WATEREUSE

EMEDIATIOn

Merav Gil-Ad

ARCH 901 DESIGN 1: INTRO TO MEDIUMS & METHODS

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12|03|20

1Project 2scales

My research proposes 2 scales of water remediation systems on the island:

- Small scale greywater treatment system
- Large scale desalinization plant.

Hypothesis

What if we could create closed water system by reusing greywater and harvesting rainwater?

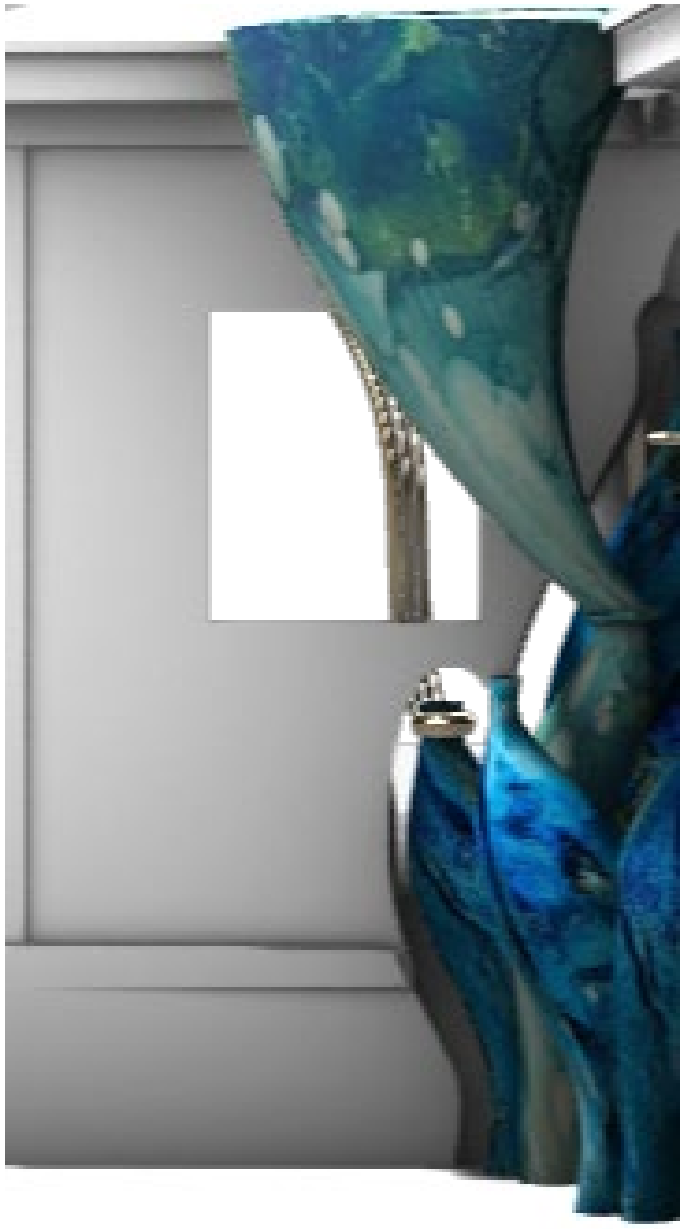
What if we could desalinate rising seas at a minimal energetic cost?

Problem

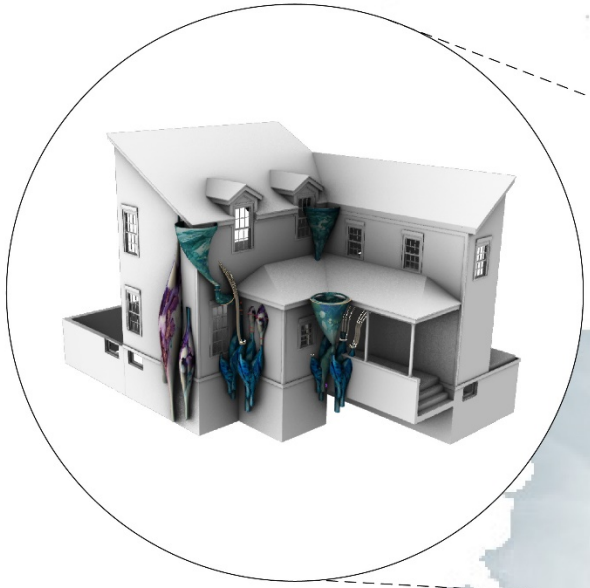
While framed as a beacon of climate change resilience, Governors Island imports all its water. Drinking water supplied by NYC water system, and a few fountains across GI provide fresh water for drinking. This is an opportunity to make the island waterwise independent as part of it’s ongoing development.

The houses on governors Island currently do not have potable water services within them, so they serve as a perfect test bed for experimenting with small scale water remediation systems.

Domestic scale | factory scale

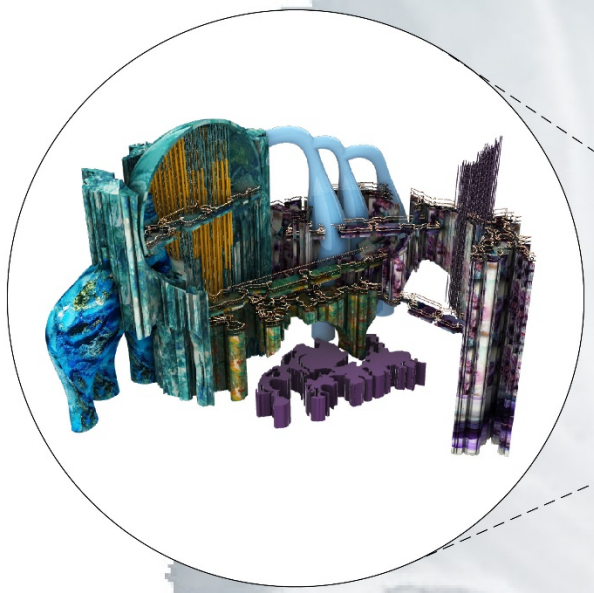


Sites



Project A – domestic scale:

Greywater recycling + rainwater harvesting at Building 14



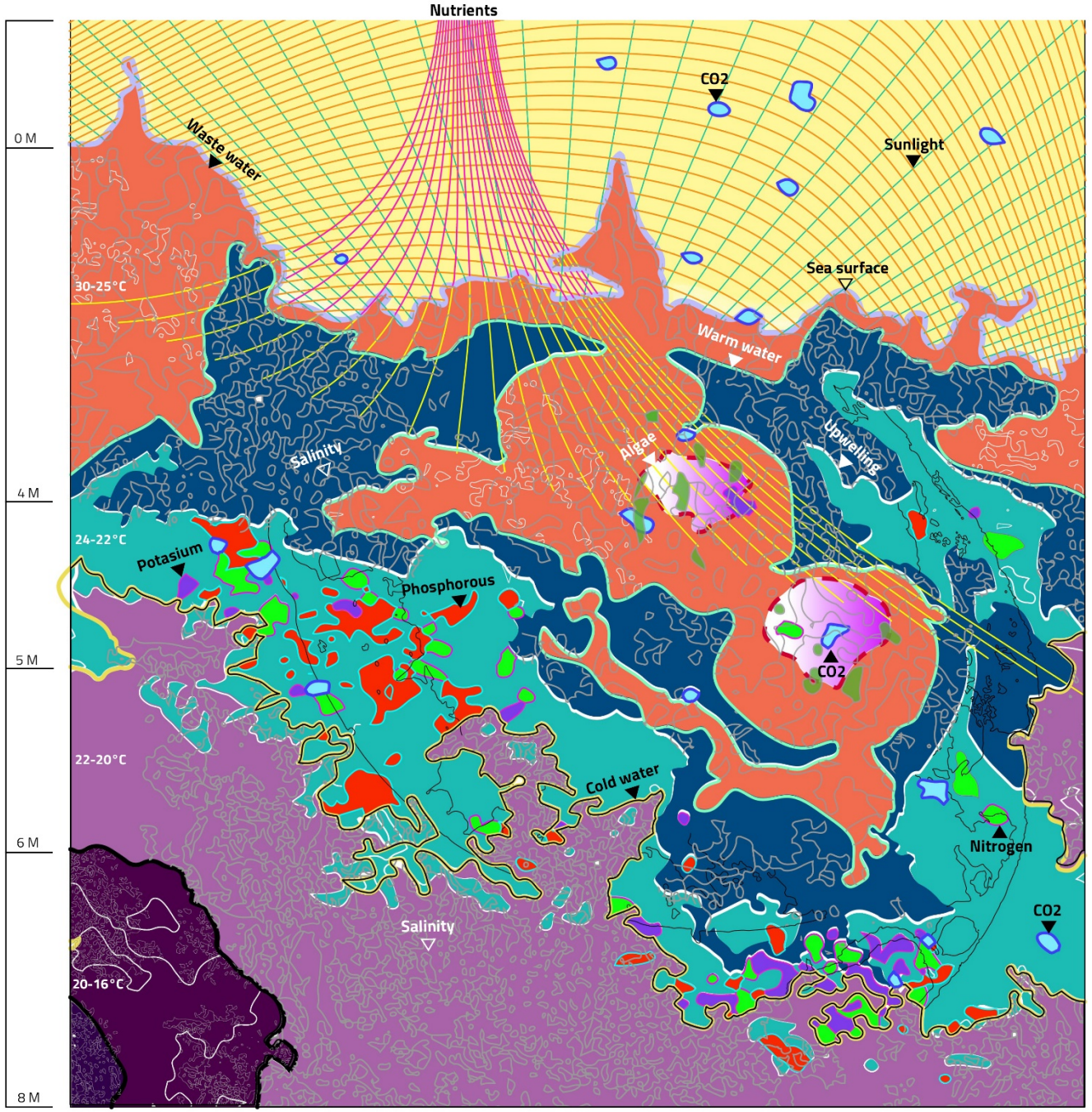
Project B – Factory scale : Tidal Desalinization plant at the south prow

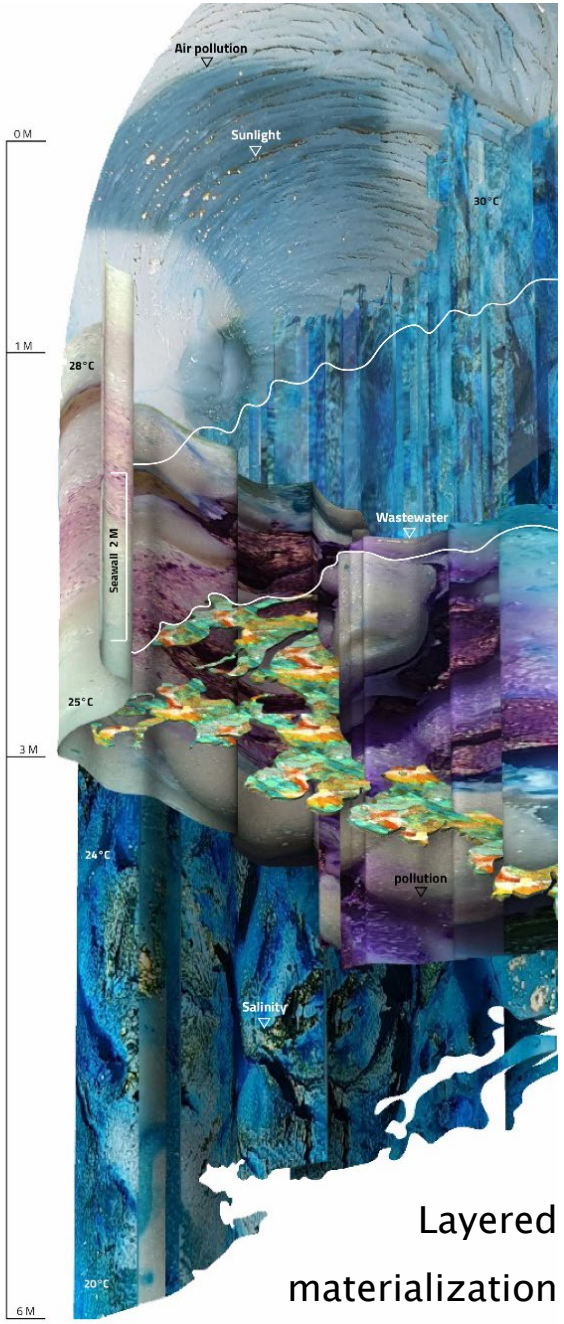
Context

Speculative Section

Micro view

Water composition





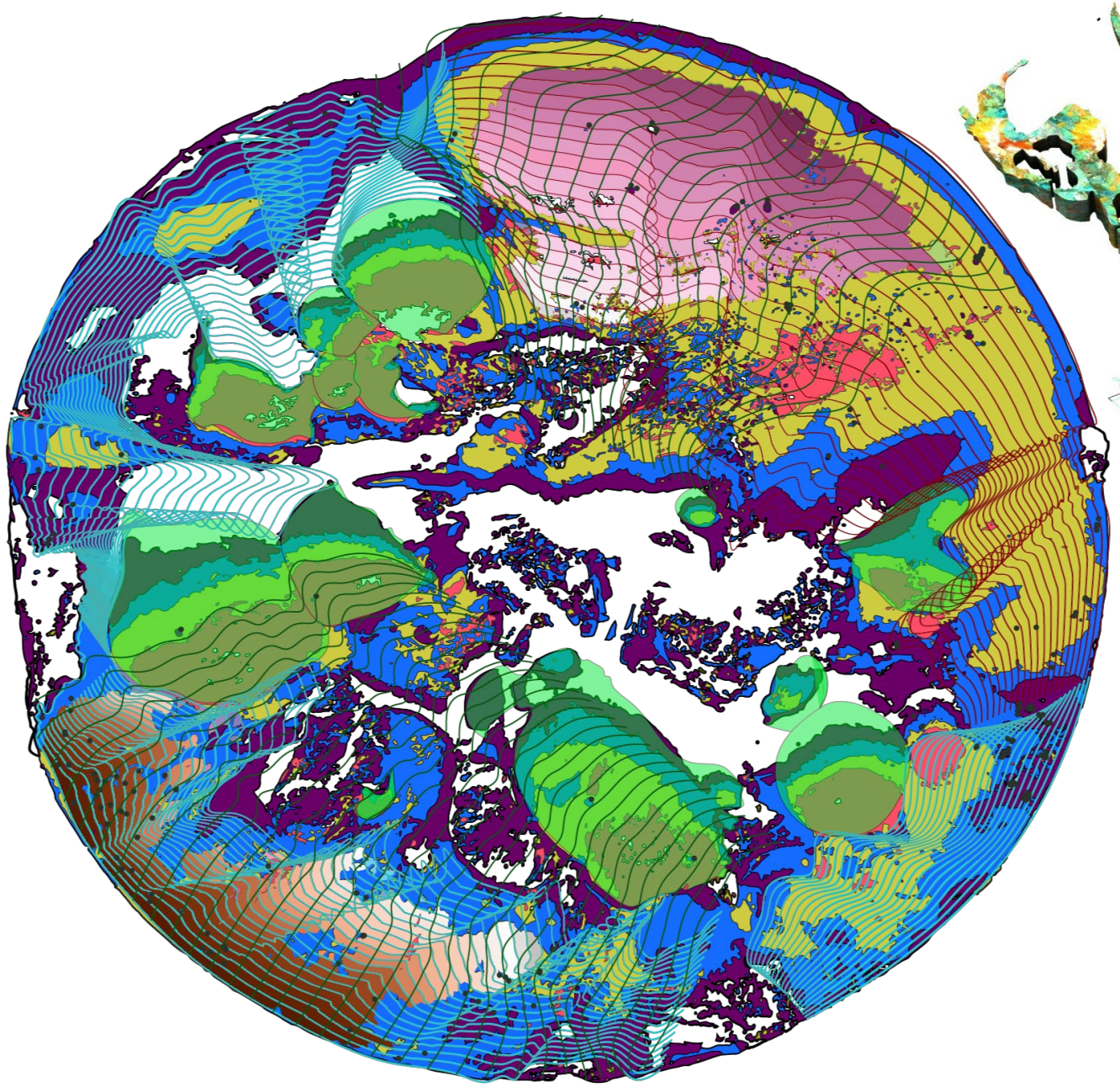
Layered materialization

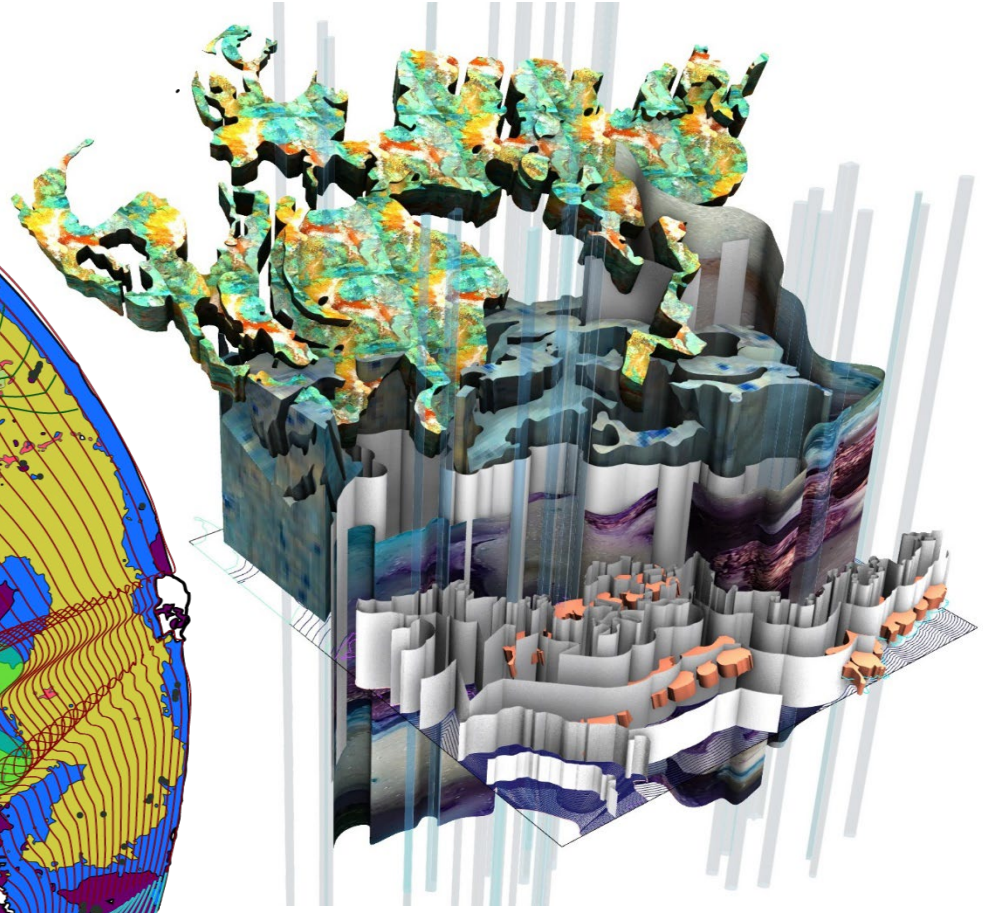
Speculative

Plan

Macro view

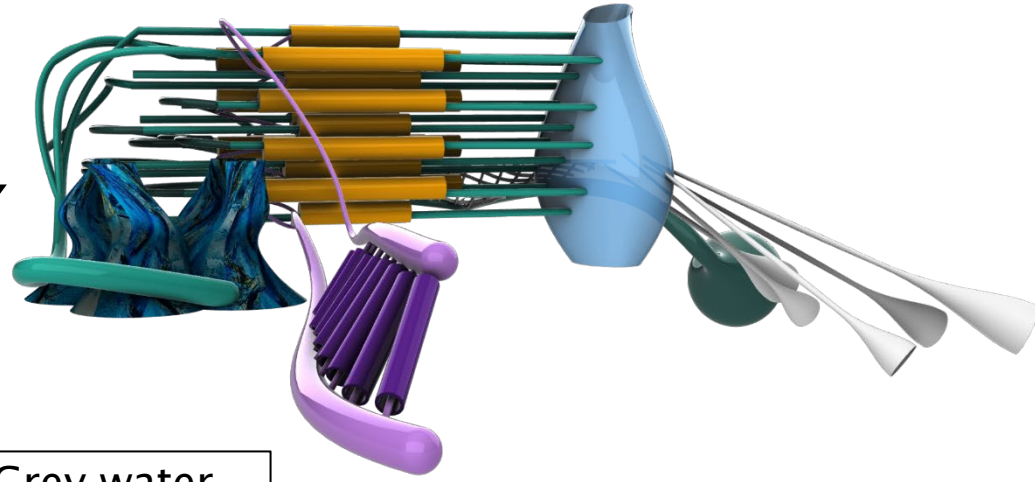
Global likelihood
of rising sea





Layered materialization

Thinking path



Water filtering

Algae

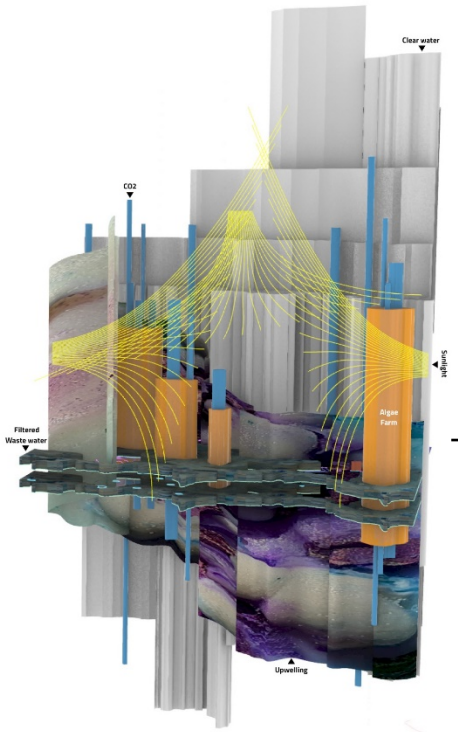
Wastewater treatment

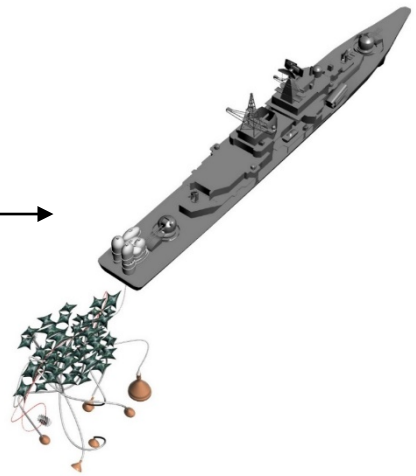
Energy production

Grey water remediation

Water reuse

Rainwater harvesting

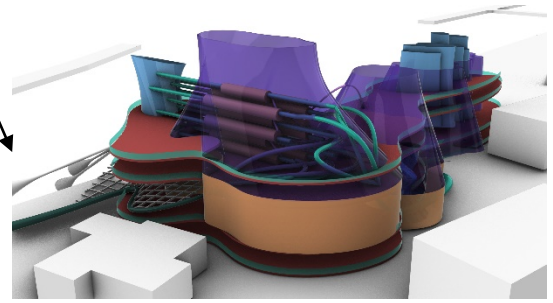




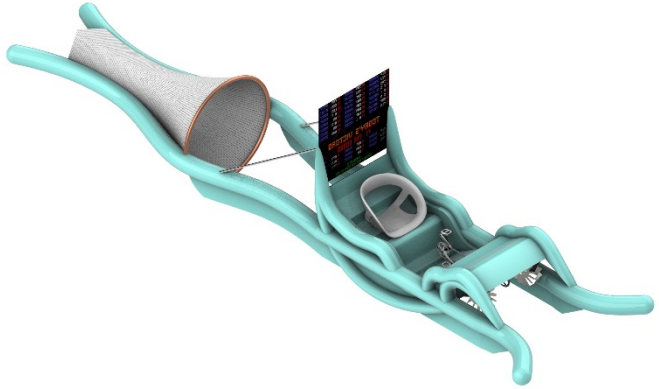
Drinking water production

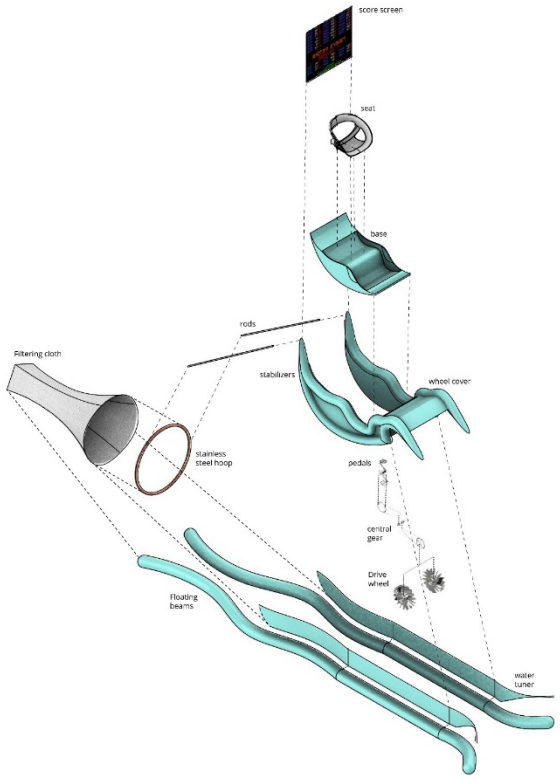
Desalinization

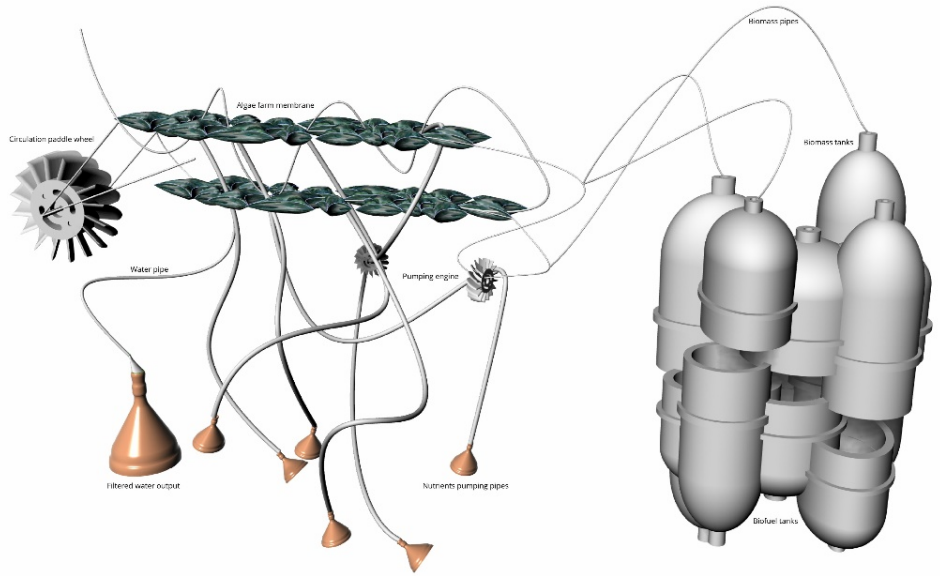
Tidal force



Ecological Devices

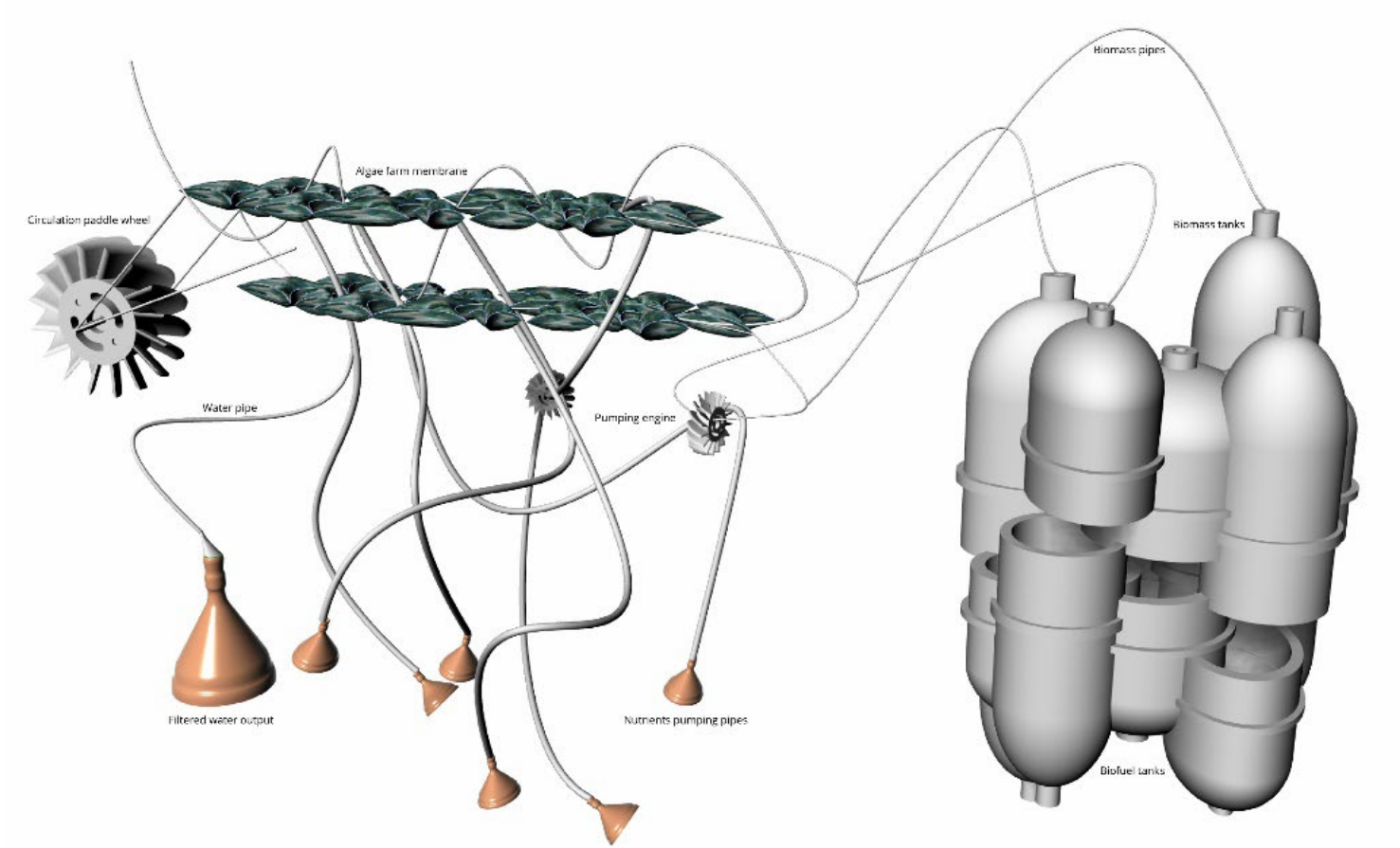


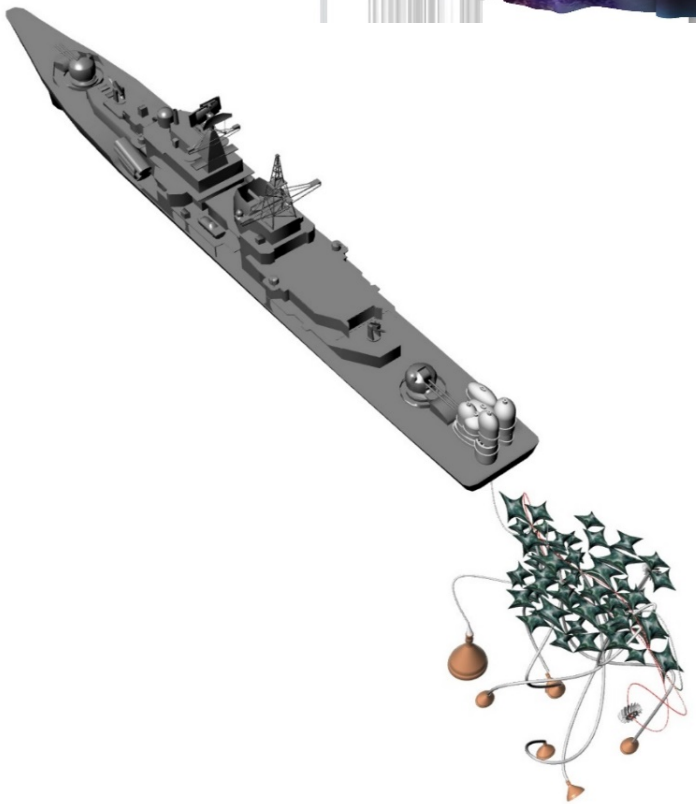




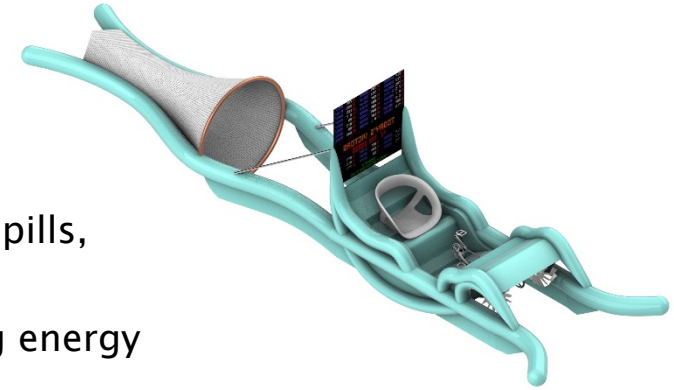
Device #1 | The Ferry tail

A floating algae farm connected to the back of the ferry and fed by nutritious from the water pollution produces by the ferry. The oil produced by microalgae transfer to container and becomes biofuel after chemical extraction.

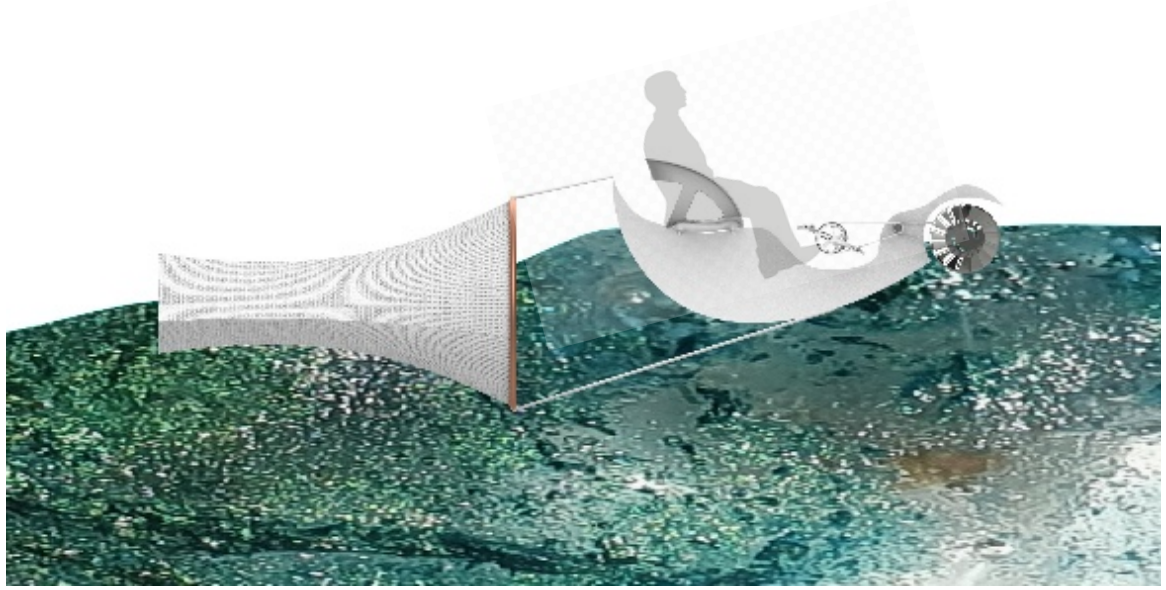


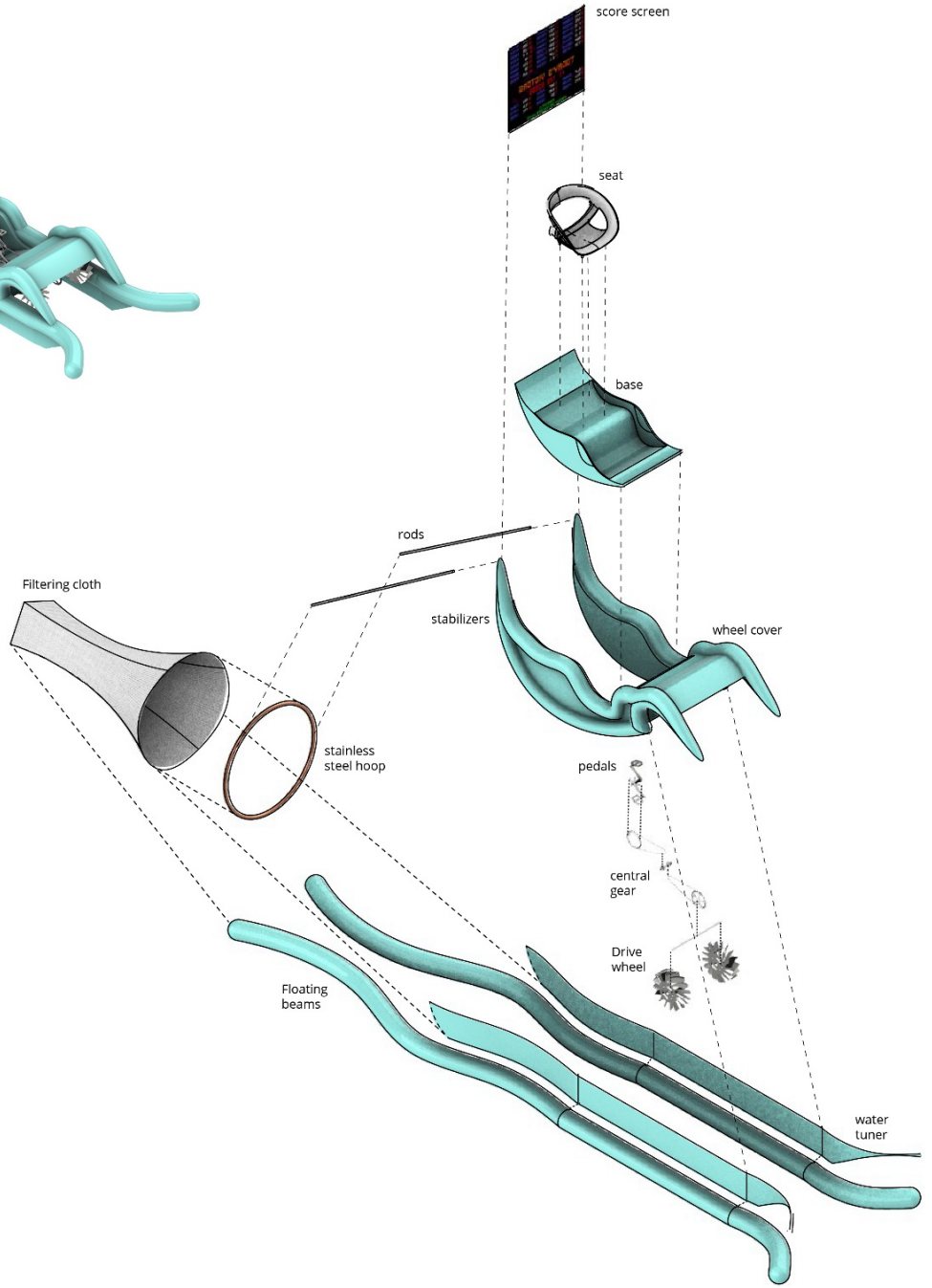


Device #2 | Eco filter Race boat



Oceans are polluted by oil on a daily basis from oil spills, routine shipping, run-offs and dumping.
The idea is to filter seawater from oil pollution using energy generated by rotating pedals.
The device is similar to a pedal boat that is mechanically driven by a system of gears and chains. The device will be connected to a hard hoop wrapped in a special fabric that filters oil from water. This filtering capability of this cloth is possible thanks to an oleophobic-hydrophobic material coating.





Project A

domestic scale

Greywater recycling

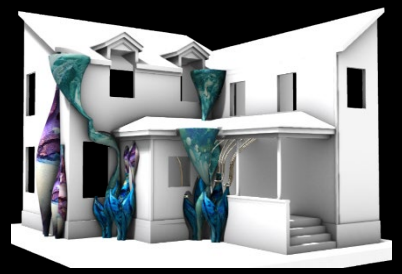
and rainwater harvesting

Exterior

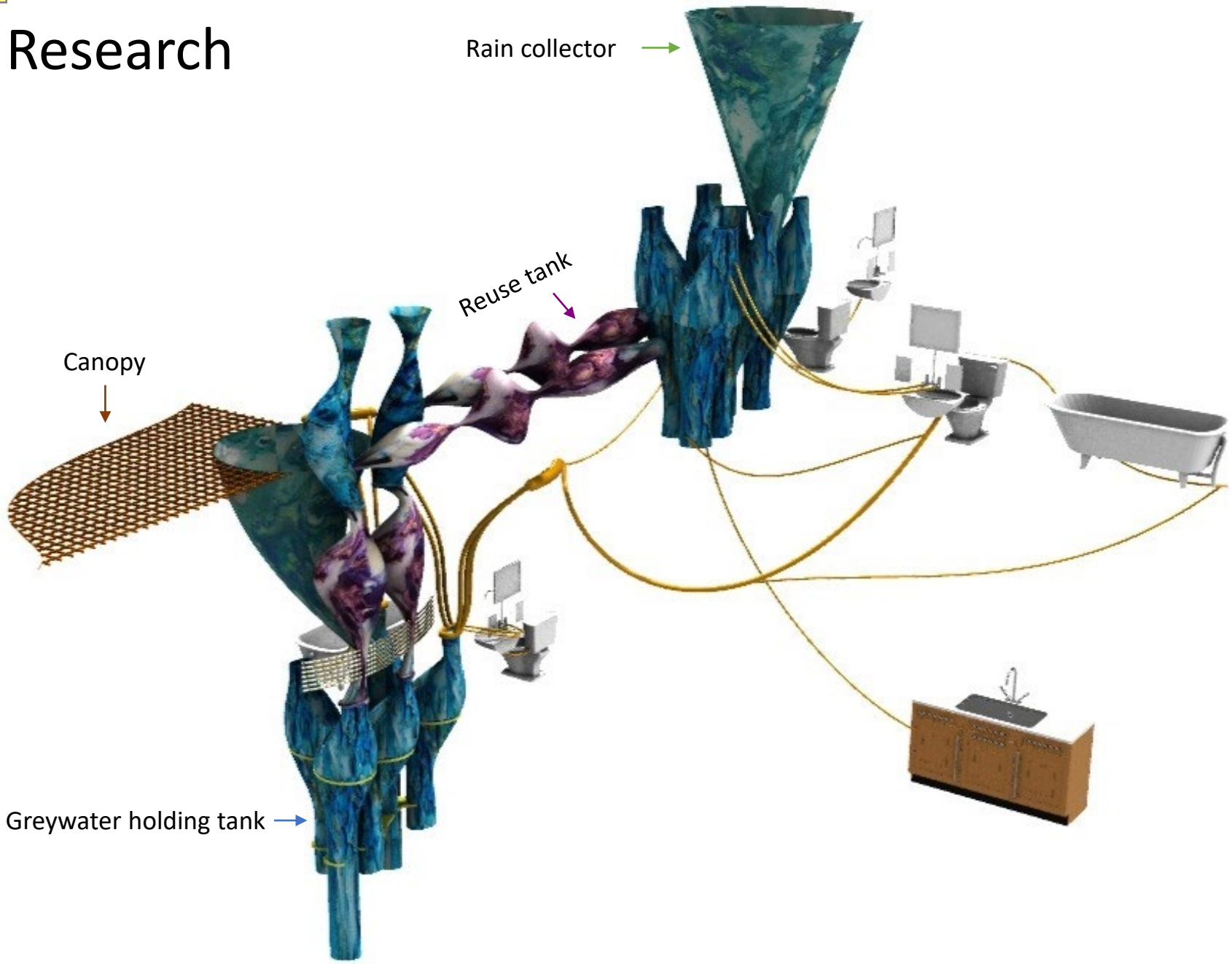
Rain collector

Reuse tank

Greywater holding tank



Research



<u>Average volumes for managing greywater systems</u>

Holding tank capacity: 2832 Liters

Reuse tank capacity: 3534 Liters

<u>Average volumes for managing Rainwater harvesting system</u>

Averages of annual rainfall plus snowfall in New York

41.8 inches 1062 millimeters

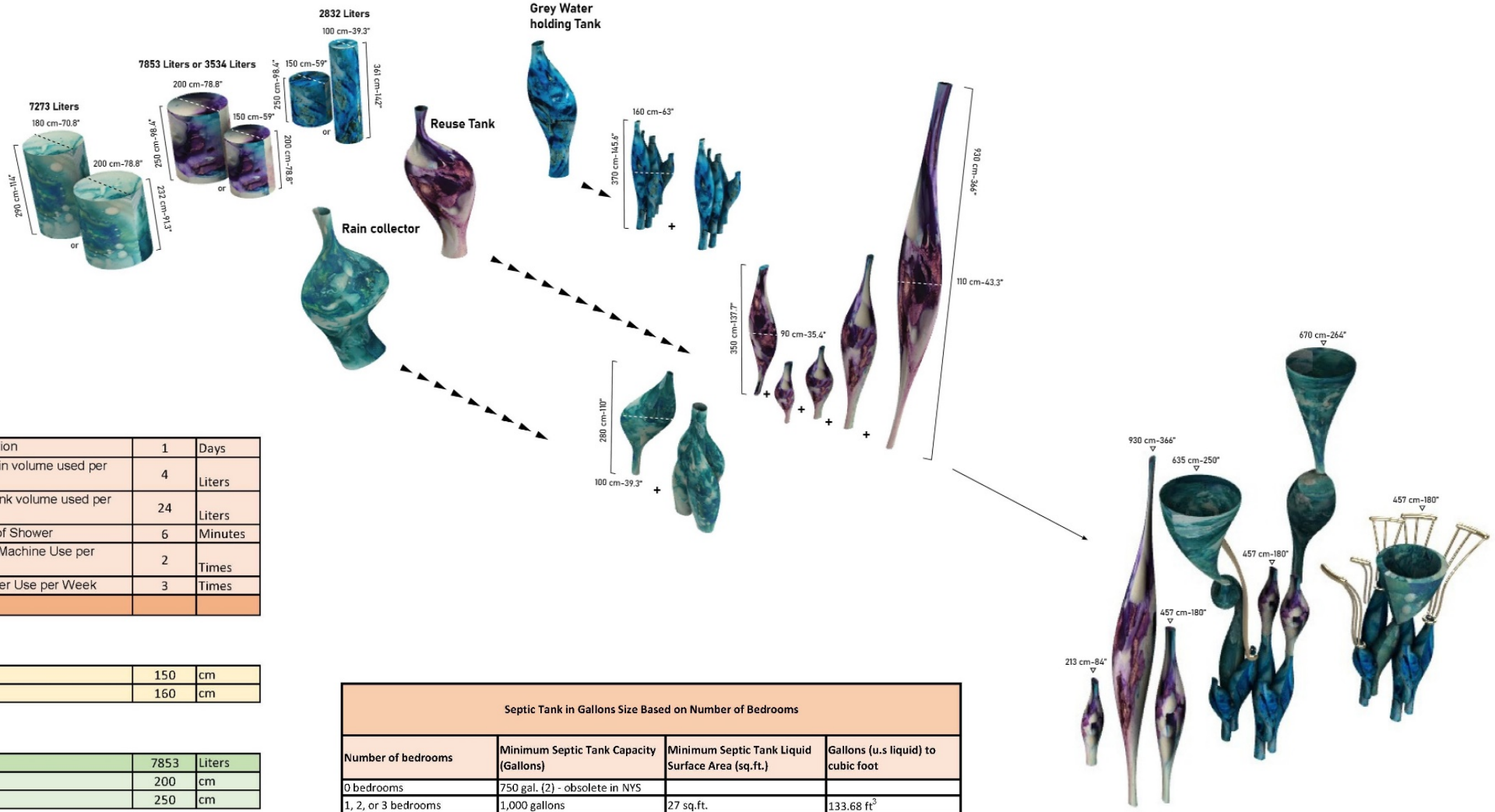
House 14 roof surface 174 m2

41.8* 174= 7,273.2 liter

Rain collector dimensions: 7273 liter

Home Graywater Recycling System

Capacity | volume | scale



Grey water capacity calculation

Number of People	6	Trip Duration	1	Days
Use of Hand basin per day	15	Hand basin volume used per Use	4	Liters
Use of Kitchen Sink per day	12	Kitchen sink volume used per Use	24	Liters
Litres per Minute for Shower	60	Duration of Shower	6	Minutes
Washing machine- Litres per Wash Cycle	70	Washing Machine Use per Week	2	Times
dishwasher- Litres per Wash Cycle	9	Dishwasher Use per Week	3	Times
Average Volume of Grey Water per	**2832**	**Liters**		

Grey Water holding - round Tank Dimensions

Diameter of the Cylinder	100	cm	150	cm
Length of cylinder	361	cm	160	cm

Reuse - round Tank Dimensions

estimated capacity	3534	Liters	7853	Liters
Diameter of the Cylinder	150	cm	200	cm
Length of cylinder	200	cm	250	cm

Filtering device size

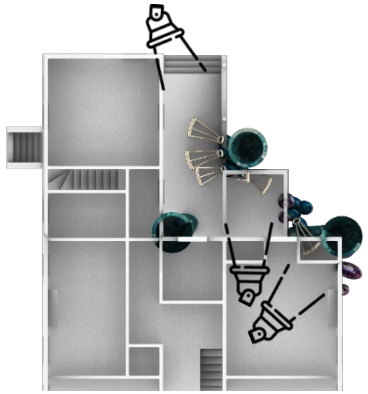
Rain collector - round Tank dimensions

estimated capacity	7,273	Liters	7,379	Liters
Diameter of the Cylinder	200	cm	180	cm
Length of cylinder	232	cm	290	cm

Septic Tank in Gallons Size Based on Number of Bedrooms			
Number of bedrooms	**Minimum Septic Tank Capacity (Gallons)**	**Minimum Septic Tank Liquid Surface Area (sq.ft.)**	**Gallons (u.s liquid) to cubic foot**
0 bedrooms	750 gal. (2) - obsolete in NYS		
1, 2, or 3 bedrooms	1,000 gallons	27 sq.ft.	133.68 ft^3
4 bedrooms	1,200 gallons	34 sq.ft.	160.41 ft^3
5 bedrooms	1,500 gallons	40 sq.ft.	200.52 ft^3
6 bedrooms	1,750 gallons	47 sq.ft.	233.94 ft^3

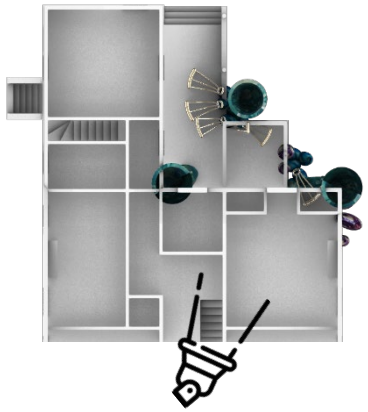
numbre os small houses (1-3 BR)	numbre os large houses (5 BR)	total number of people	Water tank capacity	Volume
50	30	280	95,000 gallons	12,700 ft3

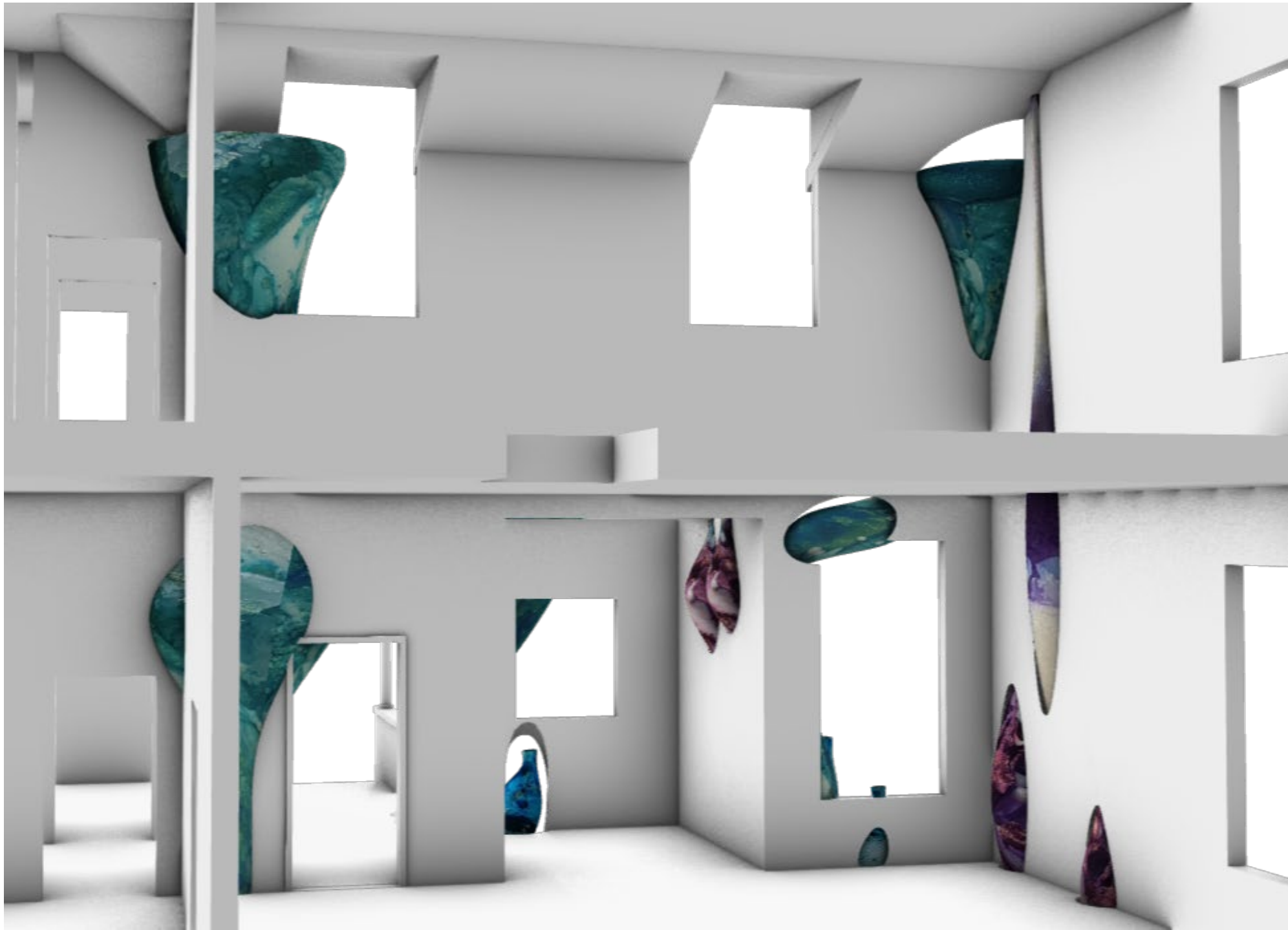
Interior



The remediation system embedded within the house

Interior

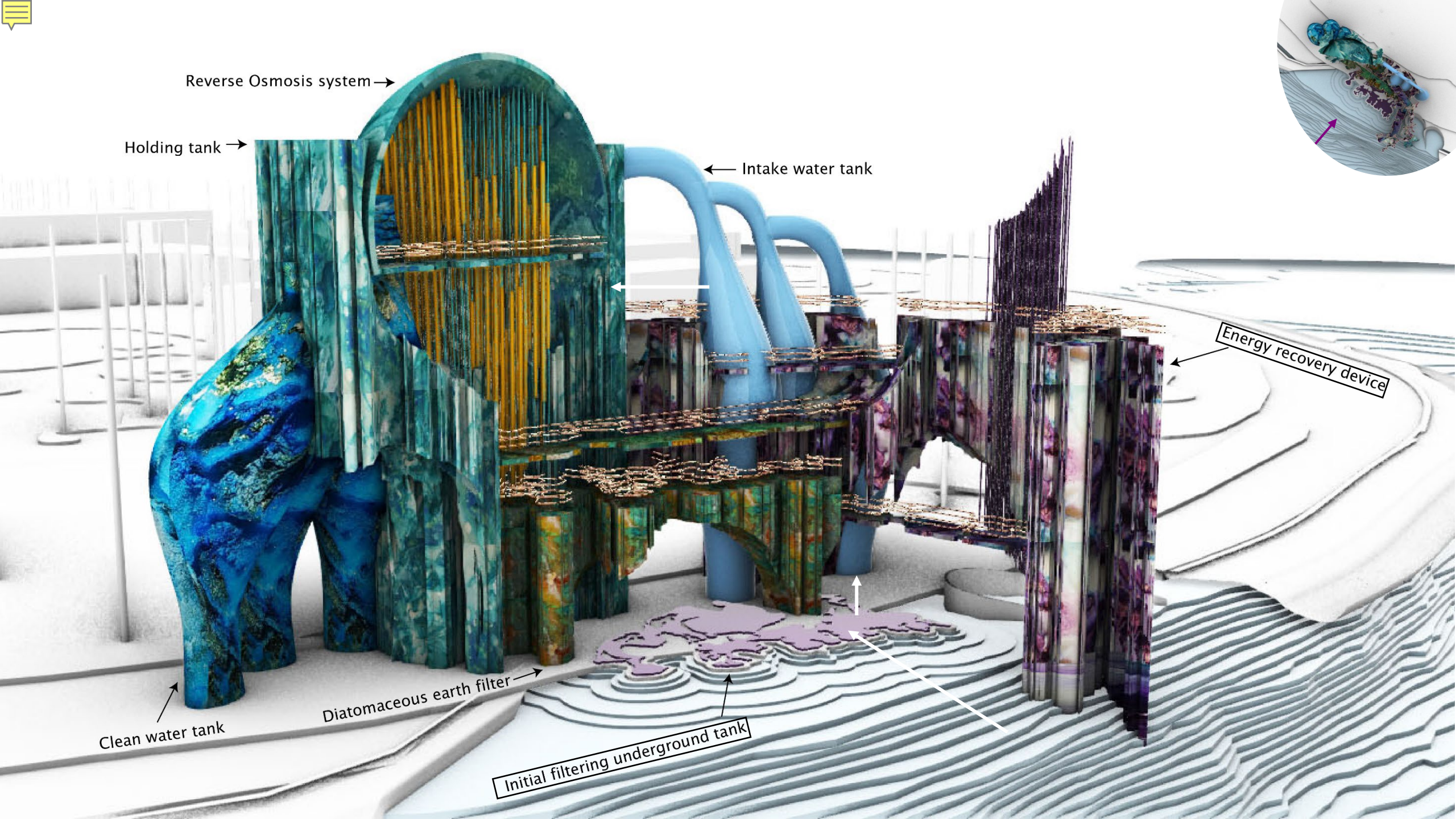




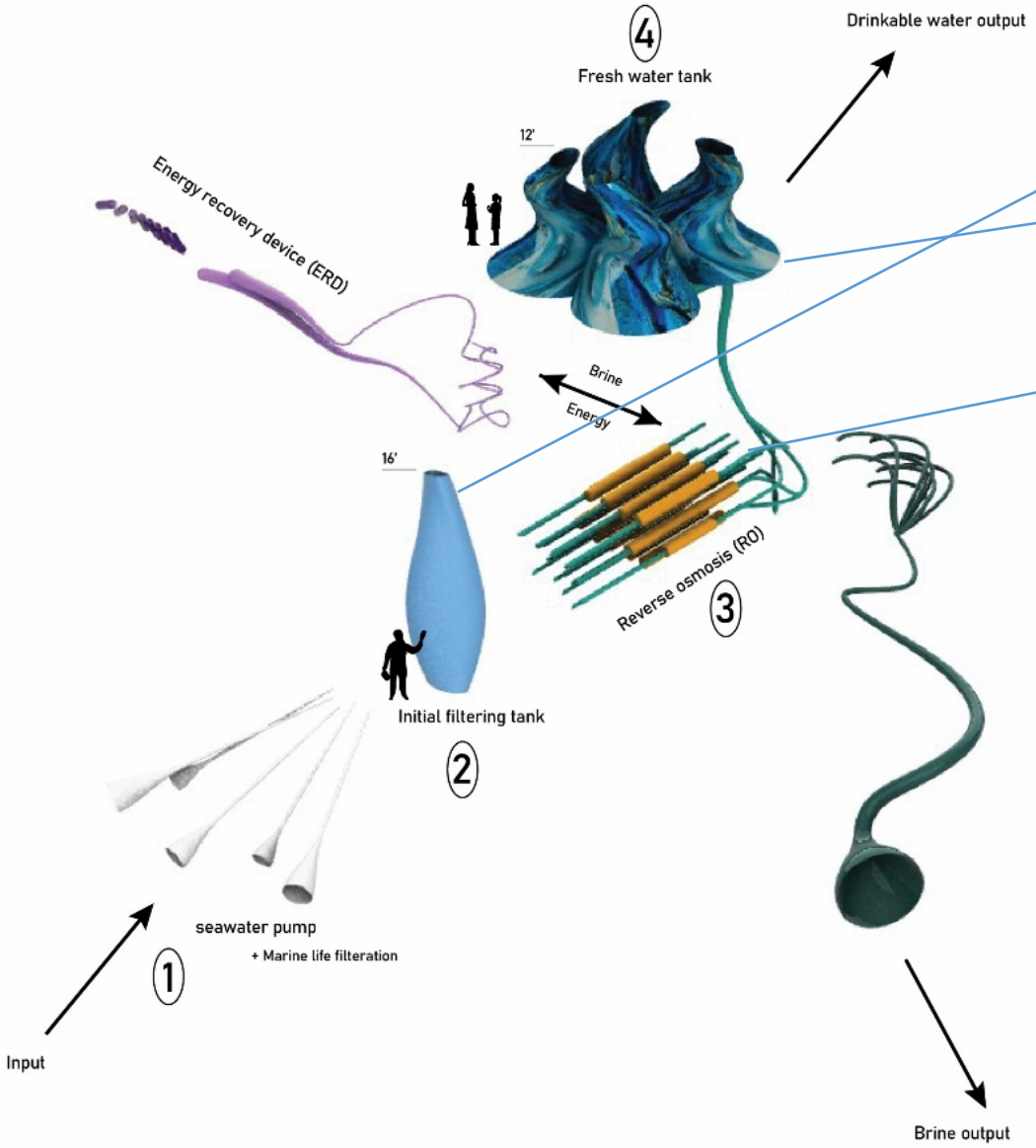
Project B

Factory scale


Tidal Desalinization plant


Reverse Osmosis system
Holding tank
Intake water tank
Energy recovery device
Clean water tank
Diatomaceous earth filter
Initial filtering underground tank

Research | *Tampa Bay facility* as framework for sizing GI Proposal



Intake water Tank Dimensions

Max apacity	41,496,048	Gallons	39,914,012	Gallons	40,666,127	Gallons
Diameter of the Cylinder	50	m	45	m	35	m
Length of cylinder	80	m	95	m	160	m

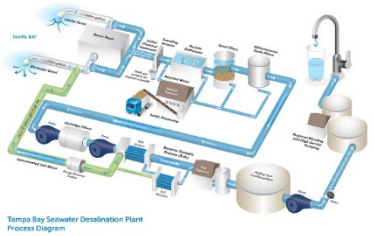
Holding Tank Dimensions

Max apacity	5,062,517	Gallons	5,187,006	Gallons	5,601,966	Gallons
Diameter of the Cylinder	20	m	25	m	30	m
Length of cylinder	61	m	40	m	30	m

Drinkable water Tank Dimensions

Max apacity	25416329	Gallons	24897629	Gallons	25935030	Gallons
Diameter of the Cylinder	35	m	40	m	50	m
Length of cylinder	100	m	75	m	50	m

Size of each aeration tank							
length:	20 ft	width:	60 ft	water depth:	10 ft	volume:	12,000 ft3
length:	15 ft	width:	40 ft	water depth:	20 ft	volume:	12,000 ft3
Total volume of all aeration tanks							
Number of aeration tanks:	2	Total volume:	24,000 ft3				



Size of each secondary clarifier							
length:	10 ft	width:	30 ft	water depth:	40 ft	volume:	12,000 ft3
length:	25 ft	width:	s5 ft	water depth:	20 ft	volume:	12,500 ft3
Total volume of all secondary clarifiers							
Number of secondary clarifiers:	2	Total volume:	24,500 ft3				

The Tampa Bay facility is the **largest** plant of its kind in the US, locates on the west coast of Florida.

Seawater coming into the plant goes through a rigorous pretreatment process then freshwater is separated from the seawater using reverse osmosis.

Population of Tampa bay region – **3,194,831** (2019)

The plant produces high-quality drinking water that supplies up to 10 percent of the region's needs.

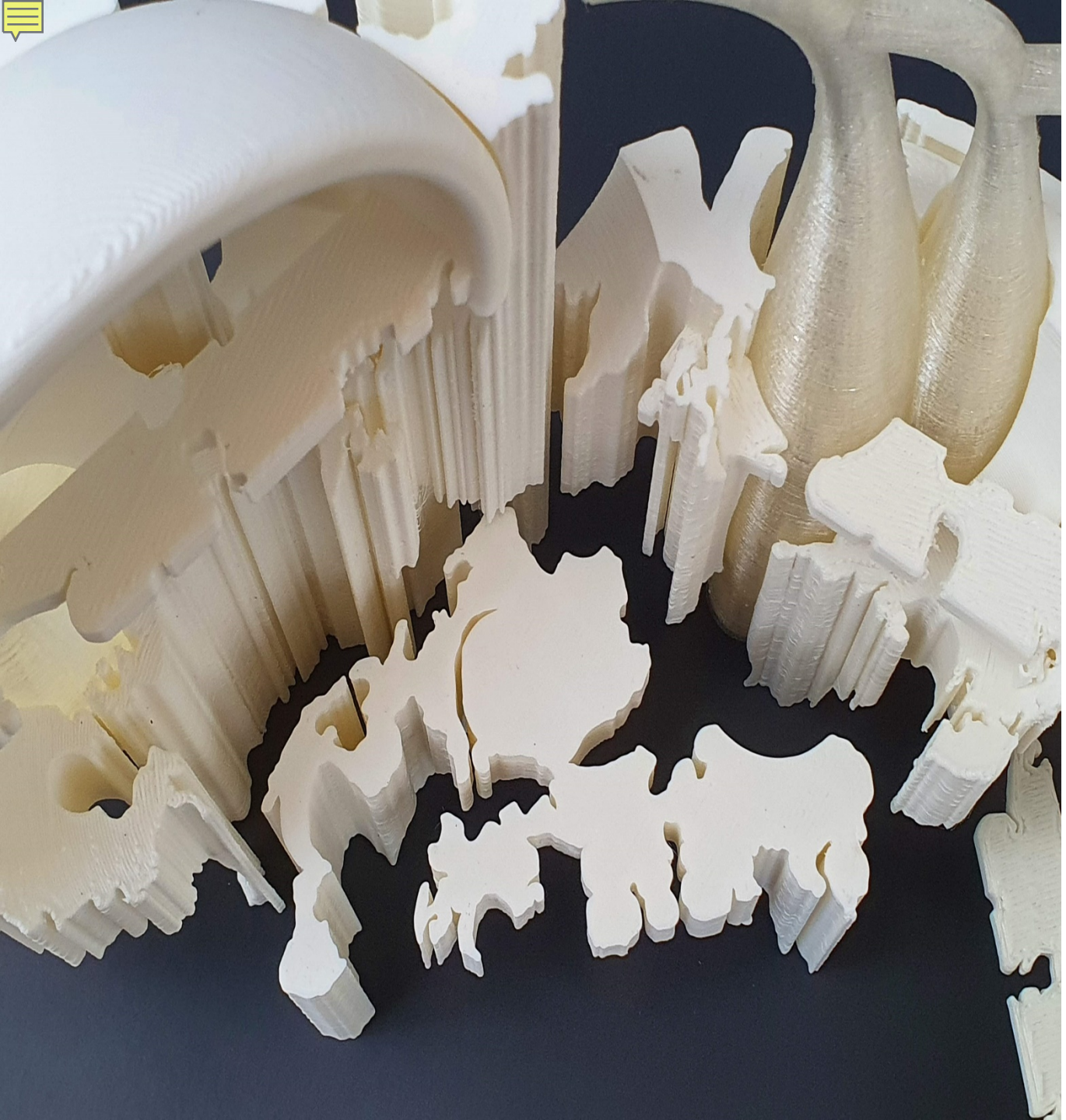
Intakes **44 million gallons of saltwater** from a nearby power plant where it used as cooling water.

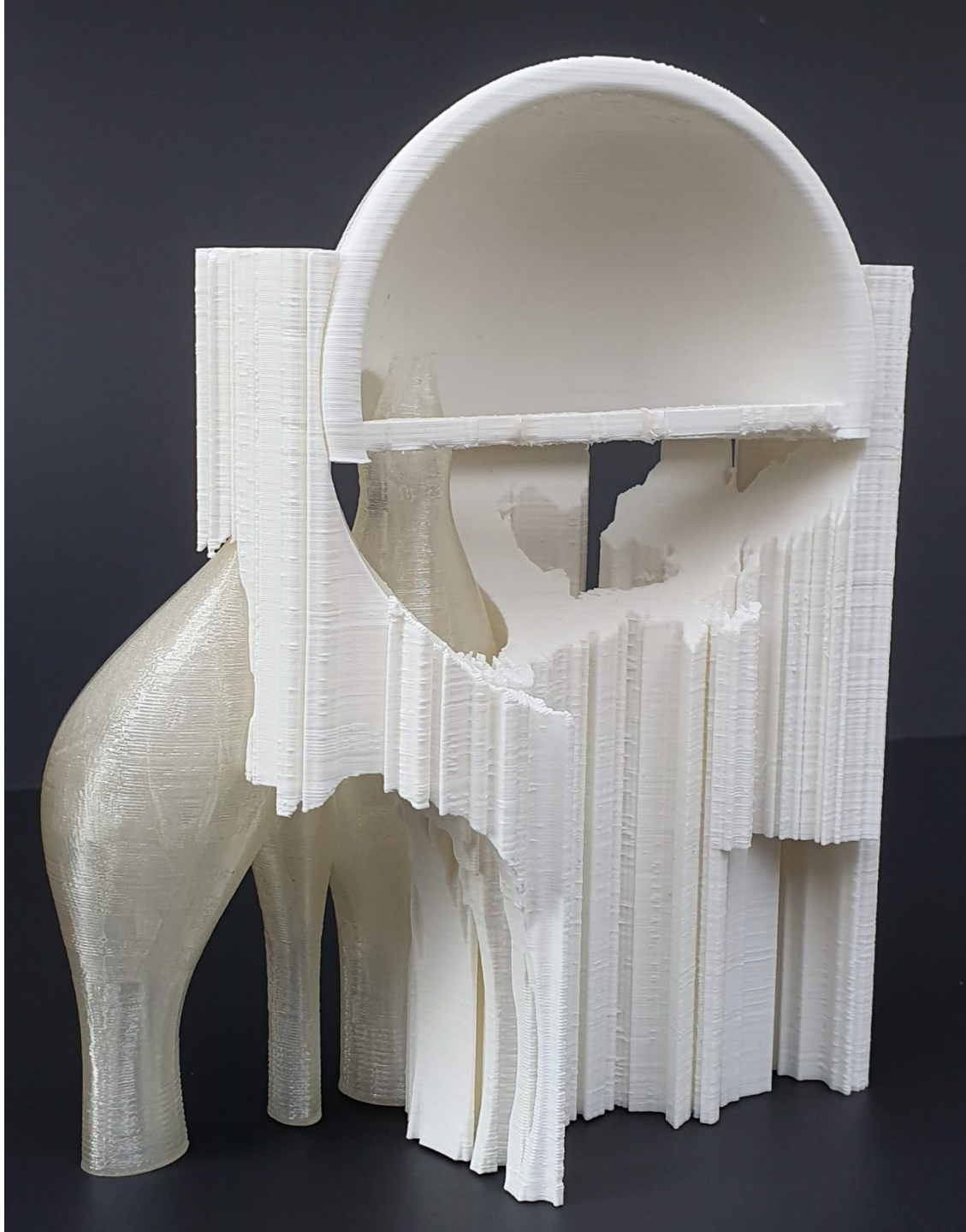
Produce up to **25 million gallons of drinkable** water per day

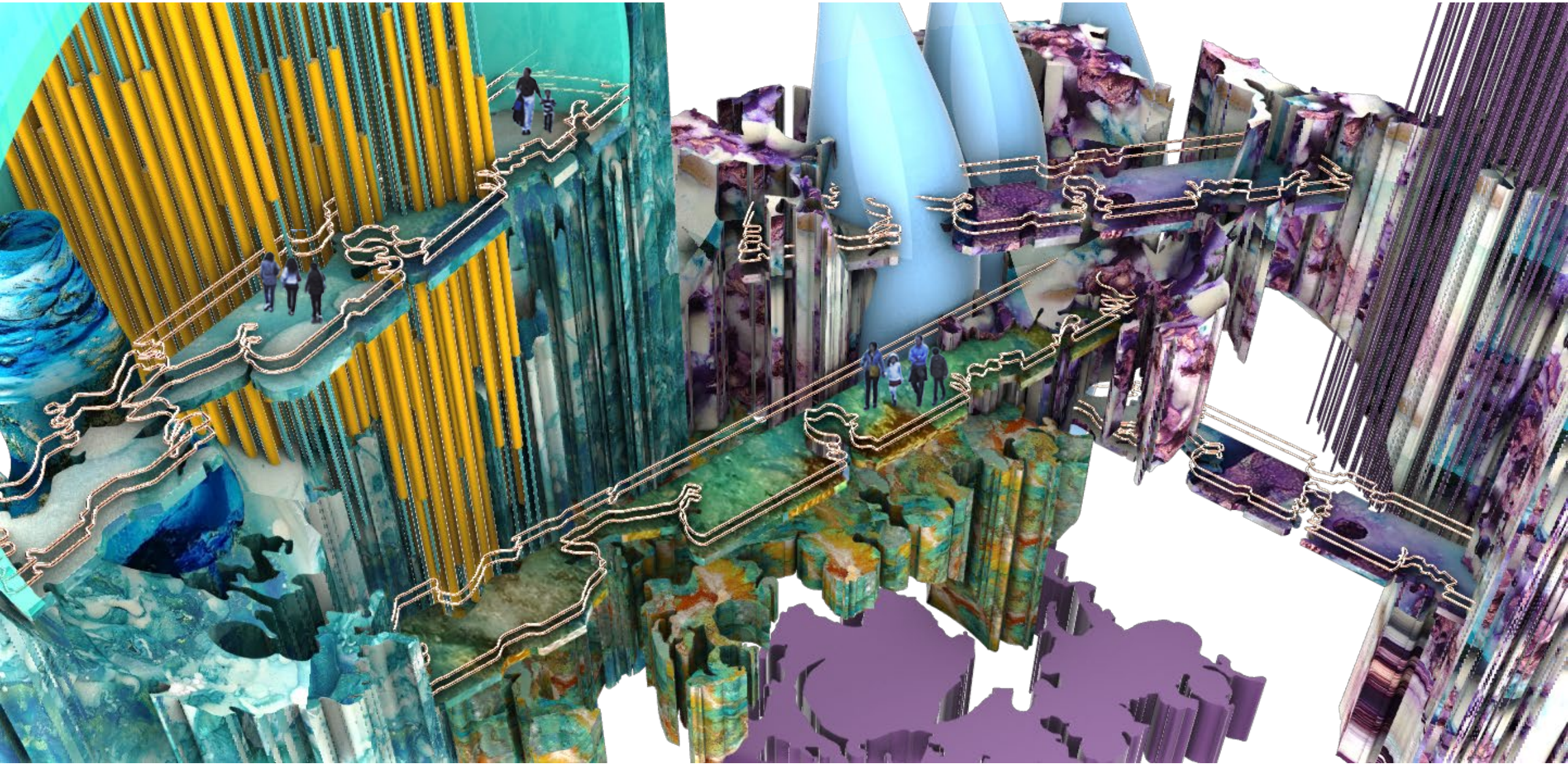
Holding tank- 5 million gallons

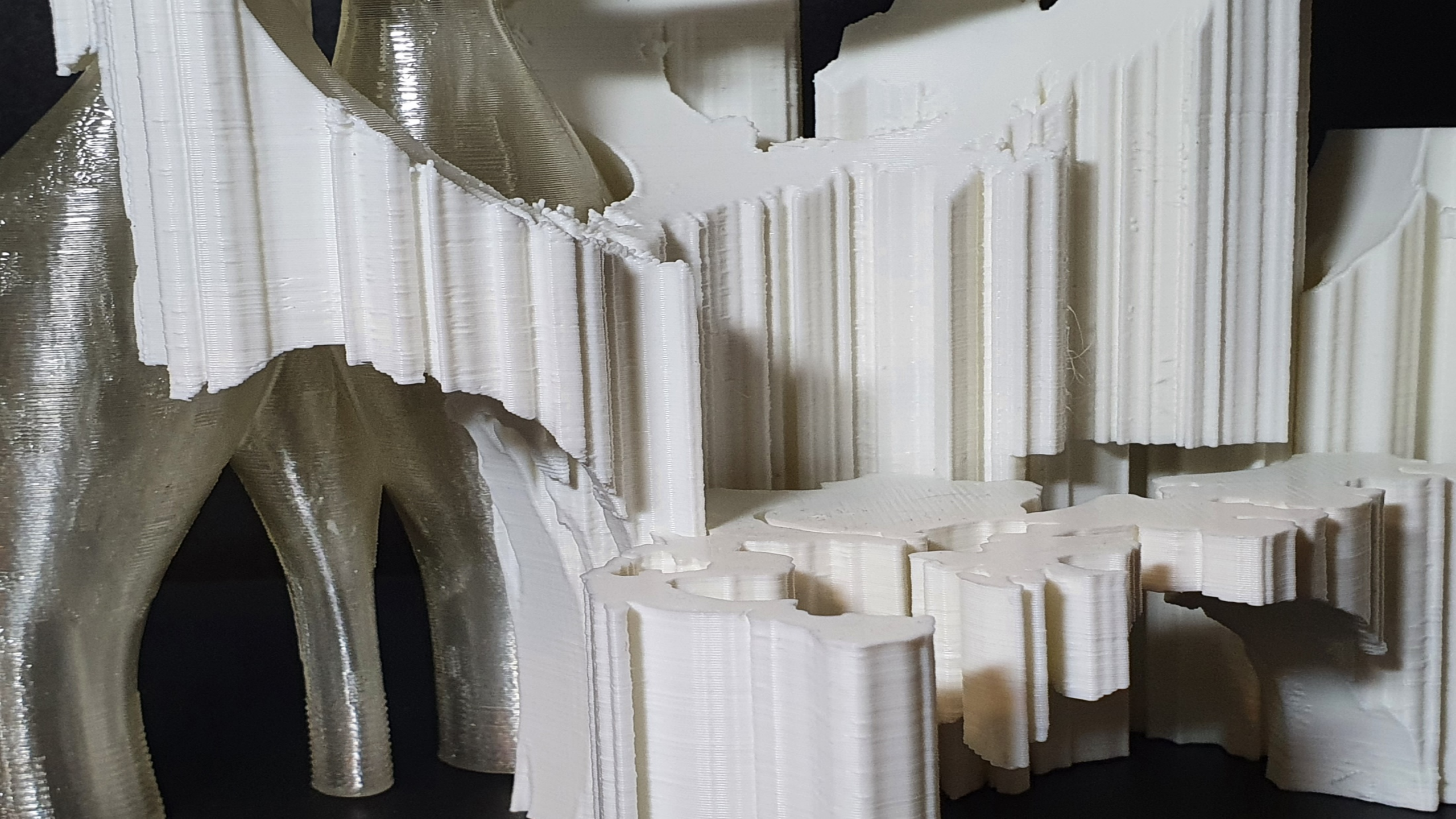
Discharge **19 million gallons** per day of twice-as-salty seawater to the bay.

Blending system can reduce salinity for 1.0 to 1.5 percent higher, than water from Tampa Bay.









Museum of desalinization

the public experience

The Future | GI as an off-grid independent water system

Greywater remediation

Tidal Desalinization plant

PROJECT WATER USE ANALYSIS FOR NON-RESIDENTIAL BUILDING

Variables:		
Net Sq Ft per person		250
Space Efficiency		0.9
Occupancy	Males	0.5
	Females	0.5
	Total	1
Work days per year		260
Lav faucet use (hr)		6
Public lavatory faucet flow rate		0.5 (gpm)

TOTAL BUILDING SQUARE FOOTAGE	
Gross Square Footage	20,000
Net Square Footage	18,000
Net Square Feet/Person	250
Occupancy (persons)	72
Males	36
Females	36

	Frequency of use per day	Amount per use (gal)	WATER USE (GAL PER YEAR)
Flush fixtures			
Toilets-Males	1	1.28	11,981
Toilets-Females	3	1.28	35,942
Urinals-Males (usage is average)	2	0.5	9,360
Flow fittings			
Commercial lavatory faucets	5	3	280,800
SUB-TOTAL-PLUMBING (Gal/year)			338,083
OCCUPANCY ADJUSTMENT FACTOR			1.00
ADJUSTED SUB-TOTAL-PLUMBING			338,083
Other Systems			
Comfort systems (HVAC)			
Landscape irrigaton			
Pools, fountains, spas			
Process equipment (food, medical, etc.)			
TOTAL WATER USE - PROJECT			**338,083** GAL PER YEAR

WATER USE ANALYSIS FOR MULTI-FAMILY RESIDENTIAL PROJECT

TOTAL BUILDING SQUARE FOOTAGE		
400,000		
Avg size of residential units (sf)	1800	222 No. of units
Occupancy (persons/unit)	2	444 No. of persons

	(flushes per day/person)	(WATERSENSE max gallons per flush)	WATER USE (GAL PER YEAR)
Flush fixtures			
Toilets-Males & Females	5	1.28	1,038,222

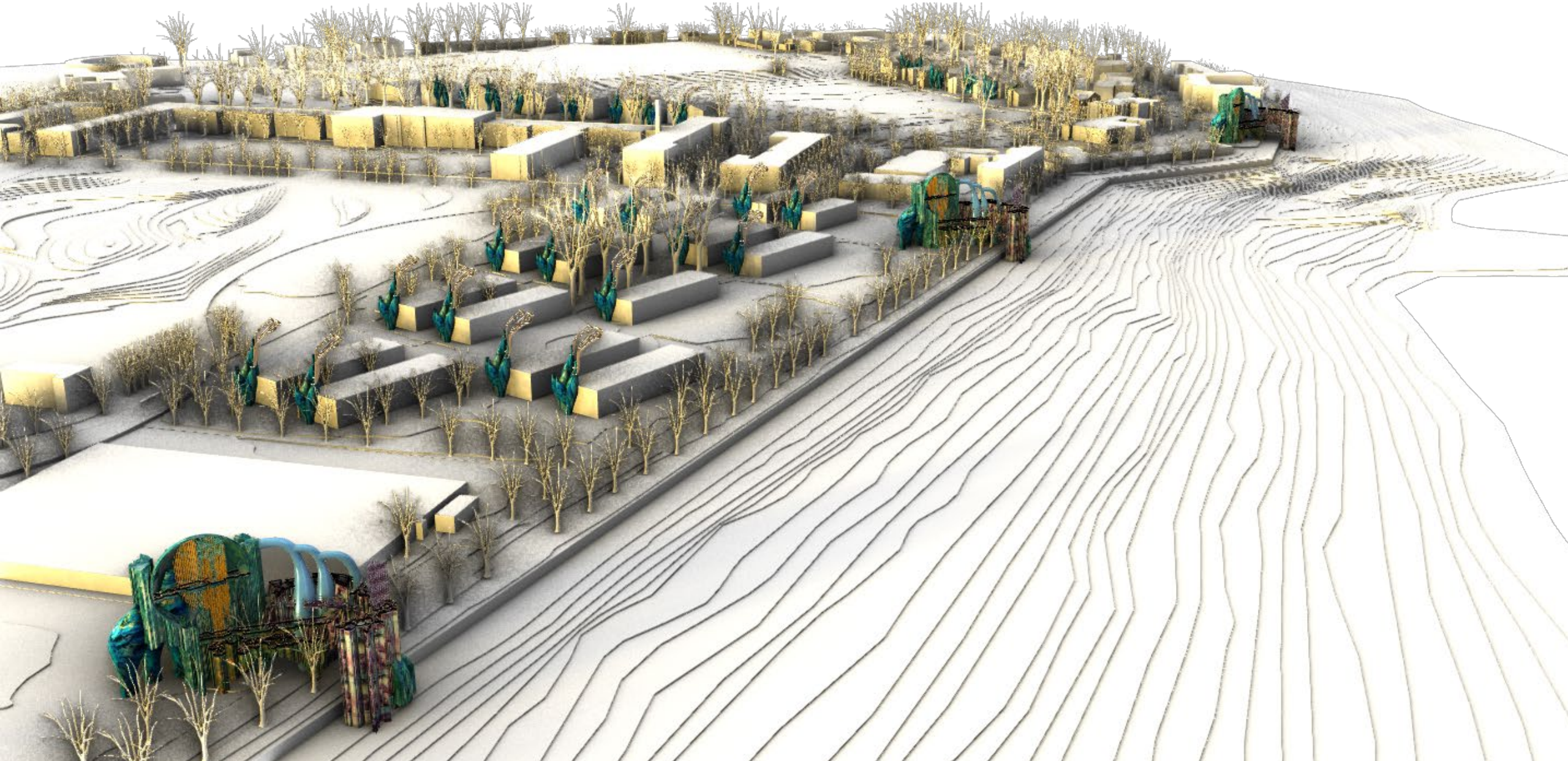
	(uses per day/person)	(gallons per use)	
Flow fittings			
Residential lavatory faucets	8	0	0
Residential showerheads	1	0	0
Resid. kitchen sink faucets	4	0	0

	(U.S. EPA cycles per yr)	(gallons/yr per unit)	
Residential Appliances			
Clothes Washer	392	0	0
Dishwasher	215	0	0

SUB-TOTAL-PLUMBING & APPLIANCES	Gallons/yr	1,038,222
	Acre-feet/yr	3.19
	Acre-feet/yr/unit	0.01

Other Systems	
Comfort systems (HVAC)	
Landscape irrigation	
TOTAL WATER USE - PROJECT	**1,038,222** GAL PER YEAR

The Future | GI as an off-grid independent water system



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