CLAIMS

1. A device for reducing biofouling in a water system, the device comprising:

a treatment unit comprising:

a reservoir for a volume of water;

at least one layer of a permeable fabric structure positioned within or defining a portion of a wall of the reservoir, in which the permeable fabric structure comprises an outer surface, an inner surface and a plurality of pores extending therebetween, the permeable fabric structure having a biocide on or in one or more of the outer surface or the inner surface and extending within at least a portion of at least one of a plurality of pores,

in which the treatment unit provides conditioned water from the reservoir to the water system, in which at least a portion of the water passing through the water system passes through the treatment unit,

the conditioned water requiring an average dwell time to stay within the reservoir of the treatment unit before travelling into the water system,

in which the biocide contacts at least some of the water entering into or within the reservoir of the treatment unit so as to aid in forming the conditioned water prior to the conditioned water traveling into the water system such that biofouling is reduced in the water system downstream of the treatment unit.

2. A device according to Claim 1, in which the permeable fabric structure within the treatment unit has a permeability with the range of 0.1 millilitres of water per second per square centimetre to 100 millilitres of water per second per square centimetre.

3. A device according to Claim 1, in which the at least one layer of the permeable fabric structure comprises a 3-dimensional flexible material selected from the group consisting of natural and synthetic fabrics, natural and synthetic membranes, natural and synthetic sheets, and fabrics, membranes, films and sheets made from a combination of natural and synthetic materials.

4. A device according to Claim 1, in which a dissolved oxygen content of the water entering the reservoir of the treatment unit is similar to a dissolved oxygen content of the conditioned water travelling into the water system.

5. A device according to Claim 1, in which a dissolved oxygen content of the water entering the reservoir of the treatment unit is higher than a dissolved oxygen content of the conditioned water travelling into the water system.

6. A device according to Claim 1, in which the water system comprises a once-through system.

7. A device according to Claim 1, in which the water system comprises a recirculation system.

8. A device according to Claim 1, in which the water system comprises a make-up water circuit of a recirculation system.

9. A device according to Claim 1, in which the average dwell time is an average amount of time a molecule of the water spends within the reservoir between entering the reservoir and traveling into the water system.

10. A device according to Claim 1, in which the average dwell time is determined based on the volume of the reservoir divided by an average flow rate into the water system determined over a period of an hour during operation of the water system.

11. A device according to Claim 10, in which the average dwell time is within a range of 1 minute to 6 hours.

12. A device according to Claim 10, in which the average dwell time is 1 minute or less.

13. A device according to Claim 10, in which the average dwell time is greater than 6 hours.

14. A device according to Claim 1, in which at least a portion of the conditioned water does not necessarily pass through any of the plurality of pores of the permeable fabric structure.

15. A device according to Claim 1, in which the reservoir is positioned within a body of water and a water intake for the water system is configured to draw conditioned water from within the reservoir such that water from the body of water is pulled into the reservoir to fill the reservoir to replace the conditioned water taken through the water intake.

16. A device according to Claim 1, in which the reservoir is positioned within a body of water, in which the reservoir is or defines an inlet for the water from the body of water, in which the inlet comprises the at least one layer of the permeable fabric structure such that the

water from the body of water flows through the at least one layer of the permeable fabric structure into the reservoir.

17. A device according to Claim 16, in which the at least one layer of the permeable fabric structure forms the inlet of the reservoir and is replaceable.

18. A device according to Claim 1, in which the treatment unit further includes one or more preconditioning features that are configured to adjust water chemistry of the water within the reservoir.

19. A device according to Claim 1, in which the at least one layer of the permeable fabric structure comprises a plurality of permeable fabric structures positioned in a tortious path leading to an outlet where the conditioned water is provided to the water system.

20. A device according to Claim 1, in which the reservoir is formed within a body of water, in which the permeable fabric structure is attached to a floatable device such that the permeable fabric structure extends downwardly from the floatable device into the body of water.

21. A device according to Claim 1, in which the treatment unit is an enclosure submerged completely within a body of water.

22. A device according to Claim 21, in which the treatment unit is anchored to a bottom surface of the body of water.

23. A device according to Claim 22, in which a water intake of the water system includes a pump configured to draw conditioned water from within the reservoir to provide to the water system via one or more pipes.

24. A device according to Claim 1, in which the reservoir is formed within a body of water, in which a first chemistry of the conditioned water is different than a second chemistry of water within the body of water.

25. A device according to Claim 1, in which the biocide is within a coating applied to the at least one layer of a permeable fabric structure.

26. A device according to Claim 1, in which the reservoir is formed within a body of water, in which the permeable fabric structure enables free flow of water from the body of water

without significant build-up occurring on either the outer surface or the inner surface of the permeable fabric structure for at least one month.

27. A device according to Claim 1, further comprising one or more strips or panels positioned in the reservoir, in which each of the one or more strips or panels is flexible and includes biocide thereon or therein that contacts the water in the reservoir to aid in forming the conditioned water.

28. A device according to Claim 27, further comprising an inner reservoir positioned within the reservoir, in which the inner reservoir includes the one or more strips or panels positioned therein.

29. A device according to Claim 1, further comprising an inner reservoir positioned within the reservoir, in which the inner reservoir includes one or more strips or panels positioned therein, in which each of the one or more strips or panels is flexible and includes biocide thereon or therein that contacts the water in the reservoir to aid in forming the conditioned water.

30. A device according to Claim 29, in which the one or more strips or panels are replaceable.

31. A method for reducing biofouling in a water system, the method comprising:

providing a treatment unit comprising:

a reservoir for a volume of water that is provided to the water system through a water intake; and

at least one layer of a permeable fabric structure positioned within or defining a portion of a wall of the reservoir, in which the permeable fabric structure comprises an outer surface, an inner surface and a plurality of pores extending therebetween, the permeable fabric structure having a biocide on or in one or more of the outer surface or the inner surface and extending within at least a portion of at least one of a plurality of pores;

in which the biocide contacts at least some of the water entering into or within the reservoir of the treatment unit so as to aid in forming conditioned water such that biofouling is reduced in the water system downstream of the treatment unit; and

causing conditioned water to travel from the treatment unit and into a water intake of the water system, in which at least a portion of the water passing through the water system passes through the treatment unit.

32. A method according to Claim 31, in which causing conditioned water to travel into the water intake comprises pulling the conditioned water from the treatment unit.

33. A system comprising:

a treatment unit comprising:

a reservoir for a volume of water;

at least one layer of a permeable fabric structure positioned within or defining a portion of a wall of the reservoir, in which the permeable fabric structure comprises an outer surface, an inner surface and a plurality of pores extending therebetween, the permeable fabric structure having a coating on one or more of the outer surface or the inner surface and extending within at least a portion of at least one of a plurality of pores; and

an outlet for providing conditioned water from the reservoir to a water intake of the water system, in which at least a portion of the water passing through the water system passes through the treatment unit,

the conditioned water requiring an average dwell time to stay within the reservoir of the treatment unit before traveling through the outlet and into the water system,

in which the coating contacts at least some of the water entering into or within the reservoir of the treatment unit so as to aid in forming the conditioned water prior to the conditioned water traveling through the outlet and into the water system such that biofouling is reduced in the water system downstream of the treatment unit.

34. A system according to Claim 33, in which the reservoir is formed within a body of water, in which the permeable fabric structure is attached to a floatable device such that the permeable fabric structure extends downwardly from the floatable device into the body of water.

35. A system according to Claim 33, in which the treatment unit is an enclosure submerged completely within a body of water.

36. A system according to Claim 35, in which the treatment unit is anchored to a bottom surface of the body of water.

37. A system according to Claim 36, in which the water intake of the water system includes a pump configured to draw conditioned water from within the reservoir to provide to the water system via one or more pipes.

38. A system according to Claim 33, in which the reservoir is formed within a body of water, in which a first chemistry of the conditioned water is different than a second chemistry of water within the body of water.

39. A system according to Claim 33, in which the biocide is within a coating applied to the at least one layer of a permeable fabric structure.

40. A system according to Claim 33, in which the reservoir is formed within a body of water, in which the permeable fabric structure enables free flow of water from the body of water without build-up occurring on either the outer surface or the inner surface of the permeable fabric structure that significantly adversely affects permeability of the permeable fabric structure for at least one month.

41. A system according to Claim 33, further comprising one or more strips or panels positioned in the reservoir, in which each of the one or more strips or panels is flexible and includes biocide thereon or therein that contacts the water in the reservoir to aid in forming the conditioned water.

42. A system according to Claim 33, further comprising an inner reservoir positioned within the reservoir, in which the inner reservoir includes one or more strips or panels positioned therein, in which each of the one or more strips or panels is flexible and includes biocide thereon or therein that contacts the water in the reservoir to aid in forming the conditioned water.

43. A system according to Claim 42, in which the one or more strips or panels are replaceable.

44. A system according to Claim 33, in which a first water chemistry of water within the reservoir is different than a second water chemistry of water entering the reservoir from an aqueous environment.

45. A system according to Claim 44, in which the first water chemistry is different than the second water chemistry by having at least one difference of a water chemistry characteristic, in which the water chemistry characteristic is one of dissolved oxygen, pH, total dissolved nitrogen, ammonium, nitrates, orthophosphates, total dissolved phosphates, silica, salinity, alkalinity, or chlorophyll.

46. A device for reducing biofouling in a water system, the device comprising:

a treatment unit for placement in an open water environment, the treatment unit comprising:

one or more wall portions defining an at least partially enclosed volume, in which at least a portion of the one or more wall portions comprises a structure that is or becomes water permeable, in which the structure has an outer surface, an inner surface and a plurality of pores extending therebetween;

in which the treatment unit is positioned so as to provide conditioned water from the at least partially enclosed volume to the water system,

in which the one or more wall portions form a barrier between the open water environment and the at least partially enclosed volume,

in which the structure is flexible and comprises at least one of mesh, lattice, fenestration, or holes that form the plurality of pores and enables fluid flow therethrough from the open water environment to the at least partially enclosed volume.

47. A device according to Claim 46, in which the structure enables free flow of water from the open water environment without significant build-up occurring on either the outer surface or the inner surface of the structure for at least 1 month.

48. A device according to Claim 46, in which the one or more wall portions are replaceable.

49. A device according to Claim 46, in which the one or more wall portions are configured to attach to one or more poles that are positioned within the open water environment.

50. A device according to Claim 46, in which the one or more wall portions are configured to attach to a floatable device that floats in the open water environment.

51. A device according to Claim 46, in which the treatment unit comprises a bottom extending between at least two of the one or more wall portions to form the at least partially enclosed volume.

52. A device according to Claim 46, in which the one or more wall portions define a tortious path for the at least partially enclosed volume within the open water environment.

53. A device according to Claim 46, in which the at least partially enclosed volume is positioned within an area of the open water environment, in which the one or more wall portions define one or more turns relative to a theoretical perimeter of the area of the open water environment so as to provide a length of the one or more wall portions within the area of the open water environment that is greater than a length of the theoretical perimeter of the area of the open water environment.

54. A device according to Claim 46, in which at least a portion of the water passing through the water system exits from the treatment unit.

55. A device according to Claim 46, in which the structure includes biocide.

56. A device according to Claim 46, in which the structure includes a coating.

57. A device according to Claim 46, in which the coating includes biocide.

58. A device according to Claim 46, in which a first water chemistry of the open water environment is different than a second water chemistry of water within the at least partially enclosed volume of the treatment unit.

59. A device according to Claim 58, in which the first water chemistry is different than the second water chemistry by having at least one difference of a water chemistry characteristic, in which the water chemistry characteristic is one of dissolved oxygen, pH, total dissolved nitrogen, ammonium, nitrates, orthophosphates, total dissolved phosphates, silica, salinity, alkalinity, or chlorophyll.

60. A device according to Claim 46, in which the structure has a permeability within a range of about 0.01 – 100 millilitres of water per second per square centimetre.

61. A device according to Claim 46, in which the structure has a permeability within a range of about 0.90 – 14.72 millilitres of water per second per square centimetre.

62. A device according to Claim 46, in which the structure comprises a 3-dimensional flexible material selected from the group consisting of natural and synthetic fabrics, natural and synthetic membranes, natural and synthetic sheets, and fabrics, membranes, films and sheets made from a combination of natural and synthetic materials.

63. A device according to Claim 46, in which the water system comprises a once-through system.

64. A device according to Claim 46, in which the water system comprises a recirculation system.

65. A device according to Claim 46, in which the water system comprises a make-up water circuit of a recirculation system.

66. A device according to Claim 46, further comprising an intake for water from the open water environment to enter the at least partially enclosed volume without passing through the one or more wall portions.

67. A device according to Claim 66, in which the at least partially enclosed volume is fully enclosed with respect to the open water environment except the intake or the opening.

68. A device according to Claim 46, further comprising one or more strips or panels positioned in the at least partially enclosed volume, in which each of the one or more strips or panels is flexible and includes biocide thereon or therein that contacts the water in the reservoir to aid in forming the conditioned water.

69. A device according to Claim 46, further comprising an inner reservoir positioned within the at least partially enclosed volume, in which the inner reservoir includes one or more strips or panels positioned therein, in which each of the one or more strips or panels is flexible and includes biocide thereon or therein that contacts the water in the at least partially enclosed volume to aid in forming the conditioned water.

70. A device according to Claim 69, in which the one or more strips or panels are replaceable.

71. A system for reducing biofouling in a water system, the system comprising:

one or more wall portions for placement into an aqueous environment, in which the one or more wall portions together define an at least partially protected volume, in which at least a portion of the one or more wall portions comprises a structure that is or becomes water permeable, in which the structure has an outer surface, an inner surface and a plurality of pores extending therebetween;

in which the one or more wall portions form a barrier between the aqueous environment and the at least partially protected volume,

in which the structure is flexible and comprises at least one of mesh, lattice, fenestration, or holes that form the plurality of pores and enables fluid flow therethrough from the aqueous environment to the at least partially protected volume, and

in which the one or more wall portions are arranged so as to enable providing conditioned water from the at least partially protected volume to the water system.

72. A system according to Claim 71, in which the structure includes biocide.

73. A system according to Claim 71, in which the structure enables free flow of water from the aqueous environment without build-up occurring on either the outer surface or the inner surface of the structure that significantly adversely affects permeability of the structure for at least one month.

74. A system according to Claim 71, in which the one or more wall portions are replaceable.

75. A system according to Claim 71, further comprising one or more poles or attachment features, in which the one or more wall portions are configured to attach to the one or more poles or attachment features that are positioned within the aqueous environment.

76. A system according to Claim 71, further comprising one or more floatable devices that are configured to float on a surface of the aqueous environment, in which the one or more wall portions are configured to attach to the one or more floatable device.

77. A system according to Claim 71, further comprising a bottom extending between at least two of the one or more wall portions to form the at least partially protected volume.

78. A system according to Claim 71, in which the one or more wall portions define a tortious path for the at least partially protected volume within the aqueous environment.

79. A system according to Claim 71, in which the at least partially protected volume is positioned within an area of the aqueous environment, in which the one or more wall portions define one or more turns relative to a theoretical perimeter of the area of the aqueous environment so as to provide a length of the one or more wall portions within the area of the aqueous environment that is greater than a length of the theoretical perimeter of the area of the aqueous environment.

80. A system according to Claim 71, further comprising an intake for water from the aqueous environment to enter the at least partially protected volume without passing through the one or more wall portions.

81. A system according to Claim 71, further comprising one or more strips or panels positioned in the at least partially protected volume, in which each of the one or more strips or panels is flexible and includes biocide thereon or therein that contacts the water in the reservoir to aid in forming the conditioned water.

82. A system according to Claim 71, further comprising an inner reservoir positioned within the at least partially protected volume, in which the inner reservoir includes one or more strips or panels positioned therein, in which each of the one or more strips or panels is flexible and includes biocide thereon or therein that contacts the water in the at least partially protected volume to aid in forming the conditioned water.

83. A system according to Claim 82, in which the one or more strips or panels are replaceable.

84. A method for reducing biofouling in a water system, the method comprising:

positioning one or more wall portions of a treatment unit in an open water environment, the one or more wall portions defining an at least partially enclosed volume, in which at least a portion of the one or more wall portions comprises a structure that is or becomes water permeable, in which the structure has an outer surface, an inner surface and a plurality of pores extending therebetween; and

providing an outlet or a water system intake for providing conditioned water from the at least partially enclosed volume to the water system,

in which the one or more wall portions form a barrier between the open water environment and the at least partially enclosed volume,

in which the structure is flexible and comprises at least one of mesh, lattice, fenestration, or holes that form the plurality of pores and enable fluid flow therethrough from the open water environment to the at least partially enclosed volume.

85. A method according to Claim 84, further comprising causing the conditioned water to be provided to the water system by pulling the conditioned water from the at least partially enclosed volume.

86. A device for reducing biofouling in a water system, the device including a volume between an inlet and an outlet, in which the inlet receives water from an external water source, the device comprising:

a plurality of strips positioned in the water contained within the volume, in which each strip of the plurality of strips is flexible, in which the each strip of the plurality of strips has an outer surface and an inner surface;

in which the each strip of the plurality of strips includes biocide thereon or therein that contacts the water in the volume to aid in forming conditioned water,

in which at least some of the water entering the water system exits from the volume, the conditioned water staying within the volume for a dwell time prior to entering the water system.

87. A device according to Claim 86, in which the dwell time is an average amount of time a molecule of the water spends within the volume between entering the volume and exiting from the volume.

88. A device according to Claim 86, in which the dwell time is determined based on a size of the volume divided by an average flow rate through the volume determined over a period of an hour during operation of the water system.

89. A device according to Claim 86, in which the dwell time is within a range of 1 minute to 6 hours.

90. A device according to Claim 86, in which the dwell time is 1 minute or less.

91. A device according to Claim 86, in which the dwell time is greater than 6 hours.

92. A device according to Claim 86, in which a first water chemistry of water being supplied to the volume is different than a second water chemistry of water within the volume.

93. A device according to Claim 92, in which the first water chemistry is different than the second water chemistry by having at least one difference of a water chemistry characteristic, in which the water chemistry characteristic is one of dissolved oxygen, pH, total dissolved nitrogen, ammonium, nitrates, orthophosphates, total dissolved phosphates, silica, salinity, alkalinity, or chlorophyll.

94. A device according to Claim 86, in which the each strip of the plurality of strips is or becomes water permeable and has a permeability within a range of about 0.01 – 100 millilitres of water per second per square centimetre.

95. A device according to Claim 86, in which the each strip of the plurality of strips is or becomes water permeable and has a permeability within a range of about 0.90 – 14.72 millilitres of water per second per square centimetre.

96. A device according to Claim 86, in which at least one strip of the plurality of strips is non-permeable.

97. A device according to Claim 86, in which the each strip of the plurality of strips comprises a 3-dimensional flexible material selected from the group consisting of natural and synthetic fabrics, natural and synthetic membranes, natural and synthetic sheets, and fabrics, membranes, films and sheets made from a combination of natural and synthetic materials.

98. A device according to Claim 86, in which at least one strip of the plurality of strips is configured to form a shape.

99. A device according to Claim 98, in which the shape is a ball.

100. A device according to Claim 86, in which at least one strip of the plurality of strips is attached to a wall or structure of the device in a tensioned manner.

101. A device according to Claim 86, in which at least one strip of the plurality of strips is attached to a wall or structure of the device such that at least one end of the at least one strip hangs within the volume in a loose manner.

102. A device according to Claim 86, in which the biocide is on or in only one of the inner surface or the outer surface of each of the plurality of strips so as to maintain flexibility of the each of the plurality of strips.

103. A device according to Claim 86, in which the water system comprises a once-through system.

104. A device according to Claim 86, in which the water system comprises a recirculation system.

105. A device according to Claim 86, in which the water system comprises a make-up water circuit of a recirculation system.

106. A system for reducing biofouling in a water system, the system comprising:

a container including a volume between an inlet and an outlet, in which the inlet receives water from an external water source; and

a plurality of structures positioned in the water contained within the volume;

in which the each structure of the plurality of structures defines a shape and includes biocide thereon or therein that contacts the water in the volume to aid in forming conditioned water,

in which at least some of the water entering the water system exits from the volume, the conditioned water staying within the volume for a dwell time prior to entering the water system.

107. A system according to Claim 106, in which the dwell time is an average amount of time a molecule of the water spends within the volume between entering the volume and exiting from the volume.

108. A system according to Claim 106, in which the dwell time is within a range of 1 minute to 6 hours.

109. A system according to Claim 106, in which the dwell time is 1 minute or less.

110. A system according to Claim 106, in which the dwell time is greater than 6 hours.

111. A system according to Claim 106, in which a first water chemistry of water being supplied to the volume is different than a second water chemistry of water within the volume.

112. A system according to Claim 111, in which the first water chemistry is different than the second water chemistry by having at least one difference of a water chemistry characteristic, in which the water chemistry characteristic is one of dissolved oxygen, pH, total dissolved

nitrogen, ammonium, nitrates, orthophosphates, total dissolved phosphates, silica, salinity, alkalinity, or chlorophyll.

113. A system according to Claim 106, in which at least one of the plurality of structures defines the shape of a ball.

114. A system according to Claim 106, in which at least one of the plurality of structures defines the shape of an elongated strip.

115. A system according to Claim 106, in which the plurality of structures are free-floating in the container.

116. A system according to Claim 106, in which the plurality of structures are attached at least one of to an anchor that is fixed relative to the container or to the container.

117. A system for reducing biofouling in a water system, the system comprising:

a container including a volume between an inlet and an outlet, in which the inlet receives water from an external water source; and

a plurality of strips positioned in the water contained within the volume, in which each strip of the plurality of strips is flexible, in which the each strip of the plurality of strips has an outer surface and an inner surface;

in which the each strip of the plurality of strips includes coating thereon or therein that contacts the water in the volume to aid in forming conditioned water,

in which at least some of the water entering the water system exits from the volume, the conditioned water staying within the volume for a dwell time prior to entering the water system.

118. An apparatus for reducing biofouling in a water system, the apparatus comprising:

a flexible structure for positioning within a volume of water, in which the structure has an outer surface and an inner surface; and

at least one connection or anchor feature for mounting the structure to a fixed surface or floatation device for positioning the structure within the volume of water;

in which the flexible structure includes biocide thereon or therein for contacting the water in the volume of water to aid in forming conditioned water within the volume of water;

in which at least some of the water entering the water system exits from the volume of water.

119. An apparatus according to Claim 118, in which the biocide is on or in only one of the inner surface or the outer surface of the structure so as to maintain flexibility of the structure.

120. An apparatus according to Claim 118, in which the structure is a ball.

121. An apparatus according to Claim 118, in which the structure is a strip.

122. An apparatus according to Claim 118, in which the structure is configured to be free-floating in the volume of water.

123. An apparatus according to Claim 118, in which the structure is or becomes water permeable.