Excerpt from report

### Nanobubble technology

This very recent technology which is said to take the hypolimnetic oxygenation process using Speece cones (Speece et al. 1973) to the next level. At present there have been a number of product documents and videos presentations but no peer reviewed publications, which give the information required to assess the efficacy of this product. The product brochures say the nanobubbles are produced through the walls of a special ceramic cone over which water flows. This water carries the nanobubbles into the lake where they sink the bottom. This concept may work in rivers and shallow lakes but may not work where the internal lake currents can be substantial, as in Lake Hayes. If it did work as described and the nanobubbles were entrained into the density current, this could be a useful tool.

The main issue with the nanobubble technology is that it relies on providing all of the oxygen to sequester the DRP in the hypolimnion. Based on the calculations of HOD in December 2016 (average 60 mg m-3 d-1) it would need to provide >1.57 t O2 d-1 (Section 3.2) just to hold the DO concentration at the level it was when the nanobubble technology was switched on. That oxygen input would need to be much larger if the nanobubble technology was going to re-oxygenate the lake. The other issue is that the special ceramic cone used to generate the nanobubbles is produced in only one facility in Japan. I believe that no one else has been able to reproduce this cone, without which the nanobubble machine does not work. This is a high risk situation if this vital part fails.

The supply agents advise that, if the power fails, water can slowly seep into the ceramic cone causing a blockage and the nanobubble machine will not work when the power is restored. This situation can be recovered by removing the cone from the water and allowing it dry for 24-48 hours.

A quotation for using the nanobubble technology in Lake Hayes was obtained (Appendix A). The design supplied included seven nanobubble ‘engines’ spaced around the lake at an installation cost of $4.7 million.