



**The benefits of using pure seawater for agricultural production- *and I mean*
*"pure seawater!"***

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1. Introduction

Water scarcity is now the greatest single threat to human health, the environment and the global food supply¹

The purpose of this paper and my research is to educate, advocate and convince decision makers and potential partners, and governments to provide funds and land for the creation of food production and greening of the world's deserts, by the use of seawater agriculture.

Success will result in programs that will feed hundreds of millions of people whilst reducing global warming via carbon sequestration.

On a worldwide basis, most countries are experiencing a severe shortage of potable and usable water for drinking, agriculture, household use, leisure and industry. With global warming and population increase, as well as essential increases in industry and agriculture, the situation will only get worse as fresh water is a diminishing and finite resource. Whilst desalination is always a possible source of potable water for coastal regions the cost will always prevent it from becoming the solution in all countries. Moreover desalination contributes to the environmental pollution and global warming, whereas using seawater does not. This is expected to be compounded if evaporation rates increase, deforestation continues and water pollution increases.

The consequences, worldwide, of water shortages are dire and are resulting in:-

- Crop Failure
- Increased poverty
- Increased illness and fatalities
- Worsening living standards
- Reduction in development
- Lower industrial output
- Conflicts over water resource
- Loss of wild life
- Soil erosion
- Increase in soil salinity
- Worsening micro-climates
- Increase in global warming

The above problems will be particularly severe for the smaller and poorer countries which are already suffering from severe water shortages, crop failure and famine.

I also believe that the products of sea water agronomy are in line with the vision and mission of all major environmental groups that aim is to reduce global warming.

For sea water agronomy to be fully successful in the shortest possible time frame it require cooperation, financing and support from Governments.

¹ Bushnell, Dennis (2006)
Seawater/Saline Agriculture for Energy, Warming, Water , Rainfall, Land, Food and Minerals
NASA Center: Langley Research Center
Document ID: 20060010538
Updated/Added to NTRS: Dec 15, 2007

2. What am I talking about?

A very important distinction to start: I'm NOT talking about desalinating seawater!

What I am talking about is growing food *directly* from seawater, either seawater from the oceans of the world. The advantages of using salt water are:

- Grow crops and marine animals for human and animal consumption, increasing the opportunities for food production in arid parts of the world leaving precious fresh water for human use.
- Absorb large quantities of Carbon Dioxide, a green house gas to help reduce global warming
- Produce oil from seed crops that can be used as a bio-fuel, reducing our dependency on fossil fuels.² NASA estimates indicate that biomass grown on the Sahara alone could supply the World's Energy Requirements. One of the drawbacks of normal Bio Fuels is that they have an environmental impact as growing the plants usually means deforestation and the use of scarce fresh water. Salt water biofuel plants however use deserts, barren and arid land, and moreover they use seawater not fresh water.
- Employs hundreds of people (soon to be thousands, and eventually hundreds of thousands), in the developing world in locations, where few or no jobs exist.
- Reverses the degradation of intense aquaculture (such as shrimp farms) by using the nutrient rich effluent formerly released directly back into sensitive marine environments
- Environmentally enhances the arid lands where Seawater Farms are placed, increasing biodiversity and opportunities for recreation and ecologically sound development.
- Produces electrical power via solar ponds
- Seawater contains a wide variety of important minerals including ~ 80% of nutrients required for agriculture.
- Is available in unlimited quantities in close proximity to a number of dry/desert areas.

Additionally:

97% of all water on our planet is seawater - it will not "Run Out"

References

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² Bushnell, Dennis (2006)

Seawater/Saline Agriculture for Energy, Warming, Water, Rainfall, Land, Food and Minerals | NASA Langley Research Center.

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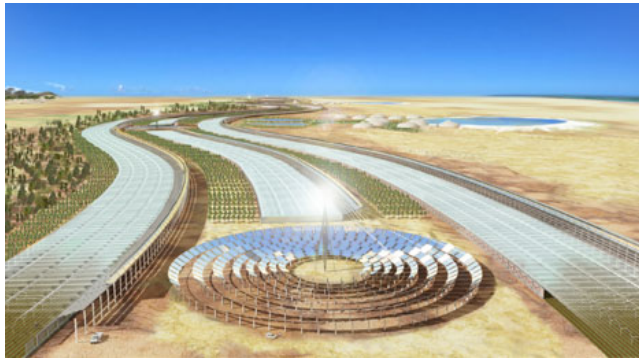


“Water scarcity is now the single greatest threat to human health, the environment and the global food supply”

Extract from
NASA Langley Research Center

Alternative Salt water Agronomy Employment Approaches

- **Desalinization** [in general, too expensive for Agriculture]
- **Cold/deeper Ocean water** to [via heat exchangers] precipitate moisture from the atmosphere
- **Seawater Greenhouses** [uses solar power vaporization/re-precipitation to create fresh water from salt water- already in Oman, UAE, Australia and Tenerife- 80m Euros for 20Ha of greenhouses]



Examples: Sahara Forest Projects

- **Direct Plant Seawater Irrigation**

What am I talking about!!!

A very important distinction to start: I'm **NOT** talking about **desalting seawater!**

What I am talking about is **growing food directly from seawater** - from the oceans of the world.



High tide



A natural example low tide



Area used for sheep grazing



Seawater Agriculture

Quasi-Conventional

For Food & Fodder

“Reclaim”/Desalinate land via Biologics

Unconventional

For Land, Water, Energy ,Warming, Minerals, Food

Terra-Forming/enhanced Rainfall i.e. STRATEGIC Not
Tactical, to Contribute to ALL the Major Problems, not
just food

The Advantages

Salt water agronomy

- Grows crops and marine animals for human and animal consumption, increasing the opportunities for food production in arid parts of the world leaving precious fresh water for human use.
- Absorbs large quantities of Carbon Dioxide, a green house gas to help reduce global warming
- Produces oil from seed crops that can be used as a bio-fuel, reducing our dependency on fossil fuels.
6% of U.S. land mass producing Biomass could supply the U.S. with current Oil and Natural Gas Usage
NASA Estimates indicate that Biomass grown on the Sahara alone could supply the World's Energy Requirements
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Salt water Bio Fuel plants however use deserts , barren and arid land, and moreover they use seawater not fresh water .
- Employees hundreds (soon to be thousands, and eventually hundreds of thousands) of developing world citizens in locations where few or no jobs exist.
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- Environmentally enhances the arid lands where Seawater Farms are placed, increasing biodiversity and opportunities for recreation and ecologically sound development.
- Produces electrical power via solar ponds
- 97% of all water is seawater, will not "Run Out"
- Seawater Contains:
wide variety of important minerals
~ 80% of Nutrients required for Agriculture [need to add Nitrogen, Phosphorus and Iron]
- In proximity to a number of Dry/Desert Areas



Solar ponds at Pyramid Hill

Salt Water Vegetable Farms

Already farmed commercially and greatly consumed openly, particularly in China, Japan and Korea, (as well as covertly), via the use of seaweed phycocolloids - used as food additives and for bulking up products such as ice-cream as well as cosmetics and industrial applications.

- Sea Kale- a leafy plant that when fried with olive oil has a nutty flavour.
- Samphire - Asparagus-like flavour
- Beets
- Dates
- Pomegranate
- Sea vegetables – Sea weeds, kelp and algae's- Nori, Dulse, Kombu, Wakame, Bull Kelp Hijid, Sargassum, Sea-Palm, Sea Lettuce, Sugar beets
- Coconuts
- Ascophyllum (Rockweed)
- Some Mangrove tree fruits (Nypa palm)
- Eelgrass seed- which can also be ground into flour to make bread

+

There are 10,000+ “Natural” Halophyte Plants, 250 of these are potential “Staple” crops

Over 100 halophyte plants are now in “trials” for “Commercial” applications

Sea Vegetables Nutritional Profile

Ref: U.S.Food and Drug Administration's "Reference Values for Nutrition Labeling"

Kelp (sea vegetable) 0.25 cup 20.00 grams 8.60 calories				
Nutrient	Amount	DV (%)	Nutrient Density	World's Healthiest Foods Rating
iodine	415.00 mcg	276.7	579.1	excellent
vitamin K	13.20 mcg	16.5	34.5	excellent
folate	36.00 mcg	9.0	18.8	very good
magnesium	24.20 mg	6.0	12.7	very good
calcium	33.60 mg	3.4	7.0	good
iron	0.57 mg	3.2	6.6	good
tryptophan	0.01 g	3.1	6.5	good
World's Healthiest Foods Rating	Rule			
excellent	DV>=75%	OR	Density>=7.6	AND DV>=10%
very good	DV>=50%	OR	Density>=3.4	AND DV>=5%
good	DV>=25%	OR	Density>=1.5	AND DV>=2.5%

An example - Sea Kale

Dutch Sea Kale Grown in Salty Soil Offers Peek at Food Future

By Jeremy van Loon - December 4, 2008 21:25 EST

Dec. 5 (Bloomberg) -- At Jef Schuur's restaurant on the Dutch resort island of Texel, guests dig in with gusto to an unusual vegetable grown in the salty soil next to the North Sea.

Sea kale, a leafy plant with white stalks that's fried up with olive oil, surprises customers with its pleasantly nutty taste, said Schuur, who has served the dish for the past year. The plant, related to kale and Chinese cabbage, grows wild on Texel and was recently domesticated by biologists trying to find crops able to adapt to saltier growing conditions stemming from global warming.

"It has a stronger flavor than most vegetables but brings out very nice accents in food," Schuur said.

"Growing sea kale here shows that there are a lot more opportunities for local produce on low-lying islands affected by salt."

An example- Salicornia



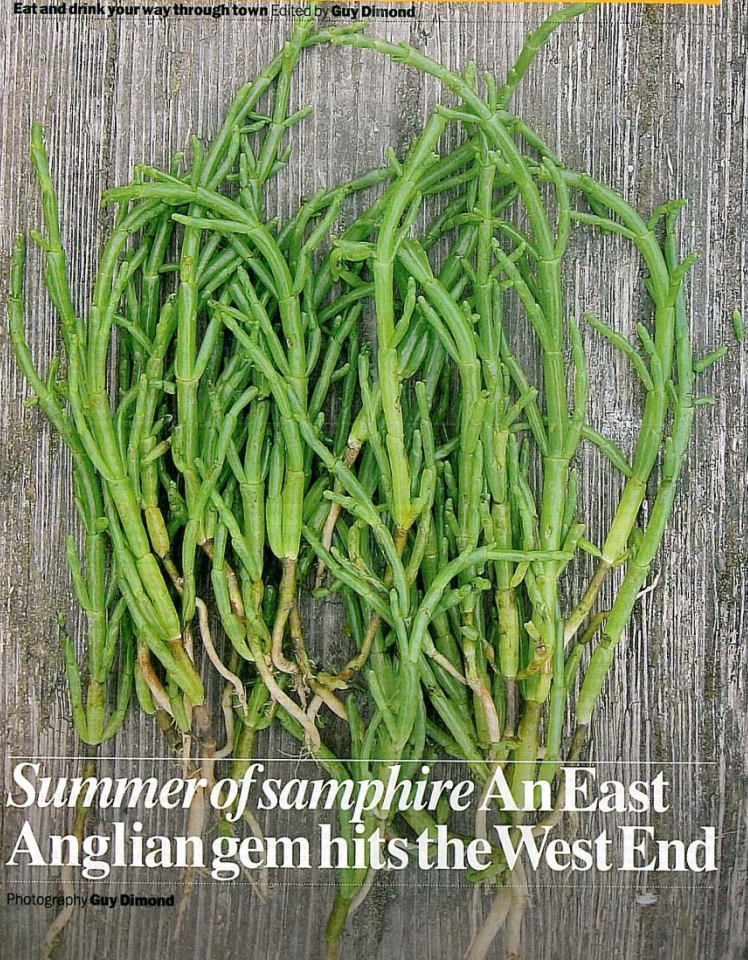
- Salicornia (also known as Samphire or sea asparagus) which has many properties :
- A high protein human food source
- A source of vegetable oil which can also be used for Bio-fuel .
- Can be used as animal fodder
- Extracts CO₂ from the air
- Produces a carbohydrate root from the CO₂
- Revitalizes the soil with nutrients from the roots
- No CO₂ when burned

Salicornia, or Samphire, as a food crop

Food & Drink

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Eat and drink your way through town Edited by Guy Dimond



Summer of samphire An East Anglian gem hits the West End

Photography Guy Dimond

Samphire season

Salt of the earth



Samphire is picked from the coastal mudflats of north Norfolk (above) to appear on the season's best-dressed dishes (below)

Samphire is this season's trendy dish ingredient. **Guy Dimond** traces it from the chi-chi restaurants of London's West End back to a mudflat in north Norfolk

Samphire is literally flavour of the month. It made its debut at the start of June at Le Caprice, then was sighted at Scott's and J Sheekey. By July (peak of its season), the best-dressed menus in town will be featuring it. By September, it will be history. So what is samphire – and what's the appeal?

Samphire (*Salicornia europaea*) is a wild edible plant that grows on estuarine mudflats. It has 'suddenly' appeared because it's just come into its short season (around mid-June until late August); after that, British samphire starts to develop inedible woody 'skeletons'. And samphire is everything that food fashionistas hold dear: seasonal, British and expensive (costing around £10 a kilo).

Mark Hix, award-winning food writer and chef-director of Caprice Holdings, says: 'Samphire's a perfect garnish for many fish dishes, such as red gurnard fillets with coddles. We also have it on the

menu at Scott's, and at J Sheekey as a side dish for the real addicts. I'm surprised it's not more popular with the general public.'

It might only be a matter of time before Tesco is stocking it, as samphire has recently been getting television exposure. It had an inauspicious screen debut in the 2003 comedy series 'Posh Nosh' (starring Richard E Grant and Arabella Weir). 'Embarrass and savage any tough roots,' advised Minty Marchmont. More recently, Norfolk-based chef Galton Blackiston has been championing it on the BBC's 'Great British Menu'.

Around 50 fishmongers and specialist vegetable retailers in London sell samphire, though supplies are erratic. Many are supplied by Jefferson's Seafoods, which operates out of New Covent Garden Market. Peter Grosvenor



Samphire is everything that food fashionistas hold dear: seasonal, British and expensive

of Jefferson's told me: 'We get a lot of ours from the Hannaford area [around Looe in Cornwall], but a lot of other stuff comes in from France, and out of season from Israel and other places. I've heard they're farming it in Saudi Arabia.' Since it's a coastal plant and easily washed abroad, samphire (various species) grow in the right conditions right around the world.

To see samphire *in situ*, I travelled to the north Norfolk coast. Cookies Crab Shop in Salthouse overlooks samphire marshes, and it's sold here at £4.95 for 1kg (still not cheap, but half the price paid in London). Owner Suzanne McKnespiey told me: 'I used to pick samphire as a child, and my husband and I used to do it until recently; now we get a lad to do it for us. You can have it as a starter with just butter on it, or serve it with fish or meat.'

Chef Galton Blackiston suggested I 'treat it as you would asparagus – just steam or preferably boil it for a couple of

minutes. You can eat it raw, but it grows in estuarine mud, so boiling is better. Don't add salt. I use a little sugar in the water instead.'

My samphire was a big success at dinner. Somewhere between asparagus and seaweed in flavour, it had the thrill of a mermaid's kiss. The texture was too chewy, however: the season started early this year, and the stems are already becoming woody.

There are no restrictions on gathering samphire; depletion of stocks is not a problem yet. The reason quickly becomes clear: you get very muddy, as the best samphire grows out of deep mud that gets covered by the tide. At low tide, don waders and head for the mudflats, much to the amusement of some watching twitches. Avoiding the slimmer specimens, an hour later I've gathered enough to keep me posh nosed for weeks. I might even try Blackiston's mousse and grilled fillet of wild sea bass on samphire with a brown shrimp and tarragon sauce. Simon and Minty would have approved

Buying it

FishWorks

£14 per kilo from the popular chain.
6 Turnham Green Terrace, W4 1QP
(020 8994 0086).

France Fresh Fish

£7.70 per kilo.
99 Stroud Green Rd, N4 3PX
(020 7263 9767).

Golborne Fisheries

£9.90 per kilo.
75 Golborne Rd, W10 5NP
(020 8960 3100).

Eating it

FishWorks

Served as a side dish for £2.95.
13-19 The Square, Richmond,
TW9 1EA (020 8948 5965).

J Sheekey

With a fish main course, around £2.
28-32 St Martin's Court, WC2N 4AA
(020 7240 2565).

The Lobster Pot

Special with smoked salmon, £9.5.
3 Kennington Lane, SE11 4RG
(020 7582 5556).

Scott's

Served as a side order for £4.25.
20 Mount St, W1K 2HE
(020 7495 7309).

Sweetings

With the day's special, £22.50.
39 Queen Victoria St, EC4N 4SA
(020 7248 3062).

Additional research: Kohinoor Sahota

An example - *Cocus nucifera*



- Can be used as Bio-fuel
- Coconuts – Food and Milk
- Coconut husks - Rope
- Leaves – Matting
- Trunks – Timber
- As well as providing shade for bushes and plants
- Landscaping benefits
- Long Life , hardy , perennial

Balancing the diet

Edible Salt Water Animals

Worms
Shrimps
Crabs
Fish
Squid
Octopus
Sea Cucumber
Lobsters
Scallops
Oysters
Mussels and other shellfish
Sea Urchins,
Pippies, Clams
Abalone, Paua
Snails
Salt water crocodiles
Terrapins and turtles
Sea Birds
Snakes
Caviar and eggs
Eels
Stingray



Balancing the diet

Animals that feed on salt water plants

Sheep and cattle – meat, cheese, milk, wool, leather



The Abaco Club at Winding Bay in the Bahamas was grassed with two seashore paspalum varieties developed by superintendent Stewart Bennett.



Island of Pag, Croatia- Renowned lamb and Sheep cheese

Changing our Thinking

Desperate need

Genetic modification.

Countries with rising sea levels, caused by climate change, and salinity problems are destined to lose some of the most productive land in the world. Pakistan's agriculture is also heavily reliant on the Indus River, which is becoming increasingly salty, threatening less food production in a country with a rapidly growing population.

If cereal crops such as rice, wheat and barley, can be genetically modified *safely*-a more secure future could be provided for billions of people around the world threatened with hunger.

The Chinese are already eating Genetically Modified (grown on “Beaches” using Seawater) : - Tomato, Eggplant, Pepper, Wheat, Rice, Rapeseed

Australian researchers at the University of Adelaide working in collaboration with the Department of Plant Sciences at the University of Cambridge have conducted successful studies to enhance genes already present in plants which lock sodium ions into the roots rather than moving up to the shoot where they can cause long-term damage.

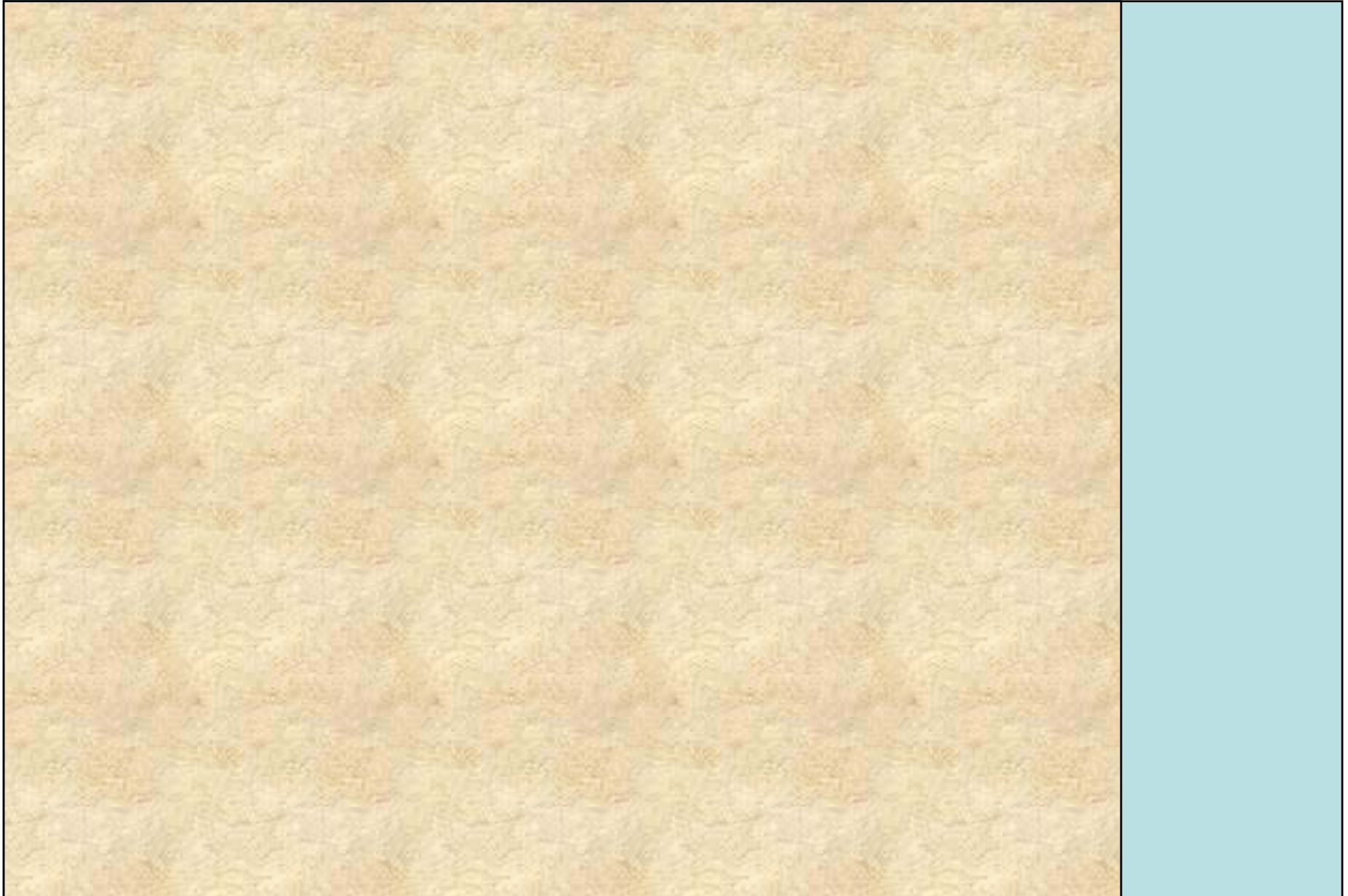
An added benefit- Mineral Extraction from Seawater

Conventional mining is one of the most environmentally damaging activities carried out by Humans

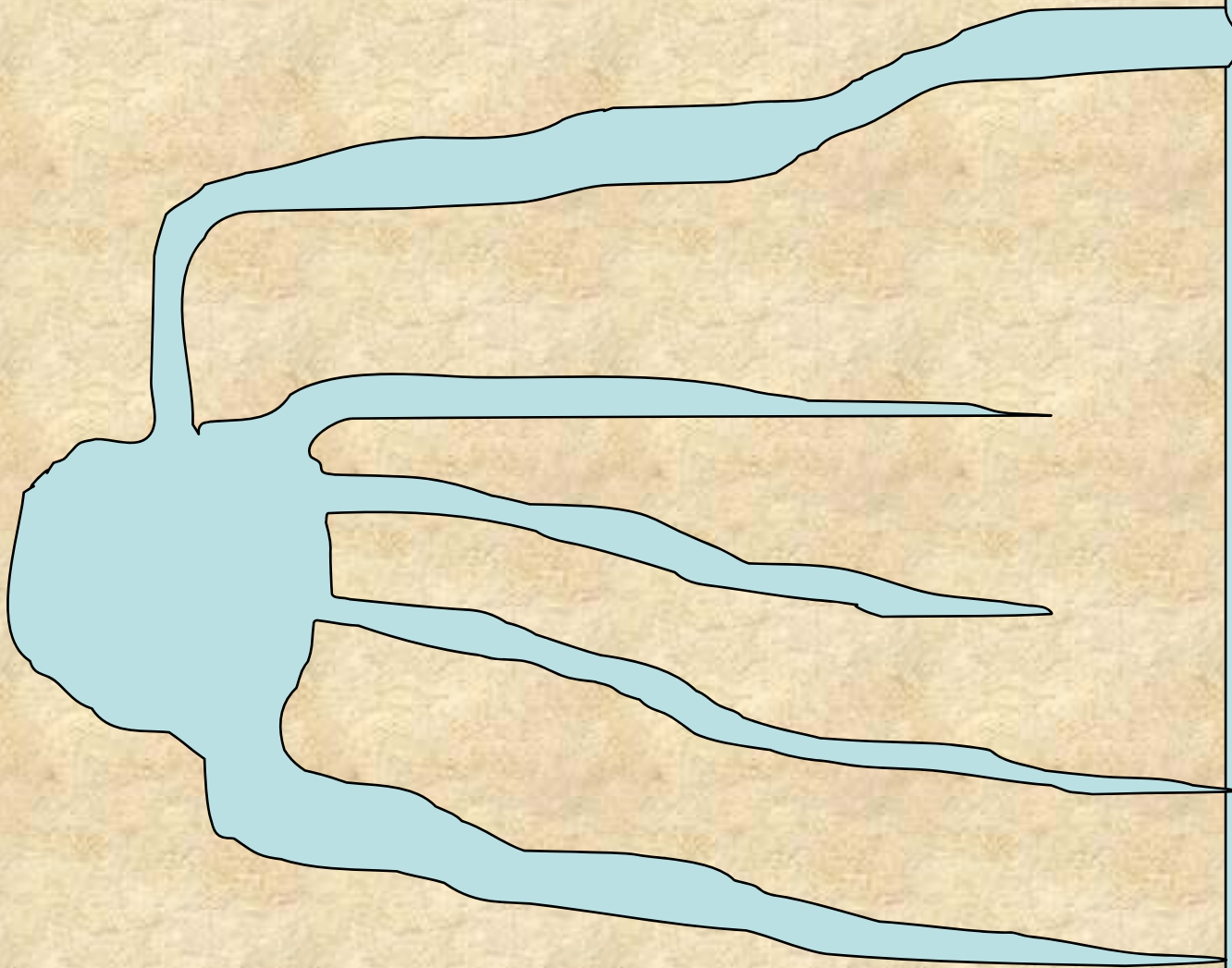
- Seawater AG puts “missing/trace Minerals” back into Food Supply
- Current Seawater Mineral Extraction - Magnesium, Bromide, Salts, Phosphorites, Metallic Sulfides,
- “Seawater and Brines appear destined to replace Mineral Ores as the main source of Light Metals”
- Nascent [low cost/energy] Bio/Algae Extraction Approaches

Creating a new Sea water system on barren
coastal land..... anywhere

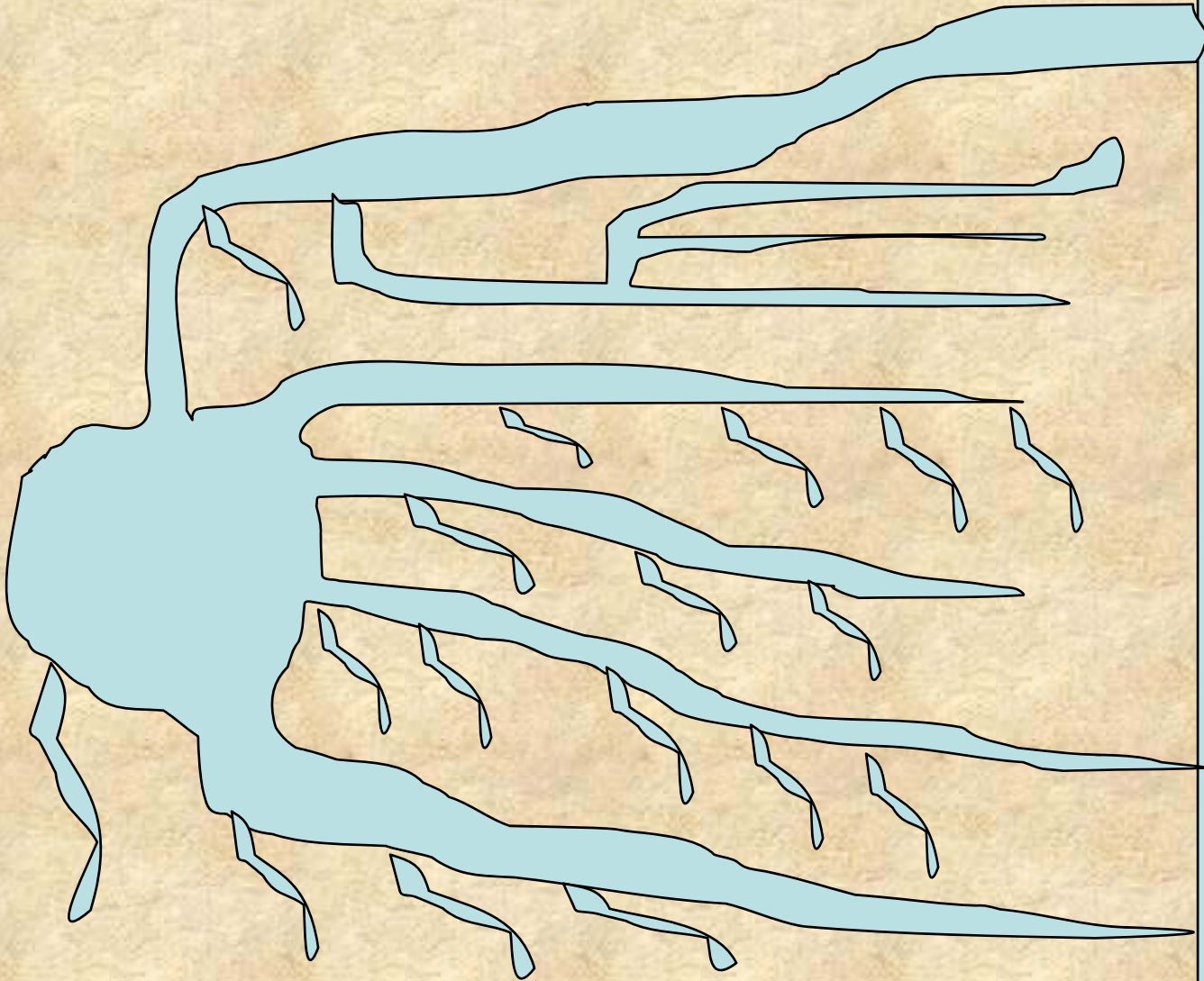
Coastal Seawater Project Concept



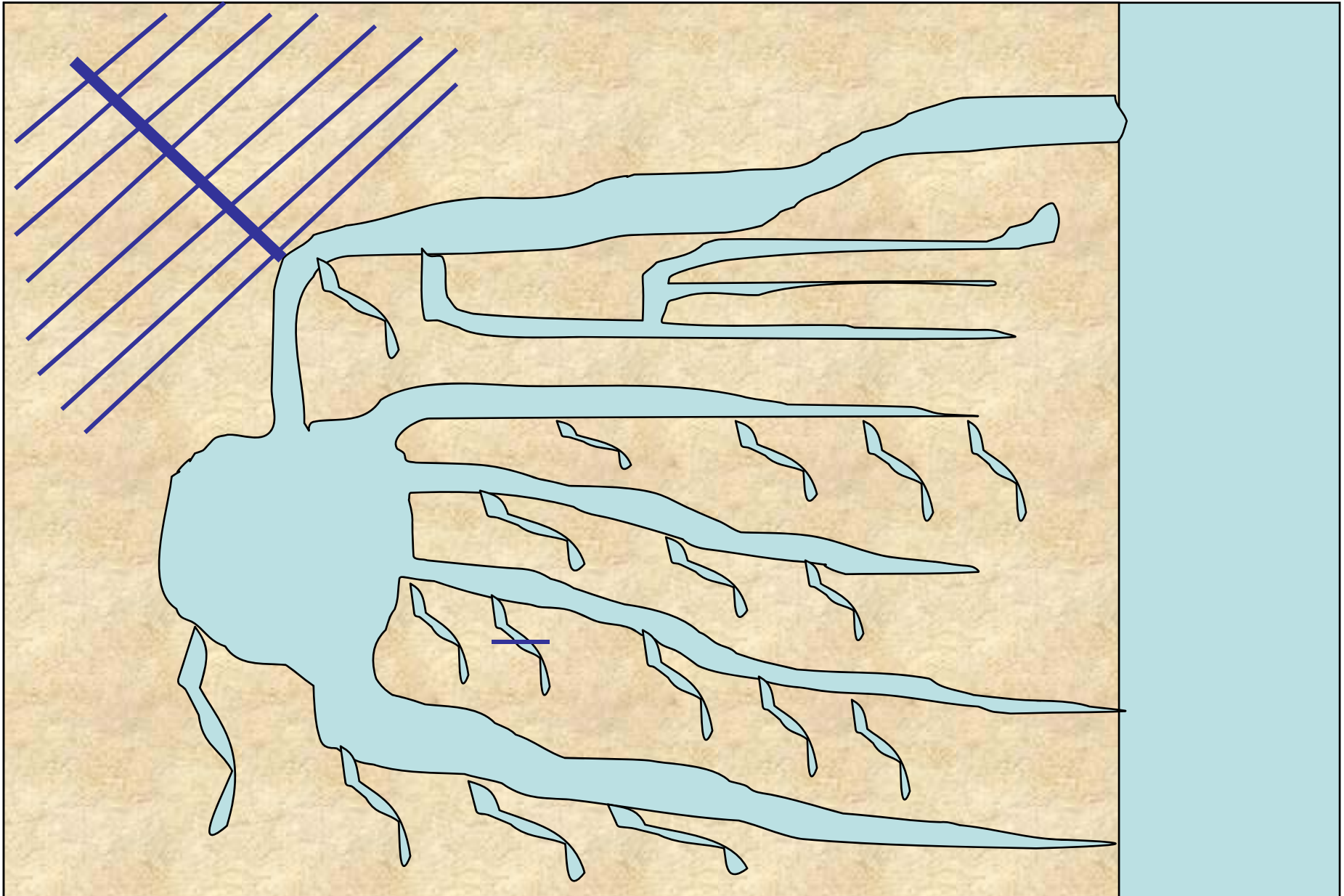
1. Excavate main salt water canals



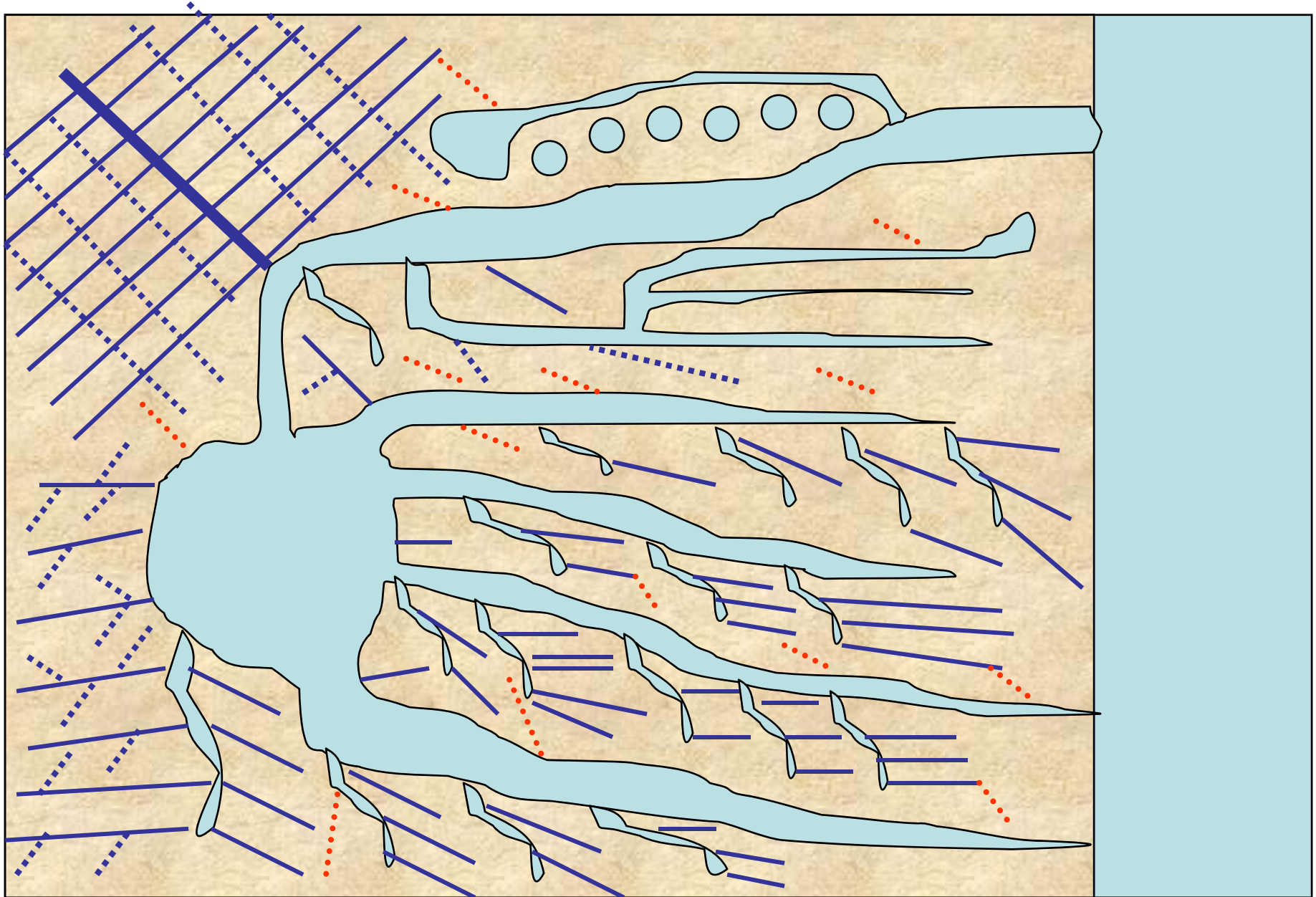
Excavate smaller salt water streams for Mangroves



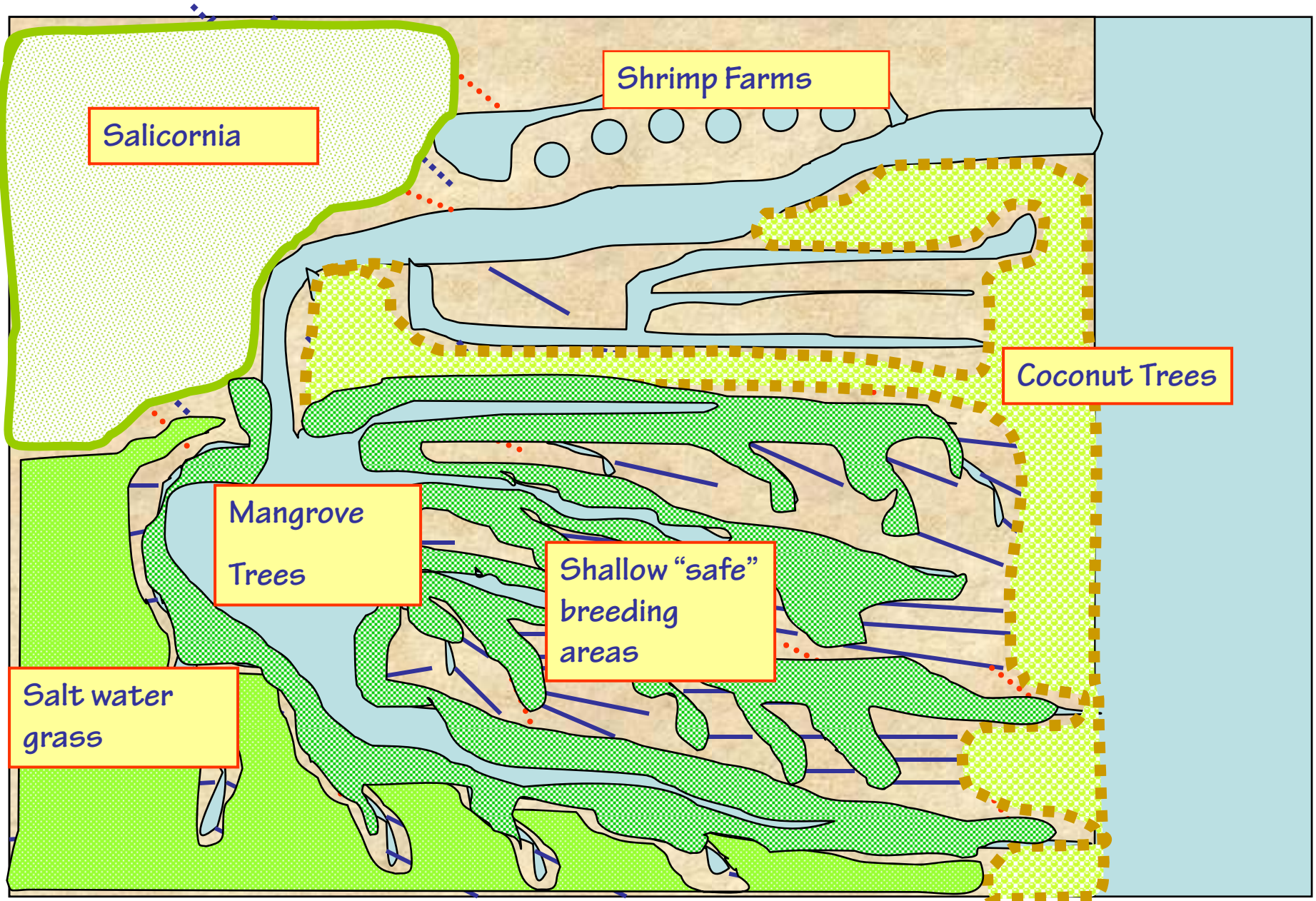
Create salicornia plantation irrigation field



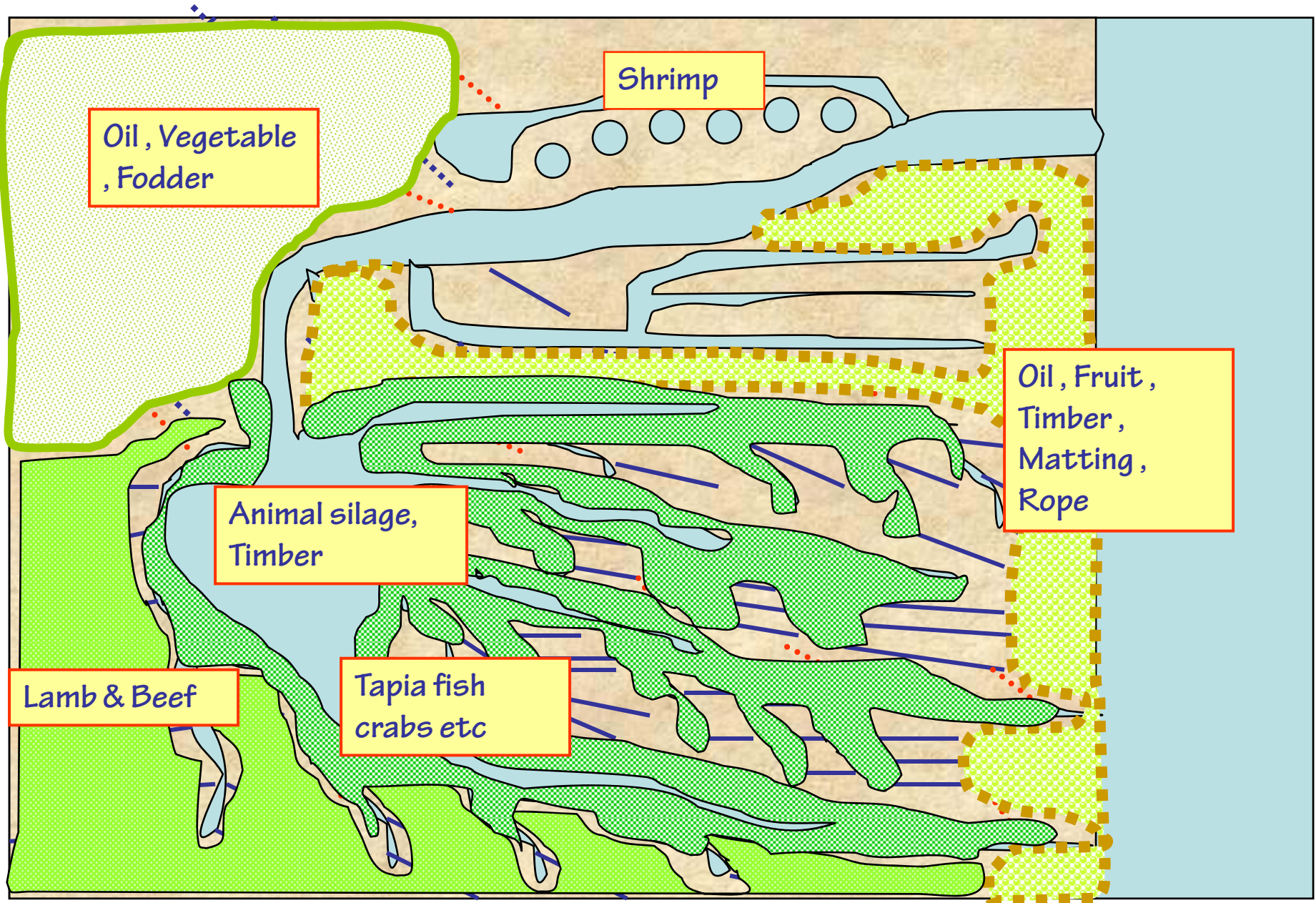
Create environments for food and fodder production areas



Final natural, biomimicked environments



Products



The “Coastal Seawater Project”

realisation

“Refuge”
Not a **detention** centre

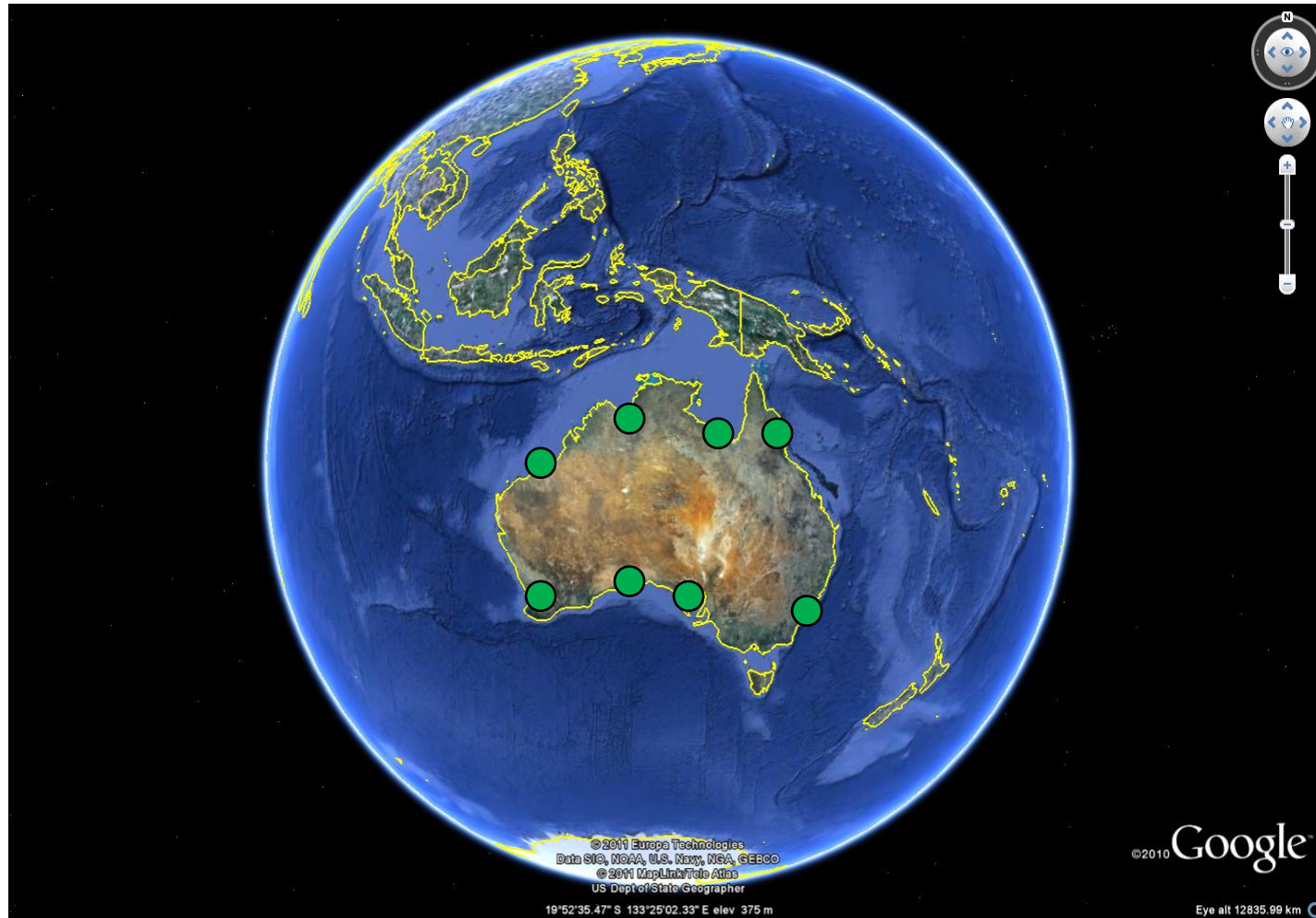
A place to call “home”

*A model sustainable city with focus on tourist facilities built by and for refugees
and Australians*

“Refuge”-Our City

- A concept for a new city designed for and intended as a safe haven for global climate, political and economic refugees on uninhabited parts of the Australian coastline.
- Refuge will use sustainable design principles, alternative energy and salt water technology to create fresh water, power and other infrastructure.
- Refuge will be built by refugees and Australians working together.
- It will be financed initially via the Australian government and with contributions from the global community.
- Eventually, it should become self-funding from tourism, real estate opportunities and by servicing remote mining communities.
- Refuge will provide a safe and secure place to land in Australia which is easy to monitor.

Some possible locations



Our Contribution

Australia provides:

- Undeveloped land
- Complete integrated new sustainable city using highest technology and independent from existing infrastructure acting as a global “model”.
- Initial temporary settlements with small low cost housing for that are set in a landscaped environment assuring future physical and financial security for the refugees as they commence to build their new home.
- Initial low cost, schools, shopping centres, recreation centers and entertainment provided to create communities and “normalcy”
- 100,000 Job Opportunities for refugees, Indigenous and other Australians
- A place to call “Home” for those displaced by climate change and conflict.
- Re-shaping the view of refugee position and value to economies.
- Creating the worlds best lifestyle
- Attracting million s of tourists and eco researchers yearly
- Australia shows it really is a humanitarian country
- Delivery of the City by 2020
- A New National Economic Stimulus

Project Numbers- “Refuge”

Total Size	20 square kilometers
Total Project Numbers	Approximate cost- 5,000,000,000 AUD
Detached Housing Units	10,000 houses
Towers Apartment	22,000 apartments
Marinas	4 Marinas for international and Australian sailing
Hotels	5 Hotels
Parks and 18 Hole Golf Courses	2 x International quality for golf tourists and 16 x recreation parks of varying sizes
Commercial Centre	120,000m2 retail centers and offices

Waterfront Land
3,000,000m2

Development Plan



Access from Sea



Conclusion

The biggest obstacle - as always - is money.

At present financing for these projects will need to come from three primary sources:

- Government Grants , EU grants , World Bank
- Carbon Credit sales
- Charities
- Philanthropists

It is essential that the money is found urgently.

Much of the worlds productive land is being sterilised and our population is growing rapidly too fast to feed and water. Utilising sea water for food production can reverse the sterilisation process and turn barren land into biologically productive farms that will feed us all.