



## APPENDIX H: CRITICAL RIFFLE ANALYSIS

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Critical riffle analysis is an empirical instream flow method used to identify minimum streamflows allowing suitable passage for salmon and steelhead, as well as maintaining habitat connectivity. Riffles contribute multiple functions in coldwater streams, and are integral to the life histories of salmon and trout. Many aquatic macroinvertebrates develop in riffles, providing a food source for salmonids. Riffles also provide salmonids with well mixed, oxygenated water, and escape shelter from predators. "Critical Riffles" are exceptionally shallow and therefore extremely sensitive to changes in streamflow. During low-flows, their depths can limit connectivity of stream habitat and impede critical life history tactics of salmon and steelhead as well as becoming potential barriers to fish passage (CDFW 2012). For the Sproul Creek critical riffle analysis, we followed the 2012 CDFW - *Standard Operating Procedure for Critical Riffle Analysis for Fish Passage in California* (DFG-IFP-001).

Critical riffle analysis assesses streamflow thresholds for young-of-the-year (YOY), 1 and 2+ juvenile and adult salmonid passage, based on the assumption that passage is not impeded if the depth threshold is exceeded over 25% of the wetted stream width or a contiguous 10% of the wetted stream width. Percentage total passage and percentage contiguous passage for each life stage at each cross section were plotted against streamflow. Passage depth criteria were applied to the curves to determine streamflow thresholds for four salmonid life stages: the depth criteria are 0.9 ft for adult Chinook salmon, 0.7 ft for adult steelhead and coho salmon passage, 0.4 ft for age 1-2+ juvenile salmonids (including downstream-migrating smolts), and 0.3 ft for juvenile salmonid YOY.

### **Methods**

In the moderate-to-low-flow range, critical riffle sites were selected according to CDFW protocol, where habitat surveys of reaches are used to rank the depth of each riffle crest. Riffles within the reach with shallowest pool tail depths are then selected as candidate sites. Candidate sites must be low gradient riffles, without features like logjams or ledges. A lack of suitable critical riffle sites within our two study reaches required additional habitat surveys and site selections from adjacent reaches. See Appendix A for description of Study Reach habitat surveys.



Streamflow for each sample event was taken from rating curve hydrographs at each study site (Appendix B). Streamflow from West Branch of South Fork was added for sites downstream of the USF study reach (USF cross sections 8+10 and 6+40). The site above the UMS reach (UMS cross section 35+00) had the estimated streamflow contribution of Dry Tributary subtracted. Dry Tributary (drainage area = 0.6 mi<sup>2</sup>) flow estimates were derived by scaling-down the streamflow at Lower Mainstem Sproul (drainage area = 24 mi<sup>2</sup>). Thus the streamflow estimate for Dry tributary was derived from the following equation: Dry Tributary streamflow = Lower Mainstem Sproul Creek streamflow x (0.6/24).

As dictated by protocol, the maximum transect length is set to the wetted width at the highest sample event. We sampled at the highest wadable flows, to ensure that maximum transect lengths were at or near the active channel margins. In one case, UMS cross section 10+10, we were unable to sample a streamflow sufficiently high to meet the 0.9 ft depth criteria over 25% of the total channel. Sample dates and streamflows are presented in Table 2.

The Standard Operating Procedure (SOP) document (CDFW 2012) instructs users to “plot the *relevant* values... and generate a best fit line”. Examples provided in the SOP show a single linear regression fit through all available data points. We followed these examples in our analysis, based on a strict interpretation of the SOP document. However, we found that analyzing passage over a broad range of streamflows often resulted in poor-fitting regression lines. We fit multiple types of regression line (linear, log, power) through the critical riffle data points. Based on R-squared values, a linear regression trendline was the best overall fit for the data. Regression lines fit through all the data at once sometimes yielded negative streamflow for passage criteria. In these cases, our results present a streamflow of zero, rather than a negative value (Table 1). Percent passage vs. streamflow graphs using the linear regression lines, following the CDFW SOP, are presented in Figures H-2-29.

To better utilize the range of data collected, we presented a method of determining passage streamflows, where points on the percent passage vs. streamflow graph were connected with line segments. The relevant line segments were then used as regression lines to determine streamflow at passage thresholds. This method is identical to the method used in McBain Associates’ site specific study on Indian Creek in the Navarro River (2016). Results from this alternate method are summarized in Table 2. Percent passage vs. streamflow graphs using this preferred method are presented in Figures H-30-57.

Streamflow thresholds resulting from this Critical Riffle analysis generally agreed with a fisheries expert’s visual assessment of passability. One exception to this general agreement occurred at Upper Mainstem cross section 10+10 (the most limiting riffle to passage of the reach). Visual assessment of this riffle revealed this cross section to be passable to adult Chinook salmon at the measured streamflow of 58 cfs, whereas the critical riffle method yielded a minimum passage flow of 124 cfs or higher.

*Table 1. Summary of Critical Riffle minimum streamflows using Standard Operating Procedure (CDFW 2012) which meet passage criteria for adult Chinook salmon (0.9 ft), adult Coho salmon and steelhead (0.7 ft), age 2+ trout (0.4 ft), and juvenile salmonids (0.3 ft). For each reach, Upper Mainstem (UMS, 17 mi<sup>2</sup>) and the Upper South Fork (USF, 5 mi<sup>2</sup>), the average minimum streamflow meeting passage criteria is shown, along with a the resulting streamflow criteria protective of each critical life stage. A zero value indicates that the regression through all points yielded a negative streamflow value.*

Reach	Cross Section	Site Name	0.9 ft Depth Criteria		0.7 ft Depth Criteria		0.4 ft Depth Criteria		0.3 ft Depth Criteria	
			Streamflow (cfs) for 25% Total Passage	Streamflow (cfs) for 10% Contiguous Passage	Streamflow (cfs) for 25% Total Passage	Streamflow (cfs) for 10% Contiguous Passage	Streamflow (cfs) for 25% Total Passage	Streamflow (cfs) for 10% Contiguous Passage	Streamflow (cfs) for 25% Total Passage	Streamflow (cfs) for 10% Contiguous Passage
UMS	1+50	CR1	94.2	53.9	57.9	32.5	22.4	0	4.2	3.1
UMS	10+10	CR2	155.9	138.1	63.3	52.4	22.4	11.7	9.2	0
UMS	35+00	CR19a	60.5	39.2	41.8	29.0	25.1	18.8	16.4	14.9
Reach Average			97.7	72.5	54.3	38.0	23.3	11.6	9.9	7.3
Resulting Criteria			97.7		54.3		23.3		9.9	
USF	7+50	CR13	41.8	21.3	20.2	7.7	0	0	0	0
USF	10+00	CR17	88.7	29.6	49.8	15.1	17.0	0	9.0	0
USF	-(8+10)'	CR19a	41.5	20.2	19.2	0	0	0	0	0
USF	-(6+40)'	CR23a	76.7	33.8	61.9	25.0	33.7	0	0	0
Reach Average			62.2	26.2	37.8	13.8	14.9	3.1	6.1	2.6
Resulting Criteria			62.2		37.8		14.9		6.1	

*Table 2. Summary of Critical Riffle minimum streamflows using alternate method (see McBain and Associates 2014) which meet passage criteria for adult Chinook salmon (0.9 ft), adult Coho salmon and steelhead (0.7 ft), age 2+ trout (0.4 ft), and juvenile salmonids (0.3 ft). For each reach, Upper Mainstem (UMS, 17 mi<sup>2</sup>) and the Upper South Fork (USF, 5 mi<sup>2</sup>), the average minimum streamflow meeting passage criteria is shown, along with the resulting streamflow criteria protective of each critical life stage.*

Reach	Cross Section	Site Name	0.9 ft Depth Criteria		0.7 ft Depth Criteria		0.4 ft Depth Criteria		0.3 ft Depth Criteria	
			Streamflow (cfs) for 25% Total Passage	Streamflow (cfs) for 10% Contiguous Passage	Streamflow (cfs) for 25% Total Passage	Streamflow (cfs) for 10% Contiguous Passage	Streamflow (cfs) for 25% Total Passage	Streamflow (cfs) for 10% Contiguous Passage	Streamflow (cfs) for 25% Total Passage	Streamflow (cfs) for 10% Contiguous Passage
UMS	1+50	CR1	86.8	41.0	51.2	32.5	22.4	4.4	4.2	3.1
UMS	10+10	CR2	138.3	124.4	65.5	78.2	13.0	4.9	5.8	4.1
UMS	35+00	CR19a	69.6	34.6	41.5	26.7	21.2	16.0	15.4	10.8
Reach Average			98.2	66.6	52.7	45.8	18.9	8.4	8.4	6.0
Resulting Criteria			98.2		52.7		18.9		8.4	
USF	7+50	CR13	25.2	25.3	10.2	7.7	3.2	2.5	2.6	1.9
USF	10+00	CR17	64.0	5.3	35.1	4.5	4.7	1.5	4.4	1.1
USF	-(8+10)'	CR19a	22.8	19.8	10.6	7.8	4.8	3.0	4.2	2.3
USF	-(6+40)'	CR23a	68.4	26.8	30.3	20.6	7.4	4.3	6.7	3.5
Reach Average			45.1	19.3	21.5	10.1	5.0	2.8	4.5	2.2
Resulting Criteria			45.1		21.5		5.0		4.5	

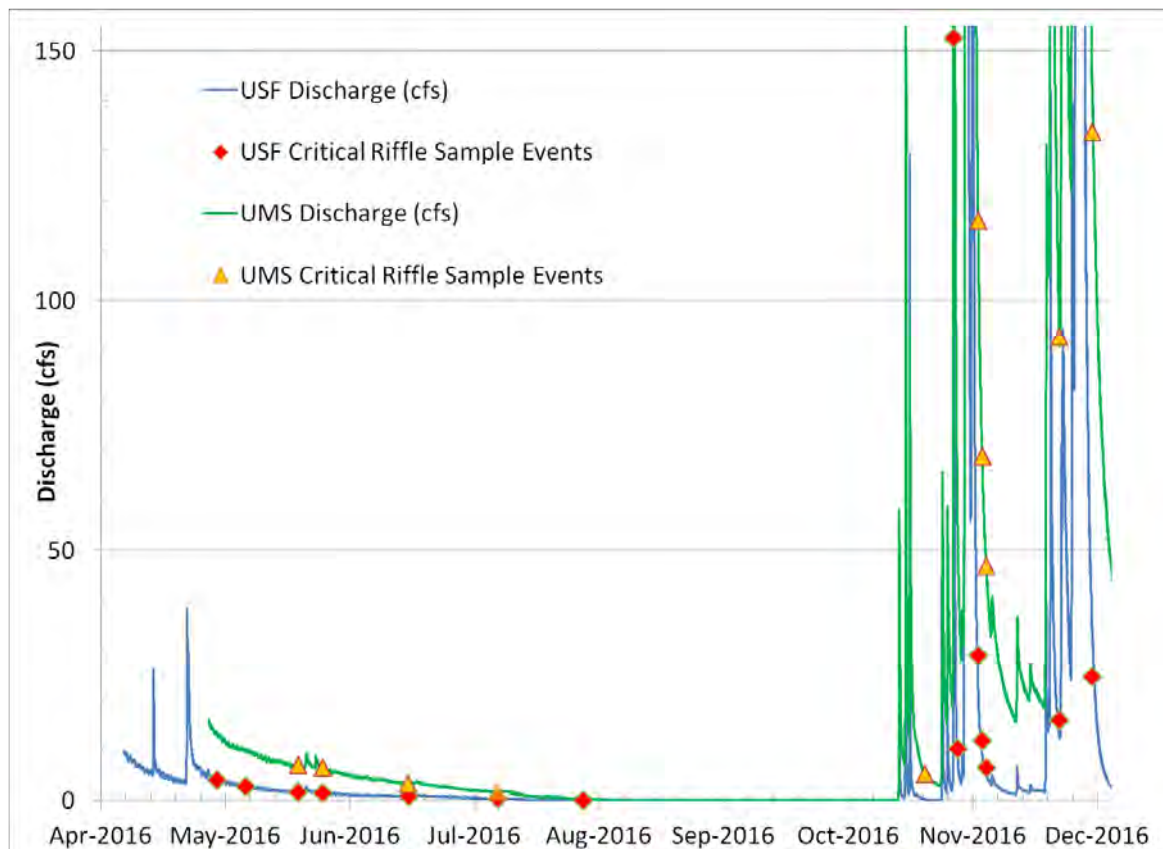


Figure H-1. Critical Riffle sample dates and hydrographs showing range of streamflow conditions on Upper Mainstem (UMS) and Upper South Fork (USF) Sproul Creek. Adult passage typically occurs during elevated fall-winter flows, while juvenile passage criteria are more relevant during the hydrograph's spring recession limb and summer baseflows.

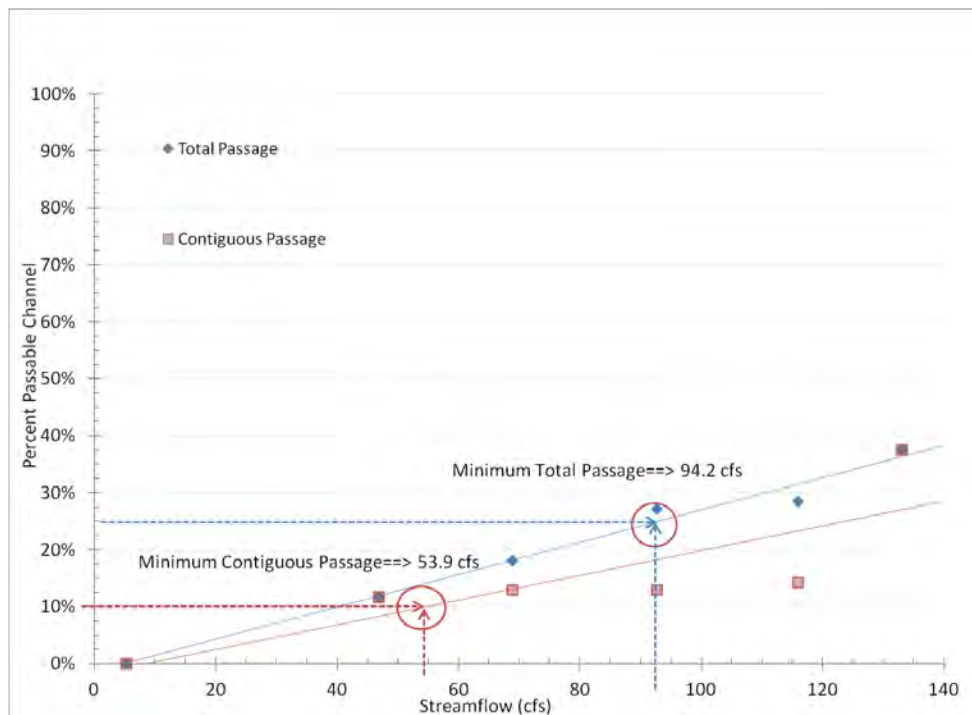


Figure H2. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section 1+50 in Upper Mainstem (UMS) Sproul Creek.

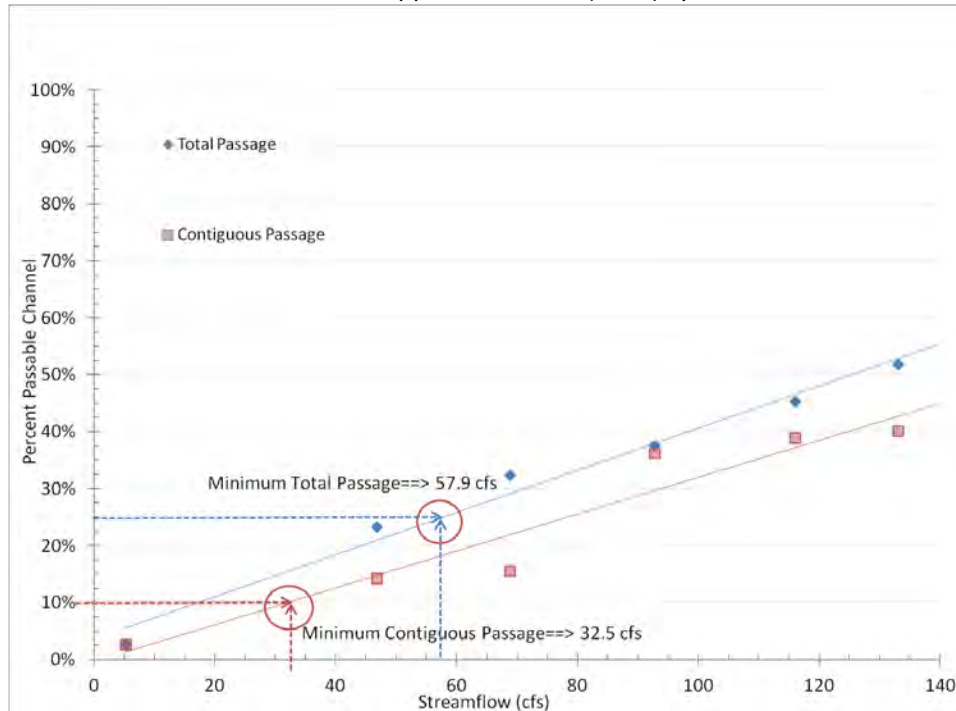


Figure H-3. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Coho Salmon and steelhead at cross section 1+50 in Upper Mainstem (UMS) Sproul Creek.

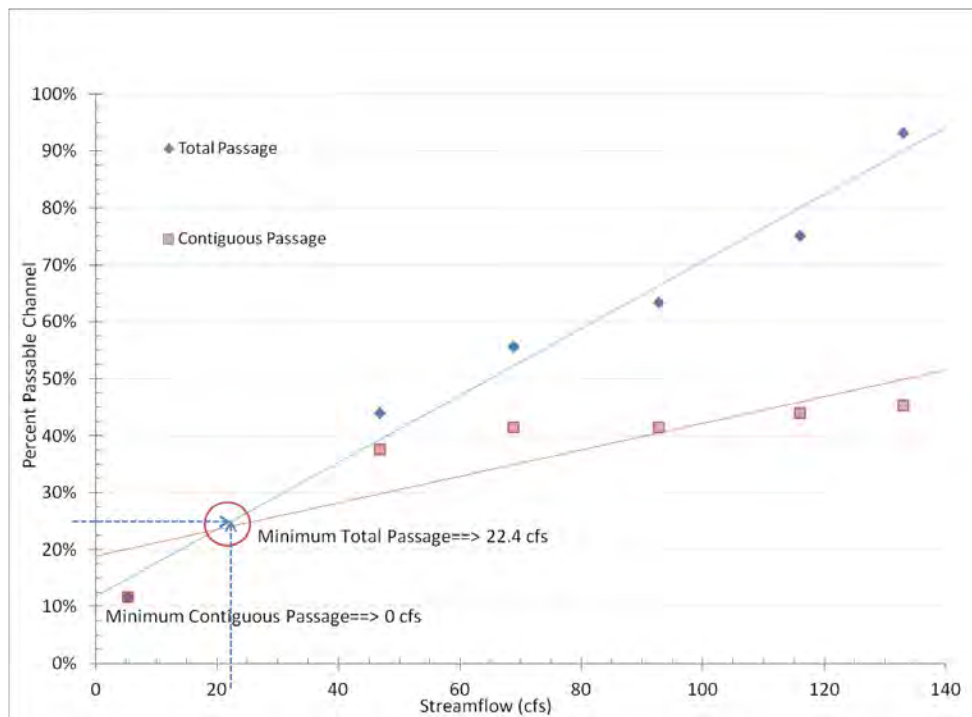


Figure H-4. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section 1+50 in Upper Mainstem (UMS) Sproul Creek.

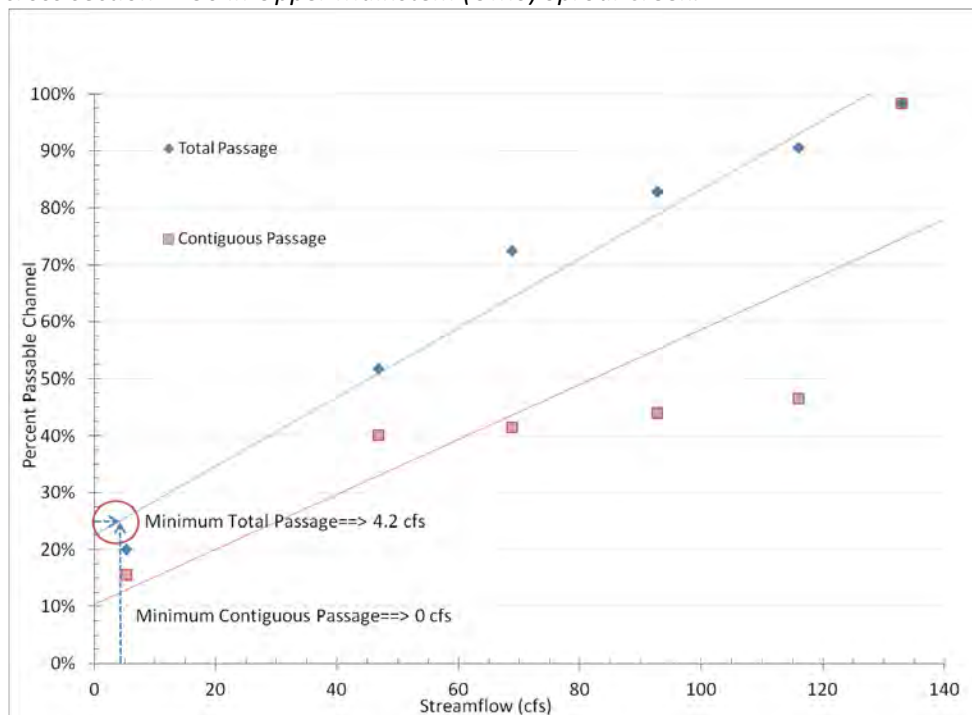


Figure H-5 Percent total passage (25%) and percent contiguous passage (10%) curves for juvenile salmonids at cross section 1+50 in Upper Mainstem (UMS) Sproul Creek.



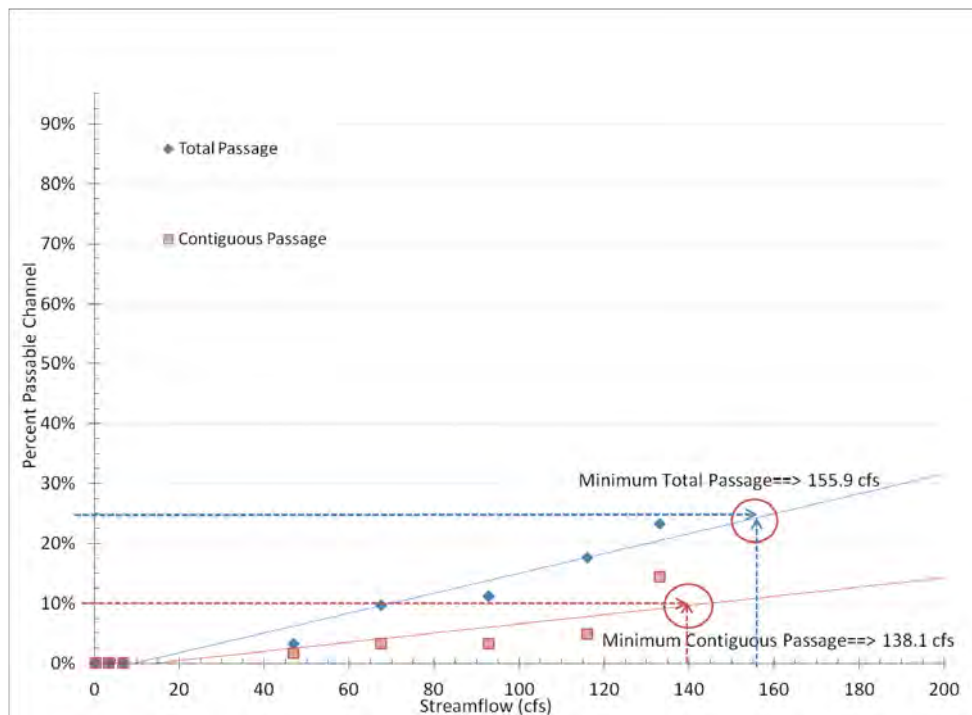


Figure H-6 Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section 10+10 in Upper Mainstem (UMS) Sproul Creek.

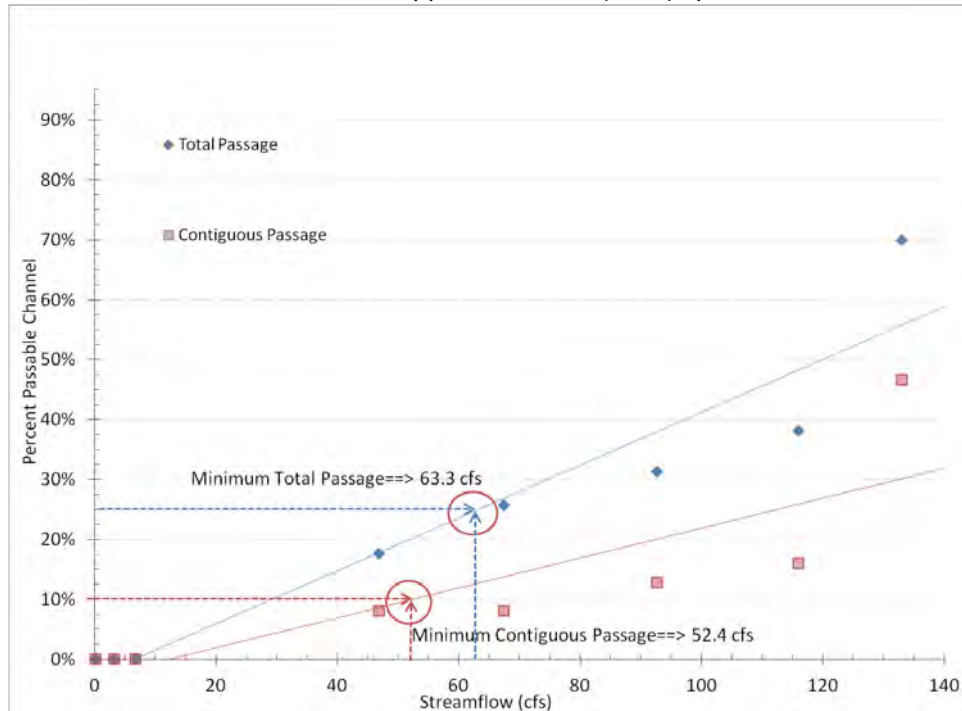


Figure H-7. Percent total passage (25%) and percent contiguous passage (10%) curves for adult coho salmon and steelhead at cross section 10+10 in Upper Mainstem (UMS) Sproul Creek.



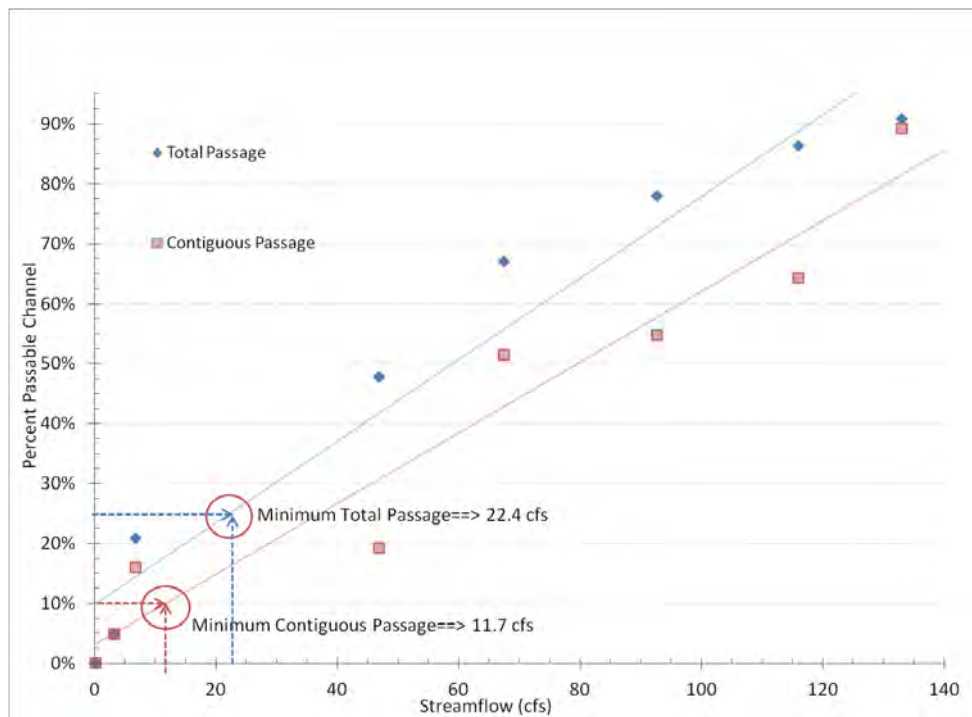


Figure H-8. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section 10+10 in Upper Mainstem (UMS) Sproul Creek.

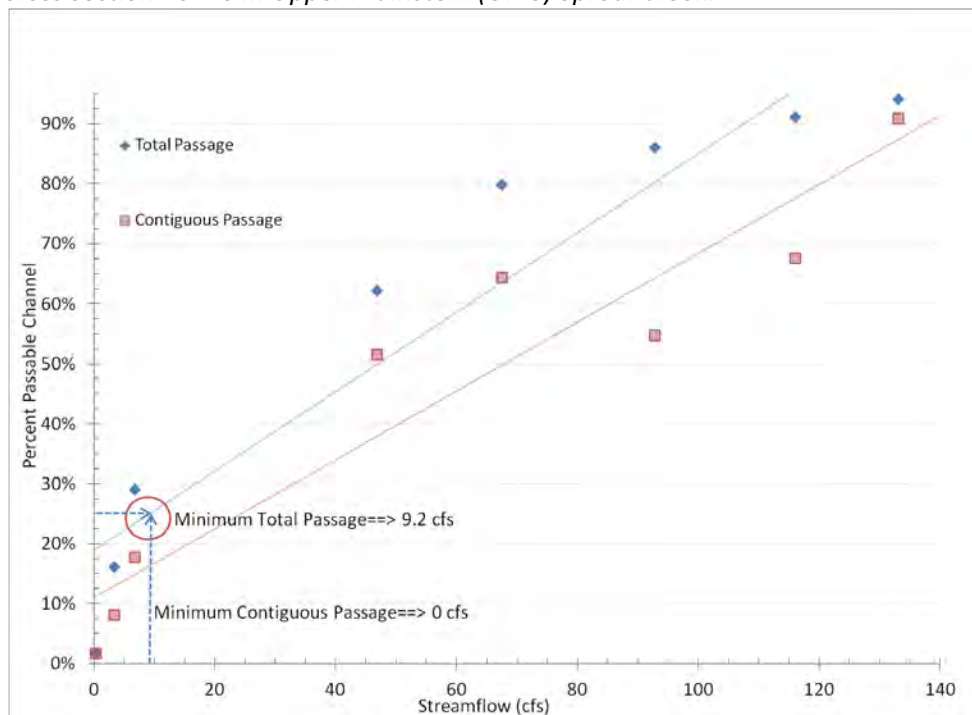


Figure H-9. Percent total passage (25%) and percent contiguous passage (10%) curves for juvenile salmonids at cross section 10+10 in Upper Mainstem (UMS) Sproul Creek.

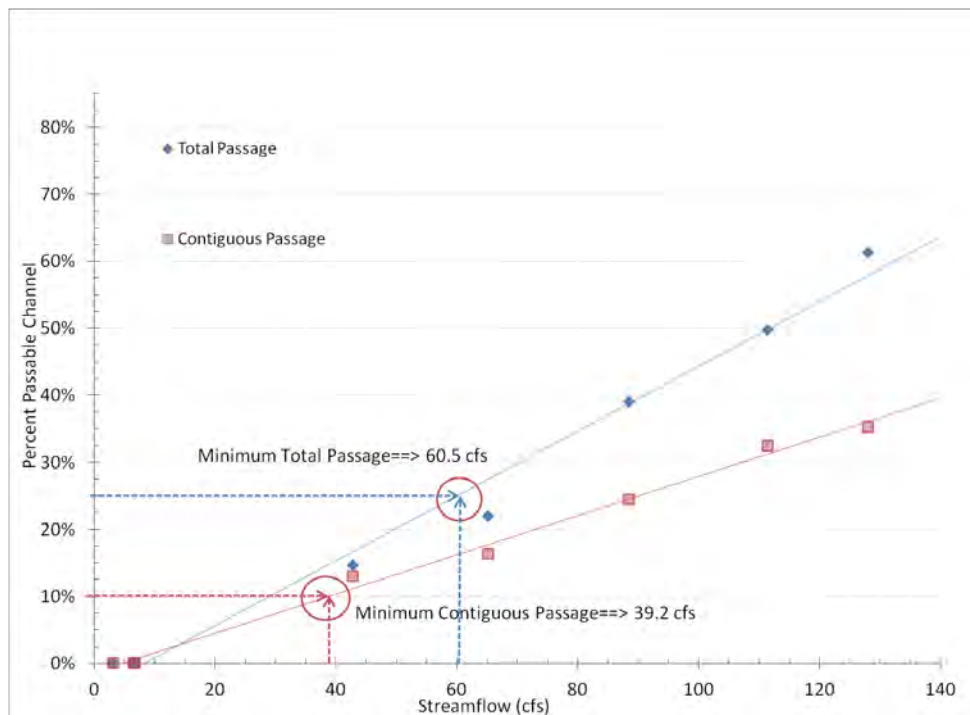


Figure H-10. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section 35+00 in Upper Mainstem (UMS) Sproul Creek.

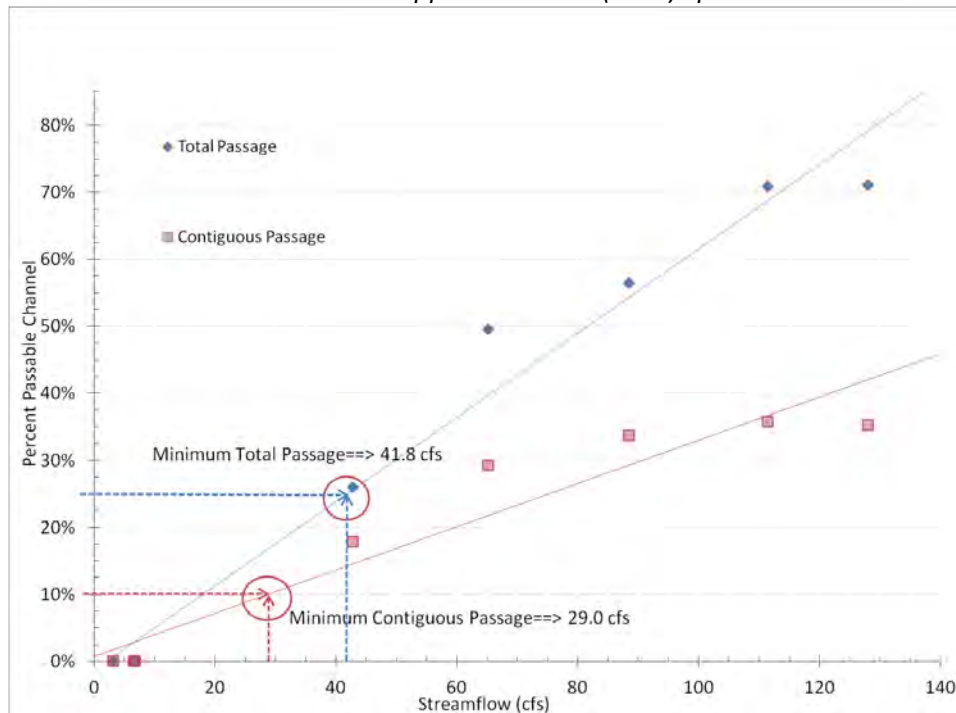


Figure H-11. Percent total passage (25%) and percent contiguous passage (10%) curves for adult coho salmon and steelhead at cross section 35+00 in Upper Mainstem (UMS) Sproul Creek.

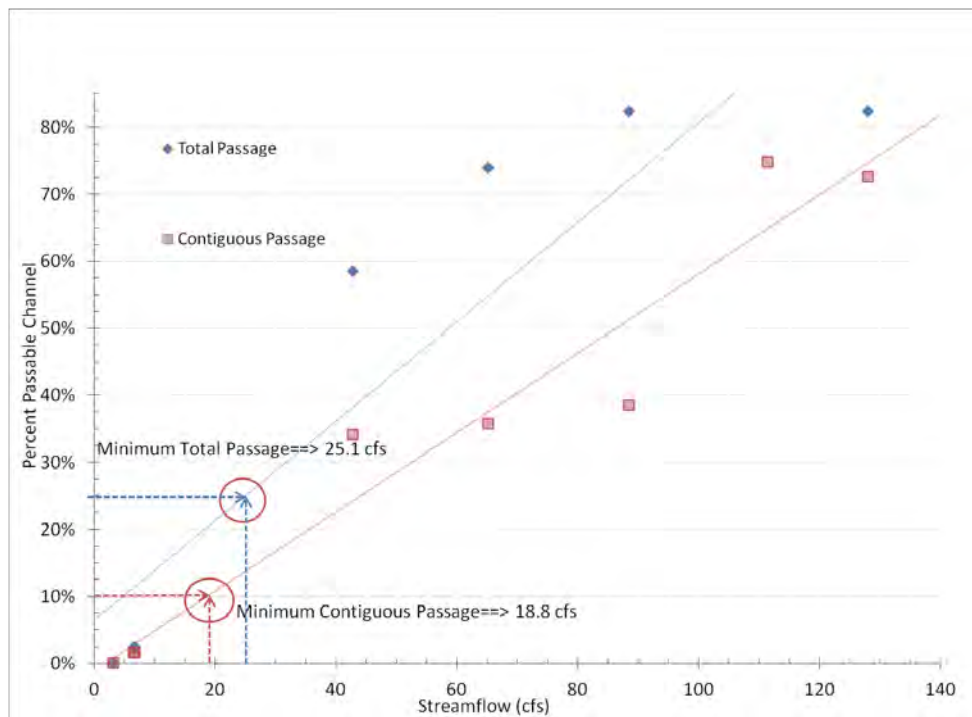


Figure H-12. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section 35+00 in Upper Mainstem (UMS) Sproul Creek.

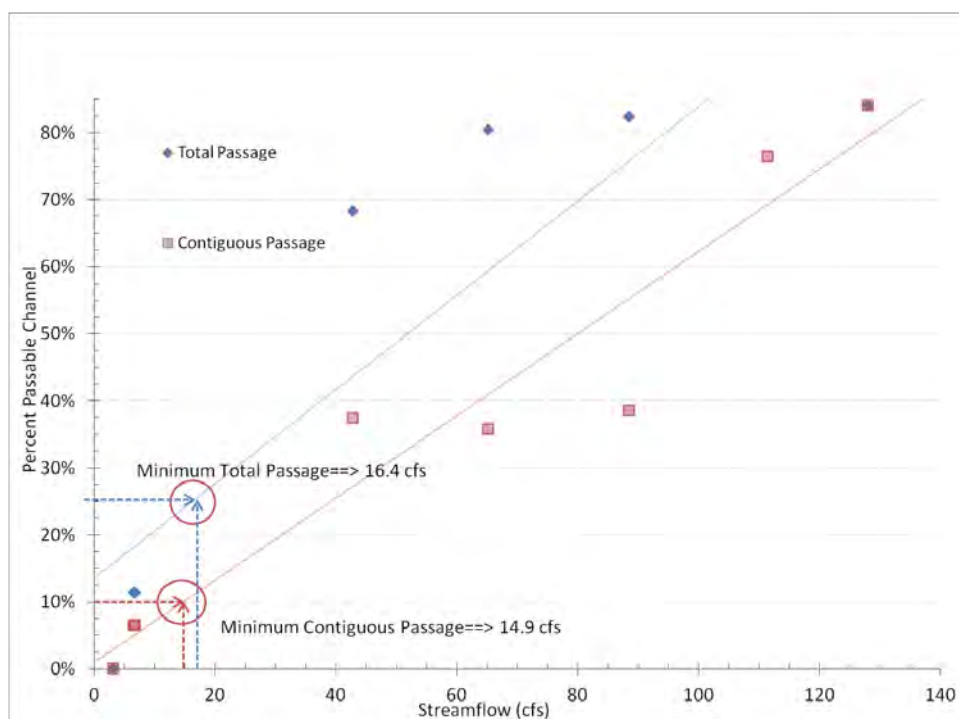


Figure H-13. Percent total passage (25%) and percent contiguous passage (10%) curves for juvenile salmonids at cross section 35+00 in Upper Mainstem (UMS) Sproul Creek.

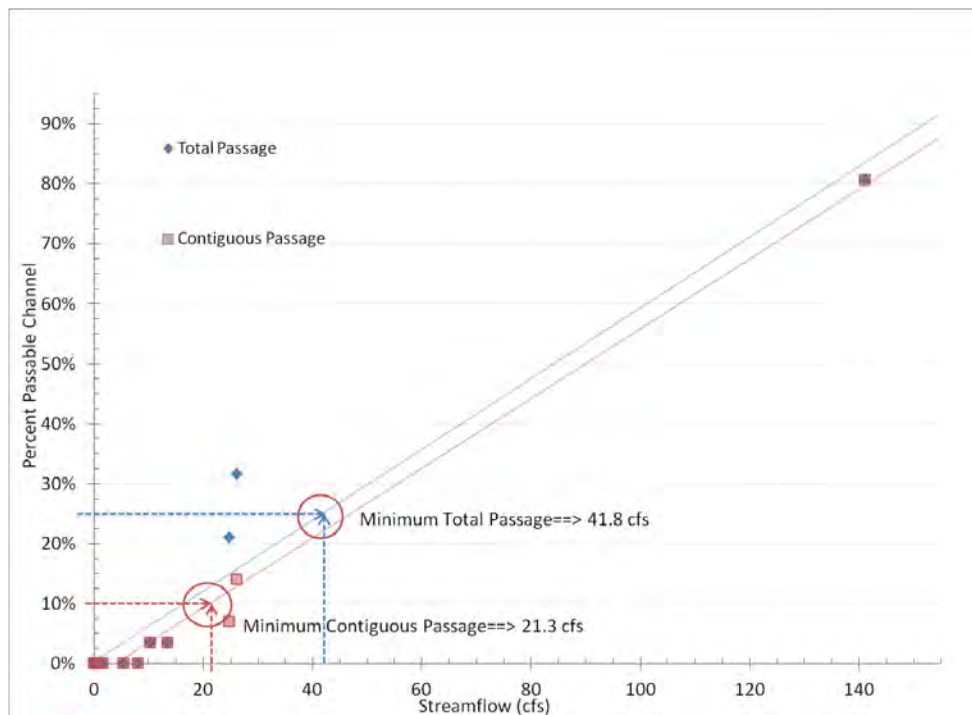


Figure H-14. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section 7+50 in Upper South Fork (USF) Sproul Creek.

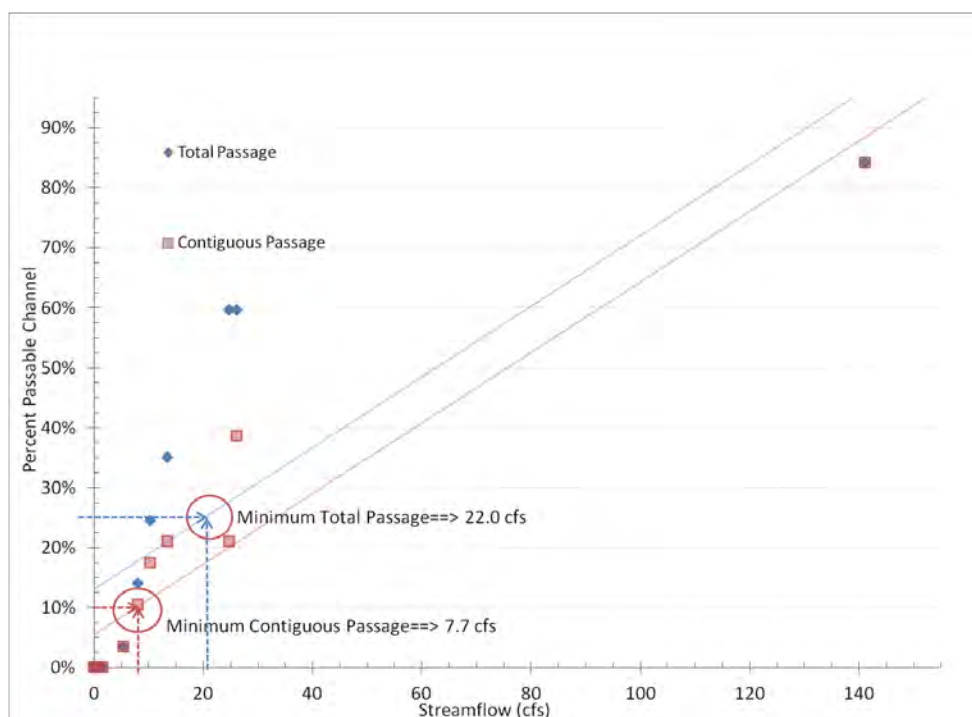


Figure H-15. Percent total passage (25%) and percent contiguous passage (10%) curves for adult coho salmon and steelhead at cross section 7+50 in Upper South Fork (USF) Sproul Creek.

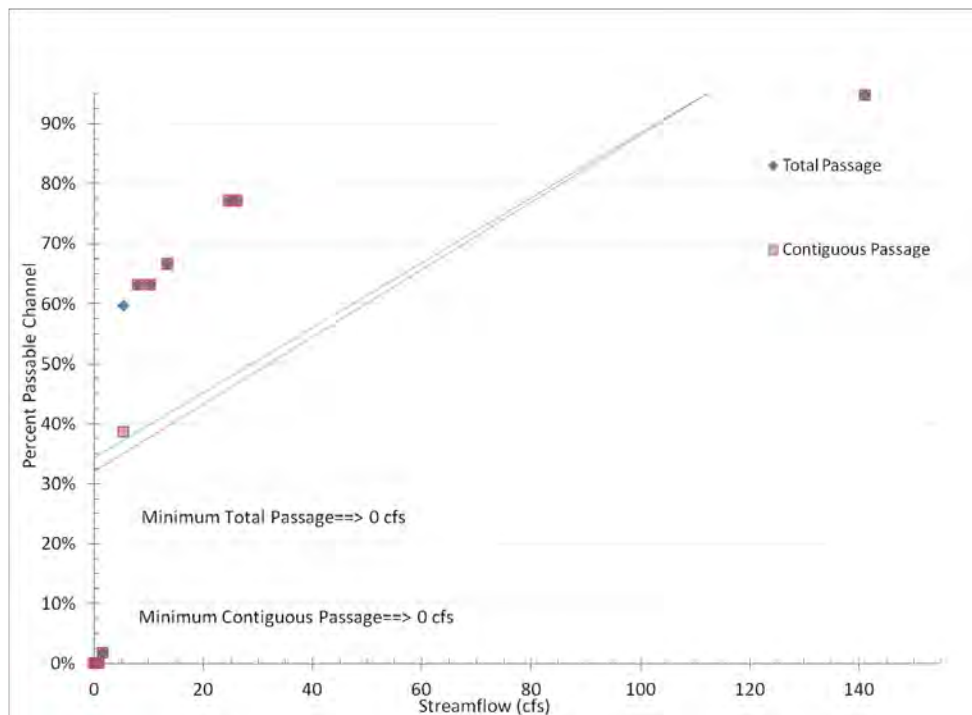


Figure H-16. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section 7+50 in Upper South Fork (USF) Sproul Creek.

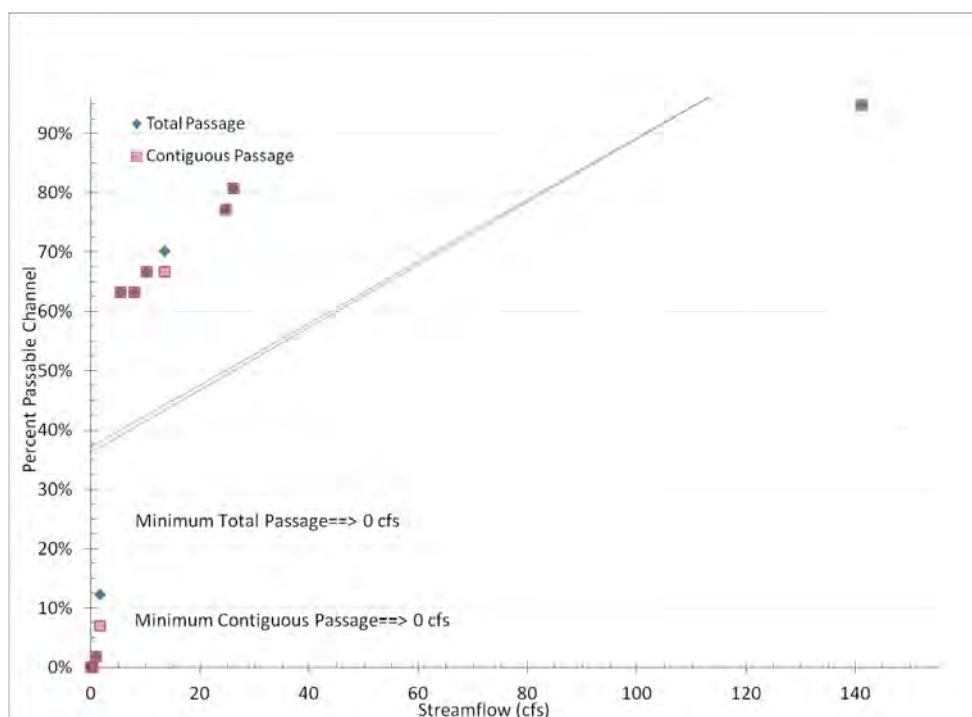


Figure H-17. Percent total passage (25%) and percent contiguous passage (10%) curves for juvenile salmonids at cross section 7+50 in Upper South Fork (USF) Sproul Creek.

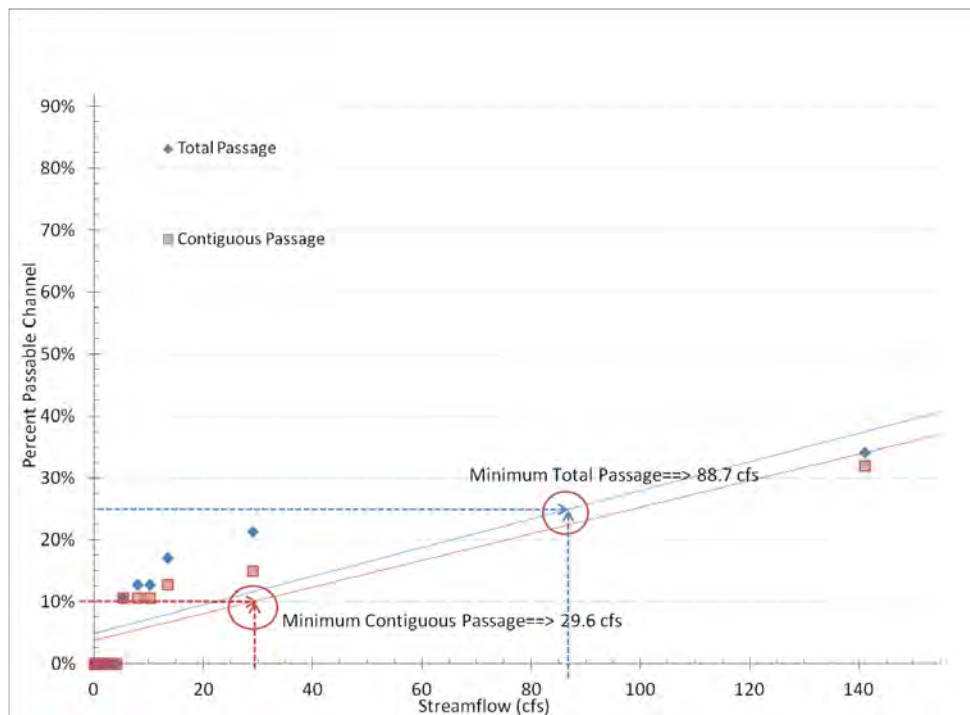


Figure H-18. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section 10+00 in Upper South Fork (USF) Sproul Creek

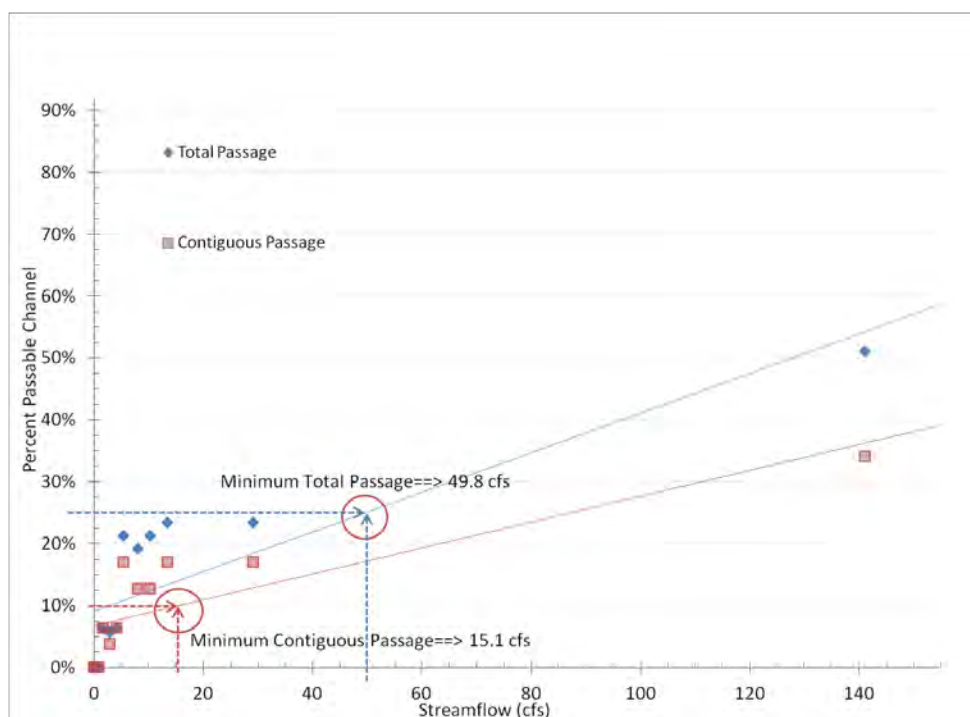


Figure H-19. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Coho salmon and steelhead at cross section 10+00 in Upper South Fork (USF) Sproul Creek.

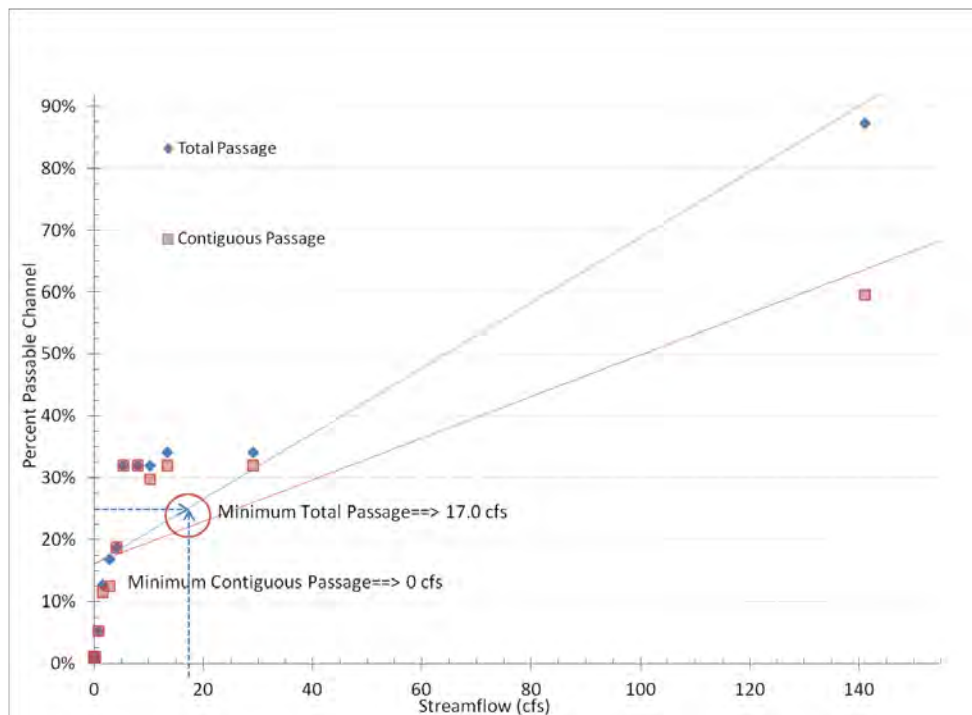


Figure H-20. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section 10+00 in Upper South Fork (USF) Sproul Creek.

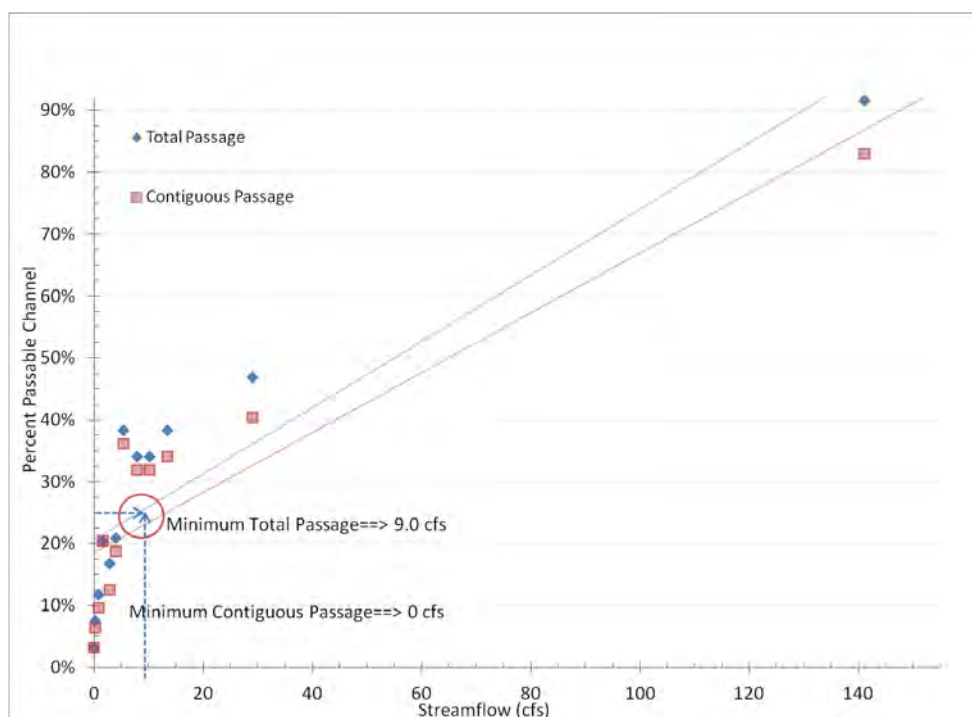


Figure H-21. Percent total passage (25%) and percent contiguous passage (10%) curves for juvenile salmonids at cross section 10+00 in Upper South Fork (USF) Sproul Creek.



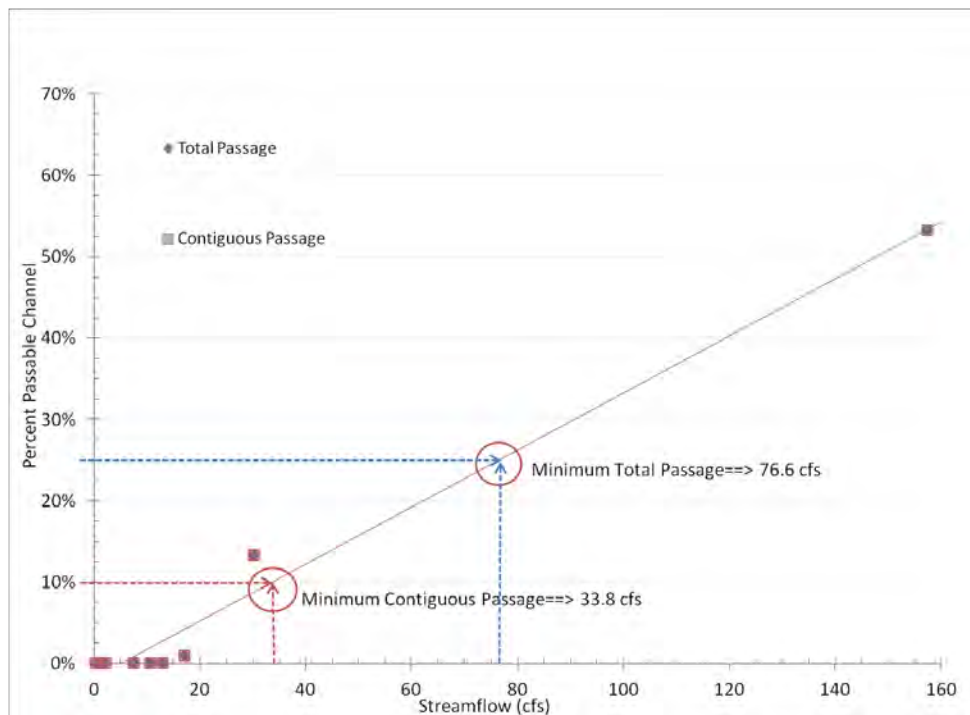


Figure H-22. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section -(6+40) in Upper South Fork (USF) Sproul Creek.

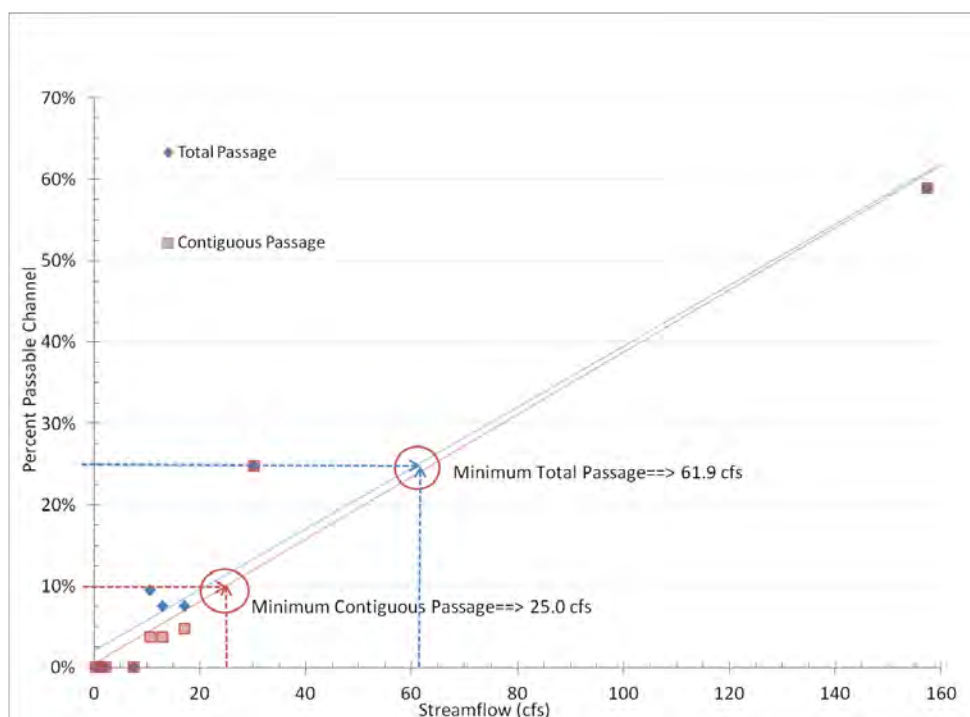


Figure H-23. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Coho salmon and steelhead at cross section -(6+40) in Upper South Fork (USF) Sproul Creek.

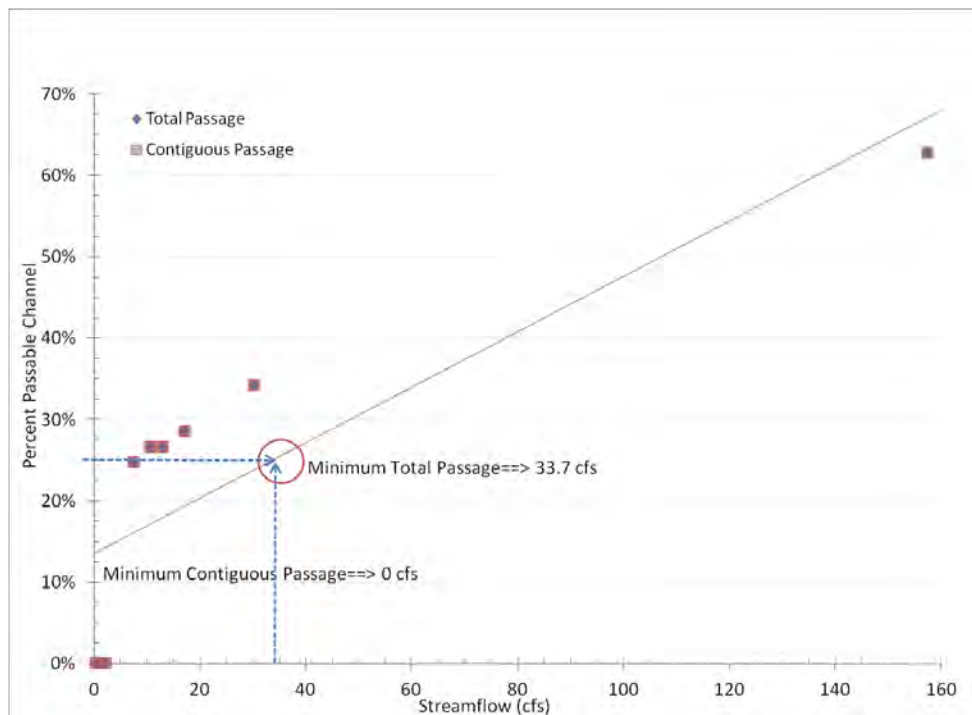


Figure H-24. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section -(6+40) in Upper South Fork (USF) Sproul Creek.

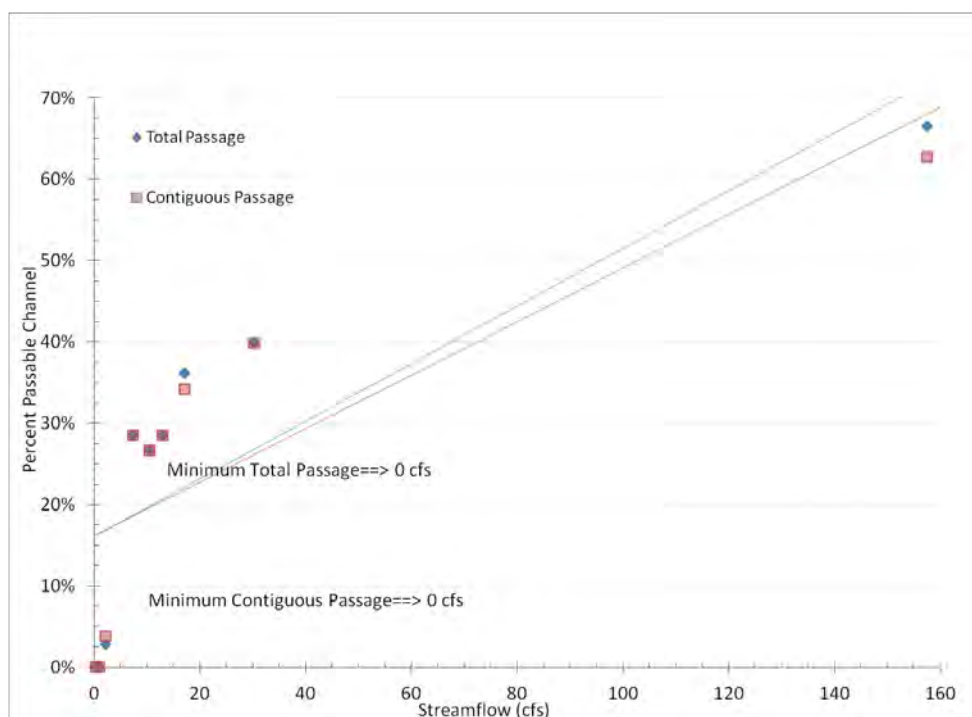


Figure H-25. Percent total passage (25%) and percent contiguous passage (10%) curves for juvenile salmonids at cross section -(6+40) in Upper South Fork (USF) Sproul Creek.

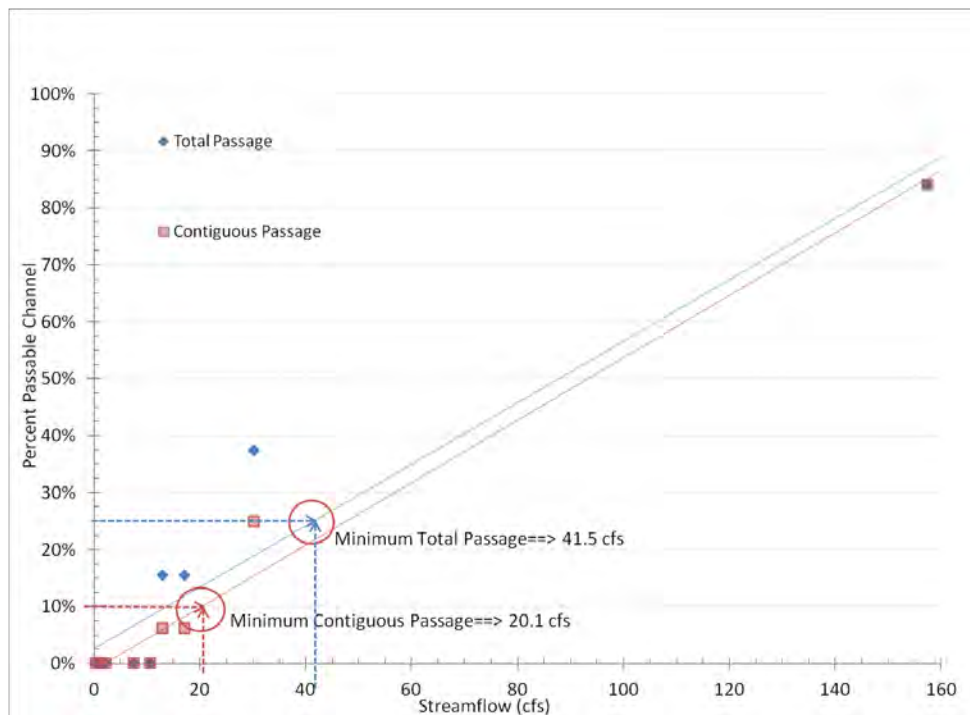


Figure H-26. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section -(8+10) in Upper South Fork (USF) Sproul Creek.

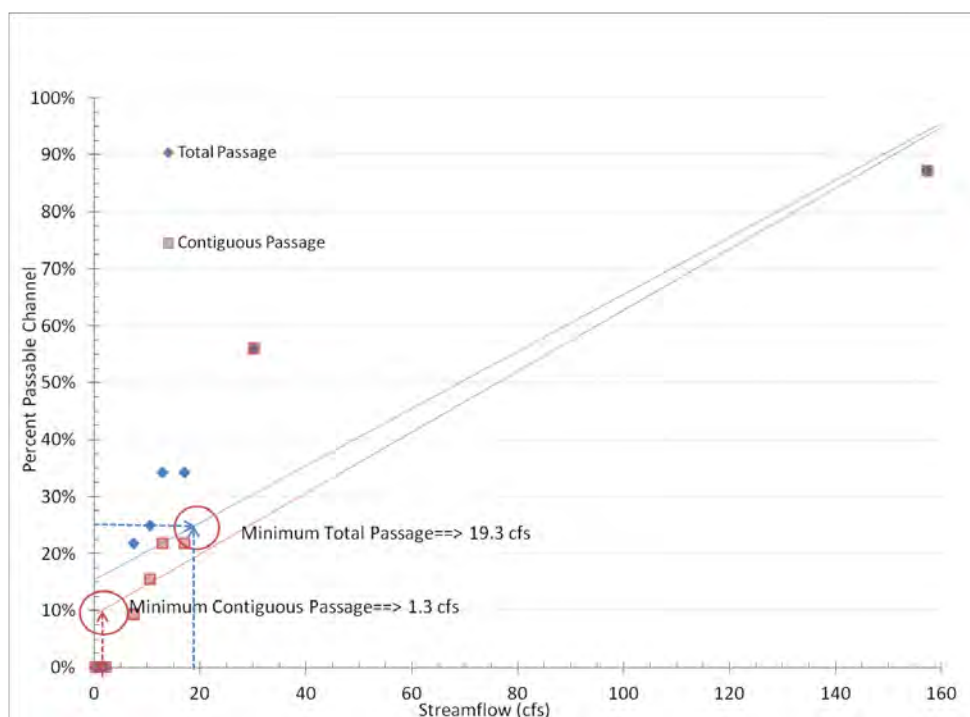


Figure H-27. Percent total passage (25%) and percent contiguous passage (10%) curves for adult coho salmon and steelhead at cross section -(8+10) in Upper South Fork (USF) Sproul Creek.

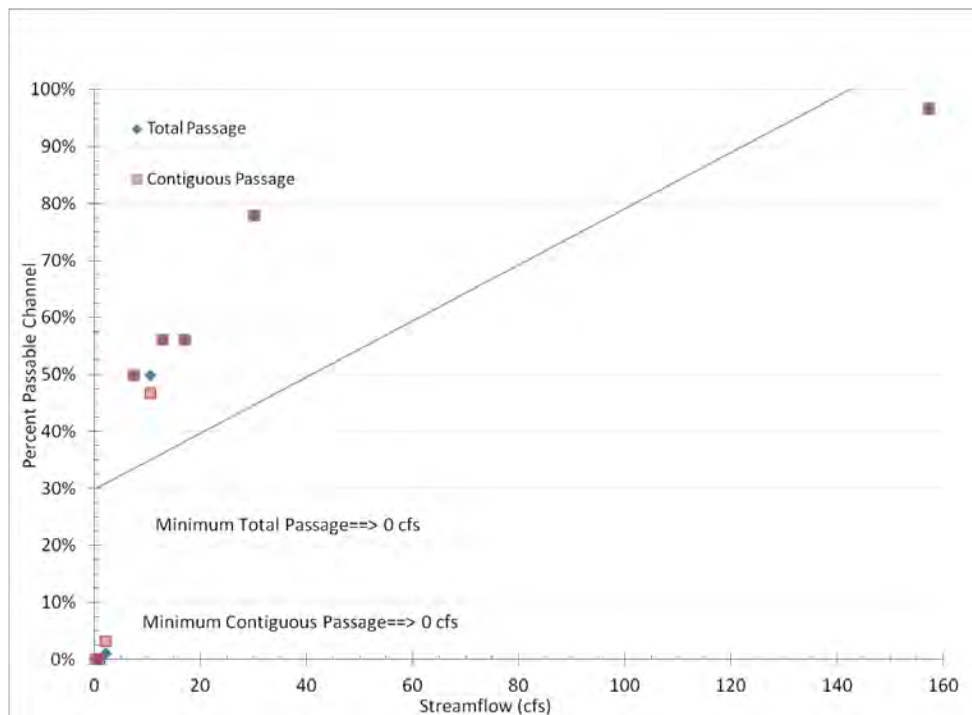


Figure H-28. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section -(8+10) in Upper South Fork (USF) Sproul Creek.

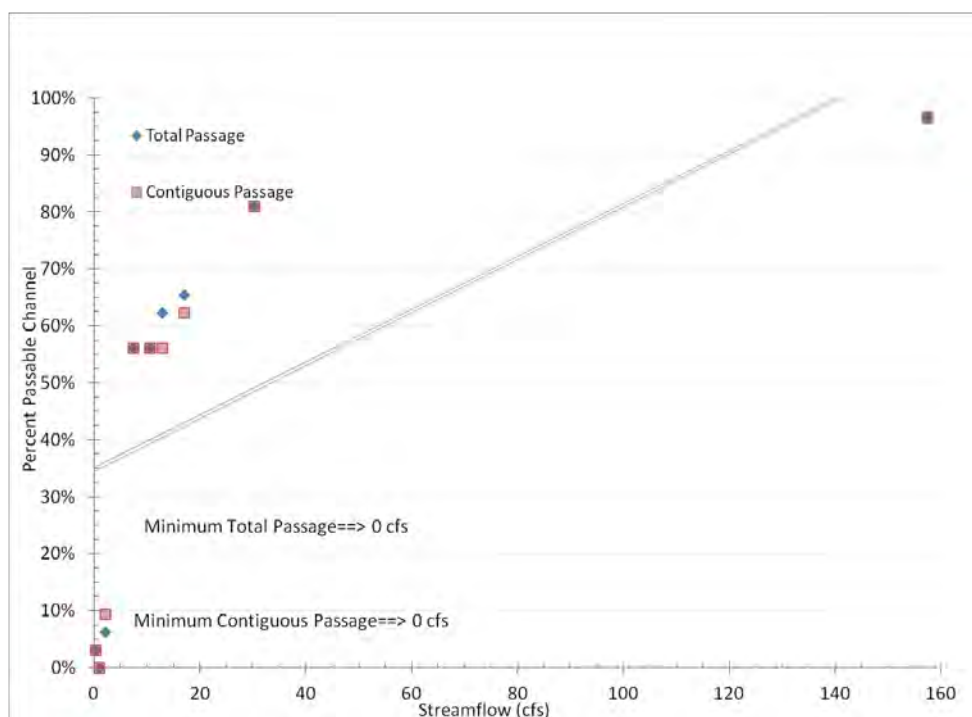


Figure H-29. Percent total passage (25%) and percent contiguous passage (10%) curves for juvenile salmonids at cross section -(8+10) in Upper South Fork (USF) Sproul Creek.

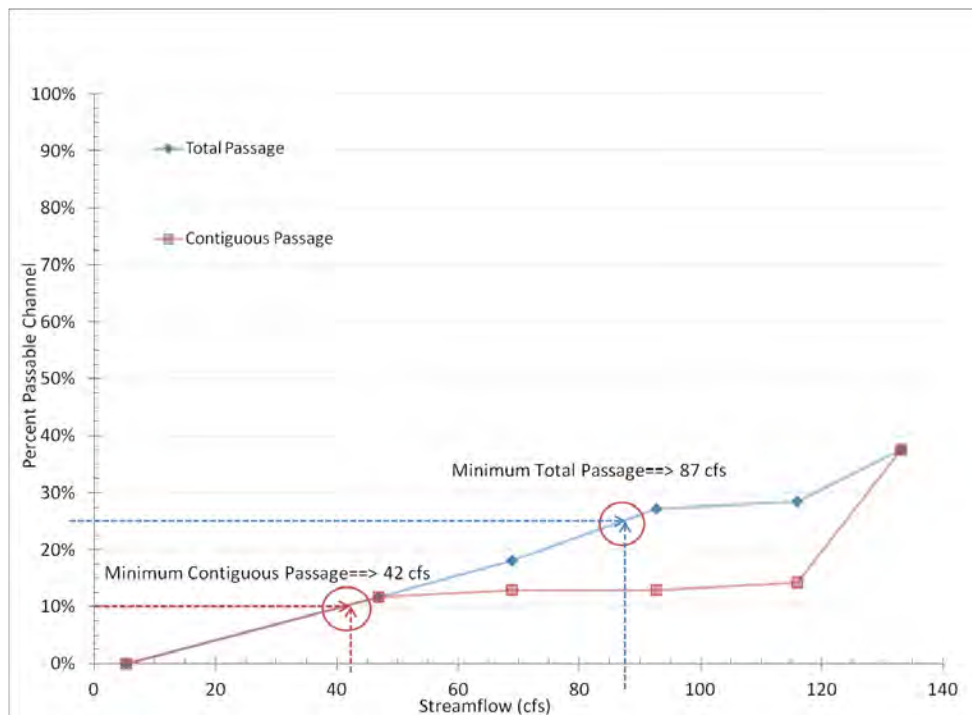


Figure H-30. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section 1+50 in Upper Mainstem (UMS) Sproul Creek.

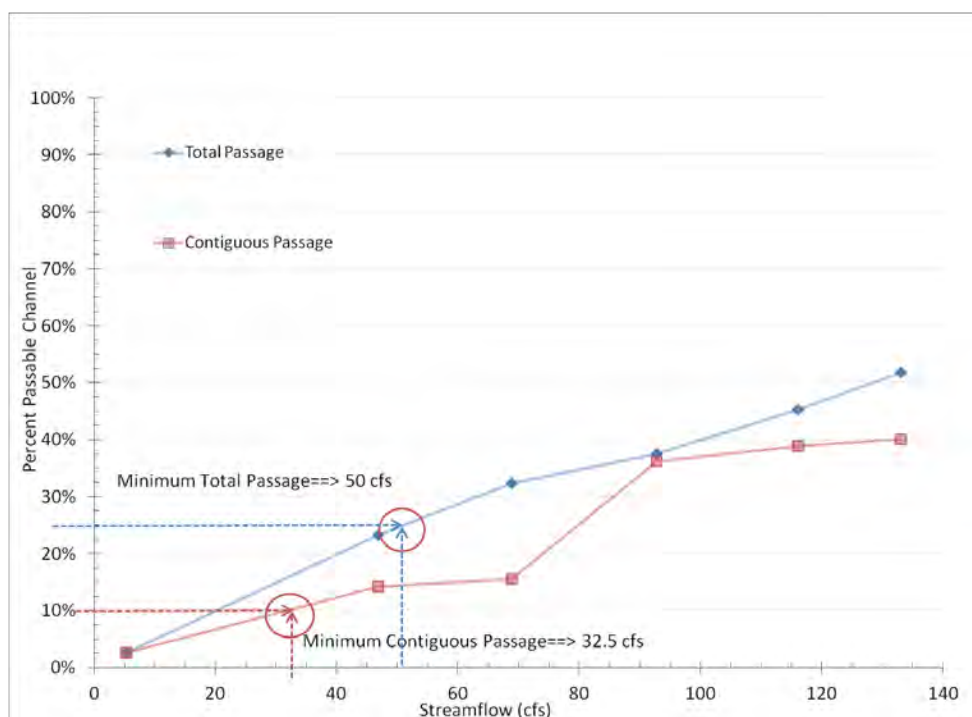


Figure H-31. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Coho Salmon and steelhead at cross section 1+50 in Upper Mainstem

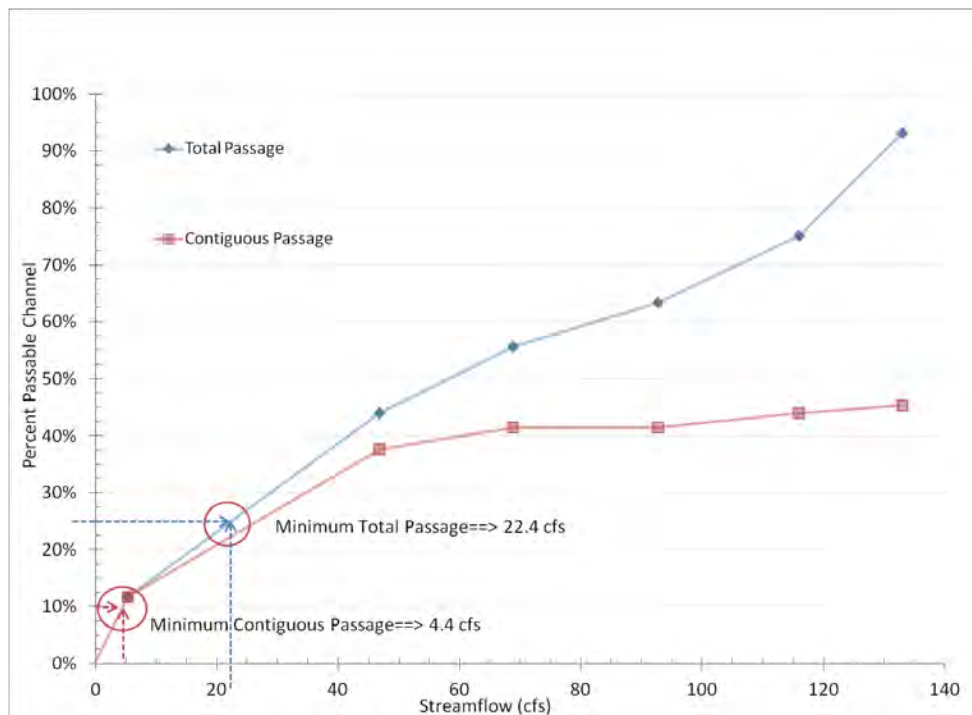


Figure H-32. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section 1+50 in Upper Mainstem (UMS) Sproul Creek.

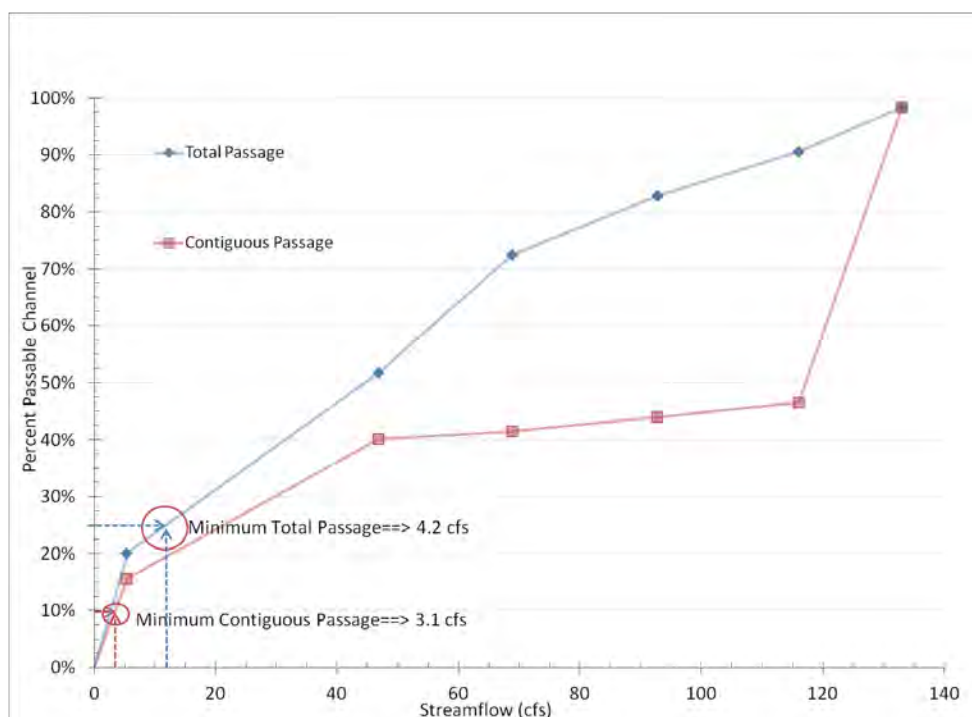


Figure H-33. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section 1+50 in Upper Mainstem (UMS) Sproul Creek.

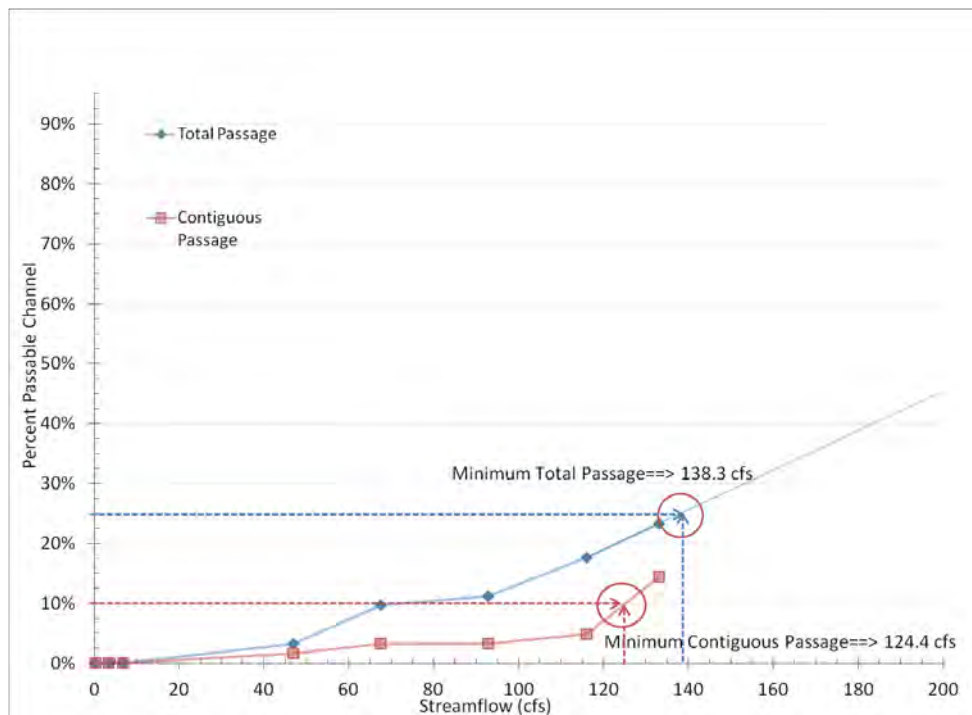


Figure H-34. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section 10+10 in Upper Mainstem (UMS) Sproul Creek.

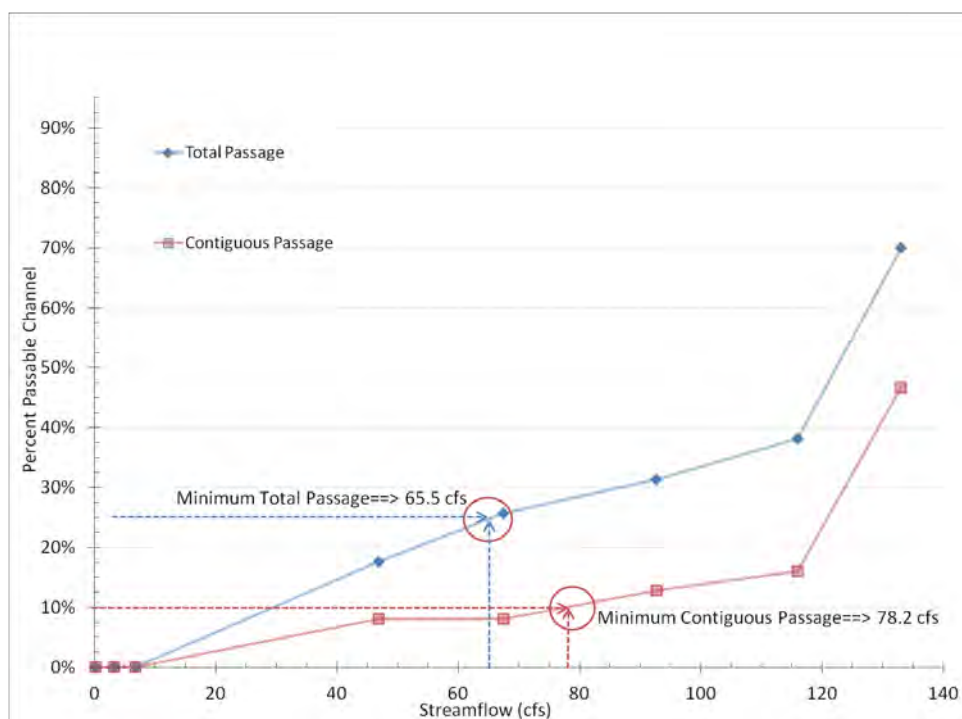


Figure H-35. Percent total passage (25%) and percent contiguous passage (10%) curves for adult coho salmon and steelhead at cross section 10+10 in Upper Mainstem (UMS) Sproul Creek.



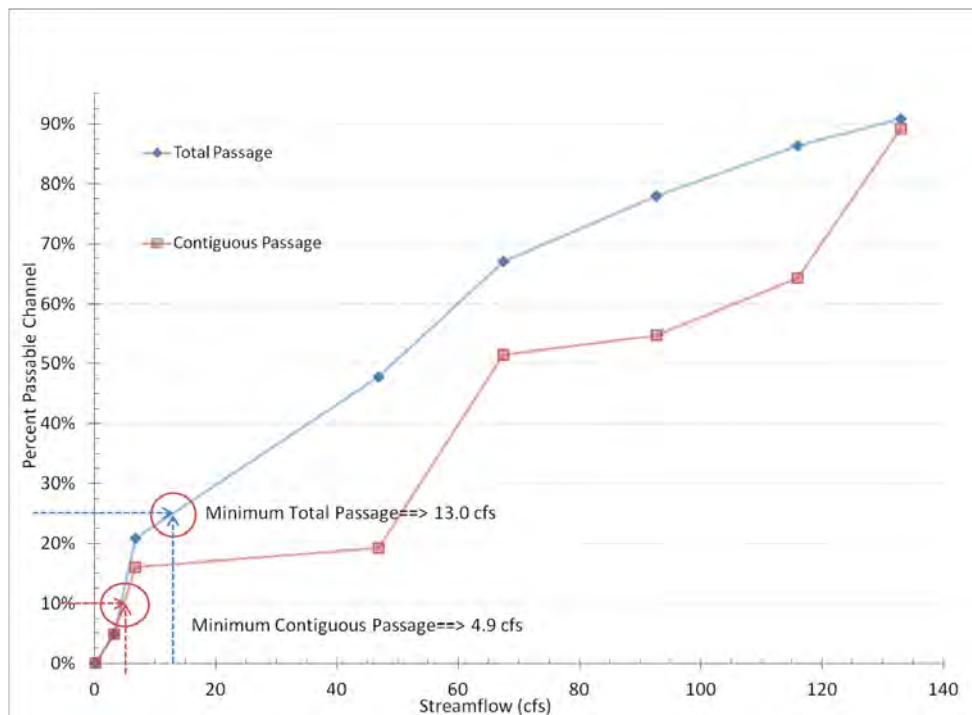


Figure H-36. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section 10+10 in Upper Mainstem (UMS) Sproul Creek.

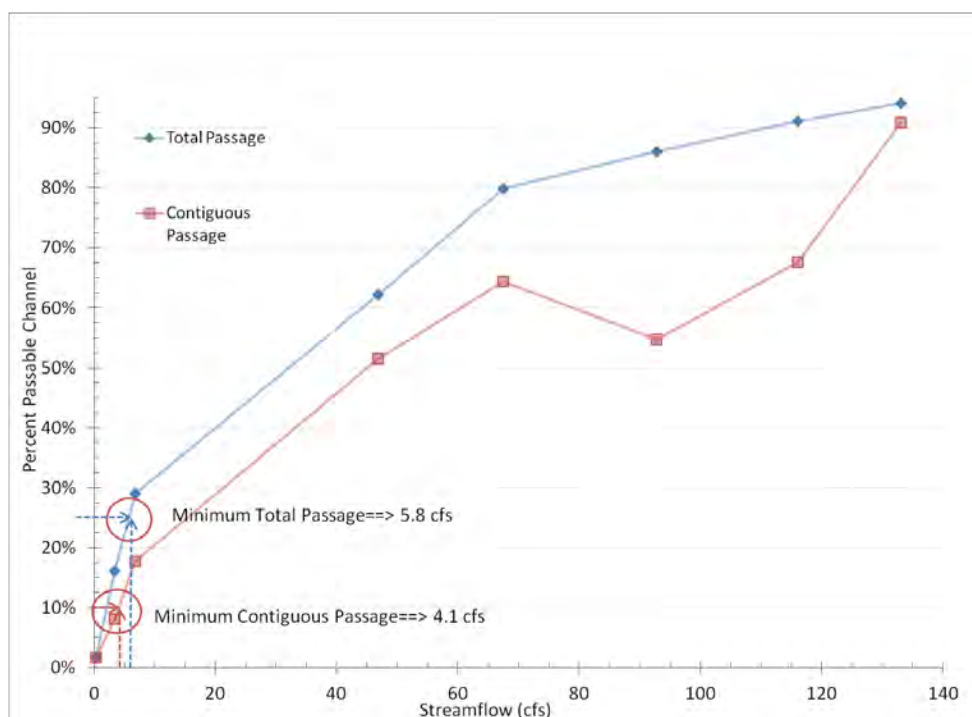


Figure H-37. Percent total passage (25%) and percent contiguous passage (10%) curves for juvenile salmonids at cross section 10+10 in Upper Mainstem (UMS) Sproul Creek.

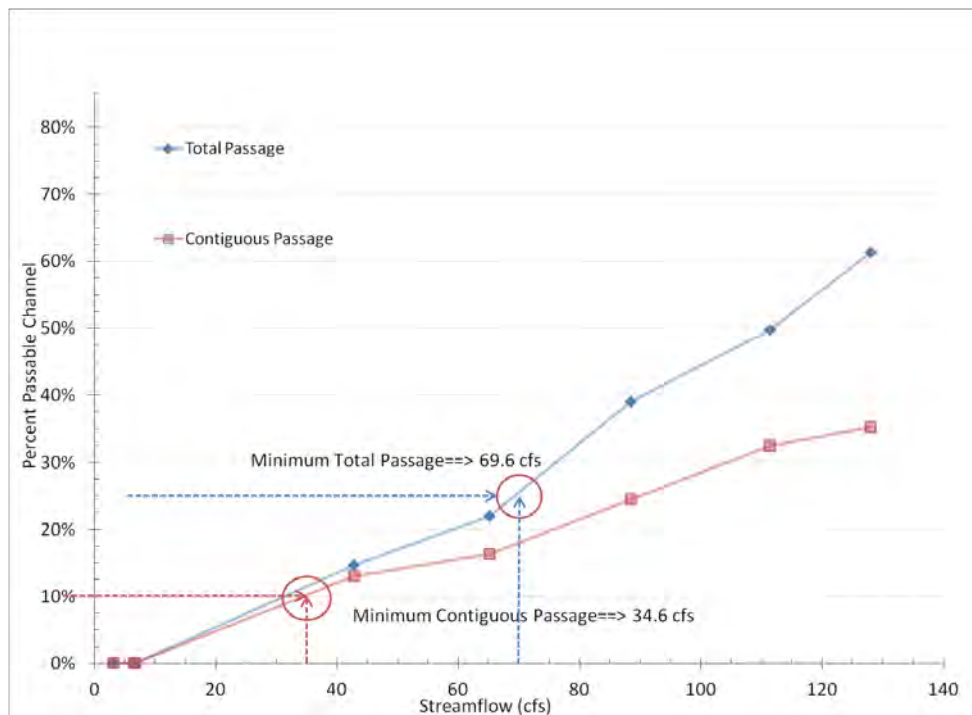


Figure H-38. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section 35+00 in Upper Mainstem (UMS) Sproul Creek.

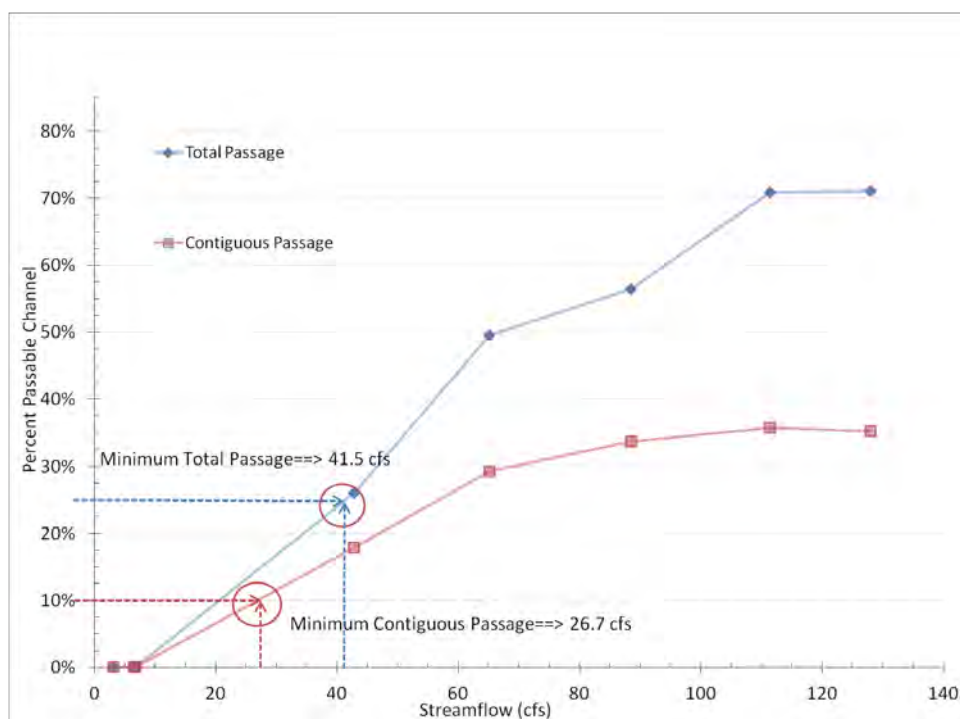


Figure H-39. Percent total passage (25%) and percent contiguous passage (10%) curves for adult coho salmon and steelhead at cross section 35+00 in Upper Mainstem (UMS) Sproul Creek.

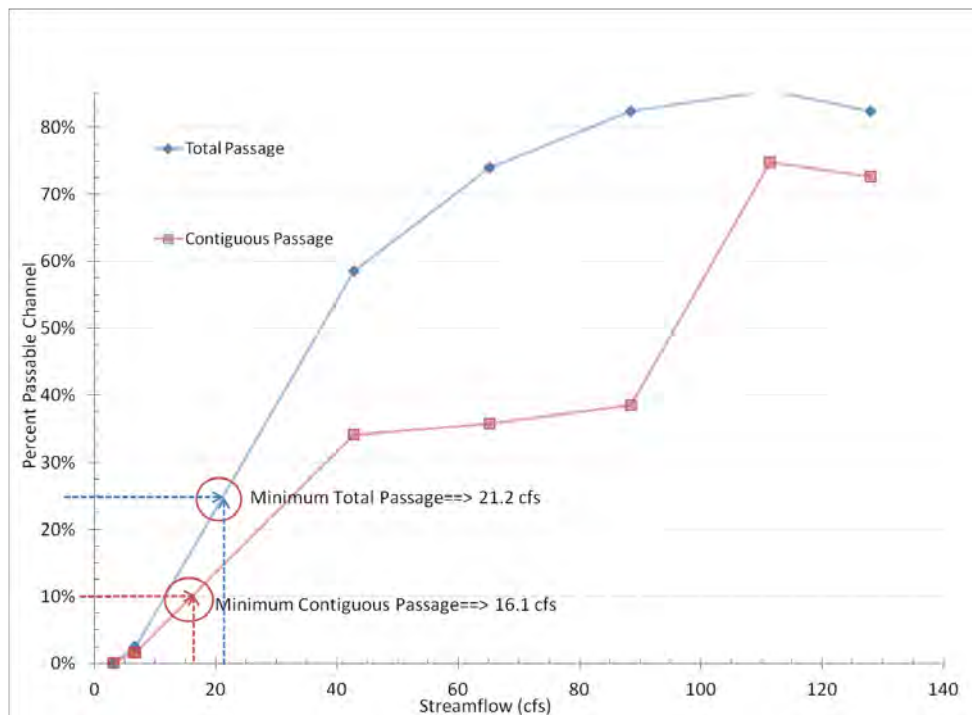


Figure H-40. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section 35+00 in Upper Mainstem (UMS) Sproul Creek.

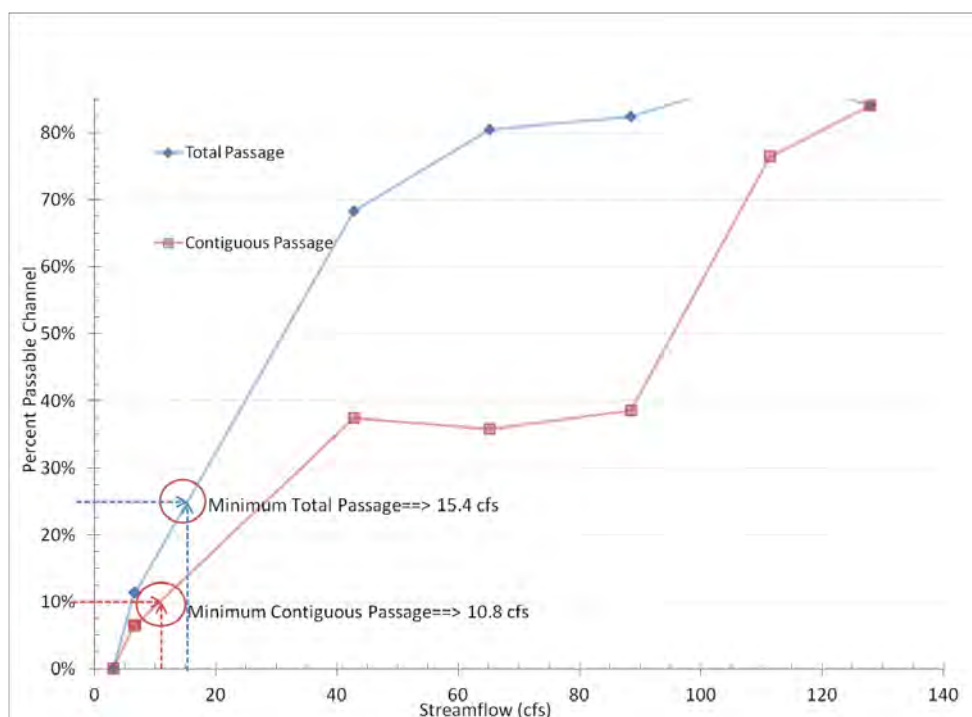


Figure H-41. Percent total passage (25%) and percent contiguous passage (10%) curves for juvenile salmonids at cross section 35+00 in Upper Mainstem (UMS) Sproul Creek.

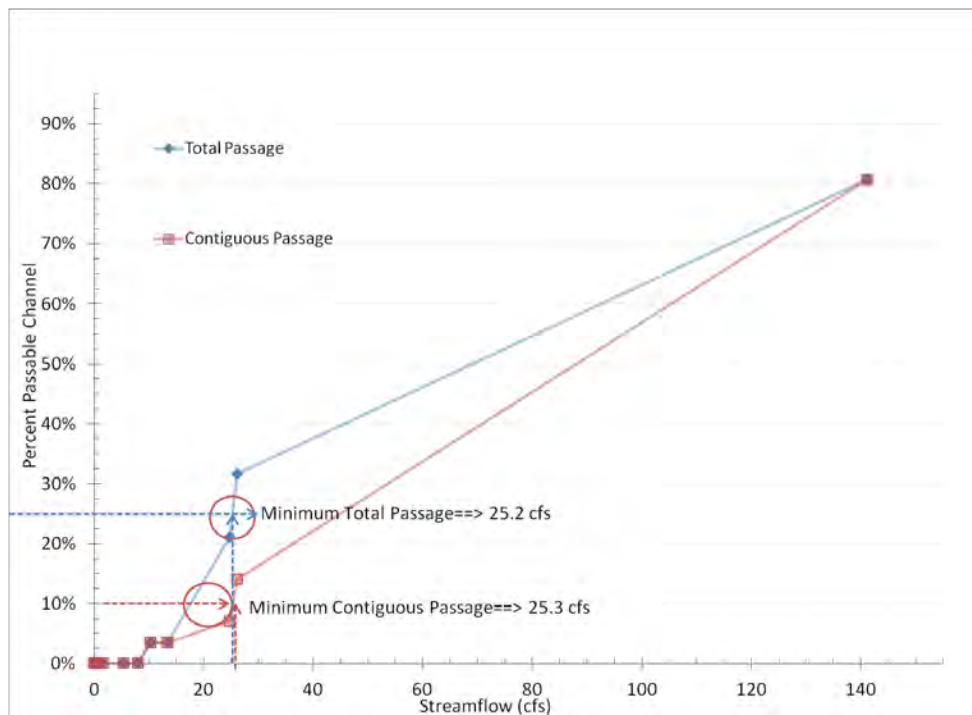


Figure H-42. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section 7+50 in Upper South Fork (USF) Sproul Creek.

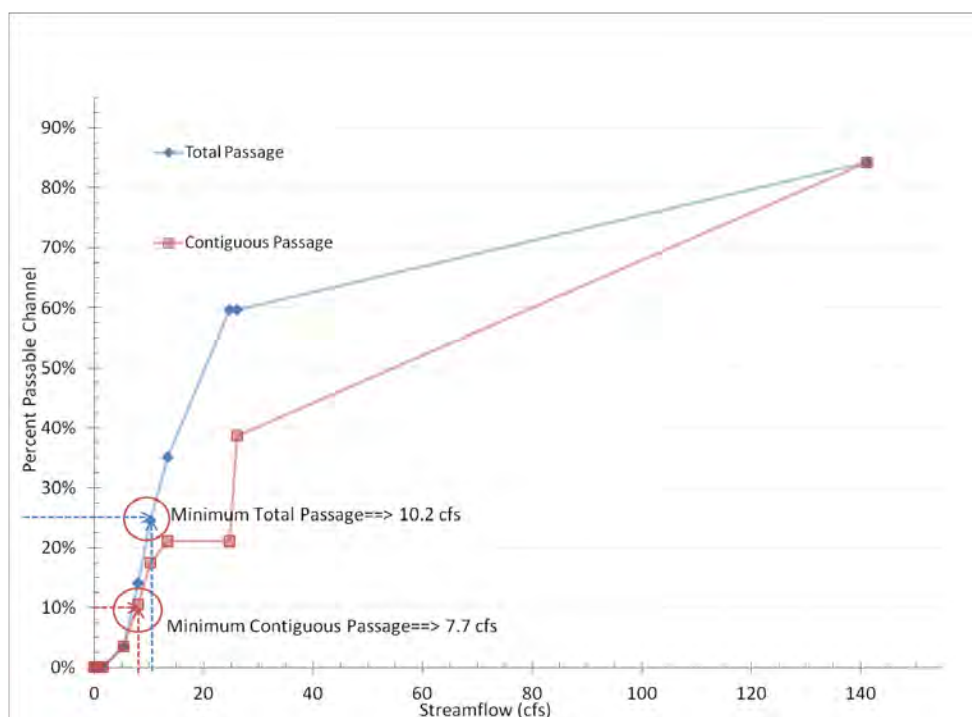


Figure H-43. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Coho salmon and steelhead at cross section 7+50 in Upper South Fork (USF) Sproul Creek.

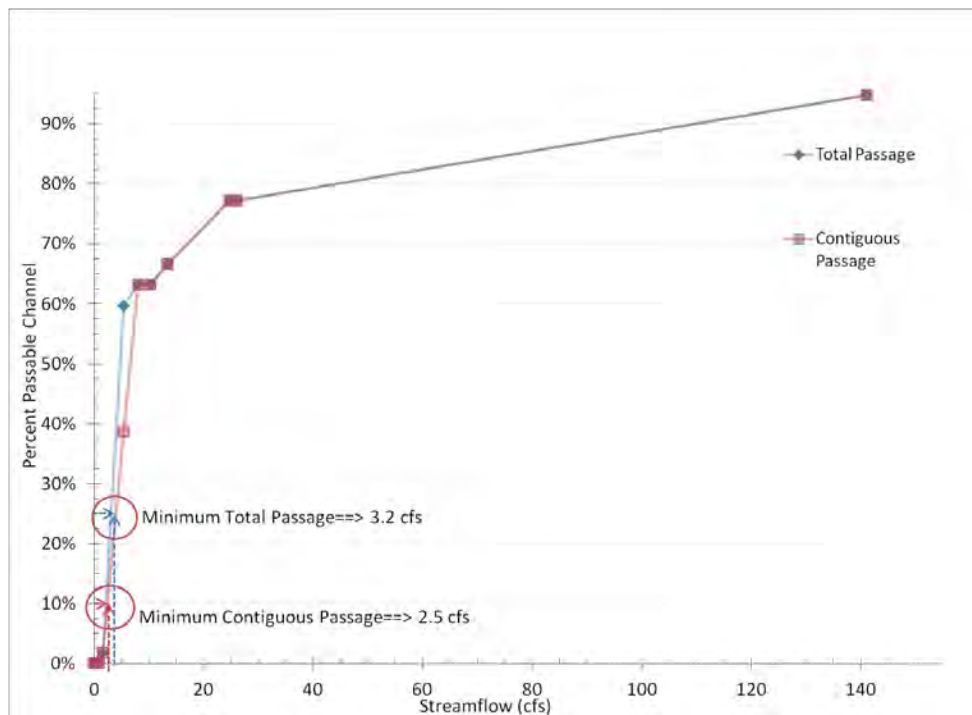


Figure H-44. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section 7+50 in Upper South Fork (USF) Sproul Creek.

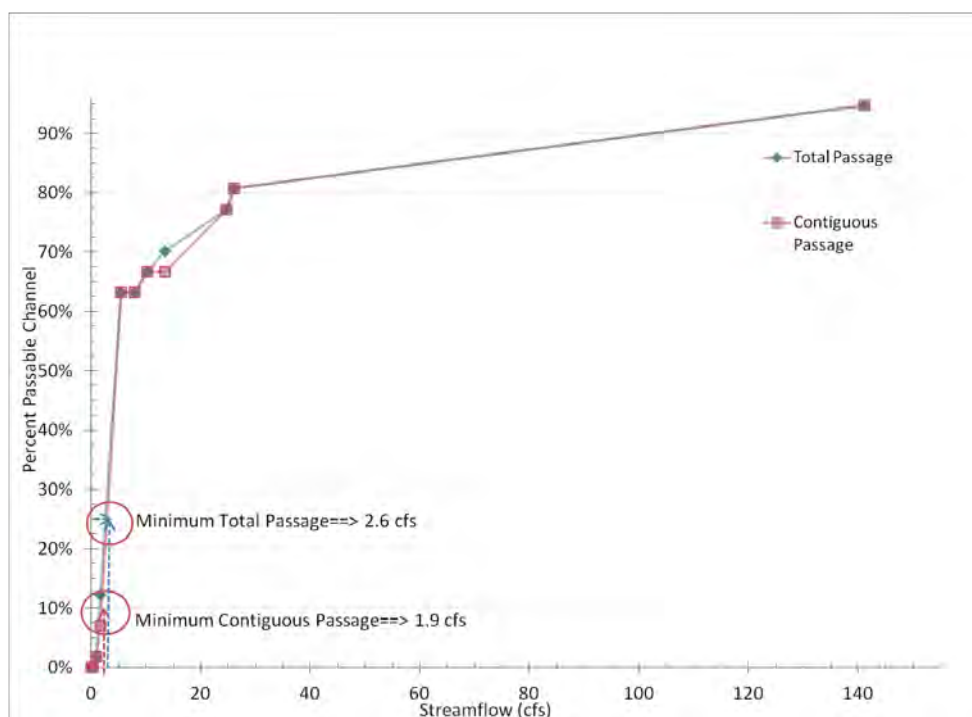


Figure H-45. Percent total passage (25%) and percent contiguous passage (10%) curves for juvenile salmonids at cross section 7+50 in Upper South Fork (USF) Sproul Creek.

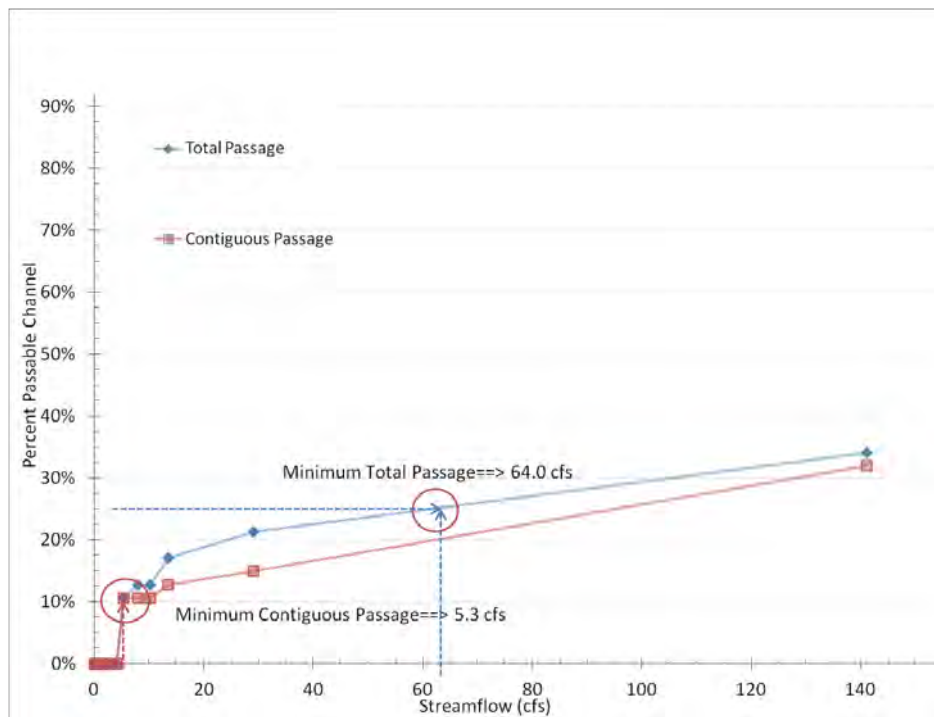


Figure H-46. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section 10+00 in Upper South Fork (USF) Sproul Creek.

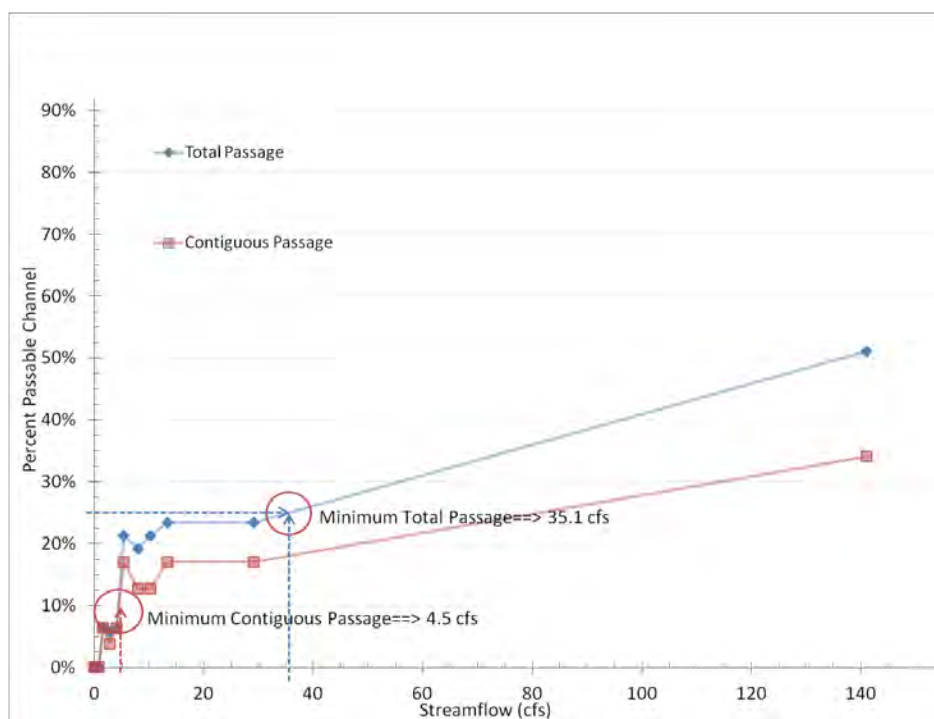


Figure H-47. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Coho salmon and steelhead at cross section 10+00 in Upper South Fork (USF) Sproul Creek.



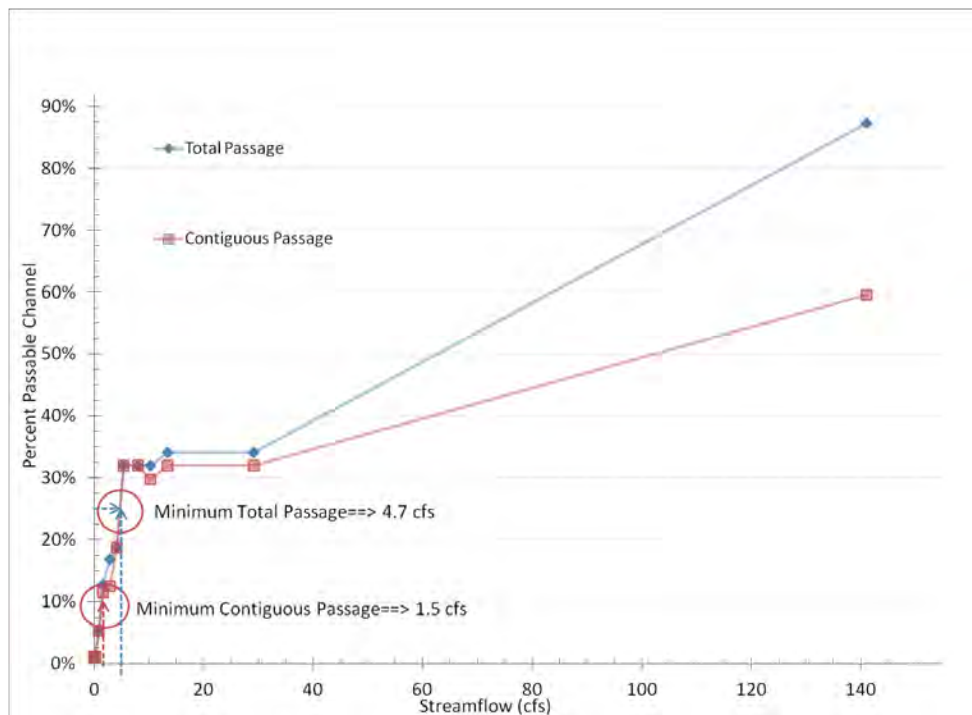


Figure H-48. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section 10+00 in Upper South Fork (USF) Sproul Creek.

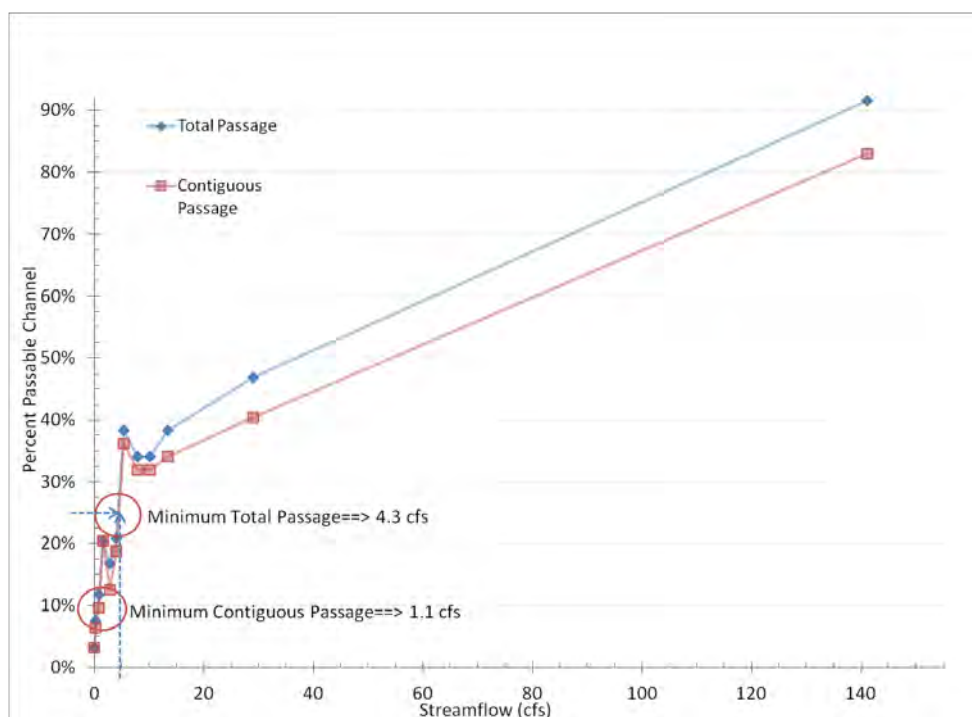


Figure H-49. Percent total passage (25%) and percent contiguous passage (10%) curves for juvenile salmonids at cross section 10+00 in Upper South Fork (USF) Sproul Creek. .



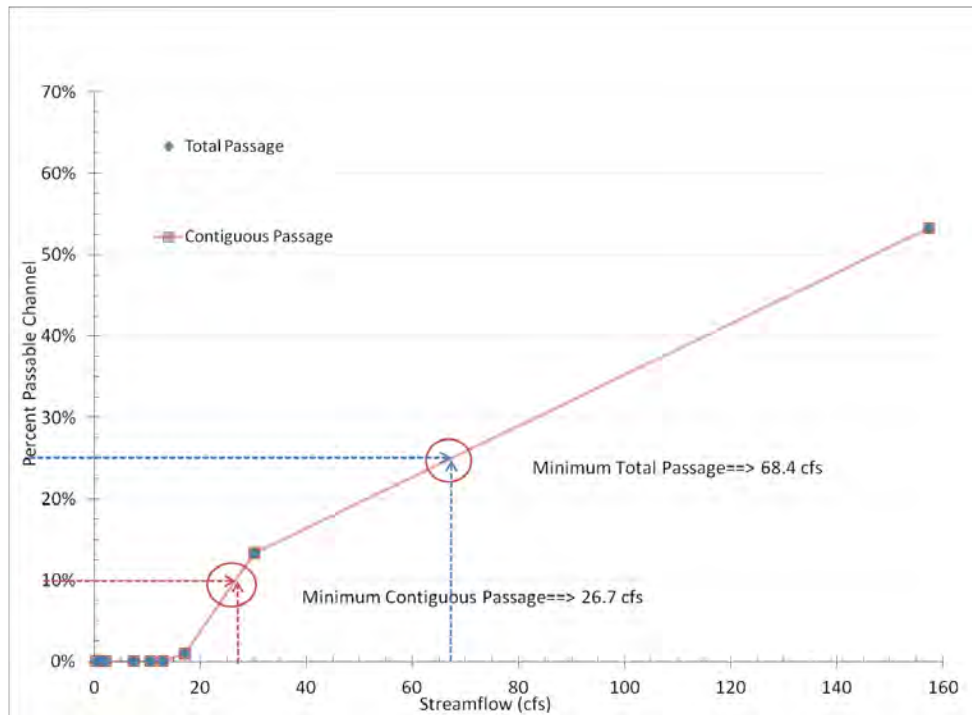


Figure H-50. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section (-)6+40 in Upper South Fork (USF) Sproul Creek.

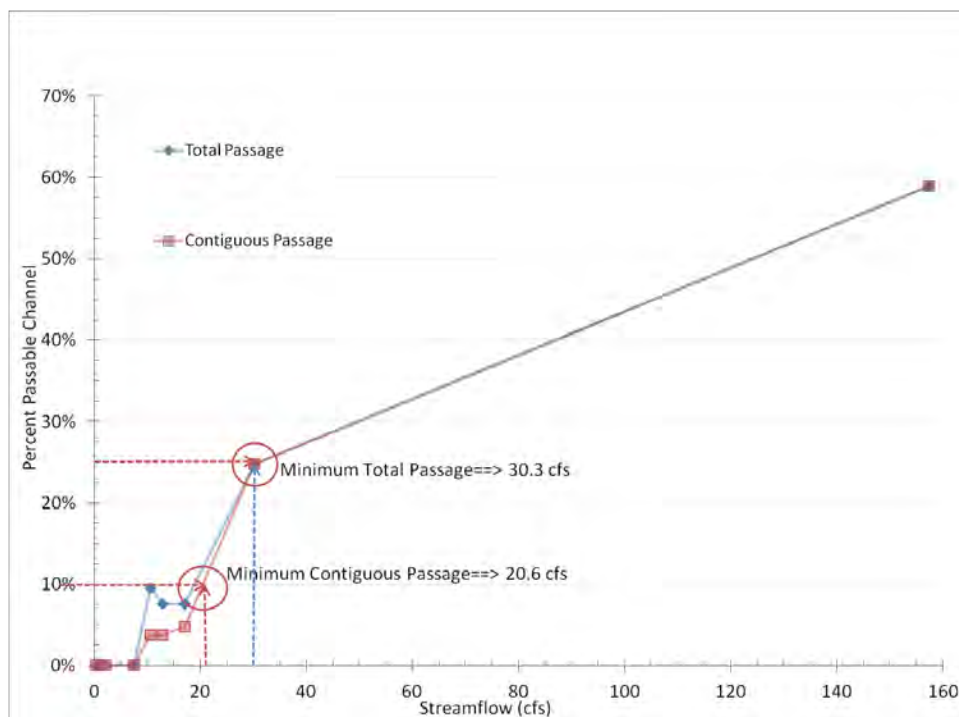


Figure H-51. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Coho salmon and steelhead at cross section (-)6+40 in Upper South Fork (USF) Sproul Creek.

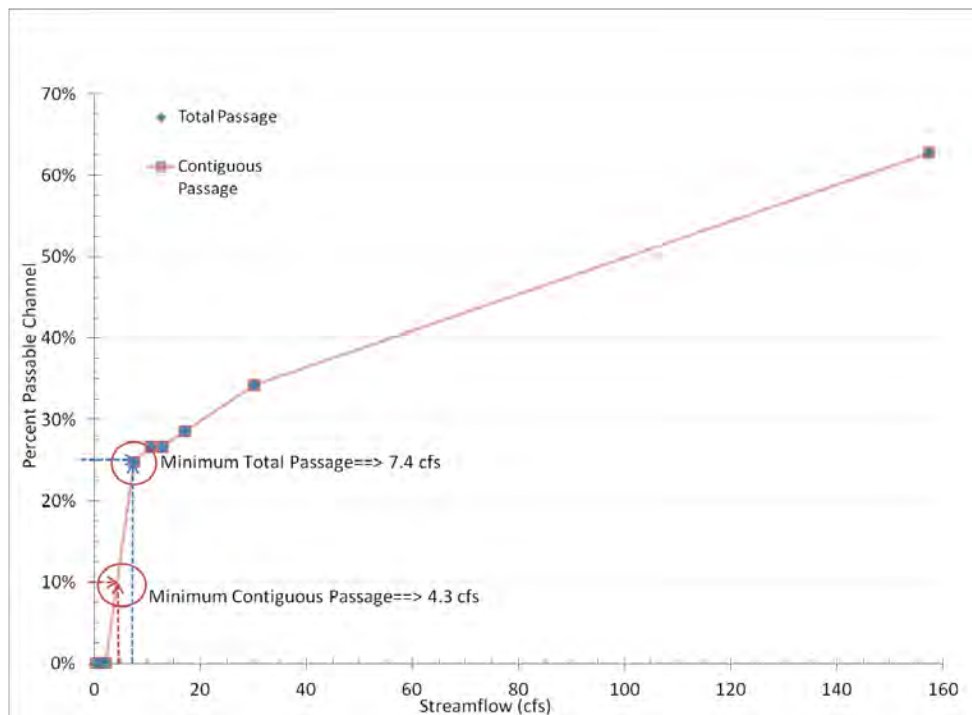


Figure H-52. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section (-)6+40 in Upper South Fork (USF) Sproul Creek.

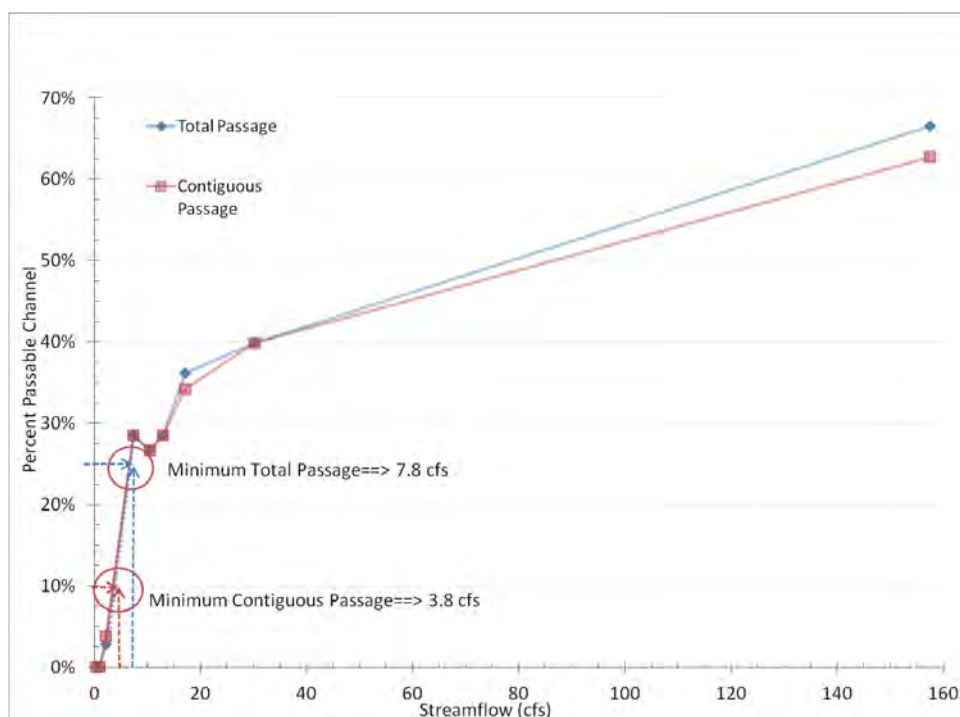


Figure H-53. Percent total passage (25%) and percent contiguous passage (10%) curves for juvenile salmonids at cross section (-)6+40 in Upper South Fork (USF) Sproul Creek.

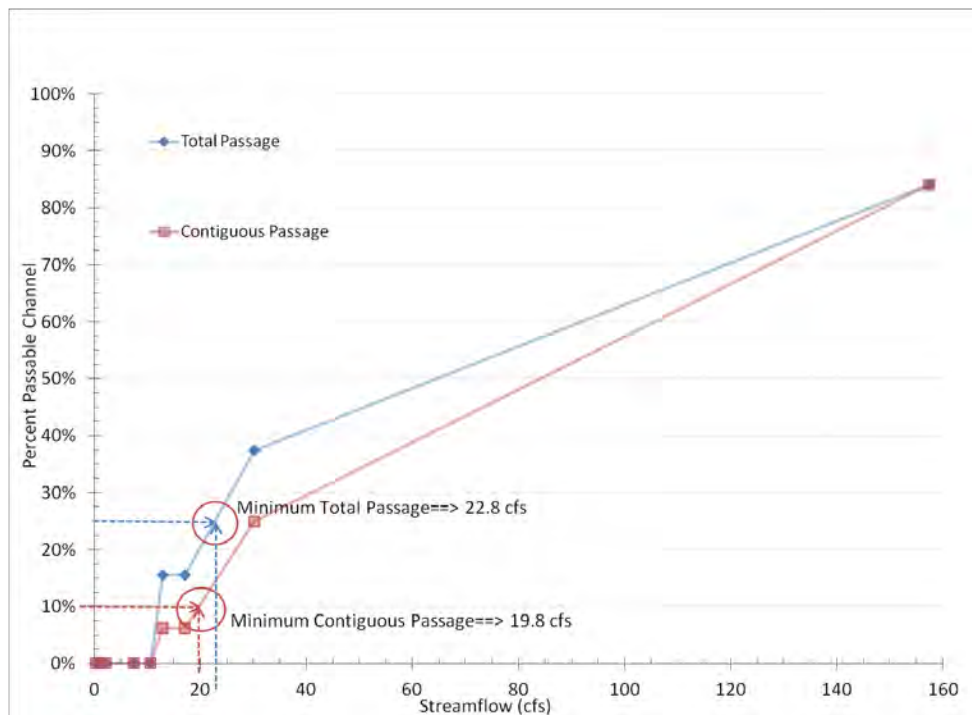


Figure H-54. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Chinook salmon at cross section (-)8+10 in Upper South Fork (USF) Sproul Creek.

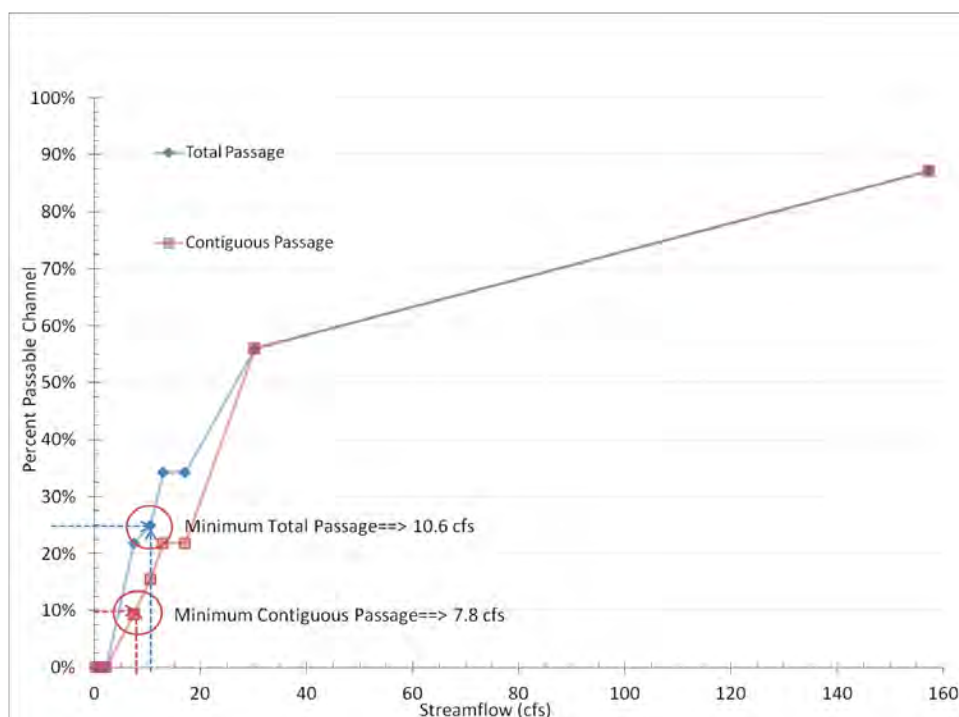


Figure H-55. Percent total passage (25%) and percent contiguous passage (10%) curves for adult Coho salmon and steelhead at cross section (-)8+10 in Upper South Fork (USF) Sproul Creek.

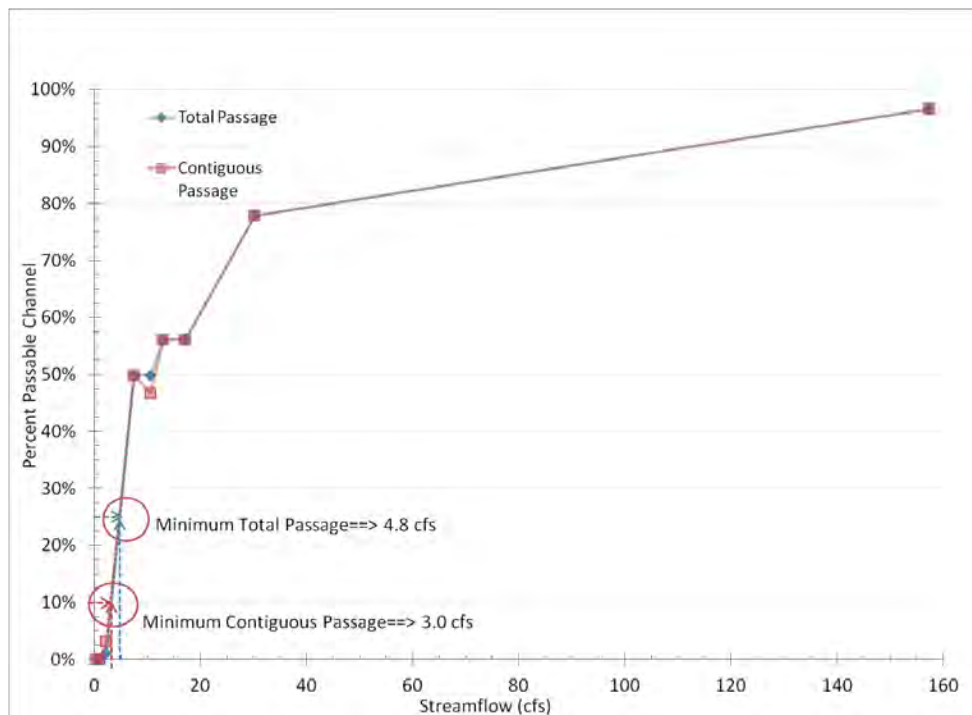


Figure H-56. Percent total passage (25%) and percent contiguous passage (10%) curves for age 2+ trout at cross section (-)8+10 in Upper South Fork (USF) Sproul Creek.

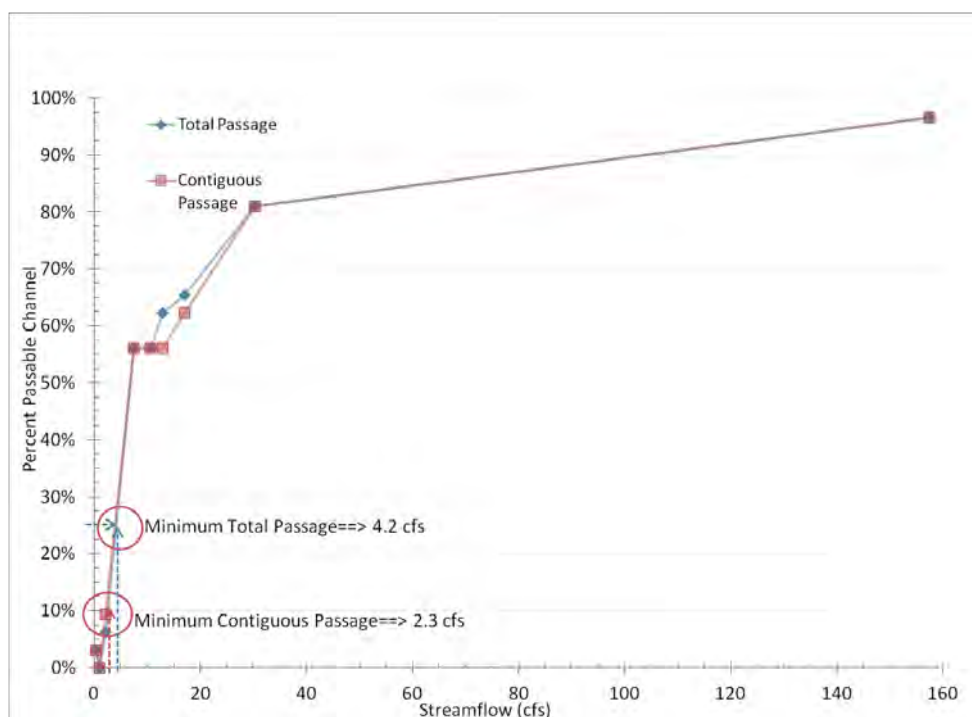
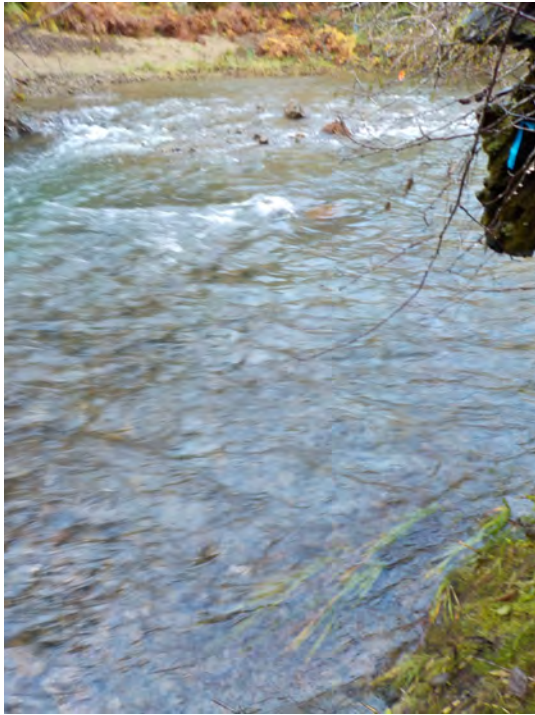


Figure H-57. Percent total passage (25%) and percent contiguous passage (10%) curves for juvenile salmonids at cross section (-)8+10 in Upper South Fork (USF) Sproul Creek.





*Figure H-58. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 1+50 at 133 cfs on November 30, 2016.*



*Figure H-59. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 1+50 at 46.9 cfs on November 4, 2016.*





*Figure H-60. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 1+50 at 5.4 cfs on October 20, 2016.*



*Figure H-61. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 1+50 at 0.27 cfs on July 27, 2016.*





*Figure H-62. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 10+10 at 133 cfs on November 30, 2016.*



*Figure H-63. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 10+10 at 92 cfs on November 22, 2016.*





*Figure H-64. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 10+10 at 68.8 cfs on November 3, 2016.*



*Figure H-65. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 10+10 at 20 cfs on April 28, 2016.*





*Figure H-66. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 10+10 at 6.8 cfs on May 25, 2016.*



*Figure H-67. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 10+10 at 0 cfs on August 17, 2016.*





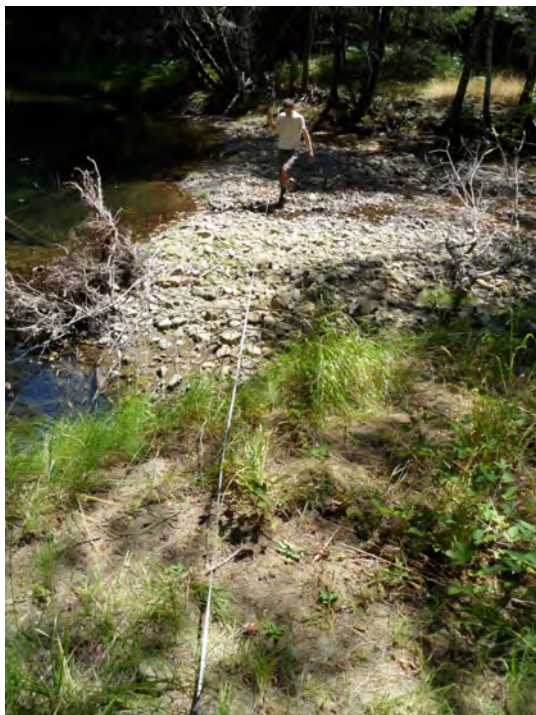
*Figure H-68. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 35+00 at 88.5 cfs on November 22, 2016.*



*Figure H-69. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 35+00 at 56.2 cfs on November 3, 2016.*



*Figure H-70. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 35+00 at 7.2 cfs on May 19, 2016.*



*Figure H-71. Upper Mainstem (UMS) Sproul Creek Critical Riffle cross section 35+00 at 0.27 cfs on July 27, 2016.*





*Figure H-72. Upper South Fork (USF) Sproul Creek Critical Riffle cross section  $-(8+10)$  at 30.3 cfs on November 2, 2016.*



*Figure H-73. Upper South Fork (USF) Sproul Creek Critical Riffle cross section  $-(8+10)$  at 2.2 cfs on May 19, 2016.*





*Figure H-74. Upper South Fork (USF) Sproul Creek Critical Riffle cross section –(6+40) at 30.3 cfs on November 2, 2016.*



*Figure H-75. Upper South Fork (USF) Sproul Creek Critical Riffle cross section –(6+40) at 2.2 cfs on May 19, 2016.*





*Figure H-76. Upper South Fork (USF) Sproul Creek Critical Riffle cross section -(6+40) at 2.2 cfs on May 19, 2016.*



*Figure H-77. Upper South Fork (USF) Sproul Creek Critical Riffle cross section 7+50 at 13.5 cfs on November 22, 2016.*





*Figure H-77. Upper South Fork (USF) Sproul Creek Critical Riffle cross section 7+50 at 5.4 cfs on November 4, 2016.*



*Figure H-78. Upper South Fork (USF) Sproul Creek Critical Riffle cross section 7+50 at 1.7 cfs on May 24, 2016.*





*Figure H-79. Upper South Fork (USF) Sproul Creek Critical Riffle cross section 7+50 at 0.03 cfs on July 28, 2016.*



*Figure H-80. Upper South Fork (USF) Sproul Creek Critical Riffle cross section 10+00 at 13.46 cfs on November 22, 2016.*





*Figure H-80. Upper South Fork (USF) Sproul Creek Critical Riffle cross section 10+00 at 5.4 cfs on November 4, 2016.*



*Figure H-80. Upper South Fork (USF) Sproul Creek Critical Riffle cross section 10+00 at 0.03 cfs on July 28, 2016.*

### **Literature Cited**

California Department of Fish and Game. 2013. Standard Operating Procedure for Critical Riffle Analysis for Fish Passage in California (DFG-IFP-001). California Department of Fish and Game Instream Flow Program, Sacramento, CA.

McBain Associates. 2016. Site Specific Study on Indian Creek, Navarro River.