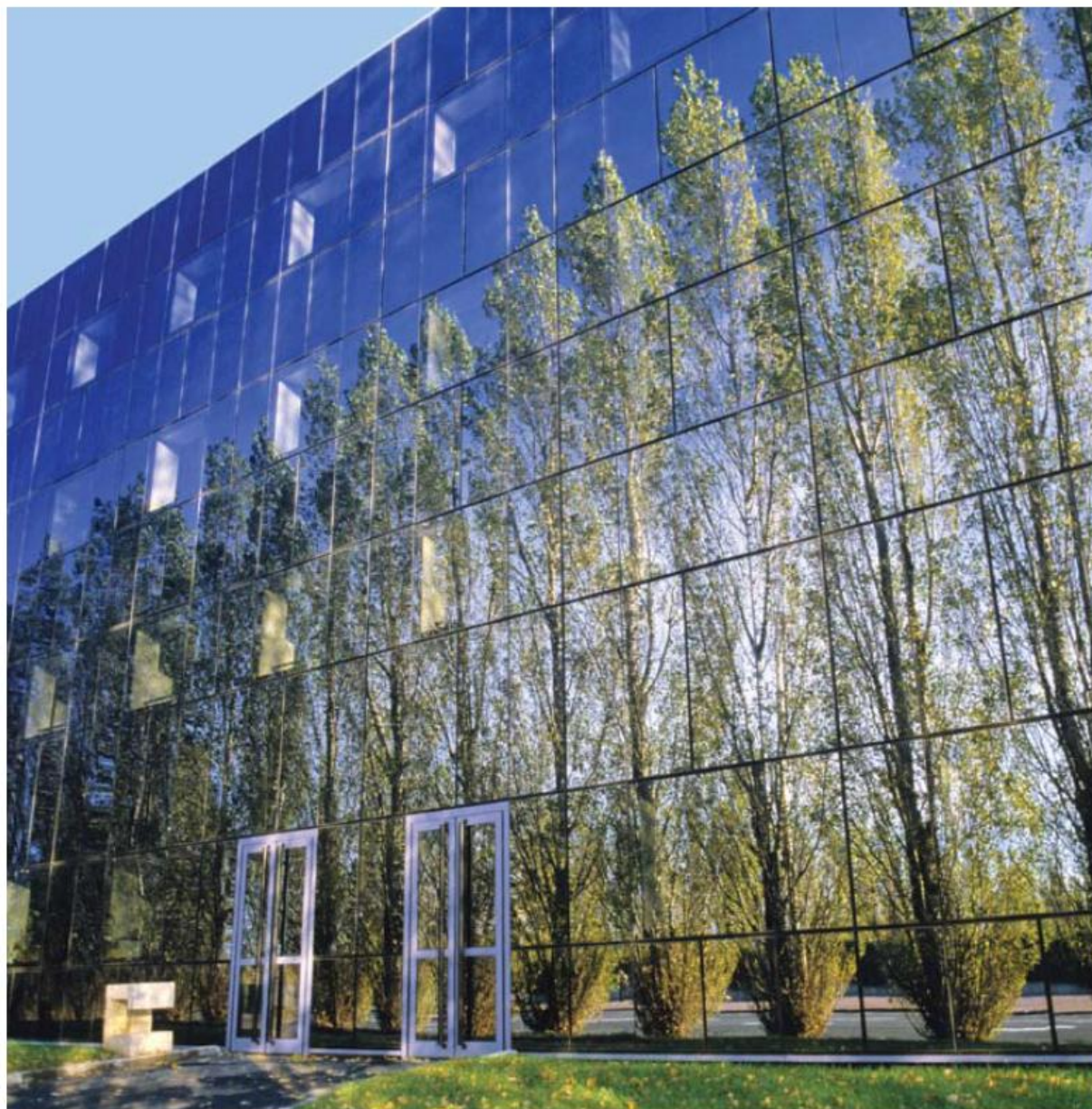


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Will the Marmara Sea Survive ? The Struggle against Pollution

By Professor Dr Derin Orhon, Professor Emeritus, Istanbul Technical University, Turkey

On the border of two continents, Europe and Asia, the Marmara Sea is undeniably one of the most picturesque marine environments in the world. It offers unique natural attractions with many islands including the famous Princes' Islands, tourist resorts and historical sites. Unfortunately, it is also under severe threat of pollution. Not so long ago, the shores of the Marmara Sea were decorated with quiet coves, beaches, small fishing villages and clusters of summer homes. During the last few decades, the rapid growth in Istanbul extended to the entire shoreline as residential areas, industrial zones, plants, and shipyards. The water body is now critically affected and subject to a multitude of wastewater discharges from all land-based sources, including the Istanbul Metropolitan area.

Alarming signals of eutrophication were given as early as 1995, in a modeling study carried out by the Water Quality Institute of Denmark. The findings of the study suggested that the quality of surface water could only be improved by advanced treatment securing effective control of nutrients in wastewaters. Similarly, in a comprehensive report prepared by a group of scientists for the Turkish Bar Association in 2007, it was argued that the Marmara Sea should not be used for wastewater discharges, due to rapid depletion of dissolved oxygen in the water body. Indeed, water quality measurements indicate now severe signs of pollution and eutrophication problems, causing more than 50 marine species to nearly become extinct. According to Yalçın Güven, representative of a local aquaculture co-operative, the number of fish species lost to pollution may be as high as 113. Turkish scientists recommend strict measures across the Marmara Sea to protect fish stocks and prevent more species from going extinct. Bayram Öztürk, president of the Turkish Marine Foundation further requests that the Marmara Sea and in particular, Princes' Islands should have protection zones.

Marmara is the smallest sea in the world, in active exchange in the north with the Black Sea through the Bosphorus and in the south with the Aegean Sea through the historical Dardanelles. It is permanently and strongly stratified with totally different characteristics between the euphotic layer in



the upper 30 m and the lower layer showing the typical properties of the Mediterranean. The Bosphorus, a romantic waterway, is also a strongly stratified narrow channel, with the upper layer carrying the low salinity outflow from the Black Sea and the bottom denser layer generated by the northerly, highly saline flow from the Mediterranean. Appreciable mixing occurs between the two layers along the Bosphorus. The mixing intensifies in the junction zone between the Bosphorus and the Marmara Sea, taking away a significant portion of the lower layer into the upper flow. This way, the lower layer is estimated to lose more than 40% of its flow back to the Marmara Sea while passing through the Bosphorus. This is critically important for evaluating the impact of pollution associated with Istanbul and the Black Sea.

Istanbul, a unique historical landmark and a major tourist destination in the world, is perhaps the oldest city in the world, in the light of 8000 year-old remains discovered during the

excavations of the Marmaray tunnel underneath the Marmara Sea. Located along the northern shores of the Marmara Sea and the Bosphorus, it is also the largest city in Turkey, currently housing close to 14 million people, 18% of the total population in Turkey. The conceptual approach for wastewater management for Istanbul was first set forth, solely based on the significance attached to the mixing conditions of the receiving waters. Historically, the mixing and dilution potential was considered as a significant remedy for wastewater management; in the early 1970s, on the basis of the limited scientific data available at that time, a series of master plan studies concluded that all discharges made to the lower layer of the Bosphorus and the Marmara Sea would be transported to the Black Sea, without significant mixing and interference with the upper layer and consequently, with no detrimental effect on the water quality of the Marmara Sea. Accordingly, the metropolitan area was subdivided into separate wastewater drainage and collection zones ending at different discharge points with deep marine outfalls.

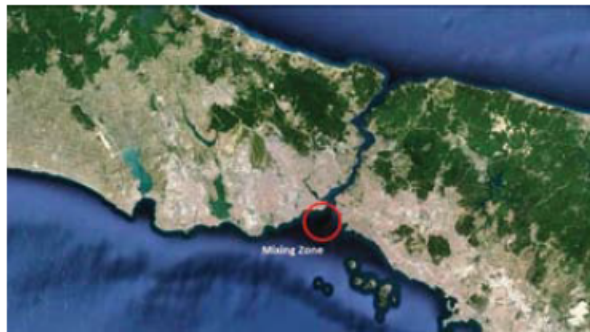
Deep sea outfalls for wastewater discharges, once quite popular in the US and in Europe, are all abandoned now in favor of appropriate treatment plants, also involving nutrient removal where necessary. Surprisingly, Istanbul still insists on keeping this obsolete practice. At present, the daily volume of wastewater generation in Istanbul is 3.1 million m³, according to the official



records; more than 70% of this wastewater flow is discharged to the Marmara Sea or to the Bosphorus through deep outfalls, without being subject to any treatment. This way, the lower layer of coastal marine environment receives on daily basis around 1100 tons of organic matter, 130 tons of nitrogen and 20 tons of phosphorus, aside from a wide spectrum of settleable solids, chemicals and hazardous materials, enough to incite and sustain a considerable level of pollution. A significant portion of this pollution load reaches the upper layer of the Marmara Sea by means of effective mixing between the upper and lower layers. From a scientific perspective, the most unsuitable location for wastewater disposal would undoubtedly be the mixing zone between the Bosphorus and the Marmara Sea. However, two major discharges with no treatment – Kadiköy and Yenikapı outfalls- accounting for around 40% of the total wastewater load in Istanbul are directly located in this mixing zone. They inevitably act as major contributors of pollution in the Marmara sea.

The Black Sea is also a significant polluter for the Marmara Sea. Consequently, the relative impact of the pollutant loads in the upper current in the Bosphorus as compared to local wastewater discharges should be given serious consideration for appropriate wastewater management programs. Monitoring studies indicated more than 30 tons of nitrogen and 9 tons of phosphorus are carried from the Black Sea on a daily basis in the upper current of the Bosphorus. However, the net input to the Marmara Sea is excessively higher, mainly because at least twice the volume of pollutants are imparted from the bottom layer, a mechanism triggered by intensive internal mixing at the Bosphorus-Marmara junction. This is a clear indication of nutrient accumulation in the bottom layer, presumably due to raw wastewater discharges in the mixing zone. In this way, a significant portion of pollutants are re-circulated back to the upper layer, explaining the alarming state of the water body, especially for lower oxygen profiles and high levels of nitrogen and phosphorus, the basic ingredients of eutrophication.

Nowadays, Istanbul and Turkey also discuss the “crazy and magnificent” project, involving a second Istanbul Channel between the Black Sea and the Marmara



Sea with the main purpose of diverting the extensive tanker traffic away from the Bosphorus. The major claim is to return the Bosphorus to its natural splendor without the risk and congestion of marine traffic. Although, the exact location is yet to be disclosed, the artificial canal will be around 45-50 km long, 400 m wide and 25 m deep and split the European side of Istanbul in two, creating this way a West Istanbul Island.

There is a great deal of controversy about this project: Most people argue that the project should not be regarded as a mere channel but as a massive infrastructure likely to attract people and create a smaller version of a new Istanbul. Melis Alpan, a journalist at Milliyet, calls the project a “disaster madness” likely to create unplanned growth with an urban development of at least 2.5 to 3 million people, exploiting the 30,000 hectares of adjacent land reserved for this purpose. It is also underlined that the project has no legal basis, mainly because the Metropolitan Plan promulgated in 2006 and slightly amended with the same basic framework in 2009 does not have any provision for it. It is further argued that the project will open the way for exceeding the population limit of 16 million people set by the same plan on the basis of environmentally sustainable land use planning for the city.

The scientific attitude toward the project is also overwhelmingly negative. Prof Cemal Saydam, a hydrobiologist at Hacettepe University, claims that the project will indeed be an ecological disaster for the Marmara Sea. He says that the channel will be another outlet for the polluted waters of the Black Sea. Its waters, rich in nutrients and dissolved oxygen will mix

with the Marmara Sea water, accelerate primary growth, which will eventually sink, disintegrate and ultimately, disturb the oxygen balance in the water body, further reducing the existing critically low dissolved oxygen levels.

Obviously, a project of such magnitude with debatable consequences

not only for the Marmara Sea but also for regional environment, should be thoroughly evaluated, also including social, economical and political aspects together with environmental and ecological issues. Environmental impact assessment (EIA) is clearly the most appropriate instrument for this comprehensive evaluation. While certainly a legal and scientific prerequisite, it is not clear whether a study of the EIA status will be implemented, in view of a recent controversial modification in the related regulation providing selected large projects exemptions from environmental impact evaluations. Regardless of all speculations, it is certain that the canal project cannot afford to remain “crazy”; it should prove itself environmentally sustainable beyond any scientific doubt, especially for the future of the Marmara Sea, before any further moves can be taken for its implementation.

In short, the Marmara Sea is suffocating and urgently needs an intelligent move for an effective action plan of pollution prevention to ensure its revival. Perhaps, the plan should primarily focus on growth management in view of the fact that environmental, ecological or social problems in the region will be easier to solve with fewer people. It should also prescribe a new wastewater management strategy for Istanbul as well as for other coastal areas also contributing to the pollution of the Marmara Sea. The existence of the two layer current system should no longer be considered as a major asset for future disposal strategy. The massive wastewater volumes discharged, should be also regarded as a resource for reuse and energy recovery.

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