The Use of a GIS-based Water Balance Model in Managing Stream Flows for Various Life History Stages of Resident and Fluvial Fish Species[AFS]

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Because of increasing demands upon limited surface water and current drought conditions, native fish in Montana's streams face threats due to inadequate flow. Efforts to increase instream flow through water conservation efforts or water rights leasing have not kept up with this increasing threat. This paper outlines the integrated use of fish life history analysis and water balance modeling to determine an optimal strategy for managing flows using a three-stage process. First, flow requirements during critical life stages (i.e. spawning, incubation, emergence, drift, and rearing) are determined for the native fish assemblage in critical stream reaches. Second, a continuous simulation hydrologic model is constructed and calibrated using HSPF (Hydrologic Software Program Fortran) software developed by EPA. Data for the model are preprocessed and managed using ArcView GIS software. HSPF uses continuous meteorologic and hydrologic records to compute stream flow hydrographs taking into account rainfall interception, surface runoff, diversions, groundwater interactions, snowmelt, and evapotranspiration. Analysis of yearly, simulated hydrographs generated for the critical stream reaches is used to determine the instream flow deficits from the flow requirements. The third and final stage is to use the Montana DNRC water rights database, within the project GIS, to determine a cost effective permitted water right or combination of water rights that could be obtained or conserved to provide the additional flows to meet critical life stage requirements.