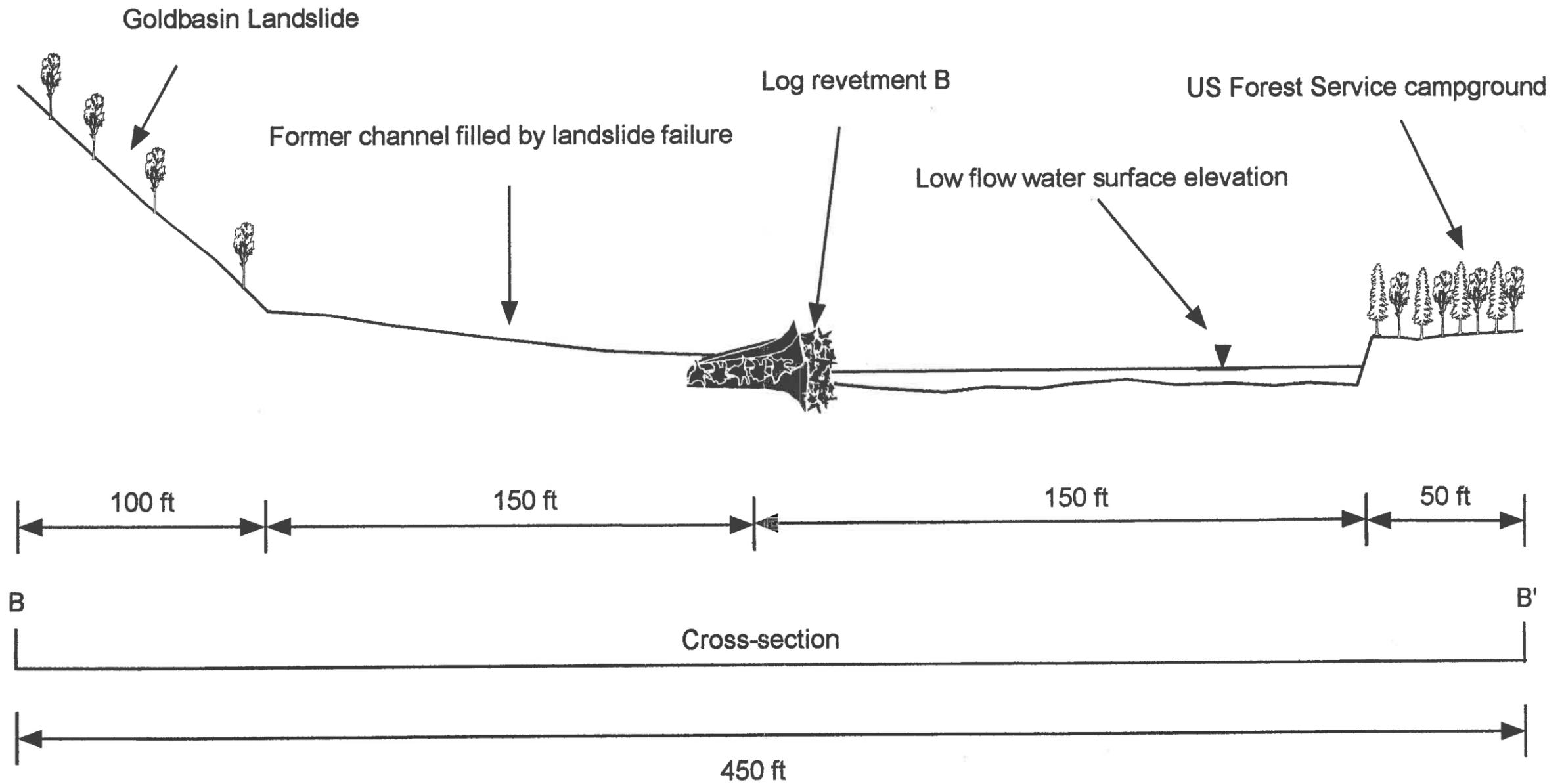
Project: Steelhead Haven Landslide, North Fork Stillaguamish river approximately RM 20.0			
Typical: Definition of log characteristic metrics			
Design By	Tracy Drury	Notes	Date
Drawn By	Tracy Drury		1/25/00



Project: Goldbasin Landslide, South Fork Stillaguamish river at Verlot			
Typical: Plan view of existing conditions and proposed project placement			
Design By	Tracy Drury	Notes	Date
Drawn By	Tracy Drury		1/27/00



Project: Goldbasin Landslide, South Fork Stillaguamish river at Verlot			
Typical: Proposed placement of log revetment A and existing conditions for cross-section A - A'			
Design By	Tracy Drury	Notes	Date
Drawn By	Tracy Drury		1/27/00



Project: Goldbasin Landslide, South Fork Stillaguamish river at Verlot			
Typical: Proposed placement of log revetment B and existing conditions for cross-section B - B'			
Design By	Tracy Drury	Notes	Date
Drawn By	Tracy Drury		1/27/00