

# Water Resource Associates

*A network of consultants in hydraulics, hydrology, groundwater & environmental issues*

**Project title:** Development of a new Water Release Policy for Lake Victoria

**Summary:** Development of Hydrologically-based Rules for operating the hydro-electric generating facilities at the Lake Victoria outlet, in order to safeguard water level in Lake Victoria for all users.

<b>Client:</b> Lake Victoria Basin Commission	<b>Financed by:</b> LVBC
<b>Period of assignment:</b> Apr-Oct 2008	<b>Location:</b> Kenya, Uganda and Tanzania
<b>Project Value:</b> £67,670	<b>WRA services:</b> £21,277
<p>📍 Lake Victoria water levels at Jinja, 1899-2007</p>	<p><b>Overview</b></p> <p>WRA led the technical inputs to a study aimed at developing a new water release policy for Lake Victoria. The study resulted from concern over falling lake levels and the sustainability of current rates of power production. David Plinston and John Sutcliffe supported Frank Farquharson in this joint study with Centre for Ecology and Hydrology [CEH], Wallingford, and the University of Dar es Salaam.</p> <p><b>Lake Victoria</b></p> <p>Lake Victoria has a surface area of 68,800 km<sup>2</sup>, making it the continent's largest lake, and the largest tropical lake in the world. The lake lies within an elevated plateau in the western part of Africa's Great Rift Valley and is subject to territorial administration by Tanzania, Uganda and Kenya. The lake has a shoreline of 3,440 km and has more than 3,000 islands.</p> <p>The only outflow for Lake Victoria is at Jinja, where Nalubaale and Kiira Power Stations are located. The water originally drained over a natural rock bar at Ripon Falls; however, this was drowned by construction of Nalubaale dam and hydropower station [formerly known as Owen Falls] in 1952. At that time, British colonial engineers lowered the sill by blasting, and established an "agreed curve" which mimicked the old natural rate of outflow. This allows the outflows to vary between 300 and 1,700 cubic meters per second, depending on lake level.</p>
<p>📍 The Lake Victoria Basin and catchment area, with the three political divisions</p>	

## Objectives

Since 1952, the outflow of the lake has been artificially controlled according to the "Agreed Curve", which was the natural rating curve for Ripon Falls prior to dam construction. In 2002 a second hydropower plant at Kiira was constructed to operate in parallel with that at Nalubaale, but lake levels then fell dramatically, partly due to a period of low inflows, but made worse by releases for hydropower in excess of the Agreed Curve. By 2006, the water levels in Lake Victoria had reached an 80-year low.

Various sources suggest that more water was being released, than was allowed under the agreed curve, although inflows had also been low during this period. The WRA study carried out a complete review of the data, to provide a new optimised release policy for the lake, which would provide a sustainable operating strategy for the next 20 – 30 years and meet the needs of the various stakeholder groups and countries.

Project Number 000214

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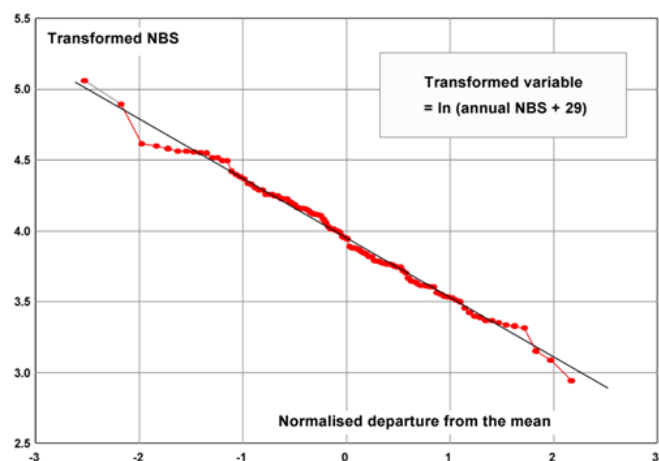
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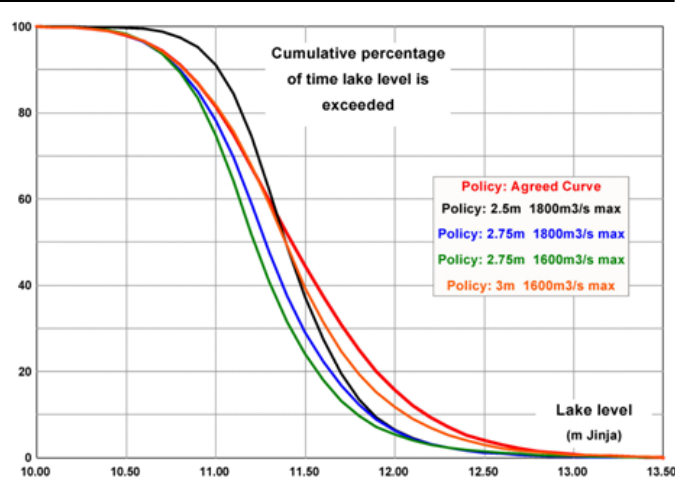


**Project Details:** Development of a new Water Release Policy for Lake Victoria

The Lake Victoria Basin Commission required that the new policy strive to reduce variations in lake level, whilst at the same time storing water in years of high inflow to augment releases during periods of drought. The two aims are of course mutually exclusive; storing water in wet years requires raising lake levels, and hence increasing the range of lake levels. A series of possible new release policies were examined seeking a compromise between the needs of the hydropower lobby, who would prefer a more uniform outflow regime, and other stakeholders who would prefer more stable lake water levels.



👉 Net Basin Supply [NBS] transform function



👉 Comparison of the impact of using different Lake Victoria Control Curves

**Development of the New Strategy**

The outcome of the study was to produce a ‘zoned’ release policy, whereby outflows remain constant within a series of level bands, which benefits power generation, whilst endeavouring to control lake water levels. The policy has been developed by routing 30 year series of Net Basin Supply (NBS) to the lake:

$$NBS = \text{Outflow} + \text{Change in storage} = \text{Tributary inflow} + \text{Net rainfall on lake}$$

- The terms have to be expressed in consistent units such as *volume*
- Tributary inflow is the volume of water supplied from the lake basin
- Net rainfall is rainfall on the lake minus evaporation from the lake surface

NBS can be accurately derived from measurements of lake releases and changes in storage, and a historical record from 1898 to 2007 was available for the study. However, the next 30 to 40 years are unlikely to be exactly like any period during the historical record, and so stochastically-generated NBS series were derived using a simple log-normal distribution.

$$\text{Transformed variable} = \ln (\text{annual NBS} + 29)$$

**Comparison of Results**

Four zonal policies were investigated, aiming to reduce lake level variations to between 2.5 and 3metres, and restricting the maximum outflow to either 1600 or 1800 m<sup>3</sup>/s. The results are summarised in the second graph, where it can be seen that restricting lake level variations to 2.75 or 3 metres can significantly reduce the percentage of time the lake is at high levels above 11 metres at the Jinja gauge.

**The Way Forward**

The policies would be refined during 2009, and a final recommendation submitted to the East African Council of Ministers.

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