ABSTRACT

In light of the increased pollution of Kingston Harbour and proposed efforts to reduce the levels of contamination, a survey of the circulation patterns and bathymetry was conducted. This was expected to yield information on the fate of pollutants in the Harbour and their rate of export. Current measurements, along with temperature and salinity readings were taken throughout the water column at 20 stations in the Harbour from April, 1994 to July, 1995. From August 7 to September 15, 1993, a bathymetric survey was conducted for the Outer and Inner Harbour while in the Upper Basin, the bathymetry was done between July and August, 1995. In addition, the tidal cycle, wind pattern and rainfall were recorded, and used to determine the main driving force of the current patterns in the Harbour. These data were analysed to determine seasonal as well as spatial variation in the circulation patterns in the Harbour under varying conditions. The presence of layers was determined and these layers characterised to determine where inflow, as well as outflow, occurred in the Harbour.

The data indicated that Kingston Harbour circulation had to be considered on the basis of different zones and layers of water masses in the Harbour, because currents in each of these zones and layers are controlled by different factors. The bathymetric survey facilitated the division of the Harbour by lines running along the length of the Harbour (from east to west) and by lines running across the Harbour from north to south. The line along the length of the Harbour showed that the submarine terrain divides the Harbour into two lobes (inner and

outer), rather than into three zones (Inner Harbour, Upper Basin, Outer Harbour) as was previously suggested. It was difficult to define a set boundary for the Inner Harbour in terms of circulation. It was evident that the more shallow regions of the Inner Harbour, in the vicinity of Middle Ground shoal and the new Airport runway, were influenced by the Outer Harbour circulation while the deeper northern region was influenced by the Upper Basin. This further justified the division of the Harbour into two lobes.

Circulation patterns in the outer lobe of the Harbour were density driven, especially in the surface layer. It was evident that the water emanating from Hunts Bay radiates in two directions: east into the inner Harbour and west towards the Harbour Mouth. During the dry season, in the outer lobe the water emanating from Hunts Bay was sufficient to maintain a superficial layer which was governed by density. During the wet season the depth of the density driven layer extended to 1 m. In the outer lobe, the density currents superseded the wind driven circulation especially in the vicinity of high fresh water input to the Harbour. However, depending on the strength and duration of the wind, the wind was able to override the effect of the density current in some regions. In the outer lobe, the wind increased vertical mixing and was important in the formation of gyres in the outer lobe.

The tidal currents were important primarily in the bottom layers of Kingston Harbour and their effects were seen at a depth of 3 m and below. The tidal

currents were not the principal currents in the Harbour as was postulated in a previous study and their effect was not similar throughout the water column. It was shown that tidal currents did not flow into all parts of the Harbour on the flood tide and outward on the ebb tide as was stated in previous studies. It was evident from this study that there was predominantly outward flow in the surface layer during both ebb and flood tides. However, water sometimes entered the Harbour in the surface layer, along the Port Royal coast on the flood tide.

In the inner lobe, the wind was the major driving force in the circulation pattern. The wind contributed greatly to vertical circulation and superseded the density currents in this zone. In the inner lobe, the wind played an important role in effecting upwelling along the palisadoes spit in the Upper Basin. The wind also contributed to the formation of gyres in the Upper Basin. In the inner lobe, the tidal currents were of great importance in the deep layers but were not effective at the surface.

When the active and slack periods of the tidal cycle were considered, the flushing time of the Harbour lengthen significantly compared to previous calculations. However, the retention times of the Harbour for a four hour period on the active tidal periods were slower than expected but were similar to those calculated previosly.