

# PREVENTING SALTWATER INTRUSION

## CASE STUDY BUBBLE BARRIER AMSTERDAM



Figure 1: Hypothesis for saltwater dynamics around Bubble Barrier Amsterdam.

**Bubble Barriers do not only catch plastic waste in waterways, they also support the prevention of saltwater intrusion from the sea towards inland waters. This conclusion is based on a case study done on the effects of Bubble Barrier Amsterdam, in the Westerdok canal, on saltwater intrusion.**

### METHODS

During dry periods, the river IJ carries salt water from the North Sea towards the inner city of Amsterdam. In this case study, a total of 48 measurement locations were covered to create horizontal and vertical cross-sectional views. The aim was to visualise the salt concentrations (measured in PSU or practical salinity unit) in the Westerdok canal. The sampling locations shown in Figure 2 were measured under two conditions: firstly, when the Bubble Barrier was turned on; and secondly, after the Bubble Barrier had been turned off for three days.

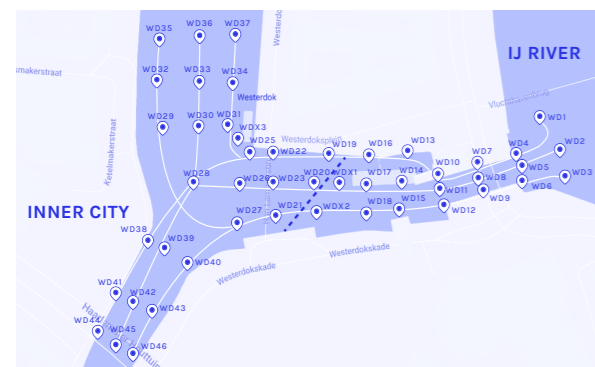


Figure 2: Visualisation of all 48 measurement locations around the Westerdok, with white lines indicating horizontal cross-sectional paths. The respective location of the Bubble Barrier is indicated by a blue dotted line.

### RESULTS

It has been observed that the salinity concentrations are higher when the Bubble Barrier is turned off. This is due to the natural fluctuations in the salinity levels of the water that comes in from the IJ. However, when the Bubble Barrier is running, it has been noticed that the saltwater tongue reduces when it encounters the bubble curtain.

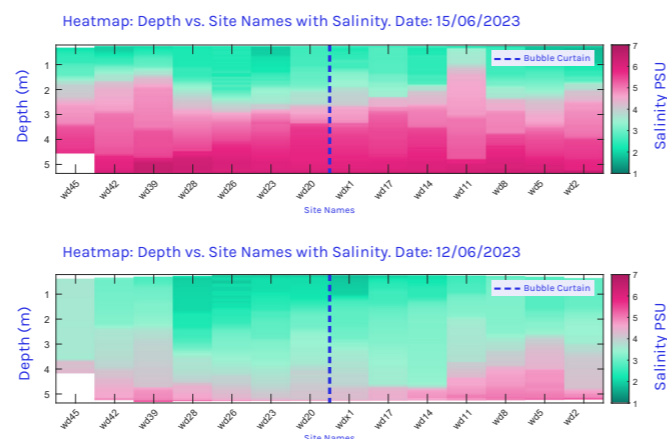


Figure 3: Bubble Barrier off (top), Bubble Barrier on (bottom). Color coded changes of salinity in practical salinity units (PSU) over depth, where pink indicates higher salt concentrations and green lower concentrations. The respective location of the Bubble Barrier is indicated by a blue dotted line.

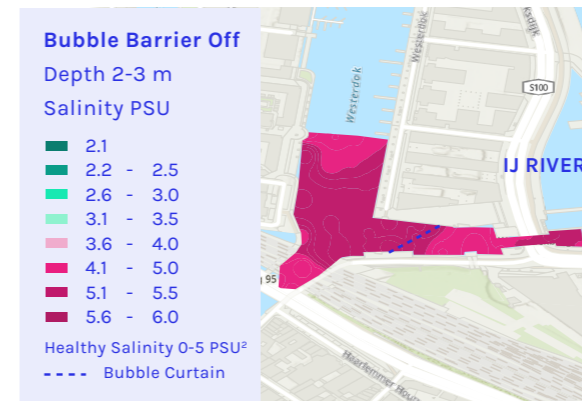


Figure 4: Salinity environment in Westerdok as measured on the 15th of June, 2023 from 08:33-10:23. Green indicates lower salt concentrations, pink indicates higher concentrations. Note that the Bubble Barrier had been turned off for approximately three days.

In the lower depth layers of 2-3m, a high concentration of salinity can be observed around and above 5 PSU. This is evenly spread throughout the canals of Westerdok, and the saltwater tongue is spreading into the canal system.

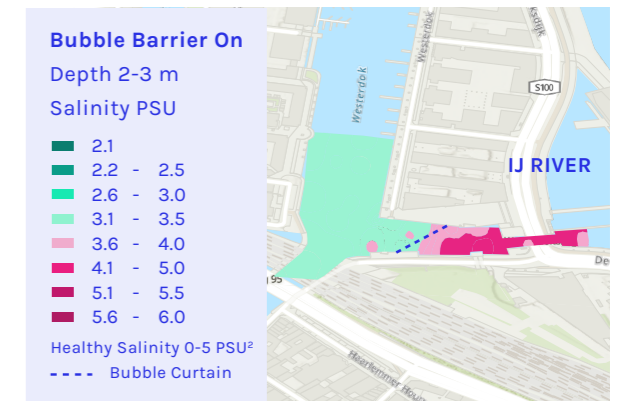


Figure 5: Salinity environment in Westerdok as measured on the 12th of June, 2023 from 09:13-12:05. Green indicates lower salt concentrations; pink indicates higher concentrations. Note that the Bubble Barrier was turned on here.

When the Bubble Barrier is turned on, the saltwater tongue, seen on the IJ-side of the Bubble Barrier, seems to be prevented from further intruding into the canal system, ensuring lower salinity levels.

### CONCLUSIONS

**In general, a trend can be observed across all graphs, indicating an increase in salinity after the Bubble Barrier was turned off. During the day when the Bubble Barrier was turned on, it can be observed that the creeping of the saltwater tongue was reduced and stopped to some degree. Therefore, we can draw a preliminary conclusion that there is a relationship between saltwater intrusion and the effectiveness of the Bubble Barrier in reducing it.**

### IMPLICATIONS

Preventing saltwater intrusion has numerous environmental benefits, which the Bubble Barrier can help address. A few examples are:

1. Cianfaglione, K. (2021). *Plant Landscape and Models of French Atlantic Estuarine Systems*.
2. James et al. (2003). *Responses of freshwater biota to rising salinity levels*;
3. Mustafa et al. (2019). *Global concern for salinity on various Agro-Ecosystems*.
4. Tansel, B., & Zhang, K. (2022). *Effects of saltwater intrusion*;

### 1 FLORA & FAUNA

Living conditions vary for different species, and the level of salinity in an environment is one of the factors that affect this. Biomes are naturally graded based on the waters that house them, which can be oceans, estuaries, or freshwaters. In the latter two systems, excessive influxes of saltwater can be harmful to the local flora and fauna, especially to those species that are accustomed to small changes in salinity concentration. At Westerdok, the salinity levels often exceed 5 PSU, creating an environment suitable for different species.<sup>2</sup>

### 2 AGRICULTURE

Interaction between crops and salinised groundwater can lead to unfavourable osmosis. This means that plant roots may start giving off water to the soil, which can lead to plant dehydration and ultimately result in crop failure. To prevent this from happening, it is crucial that the threshold of 2 PSU for irrigation purposes is not exceeded.<sup>3</sup>

### 3 INFRASTRUCTURE

Increased saltwater intrusion could lead to damage to nearby structures and infrastructure surrounding the canals, causing deterioration and safety issues.<sup>4</sup>