A cost-based risk assessment method for selecting stream restoration design alternatives

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Abstract. A low-risk, stream restoration design includes methods that validate design assumptions, incorporate uncertainty in the decision-making process during the project design phase, and reduce uncertainty by checking the final design. A two-step method of incorporating uncertainty and risk in stream restoration design has been developed as a combination of Design Failure Modes and Effects Analysis (DFMEA) and risk quantification. As a first step, DFMEA is applied to identify risk in terms of ratings with respect to consequence of failure, the likelihood of occurrence of a failure, and the ability to detect a failure. Due to its evolutionary nature, the DFMEA can be revised to account for design modifications and relative ratings are re-evaluated to examine reductions in uncertainty, and thereby, risk. The second step of the method is quantifying risk using initial and expected failure costs. Expected failure cost is defined as the product of probability of failure and the cost associated with failure. Since failure probability and cost of failure are both difficult to determine directly in stream restoration, the consequence and likelihood of occurrence ratings from the DFMEA can be used to estimate the expected cost and probability of failure, respectively. Using this method, risk can be estimated for several restoration design alternatives and compared to provide justification and guidance on selecting the most cost effective design alternative. The two-step, risk-based method is illustrated through application to a stream relocation project in Pennsylvania. Overall, the two-step method presented here can prove valuable in decision-making and will improve the likelihood of success in stream restoration design.

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