

COASTAL RESERVOIRS

Field of the Invention

The present invention relates to coastal reservoirs and refers particularly, though not exclusively, to coastal reservoirs for collecting fresh water from a source of fresh water and holding it against contaminated water in which the reservoir is located.

Background to the Invention

The Ministerial Declaration of the Second World Water Forum in Hague, Netherlands (March 2000) set water security as a principal concern for sustainable development in 21st century. It's global statistics states that approximately one in three people live in regions of moderate to high water stress. It is estimated that two thirds of all people will live in a water-stressed condition by 2025 (WBGU 1999, UNEP 1999). The densest populations in the world live near lower reaches of a river because of the fertile lands for agriculture production, fish resources, natural waterways for navigation, and relative flat topography for economic development activities. Water supply in the lower reaches of a river generally cannot meet the demand due to insufficient reservoir capacity. This results in excess rainwater being released into the sea. This frequently due to limitation of land reservoirs capacity. At present only 1/6th of global rainwater is being used by humans, and about half of all available fresh water runs into the sea. Also, fresh water generally mixes with saltwater in estuaries.

Summary of the Invention

A reservoir for collecting of fresh water from a source of fresh water. The reservoir includes a primary barrier for providing a restraint against escape of the fresh water, and to prevent ingress of unwanted water. The primary barrier is located at least in part in a body of unwanted water. In addition, the reservoir includes a secondary barrier located within a storage zone defined by the primary barrier, whereby the secondary barrier creates a buffer zone between the primary barrier and the secondary

barrier so that fresh water contaminated with unwanted water will be in the buffer zone.

The reservoir's primary barrier can be a solid barrier of a height sufficient to withstand normal tidal surges and wave action of the unwanted water. The primary barrier may keep the water catchment in a relatively calm state. The second barrier includes a water boom for floating on a surface of the water, and a skirt suspended from the boom in the fresh water and separating the fresh water and the contaminated water. In this regard, the water boom floats on top of the water and together with the flexible skirt can accommodate variation in water volume and height of the water to be an effective barrier.

The skirt may extend to the bottom of the reservoir of water. A ballast may be used to hold the skirt in position. The secondary barrier may be positioned using an anchor and chain system.

The secondary barrier can be used to separate fresh water and unwanted water, such as freshwater with seawater, clear water with turbid water, or polluted water. It can be also used to separate the moving water and stagnant water. The buffer zone traps unwanted water, to minimise the potential contamination of the fresh water collected within the secondary barrier.

The fresh water for the reservoir can be collected directly from fresh water flowing down from an estuary into the reservoir. In addition, the fresh water for the reservoir can also be collected by diversion from the river or the like into the reservoir using an artificial channel or pipelines. The diversion point may be located upstream of the river. Alternatively, the fresh water can be collected using soft barrier apparatus upstream of an estuary. When these apparatus are full of fresh water, the apparatus openings can be sealed or closed. Furthermore, the apparatus may be drifted or towed to the sea for storage or transportation to the reservoir.

A multitude of similar reservoirs can be inter-connected to each other by artificial channels or pipes. Also, in one reservoir, there can be a plurality of secondary

barriers. If there is a water level differential between the reservoirs, a tidal gate separating them can naturally by gravity release the water by flowing from a high to a low water level.

For the primary barriers, there may be tidal gates to regulate the level of water collection. The tidal gates may be able to release fresh water or contaminated water with unwanted water, when the main body of unwanted water is in low tide.

Description Of The Drawings

In order that the invention may be easily understood and put into practical effect these shall now be described by way of non-limitative example only preferred embodiments of the present invention in the description being with reference to the accompanying illustrated drawings, in which:

Figure 1 is a schematic plan view of a number of embodiments; and

Figure 2 is a side view of a reservoir of Figure 1.

Description Of Preferred Embodiment

Coastal reservoirs 101, which have first barrier 102 and a second barrier 108 within the first barrier 101, are used to isolate fresh water 110 from seawater 111 or water of another body such as, for example, a lake or ocean. Second barriers 108, located inside the primary or first barrier 102, contain the freshwater 110. A buffer zone 112 between the second 108 and first barriers 102 contains brackish water 112 introduced by surges of the main body of water 111 or polluted water introduced by inland runoff during certain period. The second barrier 108 is made of a liquid impervious skirt supported by floaters 107 on the surface 113, and held on the seabed 114 by ballasts 109.

The main advantage of the invention is to collect excess fresh water in the rainy season or otherwise and to store it in the coastal reservoirs 101. The fresh water

110 inside the coastal reservoirs 101 can be released when required. The fresh water 110 collected in the coastal reservoirs 101 can be diverted to neighbouring watersheds through artificial channels or pipelines, if desired or required.

Fig. 1 shows the plan view of coastal reservoirs 101. Each has a solid 102 barrier and a soft barrier 108, one or more tidal gates 103, and channels or pipes 105 connecting coastal reservoirs 105 to collection points 101.

Fig. 2 shows a cross-section of a coastal reservoir. Here, the barriers are the solid barrier 102, and the soft barrier 108 with floating boom 107, and ballast 109. Ballast 109 preferably holds barrier 108 in a water-tight seal with seabed 114. Boom 107 holds barrier 108 at or above the surface 113. Barrier 108 therefore forms an effective seal between fresh water 110 and brackish water 112.

All runoff from rivers 106 may flow to the coastal reservoirs 101, which may fully enclose an estuary 115 or may be located besides an estuary 116. The coastal reservoirs 101 separate the enclosed fresh water 110 and the seawater 111 by composite soft 108 and hard 102 barriers. The fresh water 110 is collected inside the soft barrier 108. Between the soft 108 and hard 102 barriers is brackish water 112. Outside the hard barrier 102 is the seawater 111. Tidal gates 103 will be necessary to regulate the water level. Gates or pump stations 104 connected to the reservoir 101 by artificial channels or pipes 105 may also enable the collection of fresh water to the reservoir 101. They can also be used to regulate the water level in reservoir 101.

The primary barriers 102 extend from the land 117 into the main body of water 111 and back to land 117 to provide a water reservoir 101. The main barriers 102 are of a normal, rigid structure and one of sufficient height to withstand normal tidal surges and wave actions. The need not be as strong as a normal dam wall as they have water on each side. By using the sloping seabed 114, the reservoir 101 may hold a sufficient volume of fresh water 110 to be useful. Secondary barriers 108 may extend from primary barriers 102 to the land 117; from land 117 to land 117; or from primary barriers 102 to primary barriers 102.

At the beginning stages, the reservoir 101 is filled with saline water 111 on the outside of the soft barrier 108 normally allocated for brackish water 112. The seawater 111 is kept out of the reservoir 101 by the hard barrier 102. Freshwater 110 will be collected within the soft barrier 108. The length or height of soft barrier 108 can be increased depending on the volume of fresh water 110 enclosed, and will vary if such volume changes as the barrier 108 is flexible and is of a height the same as barrier 102, the maximum height water in reservoir 101. The saline water 112 outside the soft barriers will pass into the sea 111 as the tidal gates 103 releases saline water 112 to the sea during low tide. The tidal gates 103 are preferably closed during rising and/or high tides. The process will be repeated until the coastal reservoir 101 is full of fresh water 110 inside soft barrier 108.

For coastal reservoirs 101 located beside estuaries 116, an artificial channel or pipeline 105 is used to divert fresh water from a gate or pump station 104 to coastal reservoir 101. Soft barriers 108 may be used to shorten the period of desalination by tidal gate 103. Intake gates or pump stations 104 may be located on the bank of the river 106 where the salinity is generally lower.

Further, coastal reservoirs 101 may be linked by artificial channels or pipelines 108. Hence, the route of water diversion can run parallel to the coastline, which can improve the quality of groundwater for coastal terrain where the groundwater has a high salinity.

In addition, water diversion among various river basins can be generated by gravity or driven by the pumping stations or tidal gates 103.

A coastal reservoir 101 may contain a plurality of sub-reservoirs partitioned by a plurality of soft barriers 108. In such cases, the soft barriers 108 may have openings if necessary.

Whilst there has been described in the foregoing description preferred embodiments of the present invention, it will be understood by those skilled in the

technology concerned that many variations or modifications may be made to details of design or construction without departing from the present invention.

The present invention extends to all features disclosed either individually, or in all possible permutations and combinations.

The Claims:

- 1) A reservoir for the collection of fresh water from a source of fresh water, the reservoir including:
 - (a) primary barrier for providing a restraint against escape of the fresh water, and to prevent ingress of unwanted water, the primary barrier being located at least in part in a body of unwanted water; and
 - (b) a secondary barrier located within a storage zone defined by the primary barrier, the secondary barrier creating a buffer zone between the primary barrier and the secondary barrier so that fresh water contaminated with unwanted water will be in the buffer zone.
- 2) The reservoir as claimed in claim 1, wherein the primary barrier is a solid barrier of a height sufficient to withstand normal tidal surges and wave action of the unwanted water.
- 3) The reservoir as claimed in claim 1 or claim 2, wherein the secondary barrier includes a water boom, and a flexible skirt; the water boom being for floating on a surface of the fresh water and the skirt is suspendable in water to separate the fresh water, and the fresh water contaminated with unwanted water.
- 4) The reservoir as claimed in claim 3, wherein water boom floats on top of the water and together with the flexible skirt can accommodate variation in water volume and height of the water to be an effective barrier.
- 5) The reservoir as claimed in any one of the claims 3 to 4, wherein said skirt extends to a seabed.
- 6) The reservoir as claimed in claim 5, wherein said soft barrier is held in sealing relationship with the seabed using ballast.

- 7) The reservoir as claimed in claim 6, wherein the secondary barrier is positioned by an anchor and chain system.
- 8) The reservoir as claimed in any one of claims 1 to 7, wherein the buffer zone traps fresh water contaminated with unwanted water to minimise the potential contamination of the fresh water collected within the secondary barrier.
- 9) The reservoir as claimed in any one of claims 1 to 8, wherein the fresh water is collected directly from fresh water flowing from an estuary into the reservoir.
- 10) The reservoir as claimed in any one of claims 1 to 9, wherein the fresh water for the reservoir is collected by diverting water in a river using an artificial channel or pipelines. A point of diversion being located upstream in the river.
- 11) The reservoir as claimed in any one of claims 1 to 9, wherein the fresh water for the reservoir is collected using at least one soft barrier apparatus upstream of an estuary.
- 12) The reservoir as claimed in claim 11, wherein when the apparatus are full of fresh water, the apparatus openings are sealed or closed.
- 13) The reservoir as claimed in claim 11 or claim 12, wherein the apparatus filled with freshwater may be moved and transported to another repository.
- 14) The reservoir as claimed any one of claims 1 to 13, wherein a plurality of reservoirs are connected to each other by artificial channels or pipes.
- 15) The reservoir as claimed in any one of claims 1 to 14, wherein there is a plurality of secondary barriers in the reservoir.
- 16) The reservoir as claimed in any one of claims 1 to 15, wherein the primary barriers have tidal gates to regulate the level of water in the buffer zone.

- 17) The reservoir as claimed in claim 16, wherein tidal gates release fresh water contaminated with unwanted water when the unwanted water is at low tide.
- 18) The reservoir as claimed in claim 14, wherein pumping stations are provided along the artificial channels or pipes.
- 19) The reservoir as claimed in claim 1, wherein the soft secondary barrier is used independently of the primary barrier.