***The Watery***

***Water of Life Reimagined***

Water is Life. As most of us know, Mother Nature takes the process of water purification and recycling to epic proportions. Adding her own theatrical flourish at every stage, clouds, energized by the Sun produce rain in a constant repeating cycle. As process artists, we immerse ourselves in and reinterpret such intrinsics if not the defining primacy of these organic systems. Reflexively, our “*Watery*” not only purifies H2O, but lends tribute to this artistically profound process. At the same time, Frank Herbert's virtuoso *Dune* played a principal role in our production. Set on a desert planet, *Dune’*s inhabitants treat their wildly scarce water resources as nothing less than sacred. Adding iconic Sci-Fi form to function, the sandworms of *Dune* reflect the leading edge of our design.

**Design:** Both novel and low-tech, The *Watery* complex distills water by mimicking the natural hydrologic cycle of evaporation, condensation and precipitation. Whereas most distillation processes require steam temperatures 100ºC (212°F) and/or elevated pressures. The *Watery* essentially creates clouds at lower temperatures 52-66ºC (125°F-150°F) and atmospheric pressures. Our clouds, if you will, are then compelled to rain. The precipitation unfolds within an enclosed vessel; the end result, distilled water. The distillation 'tube' symbolizes the very heart of our *Watery*. The sum of its parts are two connected spaces, a heated section, an evaporator; as well as a cooling section, the condenser. Hot feed water is sprayed into the evaporator in the form of a fine mist. A warm, saturated cloud begins to take shape. Contaminants are unable to stay aloft in the vapor. Ultimately these salts, minerals, etc. fall out. The left-behind residues are thereupon collected and removed. The spraying action of the warm vapor causes the cloud to flow, from the evaporator space following into the condenser space of the structure. There the flow encounters a cooled water spray. The resulting vapor causes distilled water to rain down from our cloud. The remaining dry cool air then re-enters the evaporator for re-saturation. Therein the cycle repeats. This distilled water is collected and gravity-fed into a storage tank, awaiting human consumption. The majority of the energy required to power this process comes from a low grade heat source, be it geothermal, solar thermal and/or waste heat from fossil fueled generators. We propose to capture heat from the abundant geothermal energy released by Ward’s Hot Spring 82ºC (180°F).1 By using this untapped heat source we’re able to significantly reduce operational costs, maintenance and material resources needed. Insofar as a small amount of electrical energy is required to pump water through the system, that level of generation can be provided by a small photovoltaic system.

The *Watery's* main structural components are based on Nature's 'go-to' structural template: the saddle-shaped catenoid. Though largely under-appreciated, 2Catenoids are counted amongst our strongest structures. Requiring minimal material in their construction, they’re also easily fabricated. When interlocked together, saddle-shaped catenoid panels create large enclosed volumes without need for internal beam supports. Think geodesic domes. Now think a more bad-ass, more flexible geodesic dome. Owing to the twist incorporated in the catenoid structure, they’re inherently better suited to deal with and minimize the destructive forces of large wind events. These structures are easily assembled and disassembled... if need for relocation arises.

Aligning with Nature allows the *Watery* to be cost effective in its material demand. Constructed primarily of wood, the catenoid panels are then sheathed in a heavy-duty, unbleached cotton fabric. Waterproofing is achieved via natural rubber coating.

**Activities System Supports**

Deconstructing its utility, The *Watery* offers potable H20 for drinking, personal hygiene, and any other potable water need. At the same time, the distillation tube and distilled water storage tank will evoke the body and head, respectively, of thesandworm. But this isn’t art for art’s sake. These attributes serve to draw in visitors. Viewers not only gain the value of our tribute to Nature's genius, specifically one of her life-giving cycles, its terrestrial replication offers an abundant source of potable water. The optics further enforce a substantial investment in minimal resource use/allocation.

**System Inputs**

Power: The *Watery's* primary energy source comes from untapped geothermal energy generated abundantly as low-grade heat within Ward’s Hot Spring. A small amount of solar generated electricity is required to run small water pumps and minimal lighting effects.

Feed water: Ward’s Hot Spring pond water.

Materials: The main structures will be constructed from wood, unbleached cotton fabric, rubber coating, EPDM lining, glue and iron pins.

Balance of System Components: Three small water pumps, 3kW solar electric system, non-corrosive stainless-steel tubing andHDPE (high density polyethylene) tubing.

**System Outputs**

Potable Water: Based on experimentation and real world experience, we calculate the *Watery* prototype with a hot feed water flow rate of 170L (45 gal) per minwill produce approximately 120L (32 gal) per hour of distilled water. Running on average of 6 hours a day (during sunlight) would produce 727L (192 gal) of potable water, meeting the minimal needs of 30 people/day.5  Scalability can be achieved by increasing distilled water storage capacity and battery storage capacity to allow for around the clock operation.

Chilled Air: A byproduct of our novel method of distillation is the creation of abundant moistened, cooled air. During warmer months this cool, moist air is available to cool structures for human gathering or summer greenhouse agriculture. Structures are in close proximity to the distillation complex.

Salt: Concentrated saline residue, a byproduct of distillation, can be harvested and up-cycled to support the development of small local cottage industries. These include condiment products (specialty Black Rock salt), bath salts, cosmetic scrubs, heat storage medium, deice roads and dust suppression on dirt roads within Fly Ranch.

Education: Written placards along with viewports allows visitors to peer into the internal workings of the cloud/rain-making distillation tube, complete with simulated lightening and thunder. Thereby, providing the visitor with an entertaining educational experience.

Visitors will likewise be exposed to Natures's catenoid template and utilized in almost all her creations. Honed over billions of years to be the most energy and resource efficient structure possible. Exposing visitors to Nature's finesse in both form and function as expressed in this process art piece, sparking the imagination into what's regeneratively possible. To harvest such wisdom we simply have to peruse Mother Nature's playbook.

Photography: Due to wide recognition of the classic *Dune* story both in print and movies (including a new 2021 movie version) and its iconic sandworms, many visitors will seek out this art piece for a killer selfie with a sandworm. Thereby, opening up an educational opportunity.

**Prototype dimensions**

Distillation tube (within sandworm body): 7m x 2.5m diameter, usable volume: 25m3

Distillation storage tank (within sandworm head): Height 2.5m x diameter 2.3m: 7,500L (1,980 gal)

Hot water feed tank (alien flower):Height 1.2m x diameter 1.5m: 1950L (510 gal)

Cool water feed tank (alien flower): Height 1.2m x diameter 1.5m: 1950L (510 gal)

Condenser chilling pool: 6m x 3m x 0.6m : (11m3) 11,360L (3,000 gal)

Salt residue concentration pool: 6m x 3m x 0.2m: (6m3) 5,680L (1,500 gal)

**Materials and cost estimates.**

-Wood to create saddle-shaped panels: $520

-EDPM liner for distillation tube floor, tanks, chilling pond and concentration pond: $1,460

-Cotton drop cloths for Interior and exterior sheathing of distillation tube and exteriors of water tanks: $760

 -Natural rubber coating: $2,400

-Heat exchanger stainless steel tubing (heating and cooling): $1,520

 -HDPE pipe and fittings: for moving water through system: $2,810

-Spray heads: $960

 -3 Water pumps (¾ horse power): $2,160

 -3 kW photovoltaic system: $4,000

-Site preparation: $1,000

-Other labor and equipment rental: $2,000

-Misc.: $1,000

-Artistic implementations: $1,000

Total material cost = **$21,590**

**Short Summary of Strategy**

 Catenoid panels will be interlocked together on site to create the structures that make up the distillation 'tube', distilled H2O storage tank and small water feed tanks. Additionally, the catenoid structures provide the scaffolds for the alien creations. In addition two small, shallow pools will be recessed below ground level, one for evaporative cooling and one for concentrating the salt residue. Catenoid panels will be prefabricated offsite, stacked like Pringle potato chips and shipped to Fly Ranch to be assembled into the *Watery*. A small moving truck will transport the panels and all accessory components to the site. Minimal site preparation is required, which involves recessing slightly the ground level for the main structural components to take advantage of gravity flow, anchoring and wind resistance. Assembly of the distillation tube and holding tanks is relatively straight-forward, requiring a small volunteer labor force led by a few team members. Assembly of the catenoid skeletons that give form and strength to the main components require 2-4 days with the entire distillation complex art-piece expected to be operational within 3 weeks. Once assembled and optimized the *Watery* requires minimal maintenance to operate. As several components of the distillation complex will be recessed below ground level, they will not distract from the surrounding landscape or the visual impact of the artistic rendering of the sandworm.

**ENVIRONMENTAL IMPACT STATEMENT:**

The *Watery's* construction and operation mimics Nature and by doing so, exhibits a remarkably low environmental footprint. The *Watery* requires minimal space, site disturbance and material resources, both in construction and operation. Most materials are natural in origin (wood, cotton fabric and natural rubber) and assembled using a largely unknown and under-appreciated structural approach copied directly from Nature. Most construction components can be repurposed once their effective usefulness in the distillation complex has expired. According to product specifications, the natural rubber coating applied to the interior and exterior sheathing on major components of the *Watery,* is UV stable and can handle temperatures up to 107ºC (225ºF) under continuous use. Therefore, is expected to operate for approximately 5 yearsbefore reapplication of the rubber coating is required.  **T**his regular re-coating should allow for a total lifetime of the sheathing of 25 years**.** After 25 years the fabric liners, interior and exterior, will likely need to be replaced. The old sheathing can be up cycled into multiple uses (Ex: UV covers for equipment, canvases for artwork, drop clothes for construction projects, etc.). The saddle-shaped wood panels that make up the skeletons of the structures are expected to last longer than 25 years as they are protected from UV and water. Moreover, as most materials used in the *Watery* are of natural origin they are biodegradable once their useful lifetime has expired. A necessary component of the *Watery* is non-corrosive stainless-steel heat exchange tubing, which requires a relatively high embodied energy to create. However, when averaged out over its useful lifetime of greater than 50 years, the overall environmental impact is minimal. Eco-friendly HDPE tubing is used to move the water through the system. HDPE has an expected lifetime of 100 years for cold water flow and 50 years for hot water. HDPE is composed of 25-100% recycled material and itself is 100% recyclable. Most of the energy required to the operate the *Watery* will be sourced from low-grade heat available from Ward’s Hot Spring. A small amount of electricity is required to run small water pumps and lighting effects, this will be generated by a small, dedicated solar photovoltaic system. A relatively small volume of water from the Ward’s Hot spring pond will be used as the source water for the distillation process and is expected to have essentially no impact on the pond. The whole distillation complex is relatively easy to assemble and dissemble if the need to relocate arises. All materials used in the construction and operation of the *Watery* are not expected to leech chemicals into the distillate or surrounding environment. No greenhouse gases will be emitted from the operation of the proposed distillation operation.

Sources:

1. Garside, L.J. and Schilling, J.H. (1979) Thermal waters of Nevada. *Bulletin 91* Mackay School of Mines, Univ. of Nevada, Reno. Appendix 1, pg. 130.

2. <https://www.epa.gov/sites/production/files/2014-09/documents/> support\_cc1\_sodium\_dwreport.pdf

3. <https://www.epa.gov/sdwa/secondary-drinking-water-standards-guidance-nuisance-> chemicals

4. Jacobs, J.R. United States Patent 4,449,348 Composite Static Structure. May 22, 1984. (Used with permission from J.R. Jacobs.)

5. Water Usage in Desert operations: ArmyStudyGuide.com