Appendix E

Upper Middle Mainstem Columbia River Subbasin

Water Quality Parameters Affected by Hydropower Production

Total Dissolved Gas

Total dissolved gas (TDG) supersaturation often occurs during periods of high runoff and spill at hydropower projects and can be harmful to fish. Supersaturation occurs when gases, entrained by water passing over spill gates, are carried to depth by the plunging action of the spill and forced into solution by increased hydrostatic pressure (Perleberg and McDonald 2000). Fish and other aquatic organisms that are exposed to excessive TDG supersaturation can develop gas bubble trauma (GBT), a class of harmful and potentially fatal symptoms. Total dissolved gas supersaturation in the Columbia River was identified in the 1960's and 1970's as a potential detriment to salmon. Those concerns have reappeared as management agencies have reinstituted spill as a means of aiding downstream fish passage throughout the system.

The WDOE has set a TDG standard of 110 percent of saturation for all flowing waterways. The WDOE has approved an interim modification to the standard of 110 percent to allow spill for fish passage. The revisions under this modification to state water quality standards allow an average TDG level of 120 percent for the highest 12 hours of a day at the tailrace of the respective dam and allow an average of 115 percent for the highest 12 hours of the day at the forebay of the next downstream dam. The modification to state water quality standards also incorporates a maximum one-hour average TDG reading of 125 percent in the tailrace. These standards do not apply during periods when the river flow exceeds the seven-day, 10-year-frequency flood (7Q10-the level of a flood release that could be expected to occur for a period of seven days on the average of once in ten years). Total dissolved gas at the UMM hydro projects is monitored in both the forebay and tailrace of the projects. The projects typically remain in compliance with the WDOE standards, but on occasion, TDG levels exceed the maximum allowed. This exceedance usually occurs during periods of high run-off or when the water coming into a project is nearing, or is out of compliance with WDOE standards.

Water Temperature

The effect of hydropower projects on Columbia River water temperature has been to delay the time when thermal maximums are reached and when cooling begins in late summer (BPA et al. 1994). The thermal regime of the UMM is largely influenced by releases from Grand Coulee Dam, which is the main upstream deepwater storage project. The UMM hydroelectric projects are run-of-river facilities with very limited capability for storage and flow regulation. In general, the low retention times of the reservoirs at these facilities limit the potential warming that can occur.

Dissolved Oxygen

Dissolved oxygen (DO) levels in the subbasin do not typically decline below the minimum Environmental Protection Agency (EPA) standard for DO in Class A waters of 8.0mg/l.

Turbidity and Suspended Sediments

Turbidity and suspended sediments in the UMM are relatively low (BPA et al. 1994). The hydroelectric projects and their associated reservoirs slow the river flow and allow sediment to settle out. Turbidity and suspended sediments are commonly higher in the tributaries than in the Columbia River of the Columbia River (BPA et al. 1994).

Nutrients

Water quality stations throughout the Columbia River typically show ammonia concentrations that are below the EPA chronic freshwater standard. Mean annual phosphate concentrations often exceed levels that could stimulate algal blooms. Highest phosphate levels occur at the start of spring runoff, and in the late fall at the end of the low-flow season. High levels are also encountered in winter when biological uptake is lowest (BPA et al. 1994).

High levels of nitrates and phosphates have also been observed in the upper reaches of the Douglas Creek watershed, the main tributary to the Moses Coulee (Isasacson 1989), though water samples from lower reaches show higher water quality. Bartu and Andonaegui (2001) suggested that the higher flows in the lower reaches of Douglas Creek might be acting to dilute the levels of nitrates and phosphates.