

TWO AND THREE DIMENSIONAL WATER VELOCITIES IN CULVERTS

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A full understanding of the challenges that fish encounter when navigating culverts requires adequate consideration of the diversity of water velocities that exist in the culvert barrel. Contemporary models and design tools are largely based on one-dimensional hydraulic computations. While the mean velocity in the culvert barrel is informative and will often suffice for conservative predictions of passage concerns, it does not adequately express the nuances of the system that may ultimately determine whether a given fish can pass through the culvert or not. This presentation is a progress report on two studies dealing with velocity diversity in culverts. We are modeling culverts located on Mulherin Creek, a tributary to the Yellowstone River near Gardiner, Montana, using three dimensional finite volume models (CFX running on the Ansys platform). Our goal is to determine the extent to which velocity diversity as measured at the culvert inlet perpetuates through the length of the culvert. We have measured several sets of three dimensional velocities in the field using an acoustic Doppler velocimeter that we will use to validate the computational model. With the model functional, geometric or boundary condition alterations can be imposed to determine if culverts can be made more hospitable for fish passage by intentionally causing diverse inlet velocities to propagate. A related study is to use field data and interpolation methods to determine just how many velocity measurements should be made to establish usable inlet boundary conditions for three dimensional modeling.