

Assessment of Ecoregional Dissolved Oxygen Regimes
Data Report for 2006 Study Season

SECTION 1

INTRODUCTION

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Dissolved oxygen (DO) in the water column and sediments are needed to support oxidative (aerobic) metabolic processes used by freshwater aquatic life communities. In the absence of optimal and taxa-specific DO concentration requirements, alternative and less efficient anaerobic pathways may be used. The metabolic consequences (Kramer 1987, Hughes 1981, Herreid 1980) of oxygen deficient environments include many of the chronic and acute responses in fish measured or observed by investigators, such as:

- acute mortality;
- embryonic or early life stage sensitivities;
- depressed growth rates;
- reduced reproductive success; or
- aberrant behavior.

Long-held as a critical water quality indicator, DO threshold concentrations have been set forth in guidance associated with federal legislation since the 1960s, i.e. the Water Quality Act of 1965 (FWPCA 1968). Threshold concentrations necessary to support specified aquatic life communities (designated use) are termed water quality criteria (WQC). Initially proposed in 1968 (FWPCA), and included in Chapman (1986), the Missouri Department of Natural Resources (MDNR) currently enforce a 5.0 mg/L instantaneous concentration as a warm-water (WWF) and cool-water (CWF) fishery DO criterion (Carnahan 2006). In addition, a 6.0 mg/L instantaneous DO criterion has been assigned to protect cold-water fisheries in Missouri (Carnahan 2006).

Missouri ephemeral and intermittent stream segments are challenged to attain the 5.0 mg/L WWF criterion during summer and fall conditions (Sowa *et al.* 2004, Smale and Rabeni 1995a, Smale and Rabeni 1995b, Smale and Rabeni 1991, Pflieger 1971). In many cases, MDNR staff believe that natural conditions are responsible for periodic non-attainment of the WWF criterion (see 2004/2006 303(d) List, MDNR 2006). Federal DO criteria guidance supports the concept of seasonal non-attainment phenomena related to natural conditions (Chapman 1986, page 28):

“Naturally-occurring dissolved oxygen concentrations may occasionally fall below target criteria levels due to a combination of low flow, high temperature, and natural oxygen demand. These naturally-occurring conditions represent a normal situation in which the productivity of fish or other aquatic organisms may not be the maximum possible under ideal circumstances, but which represent the maximum productivity under the particular set of natural conditions. Under these circumstances the numerical criteria should be considered unattainable, but naturally-occurring conditions which fail to meet criteria should not be interpreted as violations of criteria. Although further reductions in dissolved oxygen may be inadvisable, effect of any reductions should be compared to natural ambient conditions and not to ideal conditions.”

The Assessment of Ecoregional Dissolved Oxygen Regimes (AERDOR) project significantly expands efforts initiated by MDNR to quantify DO non-attainment issues. Data collected as part of the 2006 AERDOR effort compliments MDNR-led reference stream efforts by:

- Assessing the prevalence of DO concentrations below 5.0 milligrams per liter (mg/L) during summer conditions;
- Assessing the exposure to dissolved oxygen concentrations less than 3.0 mg/L during summer conditions;
- Providing a summer season snapshot of trophic state in comparison to draft nutrient criteria developed by U.S. EPA;
- Estimating DO sources and sinks during warm weather baseflows;
- Characterizing influences of flow on observed DO regimes; and
- Assessing ecoregional or landscape influences (if present) affecting observed DO levels.

Federal guidance supports the concept of a period where DO concentrations fall below WQC due to natural conditions. For those periods where the DO criterion is unattainable, water resource managers and agencies remain in need of an alternative WQC to measure attainment of aquatic life uses. Information and results provided within the Year One AERDOR Report (the Report) will aid agencies in evaluating seasonal criteria issues and ensuring accurate protection of Missouri's aquatic life resources.