Addendum for Background Information Report

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Summary of Investigations
Moon River Walleye
Population Dynamics Versus Flow

Walleye Spawning Below Dams

Walleye are known to spawn below several dams in the Muskoka River watershed, including the spillway channel below the South Falls dam and in the Moon River below Moon Falls. Walleye spawning, egg incubation and fry emergence can be susceptible to the impacts of water management. In a natural stream setting, walleye typically spawn when water levels are rising or stable, and depend on a slowly receding hydrograph to prevent exposure and desiccation of eggs prior to hatching. Abnormally high flows/water levels during the spawning period may encourage walleye to spawn in areas that will be dewatered prior to the end of the incubation period.

The present water management regime in the watershed includes a number of measures designed to maintain and/or enhance some of these important walleye spawning habitats (Section 5). Habitat improvements have been undertaken and a specified minimum flow (3 m^3/s) is provided at South Falls to enhance spawning habitat and survival of eggs and fry. Further complications at both sites include a protracted spawning period, as fish respond to rising and falling temperature cues.

The area immediately below Moon Falls on the Moon River is an historically significant spawning area for walleye, with progeny from this area historically providing the basis for a destination fishery in Georgian Bay. MNR records indicate that the spawning population using this area has declined substantially, although a reduced population (compared to historic data) still utilizes this area as a spawning location.

Since 1969, MNR and OPG have attempted to maintain a consistent, targeted flow of 14 m^3/s in the Moon River for the duration of walleye spawning and egg incubation periods in the months of April and May. This quantity was thought to have been identified as a target in the Hackner-Holden Agreement, although historic documentation is lacking in this regard. A flow of 14 m^3/s was considered the quantity that could be provided from one year to the next

through April and May, while also minimizing the impact on power production at OPG facilities on the Musquash River. A higher flow value was not chosen as the target as it could not be provided on a consistent basis, which was thought to be essential to yearly production of walleye at this site. However, in reality, flows are often variable, with high volume, short duration peaks above the targeted 14 m^3/s a common occurrence.

Further observations and investigations have revealed that managing for stable, low flows on the Moon River often results in unanticipated peaks in flow when rain events or sudden snowmelt events occur within the watershed. These events cause dramatically increased outflow from the watershed, requiring excess water to be passed down the Moon River as the hydropower facilities on the Musquash River typically pass a maximum of 85 m^3/s (the other outflow channel for the watershed). These peaks in flow increase water levels below Moon Falls and allow spawning walleye to access habitat that will be dewatered as flows recede. This results in stranding of walleye eggs deposited during these high flows. In recent years, a lower consistent flow (8 m^3/s) has been targeted due to dry conditions in the watershed. As a whole, the fluctuations in flows in the Moon River are a result of water withdrawal for hydro generation (by OPG) coupled with a limited ability (by MNR) to store/control spring runoff in upstream lakes and provide flow into the latter part of the incubation period for walleye. Further information on studies undertaken to investigate the relationship between Moon River walleye population dynamics and flow is contained within the Draft Plan, Section15 (Acres, 2005).

Although a few strong year classes have been observed (1960, 1965, 1982, 1985), these occurred in years when flows were high (generally 100 m^3/s or higher), and where these high flow levels were sustained throughout the majority of the walleye spawning and incubation periods. Recent work conducted below Moon Falls (UGLMU, unpublished data) has raised doubts that a flow of 14 m^3/s will consistently provide a sufficient quantity of wetted high quality spawning habitat to produce strong year classes of walleye.

To quantify the issues and concerns associated with the Moon River walleye population, a number of studies (i.e., Winterton, 1975; Dillon, 1983) have been conducted. These studies indicated that walleye production below Moon

Falls was strongly related to discharge and fluctuating water levels, as anecdotal reports have often confirmed. Winterton (1975) and Dillon (1983), both identified that as peak flows recede following the spring freshet, eggs are often dewatered during the latter part of the egg incubation period, and/or deposited eggs are scoured from spawning habitat and swept downstream by high flow events. Winterton (1975) concluded through his analyses that flows accounted for 89% of the variability in walleye production, and more specifically that high, sustained flows produced strong year classes. Further analysis by Reckahn and Thurston (1989) confirmed Winterton's analysis and strengthened it by adding May air temperature and maximum snow depth variables (as precursors to high spring flow events) to the analysis (Table 1). Both sets of analysis served to highlight that high, sustained flows are required for good walleye production below Moon Falls and that managing for low, stable flows would not allow for walleye production to occur in any substantial amount.

Table 1
Correlation Between Environmental Variables and Walleye

Predictor Variable	Regression Coefficient	Sum of Squares	Cumulative Sum of Squares	Cumulative d.f.	Adjusted r^2 x 100	P
FLOW	0.0516	495.73	495.73	1	84.5	0.000
TEMP	0.4991	43.91	539.63	2	92.5	0.000
SNOW	-0.1452	22.34	561.97	3	96.8	0.002
Residual		14.63	576.60	14		

Variable definitions:
- TEMP = May air temperature (°C)
- SNOW = Maximum snow depth (cm)
- FLOW = Mean April + May Moon River flow (m^3/s)
- Residual mean square = 1.33

As noted above, flow regulation is complicated by water withdrawals for hydropower generation (on the Musquash River) and the limited ability to store/provide sufficient flow from upstream lakes. As a result, the Dillon report provided a series of potential engineering solutions, including improved storage/regulation at upstream water control structures, channelization of specific river channel sections to reduce water level fluctuation associated with flow changes and installation of strategically placed weirs to reduce water level fluctuations. Most recently, the Upper Great Lakes Management

Unit of MNR undertook an assessment of spawning activity at the site during the spring of 2004. Although the Dillon report identified options, many of these were very costly and the identified flow regimes in the options portion of the report were not discreetly compared against walleye spawning habitat below Moon Falls. In addition, the opportunity to change flow regimes for the Moon River was not available at the time, as it is now, hence the emphasis on engineered solutions rather than modified flow regimes. The fisheries issues associated with the Moon River represent an ongoing issue, with the relationship between flows and available spawning substrates an outstanding data need. Please see Section 15 of the Draft Plan (Acres, 2005) for a description of proposed work and future plans for dealing with Moon River fisheries issues.