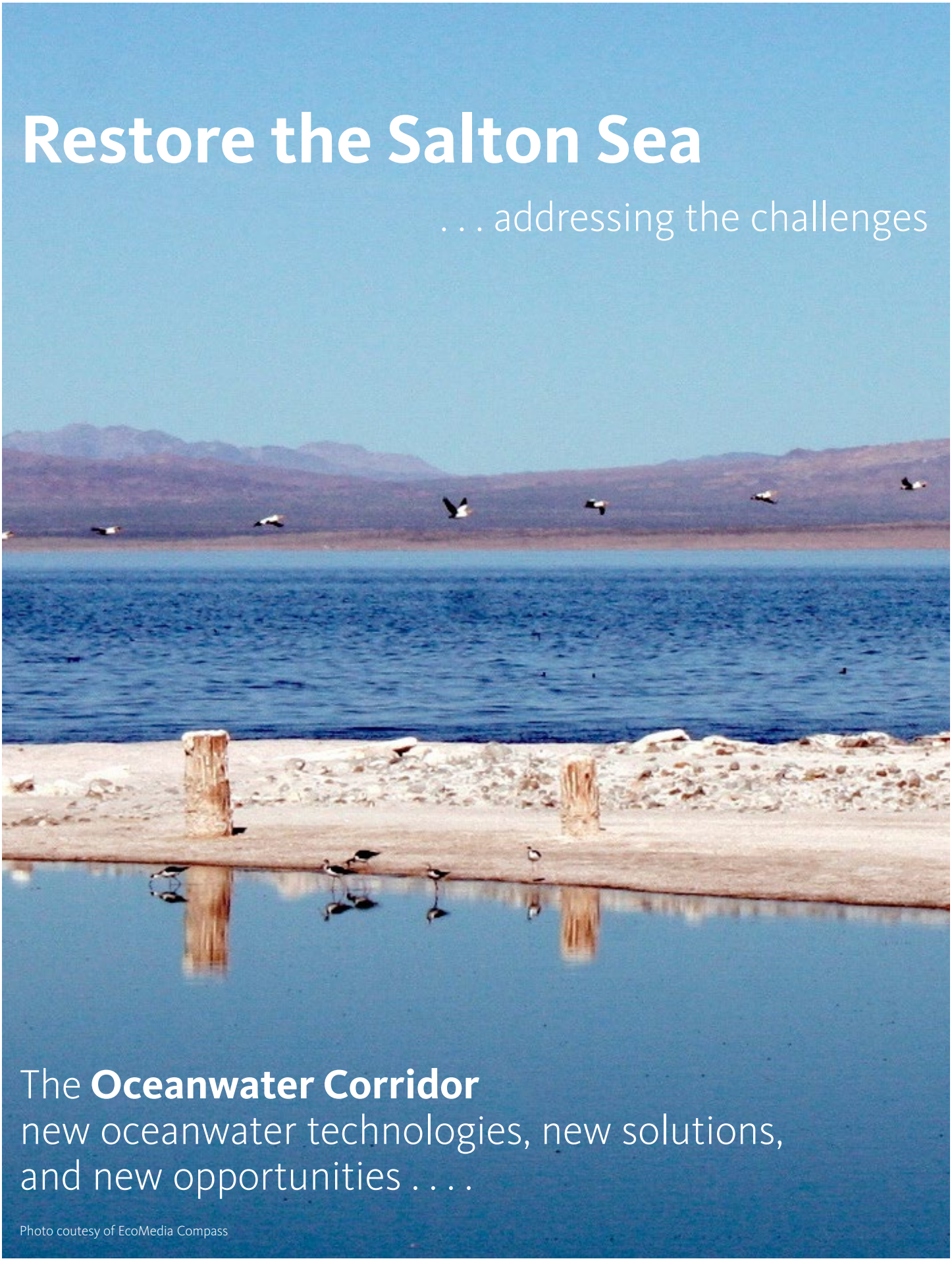
Restore the Salton Sea

. . . addressing the challenges



The **Oceanwater Corridor**
new oceanwater technologies, new solutions,
and new opportunities . . . .

Photo coutesy of EcoMedia Compass

Introduction

The world is in the midst of a fresh water crisis. It is time to seriously address those issues. The Salton Sea is a preeminent example with doable solutions. And The Seawater Works team has answers, experience and focus to stop the level of the Salton Sea from further recession because of evaporation and declining agricultural drainage and Colorado River water delivery and to raise the future level of the Sea to design proportions. We have a history of using unlimited oceanwater from the Gulf of California in Sonora for agriculture, aquaculture and wetlands and in Eritrea, East Africa in controlling extreme salinity differences by horizontal separation while providing jobs, products and habitats.

The State of California and many agencies have spent years studying solutions to resolve the problems of the lowering of the Sea, causing exposed playa health dangers and the resulting salinity that has killed fish populations and left the bird communities with nothing on which to feed. Freshwater from the oversubscribed Colorado River is needed to provide water for major cities including San Diego, Los Angeles, Phoenix, Las Vegas, Tijuana and Mexicali. And much of the country's produce and cattle depend on fresh water irrigated agriculture.

Seawater Works defines the solution as designing and implementing the Oceanwater Corridor™, beginning in the Gulf of California, enriching the Mexicali Valley, crossing the Mexican/US border, enhancing the Imperial Valley and restoring the Salton Sea and its environs and communities can do just that.

The team of Seawater Works has many years of experience developing technologies using unlimited oceanwater and learned many lessons of salinity control. At the Salton Sea we will solve salinity problems by using Floating Salinity Barriers (FSB) for vertical salinity separation. This way we can solve two pressing problems of the Salton Sea – the quantity of water and the salinity.

How can we bring all parties together to make the solution happen in an economic, environmentally enhancing and viable way attractive to both countries and all the vested communities and agencies?

We use our newly defined, Oceanwater Corridor – Oceanwater needs to get from the Gulf of California over Mexican land. There are existing canals that can transport the water if they are extended and upgraded. This can be accomplished by pumping the oceanwater up from the Gulf, through the Mexicali Valley to the highest elevation, only 48 feet above sea level and close to the US border, crossing the border in those same

Photo coutesy of EcoMedia Compass

waterways. Then it will flow by gravity through the Imperial Valley to the Salton Sea whose surface is 230 feet below sea level.

In Mexico, along the Oceanwater Corridor, Seawater Works will support the introduction of oceanwater agriculture, the technology that Seawater Works has pioneered globally, into the farming areas earlier abandoned because of the lack of fresh water.

In the US, we will refill the Salton Sea with oceanwater. Once we have stabilized the Sea at its desired level, additional oceanwater can be used to ultimately develop oceanwater agriculture in the Imperial Valley.

This approach can be a win-win. Improve the economic situation in Mexico, restore the Salton Sea as the desirable asset it is to the community and state and provide seawater agriculture opportunities in the Imperial Valley to expand farming operations and improve the economic situation around the Salton Sea.

The combination of this commercially valuable oceanwater irrigated agriculture and the Restoration of the Salton Sea is a workable solution that can be accomplished for far less money than other recently proposed solutions to the Salton Sea's problems.

Oceanwater usage will have more local, regional and worldwide benefits. These approaches have all been proven in other projects by the Seawater Works team. With the Oceanwater Corridor as the model, these technologies will spread throughout the world where the lack of freshwater has stifled development and economic progress.

Here we provide how using high salinity water from the Salton Sea in oceanwater agriculture systems answers concerns about oceanwater increasing the salinity of the Sea. Correctly done, its use will reduce the salinity of a large Perimeter Lake by Floating Salinity Barriers (FSB).

In the following sections we will detail and explain the steps and costs that will be required to finalize a specific plan of execution.

Art Gensler and Carl Hodges

arthur_gensler@gensler.com
carl@seawaterworks.com

SECTION 1.
THE LEADERS OF SEAWATER WORKS

Seawater Works was founded by Art Gensler and Carl Hodges who worked together on the New Nile project for Egypt (https://www.youtube.com/watch?v=R6IYyqXQdZU) to further develop and offer the opportunities of using oceanwater - which constitutes 97% of the planet's water, and covers 71% of the earth's surface - to Restore the Salton Sea.

Art Gensler is the founder of Gensler (Gensler.com) a privately owned company, which under his leadership grew to be the number one ranked Design Firm in the world with over 5000 employees, 47 offices in 16 countries and revenues in excess of $1.2 billion. Gensler designs and manages the construction globally of over $20 billion of construction each year, serving 2800 clients doing 7500 projects. Clients include 54 of the Fortune 100 Top Global Firms. These projects inspire people and transform communities.

Current Gensler projects include the Shanghai Tower (the second tallest building in the world) and City Center, the largest single project ever built at one time in the U.S. ($8 billion, 16 million square foot complex in Las Vegas). The portfolio includes major land planning and design projects in the United States and China and the Middle East as well.

Carl N. Hodges, is Founding Director of the Environmental Research Laboratory (ERL) of the University of Arizona. Additionally he established the Seawater Foundation, a non-profit entity which for thirty years and in conjunction with ERL researched, discovered, nurtured and brought to the forefront, seawater technologies.

Carl is an internationally known scientist. An atmospheric physicist and mathematician, much of his research was in cooperative projects in Sonora and Baja California, Mexico. Carl lead the development of Seawater Farms Eritrea (SFE),(https://www.youtube.com/watch?v=2CvRy97TJVE) an integrated aquacultural and agriculture farm in Eritrea, Africa which demonstrated new oceanwater technologies applicable in this project to: "Restore the Salton Sea".

Carl has a long-term interest in the potential in low level elevations for seawater agriculture, including the Dead Sea in Jordan and Israel, Lake Assal in Djibouti, the Qattara Depression in Egypt, and the Salton Sea. His interest was first drawn to the Salton Sea in 1965 when he and Dr Richard Kassander (retired VP for Research at the University of Arizona) interacted with the Imperial Irrigation District (IID) on the subject. Dr. Kassander emphasized that the addition of a new source of water, likely oceanwater, would one day be necessary.

Art Gensler in his office in San Francisco

Carl Hodges by Salicornia fields in Eritrea, Africa

Robert Whitfield is a Cambridge economics graduate, a Chartered Accountant, an Insead MBA and holds a Masters degree in Environmental Policy. His career reflects two prime strands, that of business and that of the environment. Robert has spent 30 years in international business, the last 15 years of which were with the Airbus partnership as Director of Business Development and later Director of Strategy and External Affairs in the UK and Senior Vice President – Finance of Airbus Industrie in Toulouse.

Since 2000, Robert has been addressing environmental issues, working with Government, business and the NGO community and since 2008, he has been increasingly focusing on the promotion of a new paradigm for water and agriculture with The Seawater Foundation, New Nile Co and now Seawater Works.

Highly qualified team members: Seawater Works has partnered with leading oceanwater agriculture scientists, engineers, technicians, farmers and marketing specialists who have worked with Carl for many years on oceanwater projects beginning in Puerto Peñasco, Sonora in the 1960s.

Robert Whitfield on a visit to the New River

Dino DeConcini and Jose Santos Gutierrez review the Oceanwater Corridor project from the Gulf of California and ending at the Salton Sea.

Section 2.
OCEANWATER TECHNOLOGIES...NEW CONTRIBUTIONS AND OPPORTUNITIES

A new element in the solution for the Salton Sea is the role to be played by oceanwater technologies which offer financial and environmental opportunities in the Oceanwater Corridor from the Gulf of California to the Northern end of the Salton Sea. They can provide an economic benefit from saline water, which was not a part of the solutions analyzed up to now. An oceanwater agriculture farm is analogous to a conventional farm based on freshwater agriculture; the agriculture deployed in any particular location can be a subset of the full integrated system.

History

In the 1960s the Universities of Arizona and Sonora, funded by the US Department of Interior, developed a Solar Energy powered desalination plant utilizing Gulf of California oceanwater in Puerto Peñasco, Sonora, Mexico. The desalination of oceanwater was a source of freshwater for communities, but would remain too costly for the greater needs of irrigated agriculture. A different approach was required for agriculture.

The plants of the wetlands of the estuaries near Puerto Peñasco offered the promise of another solution. That was to do again what early humans had first done 10,000 years ago with plants that grow on freshwater, namely get to know the plants of the world that grow on seawater - halophytes. This process originated, first by selecting the most promising halophytes, then starting to develop and irrigate them with unlimited oceanwater. Carl Hodges, and the organizations that he has led, have played and continue to play a leading role in the development of this new agricultural process[i]. The technology was developed in Mexico, where it has been proven to be sustainable for over thirty years, and led to the establishment of the world's first fully integrated oceanwater agriculture system in Eritrea.

Basic process

The oceanwater agriculture process is set out in the diagram below "Oceanwater Agriculture Systems (OAS)". The basic process is shown in the diagram as Flow 1. Oceanwater, pumped up to the appropriate elevation, is used to support various forms of aquaculture. Whilst this is not mandatory, it provides not only a significant source of protein and income, but also provides an effluent that can be used to fertilize the crops. Aquaculture grown can include fin-fish, shrimp, mollusks, etc. The oceanwater, then enriched with effluent, is used to flood irrigate crops of halophytes, with Salicornia bigelovii proving a good crop with great potential. The water then flows to irrigate forests of commercially planted mangroves, a species highly capable of sequestering carbon from the air and also mixed with Salicornia providing an excellent fodder for feeding cattle. The water then flows on to Production Wetlands and thence to the production of microalgae, artemia and ultimately salt. Alternatively the saline water can be directed to recharge groundwater resources, extend the Salton Sea inland wedge and be stored as brine for potential future uses.

OAS is thus a closed loop, fully integrated system that combines untreated seawater with arid land, (whether former farm land or desert) to facilitate the practice of aquaculture and agriculture. Collectively, these interdependent aquaculture and agriculture operations yield a wide range of co-products including fodder (similar to alfalfa in quality), seafood, protein meal, vegetable oil, solid biofuel, algae and salt. Liquid biofuels can also be made either by hydrolysing the salicornia oil or pyrolising the biomass. The system fosters biodiversity, supporting a wide range or species.

Process in restoring the Salton Sea

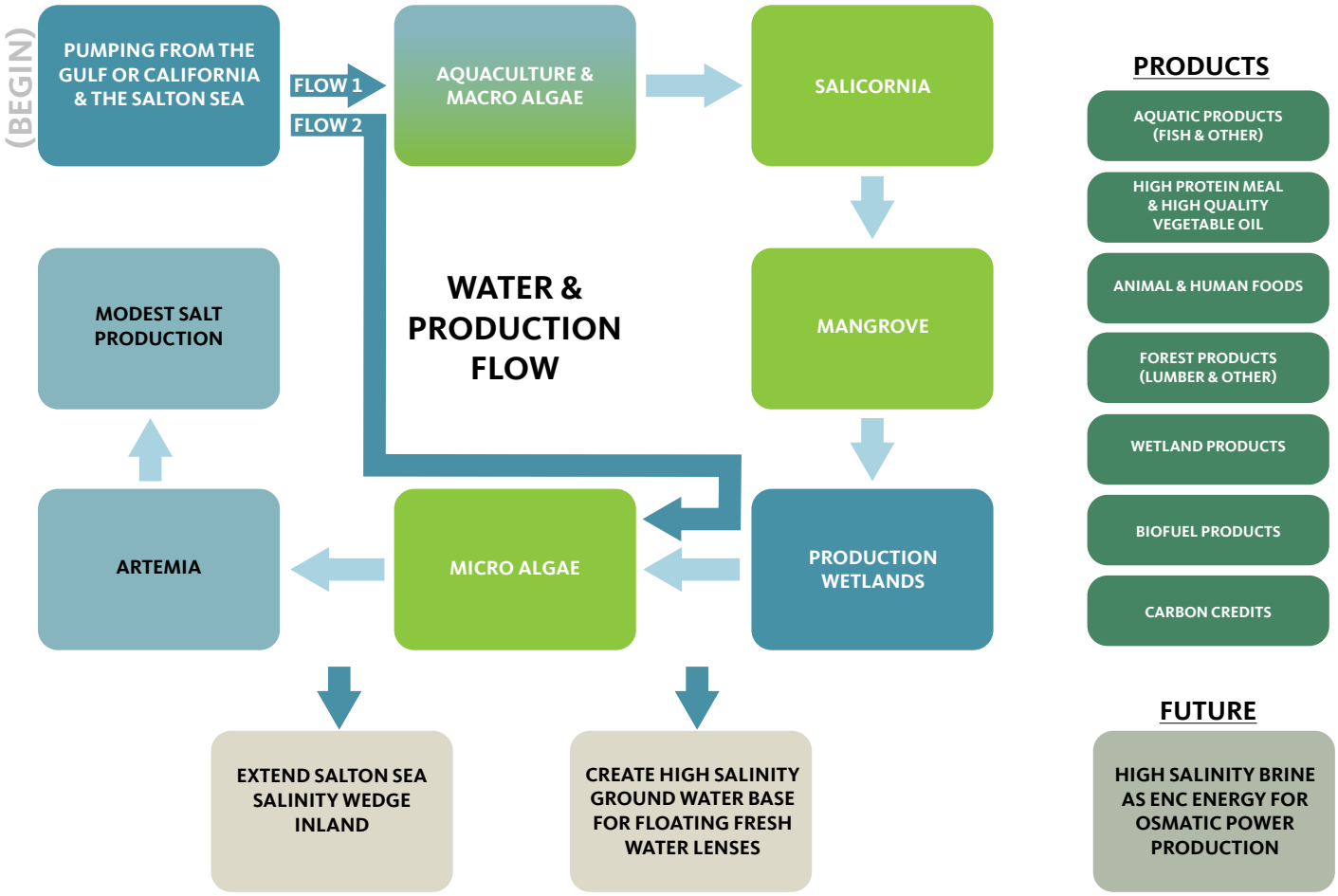
The process can be applied to the Oceanwater Corridor in at least two different ways (Flows 1 and 2 in the Diagram).

First, the full process can be used in the Mexicali Valley and also in the Imperial Valley, in the form of gravity fed oceanwater agriculture (Flow 1 in the diagram). Oceanwater would be pumped up the Mexicali Valley and then deployed there or pumped over into the Imperial Valley, combined with drainage water and deployed on suitable land.

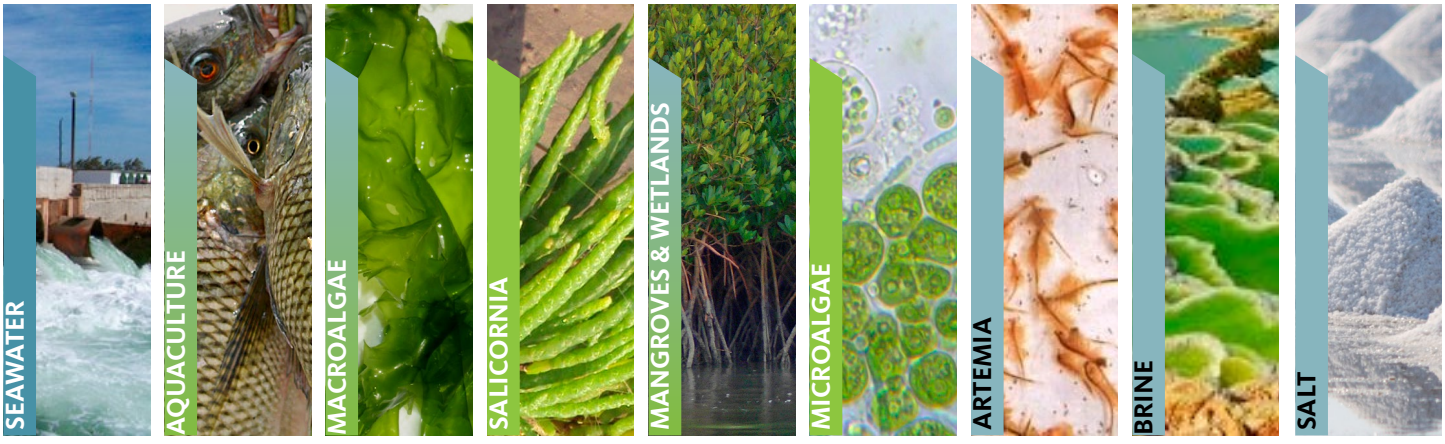
Similarly, if a Perimeter Lake is formed, the more saline water in the Perimeter Lake can be pumped out up onto the land nearby and used for a full cycle of oceanwater agriculture (Flow 1).

Secondly, the most saline water in the Salton Sea can be

Oceanwater Agricultural Systems (OAS)



Elements



The system starts with oceanwater pumped from the sea of California to the high point in Mexicali Valley. From there it flows by gravity in the Alamo and New Rivers.

There will be modest salt production as a product and to demonstrate the last component of the system. The majority of the salt will be removed from the Salton Sea and as high salinity drainage water it will provide ground water base on which there will float designed fresh water lenses.

pumped out of the Inner Lake, pumped onto the land and used for some high end oceanwater agriculture embracing microalgae and salt production (Flow 2).

Benefits of Oceanwater Agriculture System (OAS)

Oceanwater agriculture gives rise to multiple benefits as summarized below:

Food:
Provides food: aquaculture production and animal fodder.

Freshwater:
Reduces agricultural demand for freshwater.

Renewable Energy:
Generates renewable energy: biofuels.

Sea level:
Counters sea level rise.

Carbon :
Sequesters carbon.

Jobs/economy:
Provides economic diversification and sustainable livelihoods - including in Tourism.

Communities:
Enables sustainable communities and new forms of urbanisation.

Biodiversity:
Enhances biodiversity and beautification.

The oceans of the world are all interconnected. They contain 97.61% of the world's water. And, they cover 71% of the earth's surface. And, oceanwater is currently increasing due to global warming. Islands are disappearing, coastal cities are threatened, and Sea Level Rise (SLR) if not reduced will cause trillions of dollars of damage[ii]. Using oceanwater to irrigate agriculture to solve immediate freshwater limitations has both immediate local benefits as well as future benefits, when at scale, of reducing the rate of SLR.

The main benefits of the overall solution to the problems of the Salton Sea, incorporating the above benefits, are set out in Section 5 Features of the Proposed Solution.

Randy Lux and Dr. Rahul Chaturvedi inspect Salicornia selections for Salton Sea environments at IVRC

Biodiversity; Mangrove plantings from seed around every waterway for Seawater Wetland Parks

Section 3.
SEAWATER WORKS AT THE SALTON SEA. 2014-2016

Carl Hodges and the Seawater Foundation (a precursor to Seawater Works), have links with OAS in Mexico that go back several decades.

More recently, aware that the problems of the Salton Sea were unresolved, Carl Hodges began attending meetings of the Imperial Irrigation District (IID) to understand the interconnected problems that the Salton Sea was facing, and the opportunities for solutions. This preparation involved reading the extensive reports that have been written on the subject over the years.[iii iv] With 40+ years of developing integrated seawater-based agriculture and aquaculture systems, Carl began formulating a vision that he shared with Art Gensler. Together they shared their vision with the CEO of Thailand's Magnolia Quality Development CO (MQDC) Corporation, Thippaporn Ahriyavraromp (Khun B). Her organization's interest here lies in the opportunity to develop the conceptual process necessary for addressing similar freshwater issues globally.

With MQDC's partnership, in February 2016, Seawater Works leased green houses and offices from the Imperial Valley Research Center (IVRC) and began planting dozens of varieties of salt-tolerant plants from a seed bank of more than 3,000 varieties of seeds developed over the past 25 years. Carl invited leaders from the Imperial Valley's agriculture and government communities to observe these plants growing in simulated oceanwater. Carl emphasized the opportunity that the Seawater Works approach could leverage the oceanwater brought from the Gulf of California, through the Oceanwater Corridor and used for the Salton Sea elevation and salinity mitigation, to support a new focus on oceanwater agriculture in the larger Imperial Valley's agricultural economy. This could support a viable strategy to balance both freshwater and oceanwater agriculture in the Valley.

Seawater Works concurrently sought to create a suitable habitat for both fish and birds in the Salton Sea with acceptable salinity, below the current salinity level of the Sea. The answer is the sound concept of a Perimeter Lake, developed by others. But as a means of achieving this aim Seawater Works proposes channeling the relatively low salinity water coming from agricultural drainage water augmented by the Gulf of California oceanwater. The salinity of a combined water sufficient to stop the Salton Sea shoreline decline would be 17,000 PPM. This combined flow would enter the Salton Sea at the delta of the Alamo and New Rivers.

The current design by others for constructing the Perimeter Lake with earthen berms has been developed on the assumption that no oceanwater will be available to top up the Salton Sea level. Given this assumption of drainage water replenishment only, one would have to accept that the level of the inner Sea will decline. Therefore the barrier between the Inner and Perimeter Lakes would need to be able to withstand huge pressures

Dr. Wit Soontaranun of MQDC at IVRC with Art Gensler and Carl Hodges

Bruce Wilcox, Assistant Secretary for Salton Sea Policy and Carl Hodges listen to Art Gensler at IVRC

and would therefore need to be strong and substantial – and therefore costly. Seawater Works sees the potential of supplementing the current work on this design by introducing the use of Floating Salinity Barriers given augmented oceanwater flow. Such floating barriers could be of use in the very near term in helping develop the Perimeter Lake as well as longer term. See Phase 1 for more information on the Floating Salinity Barrier.

International Stakeholder Engagement to date:

Seawater Works has sought to engage with the local community as much as possible in a variety of venues.

In addition to the presentation by Art Gensler and Carl Hodges to the State Salton Sea Management Long Term Planning Committee there have been several meetings with IID Board and staff at IVRC.

Further meetings were held with Bruce Wilcox (Assistant Secretary for Salton Sea Policy) to better understand the nature of the problems of the Salton Sea and how Seawater Works might be able to help.

Carl Hodges has presented to the Board of the Imperial Valley Research Center (IVRC) and at an IID Board meeting.

A young intern from India, Dhruv Chaturvedi and Carl Hodges have interacted with Brawley High School agricultural classes. Seawater Works plans to engage actively with education in the area with information on oceanwater agriculture.

Members of the Seawater Works team have engaged with the Cucapah Indians in Mexico, Sephton Water Tech, Pronatura Noreste, the Save Our Sea team from Salton City, and many of the groups that have studied and shared ideas for solutions within the community.

Seawater Works is working with Mexican leaders including Gaston Luken, Chairman Emeritus of Pronatura noreste and Jose Santos Gutierrez, a Sonoran businessman and agricultural economist, to introduce oceanwater agriculture into the Mexicali Valley partly utilizing water conveyance facilities and land areas which were in use before irrigation freshwater was needed for Mexicali, Tijuana, and other communities.

Carl Hodges with Mexican President Vicente Fox at Bahia Kino Oceanwater farm, a Presidential Project under Fox.

Dr. Yamilett Carrillo-Guerrero , Carl Hodges and Gaston Luken, discuss the Oceanwater Corridor. Both Yami and Gaston were involved in Minute 319 signed in November 2012, a historic binational agreement between Mexico and the United States activating the Spring pulse flow of the Colorado River to the Gulf of Mexico.

Section 4:
WHAT COULD FUTURE SUCCESS LOOK LIKE?

The approach proposed in this document is aimed at the following outcome - a thriving Oceanwater Corridor:

Mexicali Valley

Oceanwater is transported from the Gulf of California to the Imperial Valley via existing canals, extended and developed as necessary.

Some of this water is used to irrigate oceanwater agriculture in the Mexicali Valley, enabling farms that have been abandoned due to lack of freshwater to be brought back to life as oceanwater farms.

Imperial Valley

Oceanwater from the Gulf of California, via the Mexicali Valley, combines with drainage water and flows in the wide channels of the New and Alamo Rivers[v], in part in the current rivers.

Within the Imperial Valley and the area surrounding the Salton Sea, ocean water agriculture is performed in various ways

- Using oceanwater and water from the New and Alamo rivers for early stage gravity fed oceanwater agriculture on desert land or abandoned farmland
- Using water pumped from the Perimeter Lake for early stage oceanwater agriculture
- Using water pumped from the most saline strata of the Inner Lake to source high end oceanwater agriculture for red algae and salt production.

Salton Sea

The surface of the Salton Sea has stabilized at the level that was agreed upon by the local stakeholders, an elevation higher than obtained in 2016 and designed to cover the playa, provide wildlife habitats and accommodate geothermal plants.

There is a Perimeter Lake, formed by a barrier following much of the shoreline of the Salton Sea. That barrier is largely expected to be in the form of a Floating Salinity Barrier, but some earthen berms could also be incorporated.

The water from the different rivers within the New and Alamo channels is directed to keep the Perimeter Lake supplied with water of relatively low salinity, whilst allowing the silt to be deposited in the Inner Lake. In this Perimeter Lake, there is an abundance of fish supporting a large population of migratory and resident birdlife.

Pumping water from the most saline sections of the Inner Lake enables the level of salinity within the Perimeter Lake to be maintained within a suitable range and some control to be exercised on the overall level of salinity of the Salton Sea.

The Seawater Works implementation of the Oceanwater Corridor will bring environmental and economic success to the people of the Salton Sea, Imperial Valley and Mexicali Valley. It will be a world model for the end goal; a happy, healthy planet for our children, their grandchildren and their great-grandchildren using the unlimited resource of oceanwater.

Salton Sea Phased Proposal

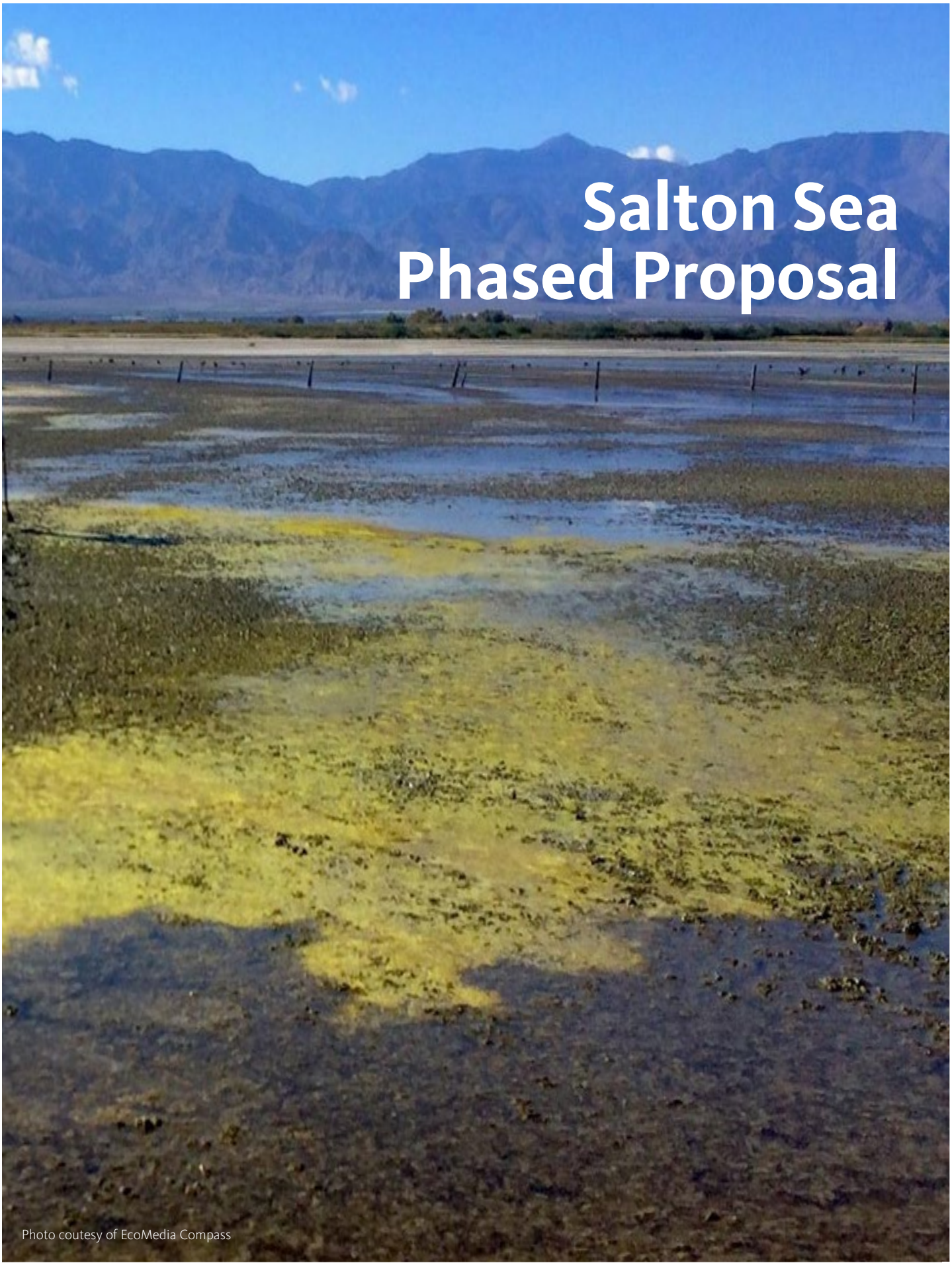


Photo coutesy of EcoMedia Compass

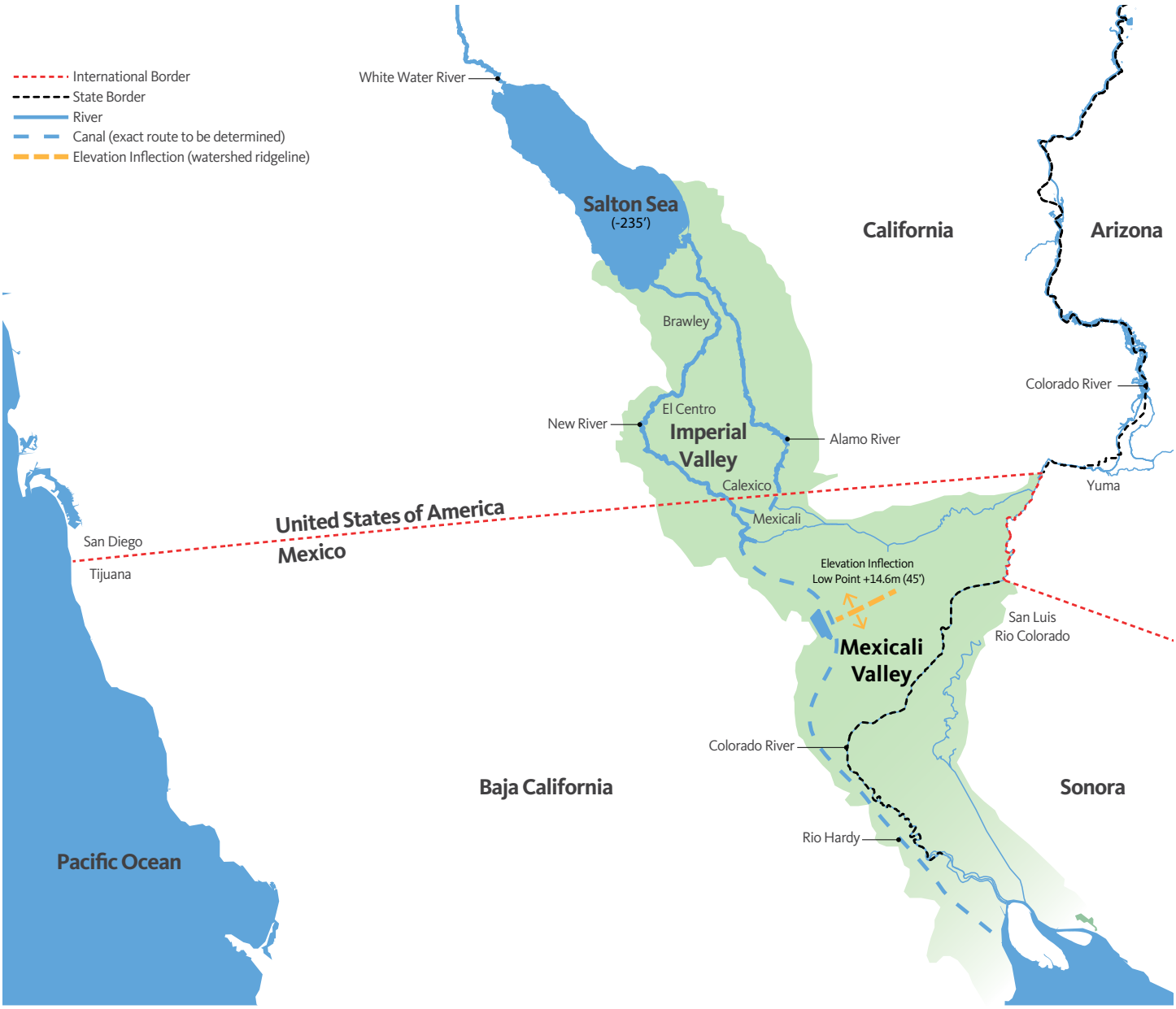
SECTION 5.
FEATURES OF THE RESTORE THE SALTON SEA PHASED PROPOSAL

Overview

The proposal set out in Section 6 is divided into three phases:

- Phase 01: Strategic Master Plan Development and Schematic Development Plan
- Phase 02: Stop the decline in the level of the Salton Sea by 2021.
- Phase 03: Raise the level of the Salton Sea to the desired (design) level and completely cover the exposed playa by 2025

The first phase (Phase 01) consists of three key elements. First of all, the development of a Strategic Master Plan involves establishing and agreeing what success looks like – and the steps to get there. This also involves establishing clearly both the team to work with (the clients / customers) and the team of experts to deliver the master plan. Secondly the phase involves the preparation of a Schematic Development Plan, addressing the key design concepts in the solution and preparing for Phase 2. And finally, it includes the preparation of prototype plots to introduce oceanwater agriculture planting.



Overview Map of Southern California, Baja, Sonora and Southwest Arizona

It is during Phase 2 that the decline in the Salton Sea is intended to be stopped and a Floating Salinity Barrier deployed to establish the boundary between the Inner and Perimeter Lakes. Early in the phase (end 2018/early 2019) Seawater Works plans to oversee the activation of a sufficient flow of oceanwater from Gulf of California to stop any acceleration of decline in the level of the Salton Sea. By the end of the phase, Seawater Works plans to have overseen the activation of sufficient oceanwater from the Gulf of California to halt the decline in the level of the Salton Sea.

The third phase is designed to bring about a rise in the elevation of the Salton Sea to the optimum level, taking all stakeholders' views into account. In parallel, oceanwater agriculture in various forms will be further developed in conjunction with water flows in the Mexicali and Imperial Valleys and water flows from the Salton Sea, thereby resulting in the vision set out in Section 4.

Low cost approach delivered

This proposal is to restore the Salton Sea at an affordable cost. Previous studies of ocean water solutions have tended to assume pipelines and lined canals, both of which are expensive and neither of which are required.

Seawater Works believes that its solution provides radically lower cost than previous estimates due to the use of:

- Existing rivers and canals on the Mexican side of the border
- Existing rivers and canals on the US side of the border
- Unlined canals except for a few instances
- Oceanwater agriculture as an alternative application for spare oceanwater capacity created to raise the level of the Salton Sea.
- Oceanwater agriculture on both sides of the border, creating economic value from existing infrastructure and improvements thereto.

In addition, the Seawater Works designed solution to the need to separate the Salton Sea into two zones utilizing permanent FSBs is estimated to cost only 5 to 10% of the cost of a fixed berm solution, be much faster to implement, and provide greater benefits.

Addressing the objectives of the Salton Sea Management Program

Governor Brown's Salton Sea Task Force, created in May 2015,directed agencies to develop a comprehensive management plan for the Sea that will:

- Meet a short-term goal of 9,000 acres to 12,000 acres of habitat and dust suppression projects, and
- Set a medium-term plan to construct 18,000 acres to 25,000 acres of habitat and dust suppression projects.

The Seawater Works proposal is designed to EXCEED both the short and medium-term goals noted above by:

  - Avoiding the need for dust suppression projects:
  - Rapidly preventing any more playa from becoming exposed as a result of stopping the level of the Salton Sea from falling any further. This could be achieved by 2019 given broad commitment to a timely solution.
  - Subsequently covering the currently exposed playa with water (and keeping it covered) – but allowing selected areas to remain uncovered if required for renewable (geothermal) energy development.
- Supporting the development of existing habitat projects – and providing a Perimeter Lake Habitat annually increasing up to as much as100,000 acres of wetland restoration.

The proposal seeks to avoid the problems of health and other environmental costs as presented in the Pacific Institute's publications HAZARD (May 2006)[vi] ten years ago, and more recently HAZARD'S TOLL (Sept 2014)[vii].

Other Regional Benefits

In addition, the Seawater Works solution provides a number of regional benefits, including

- Adding to the supply of water in the region: The region is beset with the limited supply of water compared with demand. The Seawater Works solution brings more water to the region, alleviating these pressures and offering a variety of opportunities.
- Enhanced economic growth via increased property values, both around the Sea and in the main valleys beyond, and tourism;
- Significant direct economic benefits arising from the availability of oceanwater for the development of oceanwater agriculture in the region;

- Significant direct economic benefits in the use of oceanwater for geothermal cooling.
- Complementing the region's Renewable Energy focus:, The Seawater Works proposal has several links to renewable energy development, including:
    - The delivery of oceanwater to the Salton Sea area would provide the opportunity for hydro-energy generation.
    - The approach can be compatible with renewable energy development projects on the southern shore of the Salton Sea,
    - Oceanwater agriculture delivers a number of products that can be used as renewable energy feedstocks.
    - Seawater Works is involved with a project underway at the Imperial Valley Research Center (IVRC) on the development of a new non-carbon energy system (ENC Energy). This project is separate from this proposal. It could however enable the main area of the Salton Sea to be maintained at a salinity level closer to that of oceanwater.
- Collaboration with Mexico: The Seawater Works solution is in collaboration with Mexico to the mutual benefit of both nations. The solution would provide infrastructure to help save the Salton Sea and also facilitate the introduction of oceanwater agriculture both sides of the border.
- The stabilization and subsequent raising of the level of the Salton Sea to the design level could lead to a new era of beauty and amenity. The visual impact would be of a complete single Salton Sea, with a Floating Salinity Barrier floating off shore. This would provide amenity benefits far superior to those of any solution involving the Salton Sea continuing to shrink.

Flexibility

The proposal is in phases. The Strategic Development / Schematic Development Phase (Phase 1) will set out the different elements and options and applicable time frame of the Strategic Development Plan. A decision at this point could be made as to whether to proceed initially only with the stopping of additional playa exposure – or whether to continue in parallel with the proposal to raise the Salton Sea to its design level, covering remaining exposed playa (and whether to leave selected areas for renewable energy development).

Requirement for a Cross Border Agreement

Issues concerning water rights in an international watershed typically lead to cross border discussions. Minute 319 to the 1944 Treaty between the US and Mexico, signed in 2012, is a recent example of an agreement being reached with regard to cross border water – and implemented in a simple manner. That minute was regarding a pulse of water down a river bed, in that case a substantial pulse down the lower Colorado River. It provides further evidence of the increasing trust and support for U.S.-Mexico collaboration regarding water and the Colorado River Delta.[viii]

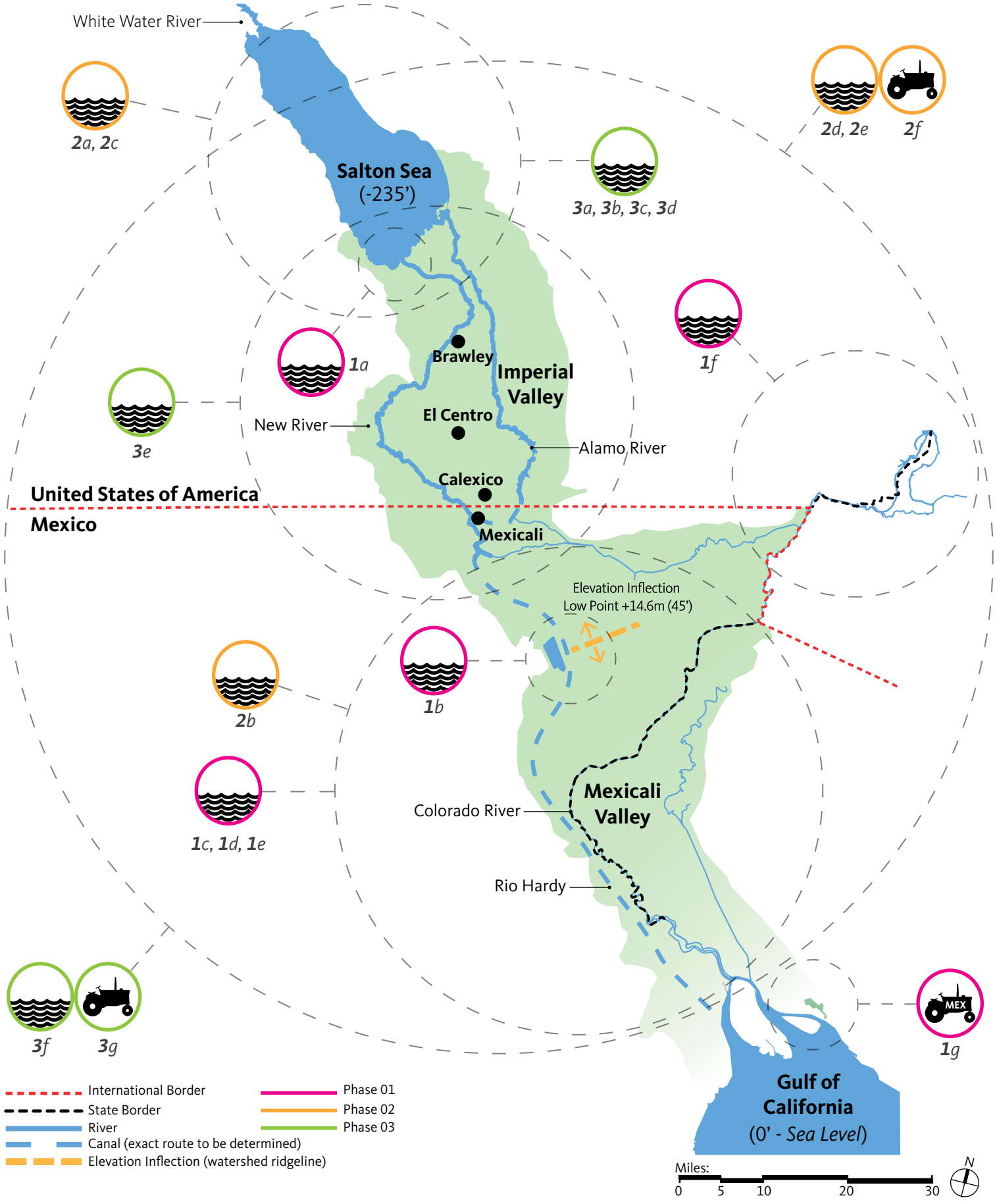
Carl Hodges has identified current interest in the establishment of oceanwater agriculture in the Mexicali Valley (per Section 3).

In addition, the world shrimp industry was developed in Sonora under Carl's direction by the University of Arizona in the 1970s. It was anticipated that oceanwater aquaculture, including shrimp, fish, etc would be the first component of an integrated Oceanwater Agriculture System (OAS). This was done at Seawater Farms Eritrea (SFE) [link to video], and anticipated as being done on a large scale in Sonora afterwards.

In 2004, Carl Hodges presented the benefits of not returning shrimp farm effluent to the Gulf of California during a visit to the region[ix]. He was invited to consider using the abandoned shrimp farm south of the Mexicali Valley for such an industry. The invitation was not accepted at that time, but now is the time to do so.

In 2007, Carl presented further thinking on how to provide an environmentally enhancing industry for the State of Sonora, and also addressing the world's problem of Sea Level Rise (SLR)[x]. A major priority for the new Governor of Sonora is the prevention of aquaculture effluent from flowing into the Gulf of California.

Seawater Works believes that, with broad support within the US, the cross-border aspect of an ocean water solution can be handled expeditiously.


White Water River
2a, 2c
2d, 2e
2f
Salton Sea
(-235')
3a, 3b, 3c, 3d
1a
1f
Brawley
Imperial
Valley
3e
New River
El Centro
Alamo River
Calexico
United States of America
Mexico
Mexicali
Elevation Inflection
Low Point +14.6m (45')
2b
1b
1c, 1d, 1e
Mexicali
Valley
Colorado River
Rio Hardy
3f
3g
MEX
1g
Gulf of
California
(0' - Sea Level)
International Border
State Border
River
Canal (exact route to be determined)
Elevation Inflection (watershed ridgeline)
Phase 01
Phase 02
Phase 03
Miles:
0
5
10
20
30
N

Phase 01

Strategic Master Plan Development and Schematic Development Plan

Duration: 24 months (dated fall 2016 to 2018)

Strategic Master Plan Development

Within the first months of the 3 phased project, the Seawater Works team will work to develop a "game plan" with the region's stakeholders to move the effort forward. This "owner's project requirements" is a performance based goal setting process that identifies:

- Vision for the long term – steps to get to the Salton Sea's and the region's agricultural economy.
- Working relationships and methods of design and delivery (procurement) with local,regional and Mexican authorities.
- Assemble the appropriate consultant team with Seawater Works – to deliver a master plan and schematic design capability within the first phase and define "best optimization" of salinity etc.

Schematic Development Plan - Salton Sea and Oceanwater Flow

1a) Initiate a Perimeter Lake investigation, using drainage water near the New River Delta, to employ a Floating Salinity Barrier (FSB), with various curtain depths, to deliver the appropriate level of salinity (with implications for biodiversity), handling of sediment etc.
By end of Phase 1 the Goal is have an initial functioning Perimeter Lake with appropriate water flow via temporary and permanent spillways from the New River

- 2 mile first discovery effort (see illustration)

1b) Design and deliver discharge of test pulses of ocean irrigation plus drainage from the Gulf of California into the New River approximately at the high point (in Mexico).

1c) Identify best water routes (pathways) in Mexico for 170,000 to 2 million Acre Feet / year and investigate water movement capacity in the United States via the New River and Alamo River.

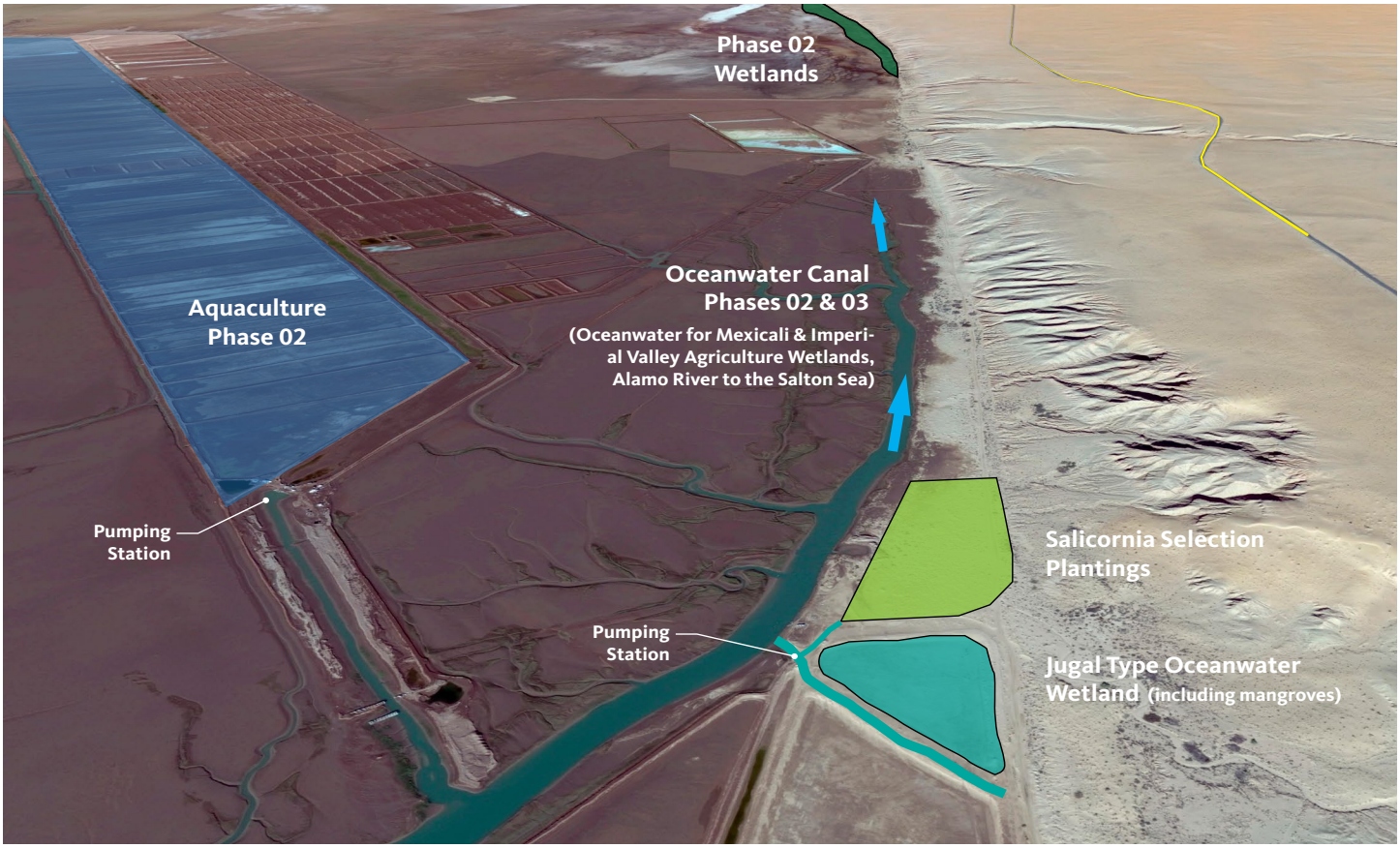
1d) Direct the Engineering (procurement) of the pathway network for 170,000 Acre Feet / year from Gulf of California either via surface flow or well sources

1e) Perform a hydrological review of all water levels[xi] and nature of soil and review the main long term salinity alternatives in a macro plan

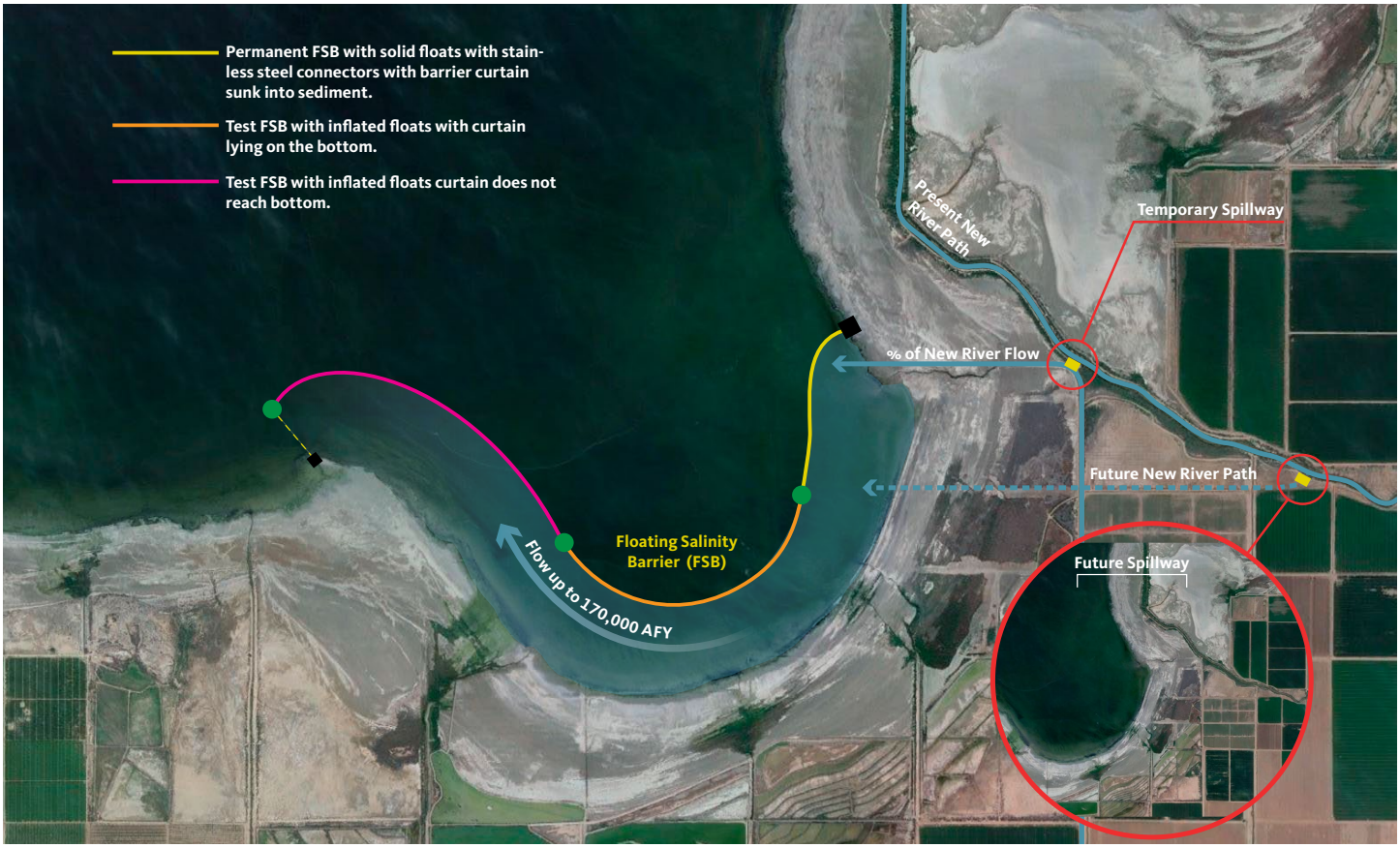
1f) Encourage the State of California and the IID to provide 170,000 Acre Feet / year mitigation flow from the Colorado River in 2018 to mitigate the potential gap of water flow. Seawater Works will work to replace this flow with oceanwater subsequently.

Mexico Oceanwater Agriculture Systems (OAS)

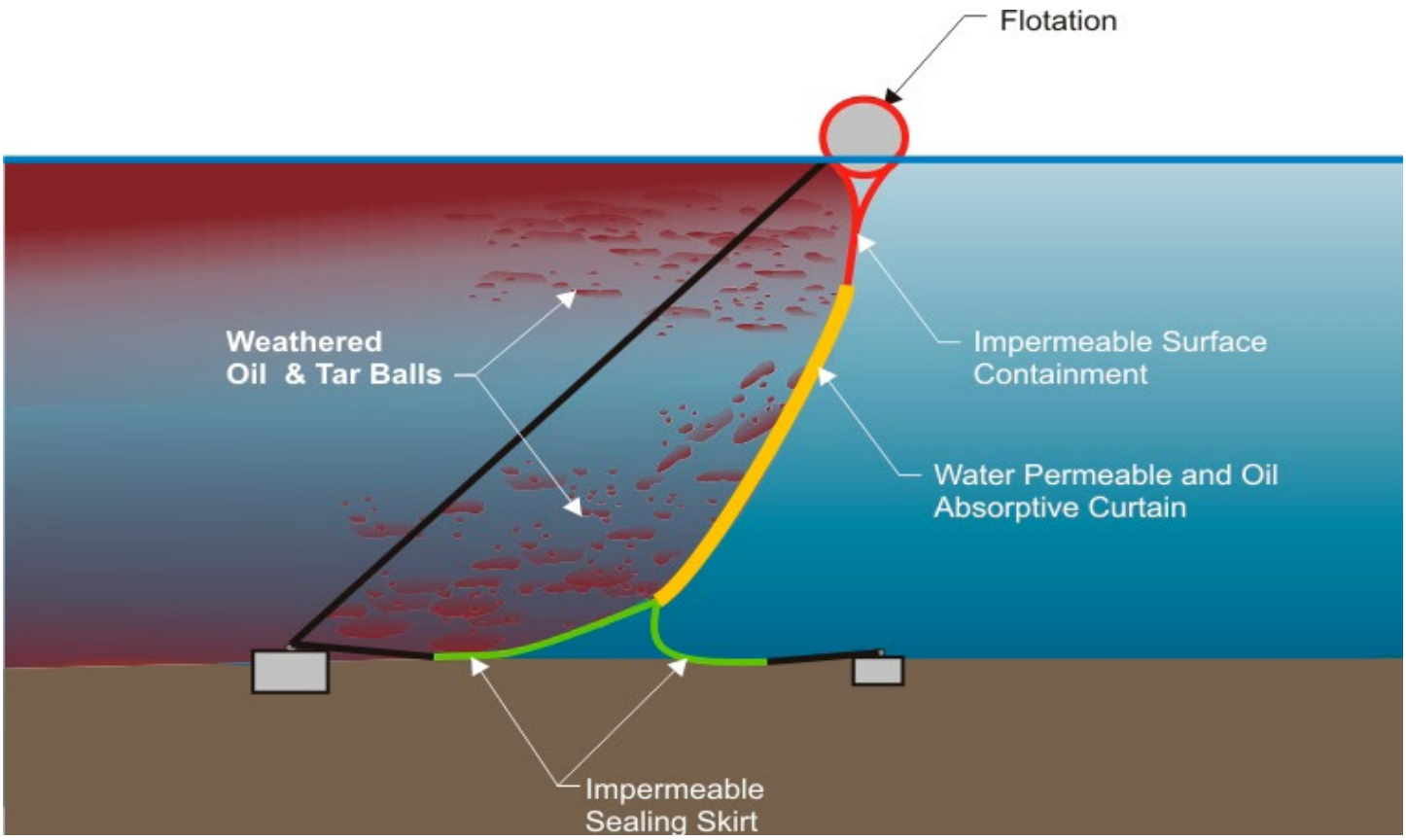
1g) Prepare prototype plots to introduce oceanwater agriculture planting (November 2016 – January 2017) into Mexico.



Gulf of California Oceanwater Entry



Moveable Floating Salinity Barrier - Phase 1



Permanent (Moveable) Floating Salinity Barrier (FSB) Details

Phase **02**

Stop the decline in the level of the Salton Sea
Duration: 36 months (2018 to 2021)

Salton Sea and Oceanwater Flow

2a) Direct the completion of inner and outer areas of the Salton Sea via Floating Salinity Barriers. (Given the flexibility of the barrier approach, develop scenarios for the placement of the "curtain" relative to the shoreline)
2b) Oversee the activation of the 170,000 Acre Feet /yr flow from Gulf of California into Salton Sea, via water routes selected in Phase 1, target 2018/9.
2c) Monitor dust and other air quality aspects with current oceanwater flow.
2d) Direct the Engineering for transporting the cumulative 520,000 Acre Feet / yr from the Gulf of California – routes to be determined including investigating new oceanwater channels on both sides of the border.
2e) Oversee the activation of the cumulative 520,000 Acre Feet / yr from the Gulf of California to the Salton Sea via water routes determined above.

US/Mexico Oceanwater Agriculture

2f) Support early commercialization of oceanwater agriculture, aligned with suitable ocean water and drainage water flow in the Mexicali Valley. Introduce concept in the Imperial Valley.

Pumping Station

Salicornia Harvest

Phase **03**

Raise the level of the Salton Sea to the desired (design) level and completely cover the playa
Duration: TBD based on fill rate. Target (2021 to 2025)

Salton Sea and Oceanwater Flow

3a) Monitor and define means to optimize "Salinity Balance" for the health of the Salton Sea: (assume perimeter lake has stable salinity with inner lake varying)
3b) Monitor dust and other air quality aspects with current oceanwater flow.
3c) Ascertain appropriate water elevation/level of Salton Sea - elevation design needs to be integrated with broad Salton Sea community stakeholder interests including air quality aspects.
3d) Oversee Engineering to attain desired optimized Salton Sea elevation.
3e) Oversee Engineering for oceanwater flow to support development of additional oceanwater agriculture in Imperial Valley.
3f) Activate/construct enough oceanwater flow to support both the Salton Sea desired elevation and development of oceanwater agriculture in the Imperial Valley.

US/Mexico Oceanwater Agriculture

3g) Support the broad commercialization of oceanwater agriculture along appropriate oceanwater routes stretching from the Gulf of California to the Salton Sea.

The Gulf of California: the source of new water for the Oceanwater Corridor from Mexico through the Mexicali Valley, across the border, into the Imperial Valley and to the Salton Sea. It is globally linked to all the oceans of the world; 97% of the water on the planet.

SECTION 7.

Link to New Nile Co's Red Sea Project (Egypt) with Energy Allied International:

https://www.youtube.com/watch?v=R6IYyqXQdZU

Seawater Farms Eritrea:

https://www.youtube.com/watch?v=2CvRy97TJVE

Link to Gensler:

https://www.Gensler.com

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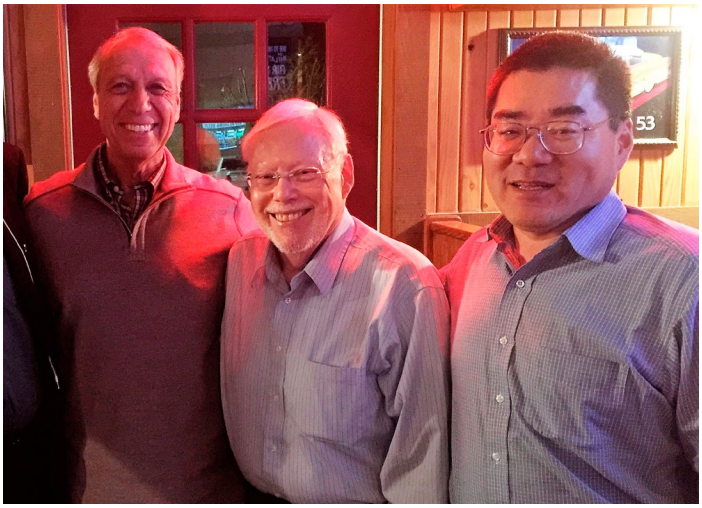
[i] Hodges, Carl N., (1981), New options for Climate Defensive Food Production, Ch 11 in Climate's Impact on Food Supplies, AAAS Selected Symposium 62, USA.
[ii] Nicholls, R.J. et al (2008), "Ranking Port Cities with high Exposure and Vulnerability to Climate Extremes: Exposure estimates" OECD Environment Working Papers, No 1, OECD Publishing
[iii] Salton Sea Study Status Report (2003), US Department of the Interior, Bureau of Reclamation, Nevada
[iv] Cal. Dept. of Water Resources, Cal. Dept. of Fish and Game with CH2MHill 2007 Final Programmatic Environmental Impact Report, Salton Sea Ecosystem Restoration Program
[v] An Evaluation of Agricultural Water Reuse Practices in the Arid US-Mexico Border Region – Mexicali, Baja California, Mexico, W-03-13
[vi] Cohen, Michael J., Hyun, K. J. 2006 Hazard: The Future of the Salton Sea with No Restoration Project, Pacific Institute, Oakland, California
[vii] Cohen, Michael J. 2014, Hazard's Toll – The Costs of Inaction at the Salton Sea, Pacific Institute, Oakland, California
[viii] Carrillo, Yamilett Minute 319: U.S.-Mexico Collaboration - Adapting to a water-stressed West forum https://vimeo.com/80317494
[ix] Hodges, Carl. Report on the Visit of the Desert Development Foundation to Sonora Mexico, August 11-13, 2004
[x] Hodges, Carl, 2007 Selections from Global Warming Opportunities paper (private paper)
[xi] Thomson, A. et al, 2008, Groundwater Availability within the Salton Sea Basin, Lawrence Livermore National Laboratory LLNL – TR – 400426, California

International team by Salicornia fields in Massawa, Eritrea, East Africa

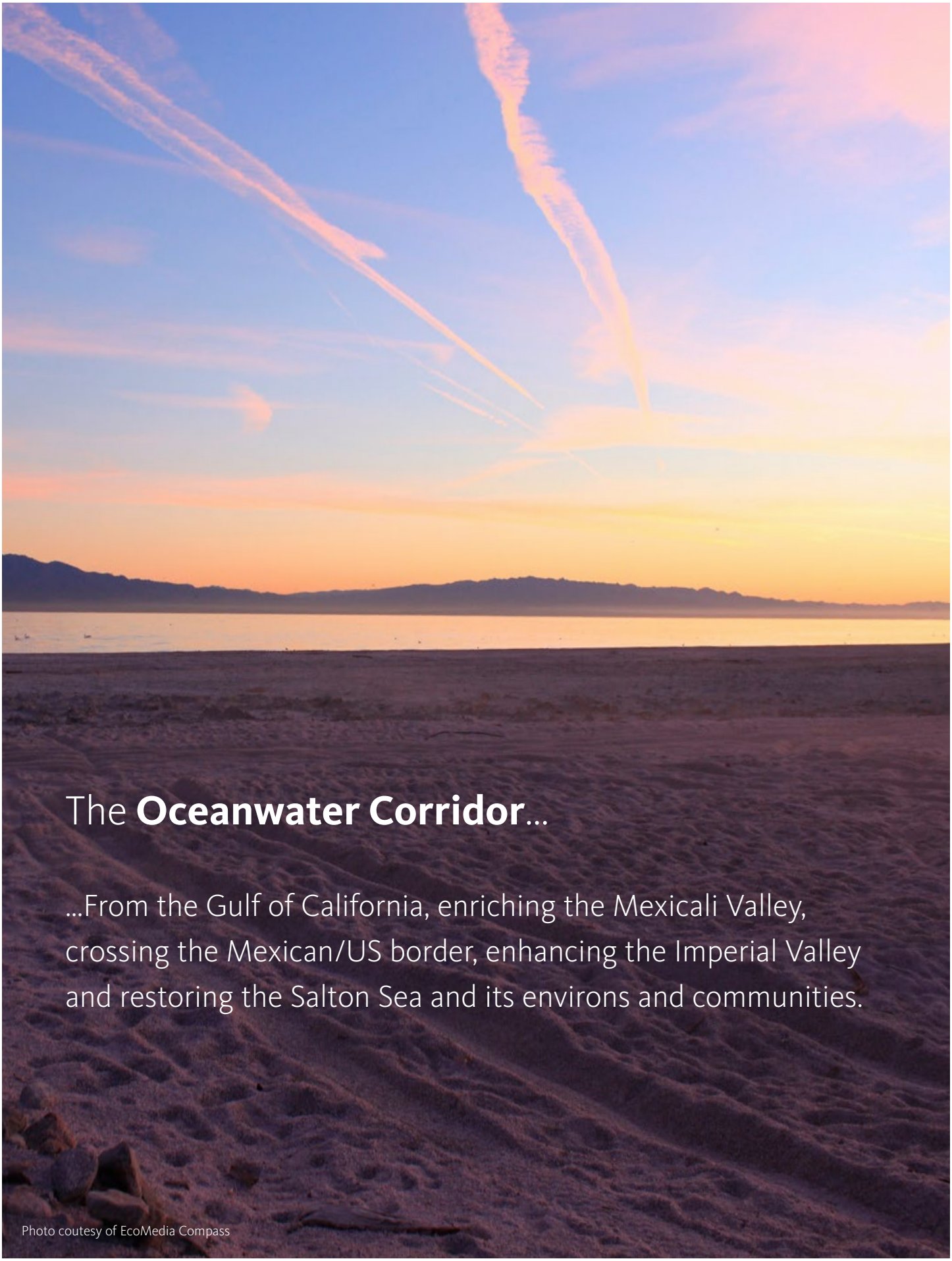
Art Gensler, Tom Sephton, and Bruce Wilcox discuss Oceanwater Corridor options.

Dr. Huruy Zerzghi and Dr. Desale Zerai, sort and protect Salicornia Seed Selections at IVRC

Salicornia selections in IVRC greenhouse, summer 2016



Howard Weiss and Mark Ginsberg run into old friend and collegue, Dr. Zhongjin Lu



The **Oceanwater Corridor**...

...From the Gulf of California, enriching the Mexicali Valley, crossing the Mexican/US border, enhancing the Imperial Valley and restoring the Salton Sea and its environs and communities.

Photo coutesy of EcoMedia Compass