DISSOLVED OXYGEN: SIMPLE CONCEPTUAL MODEL DIAGRAM

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Aerobic aquatic life requires oxygen for survival, and most are dependent upon oxygen dissolved in the water column. Dissolved oxygen (DO) concentrations are normally sufficient to maintain healthy biotic assemblages in unpolluted, free-flowing streams, but low or extremely high DO levels can impair or kill fishes and invertebrates. In addition, large fluctuations in DO levels over relatively short periods of time (e.g., daily) can stress aquatic organisms.

Human activities can significantly affect DO concentrations in streams, most notably by decreasing oxygenation and by increasing chemical or biochemical oxygen demand. Agricultural practices, forestry practices, and other activities may involve channel alteration (e.g., straightening or deepening of streams) or impoundments downstream of a location, which may decrease aeration and the diffusion of oxygen into water. Impoundments upstream of a location may discharge low oxygen water downstream, but releases also may increase turbulence and oxygenate water. These land use practices also may directly introduce nutrients (e.g., fertilizers, animal wastes), chemical contaminants (e.g., heavy metals), or organic matter (e.g., sewage, animal wastes) to streams, or indirectly increase the delivery of these substances to streams via land cover alteration. The resulting chemical reactions and increased respiration of microbes and plants can increase oxygen demand in streams, leading to decreases in DO.

These sources also may affect DO via interactions with other stressors. For example, DO saturation occurs at lower concentrations in warm versus cold water, so factors contributing to increased water temperatures (e.g., loss of riparian cover, warm effluents) may contribute to decreased DO concentrations. Similar relationships are seen with increasing ionic strength and sediment.

Although most impairments associated with DO result from insufficient oxygen levels, in rare cases DO concentrations may be too high (e.g., due to increased photosynthesis and subsequent oxygen production in nutrient-enriched streams. Even if elevated DO levels do not cause direct impairment, they may contribute to stressful DO fluctuations when followed by significant drops in DO at night.