

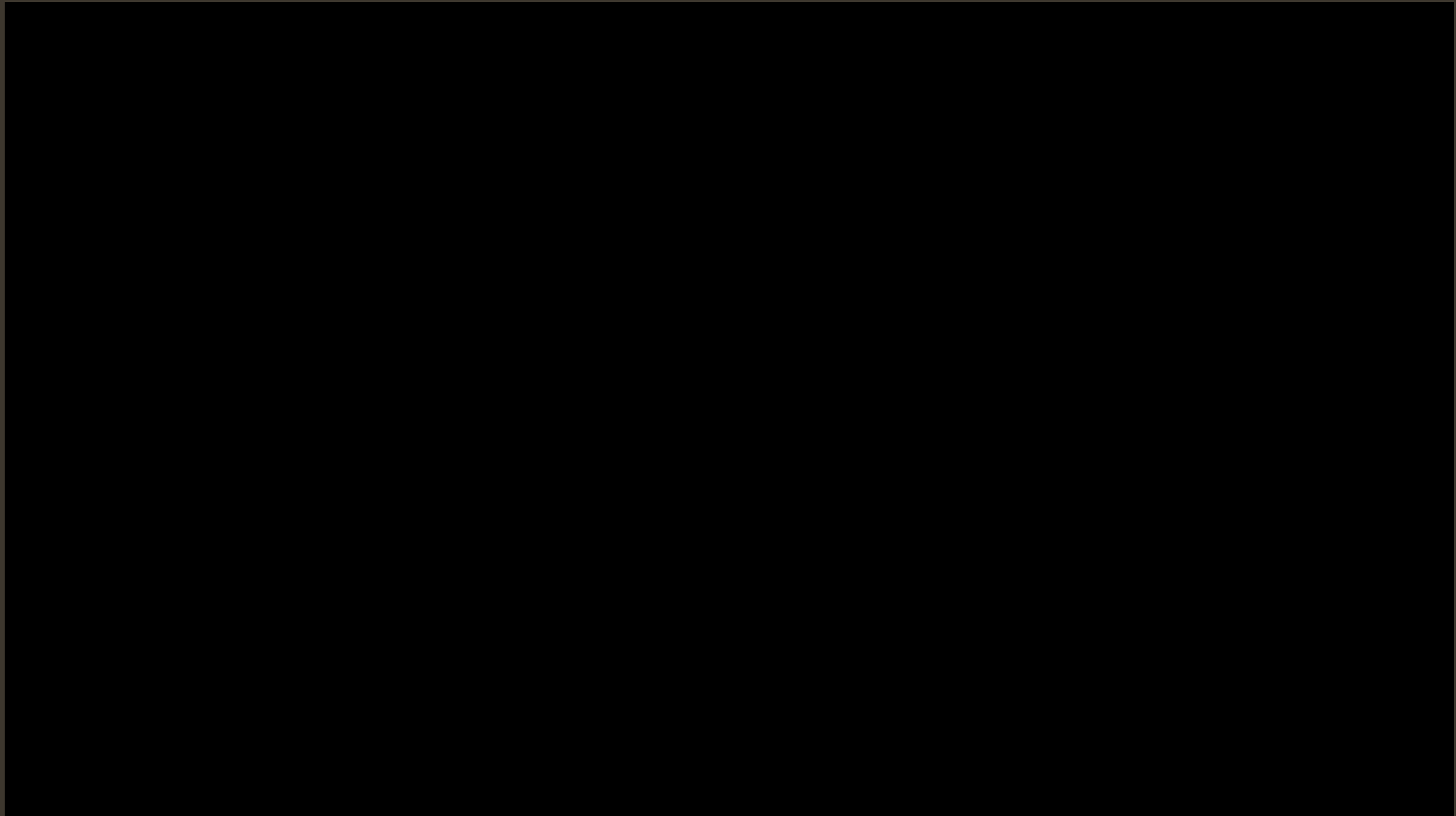
Year 9/10 Class

Town problem: No access to drinkable water for our town in the very near future. Our basin is running dangerously low, and we need to find a solution to supply our town with water; to supply our homes for household needs and quality water to drink.



The Problem







The Investigation

The Investigation

We learnt a lot of new information. Our research included;

1. Learnt where our water comes from
2. What are the current concerns and town water annual usage
3. Agreed that a small-scale desalination plant would be the best solution
4. Researched many articles and gathered information, pictures and watched videos to understand how a desalination plant works internally.
5. Researched wave, wind and solar energy
6. Decide on a location, taking into account marine life and commercial/recreational fisherman
7. Location was based on looking for strong currents and where people don't surf, swim or fish and is not visible to locals/tourists.
8. Researched the effect salt can have on our marine environment and animals
9. Researched possible salt by-products instead of dumping salt back into the ocean
10. Learnt about reverse osmosis that occurs to discard the salt
11. Devised many questions for our special guest, Mayor Andrew McLoud from the Elliston District Council
12. Andrew knows extensive knowledge on our current water issues, he is on the Bramfield Basin and Elliston Water Committee.

Special guest: Mayor Andrew McLoud from the District Council of Elliston



Mayor Andrew McLoud – Q/A Visit

- Questions for Monkey

- **Would we supply water to Bramfield if we got a desalination plant?** We would most likely, especially thinking about the future with global warming and climate change.
- **What is the best energy for a small desalination plant?** We could use solar and wind energy at the same time and we might require a generator for power outage. As solar power only generates during the daytime, batteries would need to be used by night.
- **Would Elliston we able to start a business out of the super salty brine?** Yes we could, would provide employment and it would be better not to put salty brine back into the ocean. A great way to be more sustainable and promote work opportunities in Elliston.
- **With growing populations would we need to upscale the plant in the years to come?** We would have to for an increased population of up to maybe 1,000 people.
- **If the desalination plant is out at Anxious Bay how will we transport the water back to Elliston?** Pipelines would have to be installed underground back into town and connect to the current pipelines.
- **Will we have to get storage tanks for the desalinated water?** Yes, we will need tanks for storage.
- **How much water does the township of Elliston use in 1 year approximately?** It is roughly I believe about 50 gigalitres.

Solutions – what we needed to design our desalination plant

Water pump – to pump the salt water from the ocean to the desal plant



Generator – To provide the desal plant with power when power outage OR night time if solar/wind not working



Batteries – Power stored for generator from wind/solar panels



Wind turbine – to generate power, Elliston is ideal for wind being along the coastline



Solar panels – To generate power to run the desal plant



Filters – Very fine filters are required to remove all algae, debris and sand from salt water



Reverse Osmosis – The removal of salt from the seawater at extreme pressure



Water treatment pools – To test and add chemicals to water so it can become safe to drink



Water storage tanks – Store drinkable water for when needed



Brine concentrate extract – From reverse osmosis, all the salt is extracted and is concentrated (called salty brine)

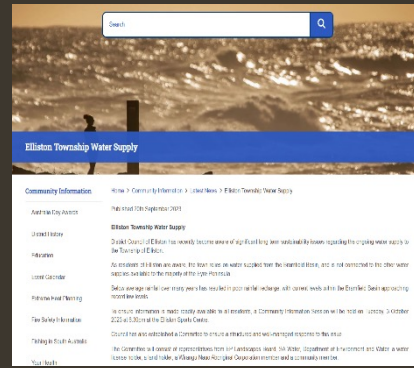


By-product ideas – Instead of placing brine into ocean make products from the salty brine (salt, bicarb soda, chloride)

Resources we used

Elliston township water supply

<https://www.elliston.sa.gov.au/community-information/latest-news/elliston-township-water-supply>



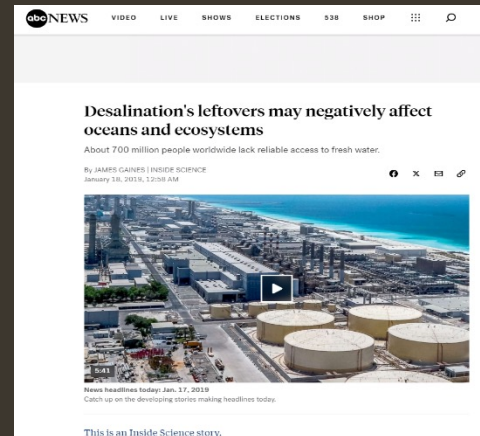
Elliston touted as solution to south Australia's power and water woes.

<https://www.abc.net.au/news/2022-11-24/elliston-touted-solution-to-sa-power-water-woes/101694028>



Desalination's leftovers may negatively affect oceans and ecosystems.

<https://abcnews.go.com/Technology/desalinations-leftovers-negatively-affect-oceans-ecosystems/story?id=60443280>



what pollutants are produced by desalination.

<https://www.envirotech-online.com/news/water-wastewater/9/international-environmental-technology/what-pollutants-are-produced-by-desalination/59737>



Small scale desalination technologies: A comprehensive review

<https://www.sciencedirect.com/science/article/pii/S0011916423006173>

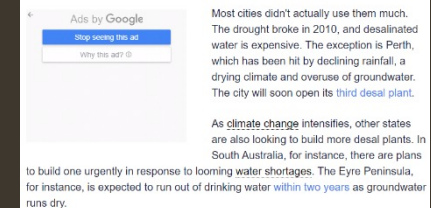


More desalination is coming to Australia's driest states—but super-salty outflows could trash ecosystems and fisheries.

<https://phys.org/news/2024-05-desalination-australia-driest-states-super.html>

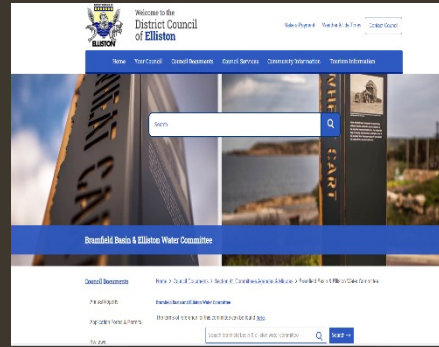
More desalination is coming to Australia's driest states—but super-salty outflows could trash ecosystems and fisheries

From around 1996 to 2010, Australia was gripped by the millennium drought. As water shortages bit hard, most of Australia's capital cities built large seawater desalination plants—Sydney, Adelaide, Brisbane, Melbourne and Perth. Remote towns have also built smaller desalination plants.



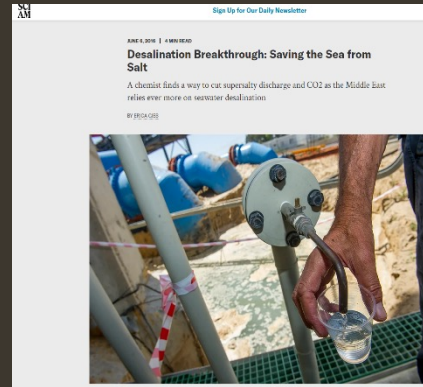
Minutes of the Bramfield basin and Elliston water committee meeting

<https://www.elliston.sa.gov.au/council-documents/section-41-committees-agendas-and-minutes/bramfield-basin-and-elliston-water-committee>



Desalination Breakthrough: Saving the Sea from Salt

<https://www.scientificamerican.com/article/desalination-breakthrough-saving-the-sea-from-salt/>



Creating useful products from desalination waste

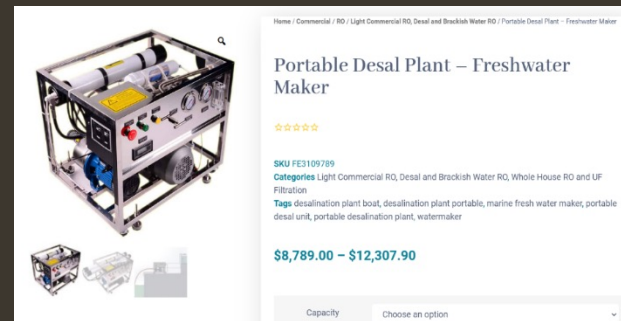
<https://www.thechemicalengineer.com/news/creating-useful-products-from-desalination-waste/>

Solar-Powered Desalination Ships: Mobile renewable Energy Solutions for Seawater Purification in Remote Coastal Areas

<https://arka360.com/ros/solar-powered-desalination-ships-mobile-renewable-energy/#:~:text=A%20potential%20method%20for%20supplying,energy%20present%20in%20these%20regions.>

Portable Desal Plant – Freshwater Maker

<https://pacificwater.com.au/product/protable-deal-plant/>



Creating useful products from desalination waste

Article by Amanda Jasi



SOLAR BASED
Solar-Powered Desalination Ships: Mobile Renewable Energy Solutions for Seawater Purification in Remote Coastal Areas

Akshay VR
Dec 5, 2023 • 12 min read



Delivering a historic desalination upgrade for outback SA community

<https://utilitymagazine.com.au/delivering-a-historic-desalination-upgrade-for-outback-sa-community/#:~:text=Delivering%20a%20historic%20desalination%20upgrade%20for%20outback%20SA%20community,-Katie%20Livingston%20May&text=For%20the%20first%20time%2C%20residents,Far%20North%20South%20Australian%20town.>

Delivering a historic desalination upgrade for outback SA community

Katie Livingston
May 15, 2024
Desalination, Features,
Projects,
Sustainability, Water



What happens at a Seawater Desalination Plant | Our water world

<https://youtu.be/mEXzzlDCkoo>

ABC Doco

<https://www.abc.net.au/news/2024-06-10/port-lincoln-desalination-plant-aquaculture-water-security/103959976>

Sundrop – Thermal energy and desalination plant

<https://www.youtube.com/watch?v=jUWdtwYh96c>

Portable Desal Plant

<https://pacificwater.com.au/product/portable-desal-plant/>

<https://www.elliston.sa.gov.au/community-information/latest-news/elliston-township-water-supply>

What Pollutants are Produced by Desalination?

<https://www.envirotech-online.com/news/water-wastewater/9/international-environmental-technology/what-pollutants-are-produced-by-desalination/59737>

Desalination Breakthrough: Saving the Sea from Salt

<https://www.scientificamerican.com/article/desalination-breakthrough-saving-the-sea-from-salt/>

What is DESALINATION?

https://youtu.be/mUtYUTTC_Bg

Building a Desalination Plant from Scratch: Crash Course Engineering #44

<https://youtu.be/J9MqzIMJOkQ>

How solar-powered desalination works - Sustainable clean water for islands & coastlines

<https://youtu.be/J9MqzIMJOkQ>

What happens at a Seawater Desalination Plant | Our water world

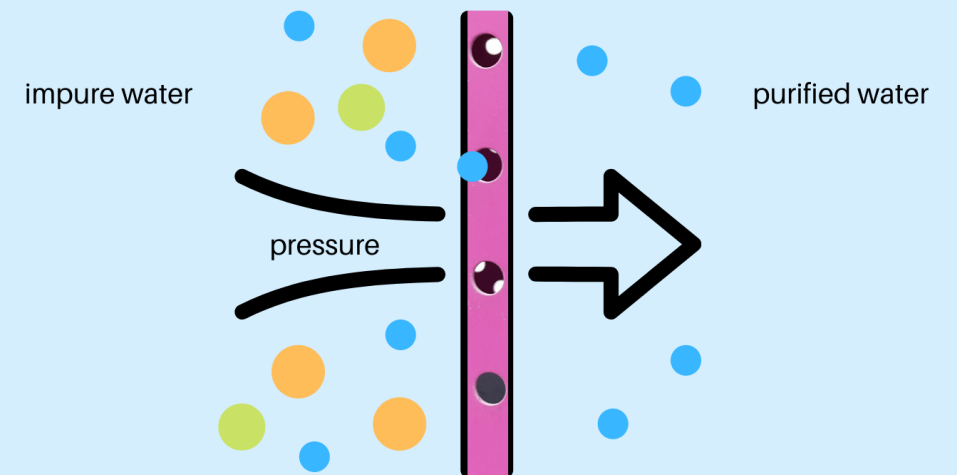
<https://youtu.be/mEXzzlDCkoo>

Solution

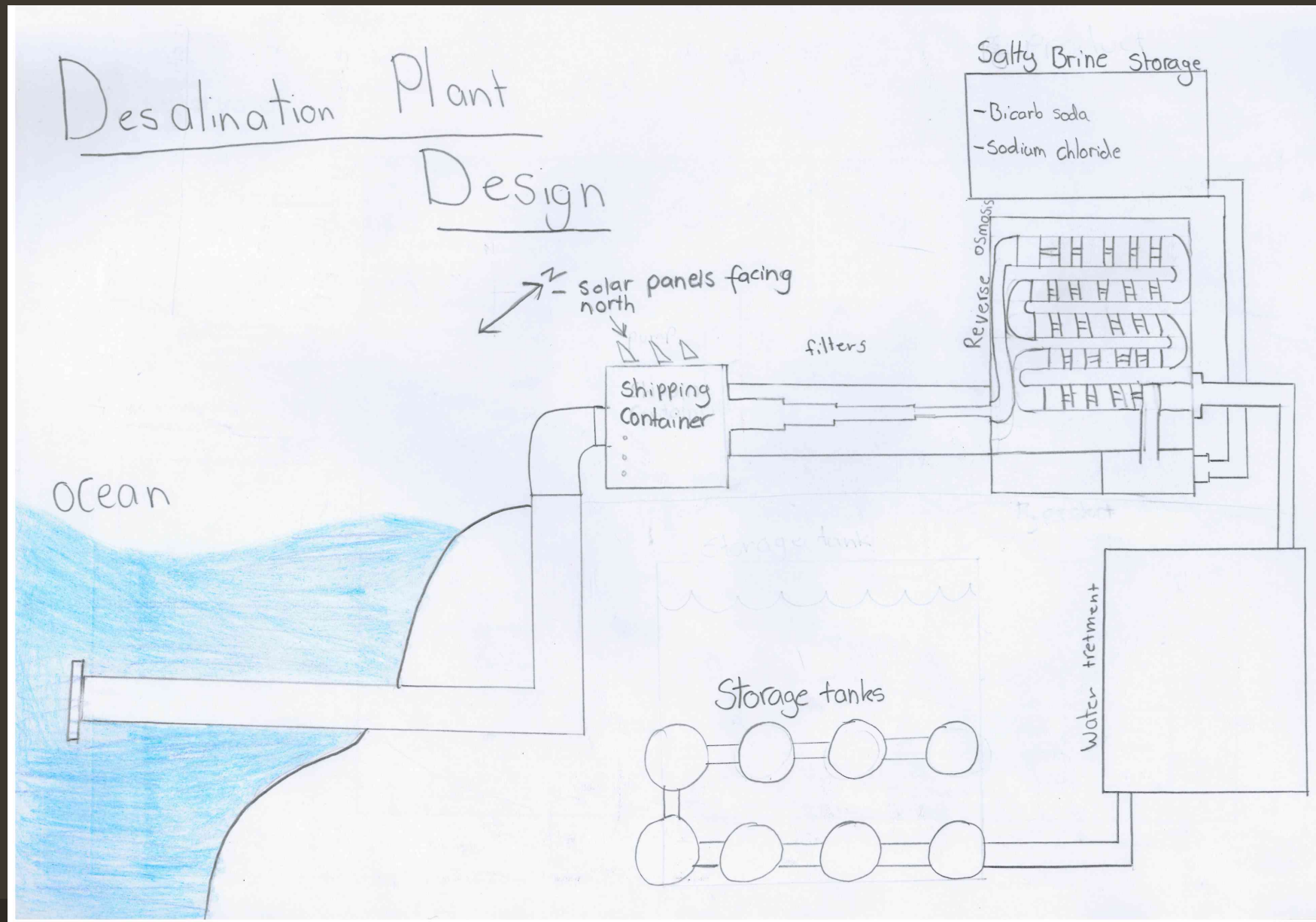


What Is Reverse Osmosis?

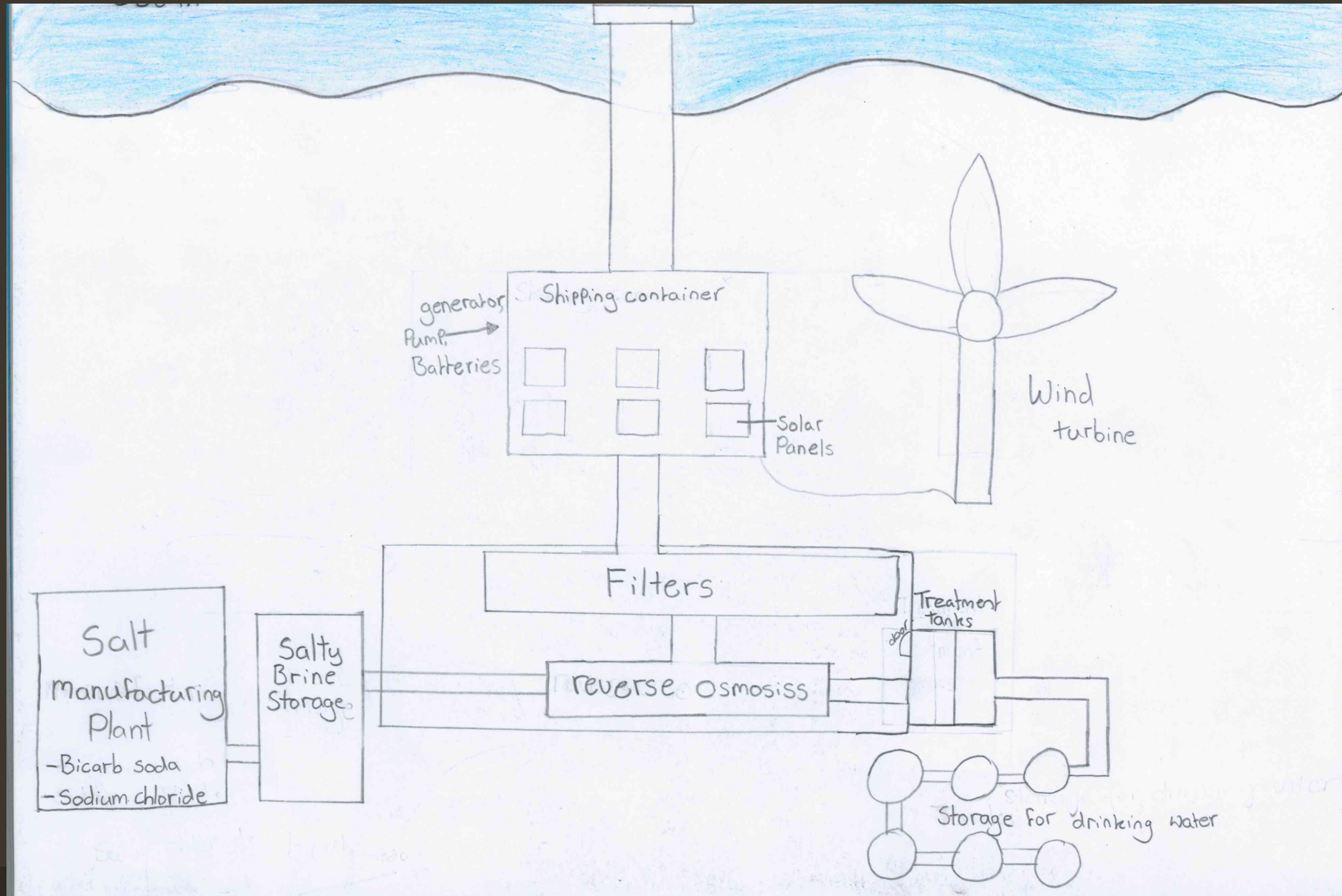
Reverse osmosis or RO purifies water by pushing it through a semi-permeable membrane.



Desalination plant design – side angle



Desalination plant design – Birds eye view



Map – Site for our desalination plant



We chose a hidden spot away from where people cannot see it, between Anxious Bay and Walkers Rocks.

It is also a great location because there is a strong current that channels between Waldegrave Island and the mainland. If we decided to release the salty brine back into the ocean, then this is where we would consider it. However, we are using the salty brine as a by-product and in turn saving our pristine environment, animals and providing employment for the locals for a more sustainable future.

The strong current allows us to put the salty brine back into the sea. The area that it is in shouldn't really affect the natural breeding grounds of marine animals. There is only a hand full of small commercial fishing taking place or surfing in this area. For these reasons this is the best location.

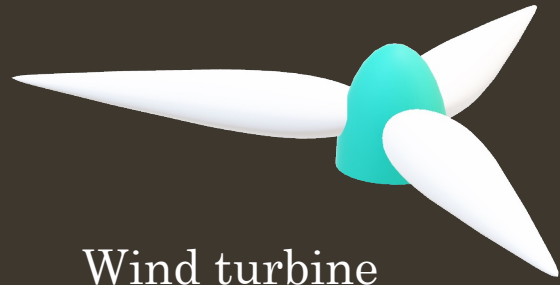
Possible by-products of salty brine water

Products that can be manufactured from salty brine

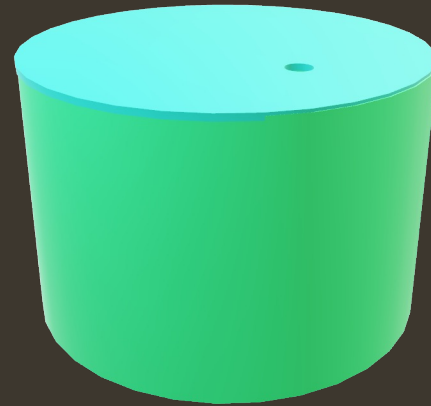
- Magnesium
 - Calcium
 - Potassium
 - Chlorine
 - Bicarb soda
 - Brine – hydrogen, chlorine and sodium hydroxide
 - Sodium Chloride
 - Spirulina – type of algae that grows in water as is consumed by humans for health benefits in tablet or powder form.
-
- We believe that having an Australian made and owned local produce would be fantastic. The Eyre Peninsula (Elliston) is known for its pristine waters and great fishing, so why stop there.
 - We think making SALT and BICARB SODA from the salty brine concentrate of the desalination plant is an exciting opportunity and essential to the town's growth.
 - Why not put a little bit of EP (Eyre Peninsula) on everyone's dinner plate.



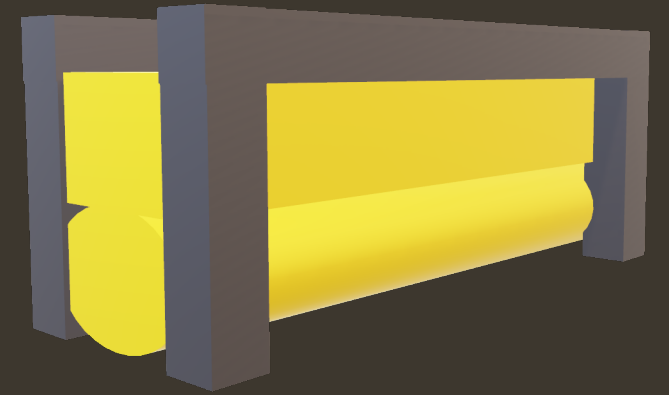
Prototype Design



Wind turbine

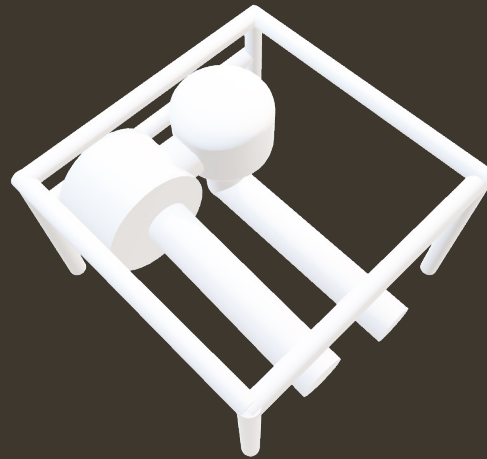


Storage tanks



Generator

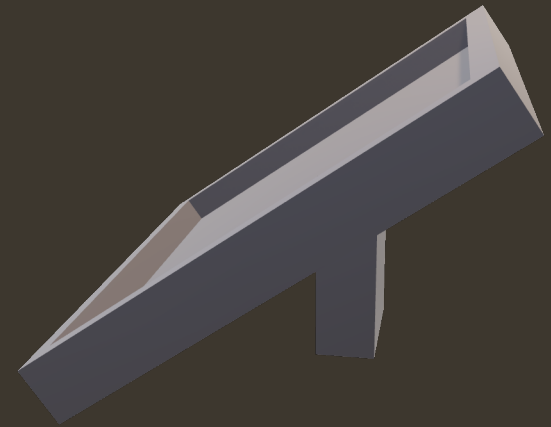
Filter and reverse osmosis designs



Water pump



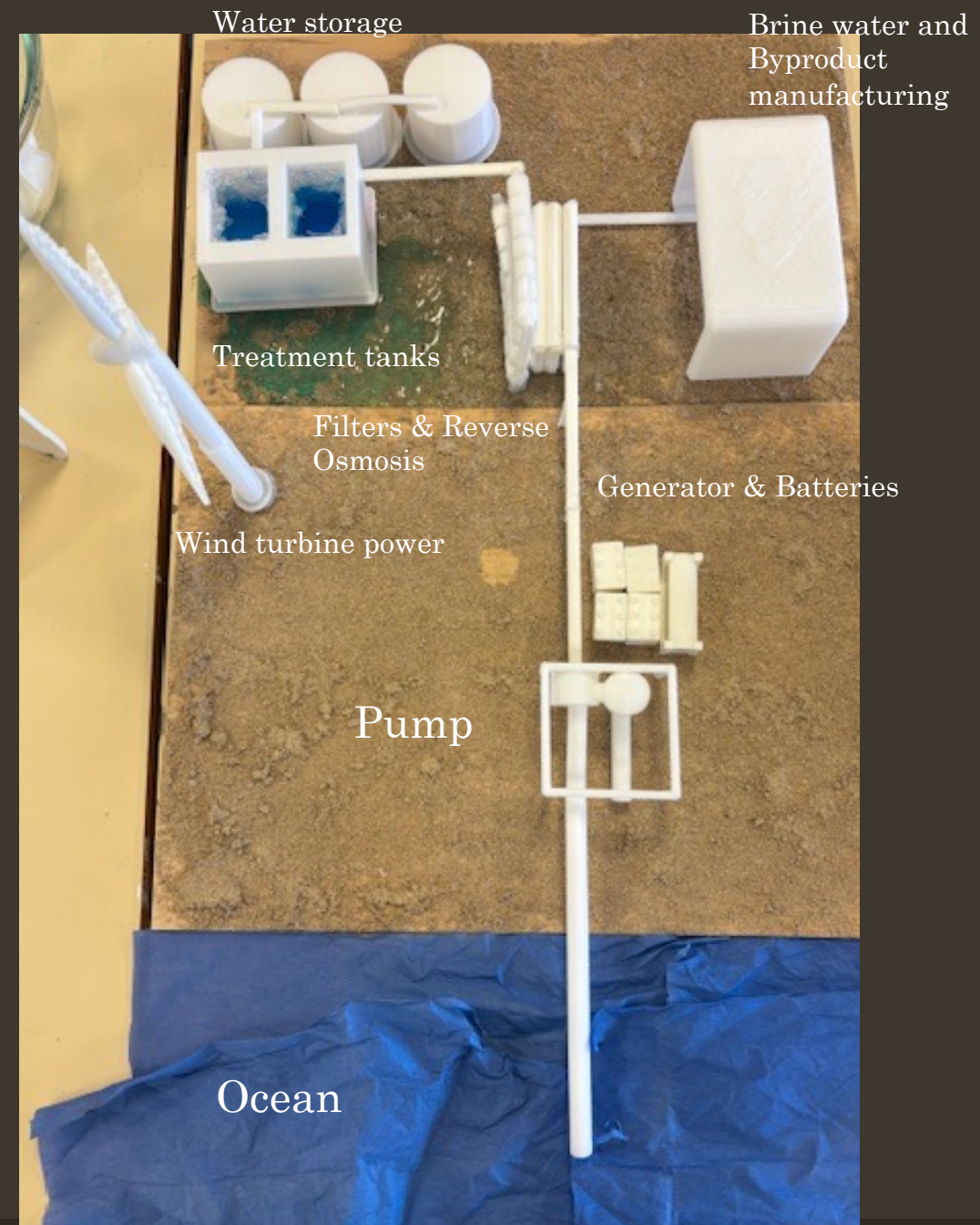
Treatment tanks

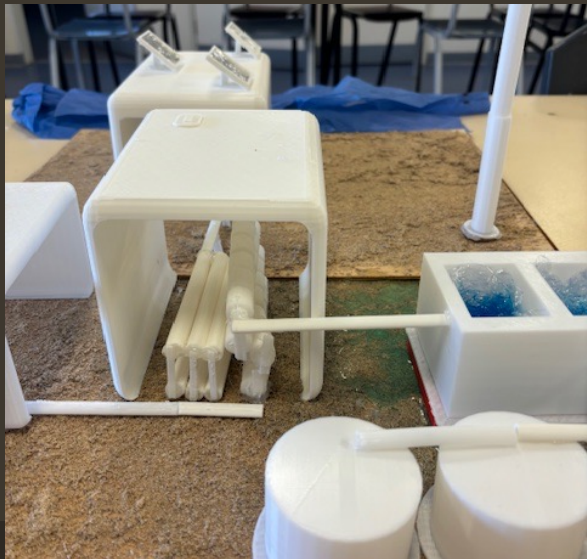
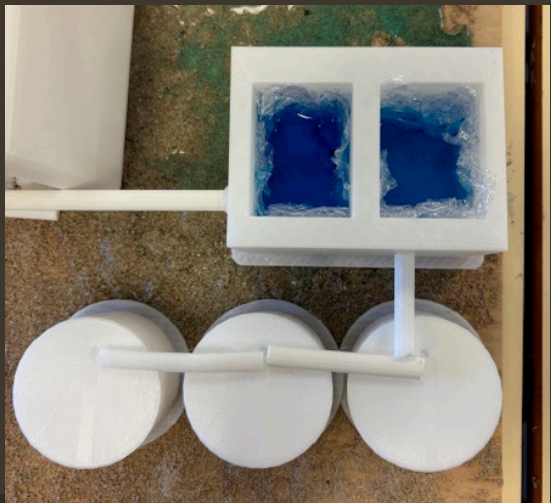
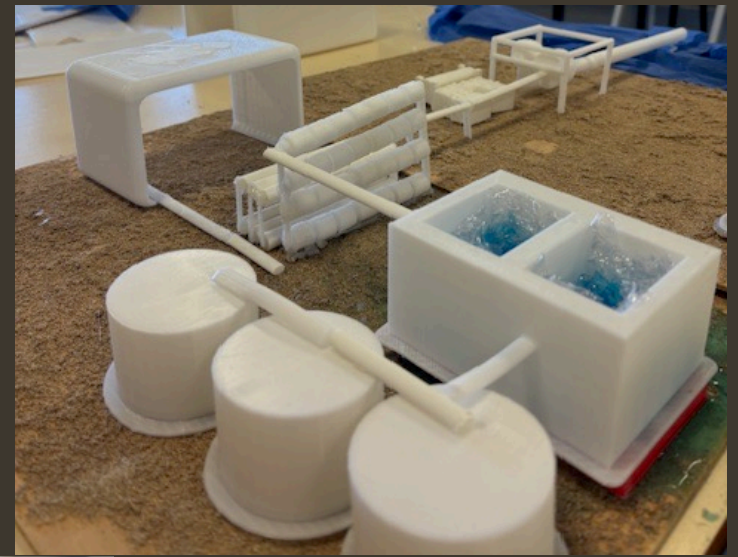
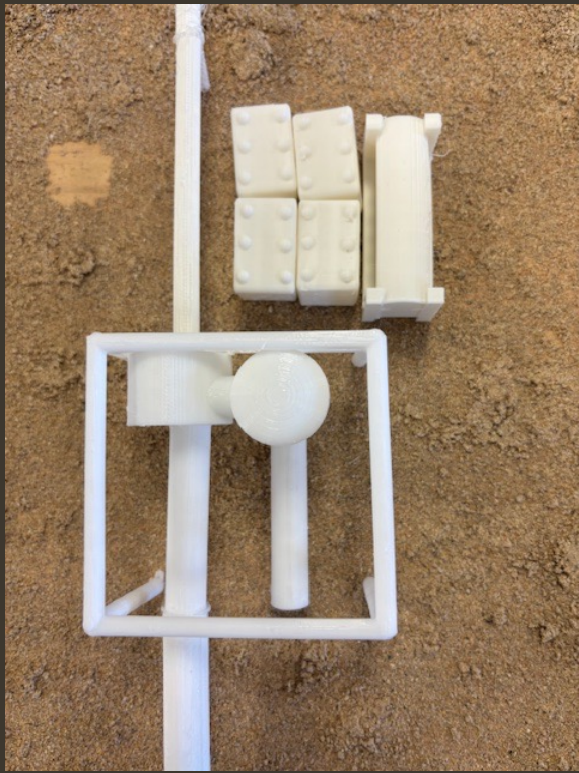


Solar panel

Scaled Model

Demonstrating both of our designs. One is with the shipping container and actual building frames. The other shows the inside workings of a desalination plant.





Solar panels

Evaluation

What worked well?

Going through the well-structured Makers Empire 3D and Careers to Construction courses

It was great to learn about job opportunities within the construction industry

Putting all the designs together through group work, collaboration and team building skills

We really enjoyed learning a lot of new information and been student driven

What could have been done better?

We could have recorded information better

We could have visited a desalination plant (although along way to travel)

We could have invited more people in from the construction area (hard in a small town)

The costs of having a desalination plant. – getting a second opinion.

How long would it take to construct a small size desalination plant

What was a struggle?

The scaling ratios of our overall designs.

Using makers empire for the first time.

Due to lots of absences we were falling behind schedule

We lost our IT lessons due to other school activities/events