THE SALTON SEA

THE BEST DAYS ARE BEHIND US

AHEAD OF

an E2EDEN, LLC proposal
CONVENTIONAL SOLUTIONS TO AN ENVIRONMENTAL DISASTER

• The Salton Sea is drying up at a rapid rate, threatening not only the local environment, but now risking the health and livelihood of cities further afield.

• The issue has now forced the state’s hands. All current proposals risk a rerun of the California High Speed Rail debacle with a conventional, costly overland canal, blasted through the terrain, acquiring all the land rights along the way, to import ocean water from Mexico.

versus

INNOVATION – GETTING MORE FOR LESS ...

• Recent cost and technological innovations in tunneling have unlocked an entirely new approach

• A direct and invisible tunnel from the pacific, under the mountains, to the Salton Sea, at ½ the distance of competing proposals, using gravity to move water.

• Adding pumping stations, and hydropower and tunnels for outflow conveyance, you could pump out the brine to circulate the sea, restore an ecological keystone, and unlock the region for development
SALTON SEA RESTORATION

• THE PACIFIC TO SALTON SEA TUNNEL ROUTE
  A FIRST PRINCIPLES PHYSICS APPROACH

KEY DIFFERENTIATORS

• An Aspirational Future
  An ecosystem reborn, and a community rebuilt

• And Achievable Path to Get There
  Leveraging tunneling innovations for a ground-breaking, straightforward and affordable approach

*Population sources: https://www.wikipedia.org/
AN INTRODUCTION FOR THE UNINITIATED
A DYING SEA

Once THE fishing and resort destination in the 1950s, Salton Sea has seen its water siphoned off to supply a growing population.

The salinity has risen to the point of fish die offs, and exposed shorelines have resulted in salt and chemical air pollution that now threaten LA, San Diego/Tijuana and Mexicali.

California has now initiated requests for proposals to address this growing crisis.
Critical stopover on pacific flyway after LA marshes were built over. Now endangered.

**DECIMATING NATURE**

**DESTROYING A CRITICAL MIGRATORY BIRD HABITAT**

*chart from USA Today

**FISH CAN NO LONGER SURVIVE**

Salton Sea's average annual salinity, 2004 to 2020
In parts per thousand

Source: U.S. Bureau of Reclamation; Pacific Institute

*chart from USA Today

\[
\text{Annual bird count at south end of lake}
\]

- **Eared grebes**: 2,845 (169 average since 1990, 2,060 in 2016)
- **American white pelicans**: 2,060 (322 average since 1990, 5,987 in 2016)
- **Double-crested cormorants**: 5,987 (659 average since 1990, 659 in 2016)

National Audubon Society

*chart from USA Today

**THEN**

**AND NOW**
The surrounding towns have the highest asthma rates in the nation.

HARMING KIDS & COMMUNITIES

HEALTH

These issues have impacted a community without much of a voice, or resources to address them.

WEALTH

*chart from USA Today

Asthma-related emergency room visits for children ages 5-17
Rate per 10,000 residents

- Imperial County
- California

2018
2017
2016
2015
2014

50
100
150


Median Household Income

$70k
$65k
$60k
$55k
$50k
$45k
$40k
$35k

2013
2014
2015
2016
2017
2018

Coachella, CA
Parent Geographies
THE POLITICAL LANDSCAPE
WE ALL HAVE A STAKE

A century of farm runoff, fertilizers and chemicals, will affect not just the farming communities...

...but increasingly will impact populated, urban areas with the financial means to solve the problem

*Population sources: https://www.wikipedia.org/
CITIES
Worried the playa dust will exacerbate existing air quality issues, and in need of a relief valve for their population

FARMING COMMUNITIES
Struggling with farmland quality loss, jobs and health degradation

ENVIRONMENTALISTS & WILDLIFE
A paradise lost, and birds with no home to go to after the LA marshes were paved over in the early 1900s

THE ONE THING EVERYONE AGREES ON...
THE SALTON SEA NEEDS SAVING
WHAT DO YOU WANT FOR OUR FUTURE
YOUR CHOICES

AFFECT NOT ONLY THE SEA...

1 SUPPRESSION ONLY
Let it dry up.
Plow the dirt to minimize dust

2 MITIGATION ONLY
Import seawater.
Let the sea turn to salt

3 RESTORATION ONLY
Import seawater, export the brine.
Watch nature heal itself
MINERS
Extractive industries, with poor job prospects, leaving wastelands behind when they leave

GEOTHERMAL & INDUSTRIAL
Develop geothermal energy & mineral resources, offering a living but no life

DEVELOPERS
Partner to bring in investment, create jobs, develop communities and set in motion a flywheel for generations

...BUT ALSO DETERMINE WHO INVESTS
AND WHAT YOU ARE LEFT WITH WHEN THEY LEAVE
Do you just dig channels for dust “SUPPRESSION”...

...Essentially flipping the soil to break up the wind...

...and sell the Salton Sea off as a wasteland to mining & extraction companies?

Mining companies have a reputation for extracting, not investing in the communities they “partner” with
...or only import water for **MITIGATION**, and watch as the salt accumulates indefinitely, killing the ecosystem?

**THE FUTURE WE DESERVE?**

Do you leave real estate value and communities to decay – supported only by Geothermal plants?
THE FUTURE WE DESERVE

Or do you build a paradise and an inheritance for ourselves and our children...

Imagine the Salton as a sea you would want to **LIVE** next to, rather than flee

At its peak, the Salton Sea was drawing more yearly visitors than Yosemite
THE CHOICE IS YOURS

*existing Salton Sea geothermal power plant

Will our kids have to work there...

...or want to work there...

...and live there
THE FUTURE WE DESERVE

1. SUPPRESSION
   Turning over the dirt to minimize dust storms

2. MITIGATION
   Import seawater to fill the Salton and permanently cover the playa

3. RESTORATION
   Import fresh seawater AND pump out the brine,
   to circulate the sea and bring life, investment, jobs and wildlife to these shores

and our kids
BUT HOW CAN IT BE DONE?
THE INTUITIVE OVERLAND APPROACH WAS TRIED ONCE BEFORE AND FAILED

COULD WE SHOW THEM HOW ITS DONE?

The Dead Sea, Israel/Jordan
$11B PROJECT CANCELLED – “RED TO DEAD SEA”

They had two options

Without cheap tunnels, they took the longer, “easier” route over land

But failed anyways...

THE TIMES OF ISRAEL

After years of delays, Jordan said to nix Red Sea-Dead Sea canal with Israel, PA

Report says kingdom will pull the plug on pipeline and instead focus on internal desalination project.

Jordan has decided to cancel a highly touted joint project with Israel and the Palestinian Authority for a canal linking the Red Sea and the Dead Sea, after years of the plan stagnating, the Kan public broadcaster reported Thursday.
INNOVATION IN RESTORATION

THE FRESH APPROACH TO HOW

Gravity Fed Tunnel Pipeline
+
Hydropowered Sea Circulation

“Creativity is just connecting things.”
- Steve Jobs
THE KEY BREAKTHROUGH

LOW COST TUNNELS
WHY TUNNELS?

COST & TECHNOLOGY INNOVATION

This project is only now feasible, thanks to the recent innovative cost and technological breakthroughs.

Tunneling Cost Before
Cost Now

$100M - 1B / mile
As low as $5M/ mile
THE UNLOCKED SOLUTION
A FULL RESTORATION

The direct, shorter route afforded by tunnels massively reduces head loss...

...enabling not only a cost effective refill, but brine removal as well.
THE 3 STEP PLAN TO DO IT...
A THREE PHASE APPROACH

PHASE 1
PROOF OF CONCEPT
A single proof of concept tunnel pipeline to the Salton to de-risk and offset evaporation

PHASE 2
MITIGATE
More pipeline capacity from the Pacific to the Salton Sea to refill the dying sea

PHASE 3
REHABILITATE
Pump out the brine from Salton Sea to Pacific to return to ocean water salinity levels

Hydropower turbines + Pumping station
<table>
<thead>
<tr>
<th>CHALLENGES</th>
<th>HOW WE SOLVE IT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FUNDING</strong></td>
<td>- Restoring the sea opens it up to tourism, development &amp; investment.</td>
</tr>
<tr>
<td></td>
<td>- An aspirational vision drives excitement, support and funding</td>
</tr>
<tr>
<td>Funding exists, but nowhere near enough.</td>
<td></td>
</tr>
<tr>
<td>How do you drive enthusiasm for a dead sea no</td>
<td></td>
</tr>
<tr>
<td>one will visit or live by.</td>
<td></td>
</tr>
<tr>
<td><strong>POLITICAL</strong></td>
<td>- We align the interests of cities, environmentalists, farmers and those</td>
</tr>
<tr>
<td>Complex treaties with Mexico.</td>
<td>that represent them.</td>
</tr>
<tr>
<td>Little to be gained, much financially to lose,</td>
<td>- No treaties needed, and a relief valve for crowded cities</td>
</tr>
<tr>
<td>and timelines longer than a politician’s career.</td>
<td>- Something to be gained by everyone</td>
</tr>
<tr>
<td><strong>TECHNICAL</strong></td>
<td>- The simplest configuration necessary</td>
</tr>
<tr>
<td>Multiple solutions, multiple components, and</td>
<td>- Involve ambitious companies for an ambitious task</td>
</tr>
<tr>
<td>experts who haven’t solved it yet</td>
<td>- Off-the-shelf technologies</td>
</tr>
<tr>
<td><strong>ECONOMICS</strong></td>
<td></td>
</tr>
<tr>
<td>Long routes, expensive approaches, and how do</td>
<td>- Gravity fed collapses costs.</td>
</tr>
<tr>
<td>you pay to remove brine?</td>
<td>- Short route back minimizes head loss, making pumping cheap</td>
</tr>
<tr>
<td></td>
<td>- Restoration of the sea to unlock development $$</td>
</tr>
<tr>
<td><strong>ENVIRONMENTAL</strong></td>
<td></td>
</tr>
<tr>
<td>A dead sea, no fish, no birds, no people</td>
<td>- Refill the sea, reduce salinity – and nature heals itself</td>
</tr>
<tr>
<td></td>
<td>- Low energy solution for lowest environmental impact</td>
</tr>
<tr>
<td></td>
<td>- Tunnels under for minimal disruption of land and life</td>
</tr>
</tbody>
</table>
# Benefits of Tunnels

<table>
<thead>
<tr>
<th></th>
<th>TUNNEL</th>
<th>OVERLAND</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Permitting &amp; Land Rights</strong></td>
<td>• No national borders crossed</td>
<td>• Issues with US – Mexico water treaties</td>
</tr>
<tr>
<td></td>
<td>• No need for land purchases, or rights of way</td>
<td>• Above ground aqueducts require the acquisition and purchase of significant property rights</td>
</tr>
<tr>
<td></td>
<td>• Only 15 miles out of 75 miles of total tunnel length is under/near private property</td>
<td>• Complex permitting</td>
</tr>
<tr>
<td><strong>Predictability</strong></td>
<td>• Not impacted by weather</td>
<td>• Unpredictable political environment with US – Mexico water treaties</td>
</tr>
<tr>
<td></td>
<td>• No above ground impact, reduced schedule risk from NIMBYism</td>
<td>• Schedule risk due to adverse weather &amp; desert climate impact on worker productivity</td>
</tr>
<tr>
<td></td>
<td>• Terrain agnostic technology allowing for direct route</td>
<td>• Long term cost unpredictability due to necessary pumping infrastructure &amp; cost</td>
</tr>
<tr>
<td></td>
<td>• Low cost of operation due to gravity fed system</td>
<td>• Multiple partners &amp; contractors</td>
</tr>
<tr>
<td></td>
<td>• Turnkey solutions with The Boring Company</td>
<td></td>
</tr>
<tr>
<td><strong>Public Opposition</strong></td>
<td>• Hard to hate an invisible, inaudible dig site underground</td>
<td>• No town is going to like a gigantic trench being dug outside their homes, schools and through their farms</td>
</tr>
<tr>
<td><strong>Speed</strong></td>
<td>• Months</td>
<td>• Years</td>
</tr>
<tr>
<td><strong>Earthquakes</strong></td>
<td>• Low risk, but vulnerable to lateral movements of land</td>
<td>• Low risk, but vulnerable to lateral movements of land</td>
</tr>
<tr>
<td><strong>Evaporation</strong></td>
<td>• None due to isolation underground</td>
<td>• Slight to moderate depending on length of the route and variables such as weather and whether the canal is enclosed as a pipe or open</td>
</tr>
</tbody>
</table>
TECHNICAL DETAILS, ASSUMPTIONS & CALCULATIONS

Full system data model available in accompanying Excel
SALTON SEA MODEL ASSUMPTIONS

<table>
<thead>
<tr>
<th></th>
<th>m³/yr</th>
<th>m³/s</th>
<th>acre-feet/yr</th>
<th>cf/yr</th>
<th>cf/s</th>
<th>gal/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaporation</td>
<td>1,603,524,000</td>
<td>50.8</td>
<td>1,300,000</td>
<td>56,627,870,000</td>
<td>1,796</td>
<td>13,288</td>
</tr>
<tr>
<td>Watershed Freshwater Inflows</td>
<td>902,907,360</td>
<td>28.6</td>
<td>732,000</td>
<td>31,885,902,546</td>
<td>1,011</td>
<td>7,482</td>
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<tr>
<td>Net Water Loss</td>
<td>700,616,640</td>
<td>22.2</td>
<td>568,000</td>
<td>24,741,967,454</td>
<td>785</td>
<td>5,806</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>km²</th>
<th>m²</th>
<th>mi²</th>
<th>ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Surface Area (Current)</td>
<td>888</td>
<td>888,366,570</td>
<td>343</td>
<td>9,562,291,200</td>
</tr>
<tr>
<td>Sea Surface Area (Filled)</td>
<td>906</td>
<td>906,496,500</td>
<td>350</td>
<td>9,757,440,000</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>g/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Starting Salinity</td>
<td>7.5%</td>
<td>75.0</td>
</tr>
<tr>
<td>Watershed Freshwater Salinity</td>
<td>0.4%</td>
<td>3.7</td>
</tr>
<tr>
<td>Ocean saltwater</td>
<td>3.5%</td>
<td>35.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>kg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity of Ocean saltwater</td>
<td>1,035.0</td>
</tr>
<tr>
<td>Specific Gravity of Salton (current) saltwater</td>
<td>1,075.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>m</th>
<th>ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Avg Depth (Current)</td>
<td>10</td>
<td>32</td>
</tr>
<tr>
<td>Target Avg Depth (Full)</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Sea height below sea level</td>
<td>70</td>
<td>230</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>km³</th>
<th>m³</th>
<th>liters (millions)</th>
<th>acre-feet</th>
<th>ft³</th>
<th>gal (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Volume (Current)</td>
<td>9</td>
<td>8,664,772,177</td>
<td>8,664,772</td>
<td>7,024,652</td>
<td>305,993,318,400</td>
<td>2,288,990</td>
</tr>
<tr>
<td>Sea Volume (Filled)</td>
<td>14</td>
<td>13,815,006,660</td>
<td>13,815,007</td>
<td>11,200,019</td>
<td>487,872,000,000</td>
<td>3,649,538</td>
</tr>
</tbody>
</table>
PHASE 1

PROOF OF CONCEPT

1. Salt water intake north of San Diego
2. A single 75 mile gravity fed seawater tunnel & pipeline to Salton Sea
3. Tunnel outlet at Salton Sea ~60 meters below sea level

COST

Fixed costs = $750M
Operating costs = NEGLIGIBLE

TIME

100 weeks

*Since tunnels are terrain agnostic, any route could be selected as needed to avoid urban areas, minimize permitting, zoning or other considerations (examples below)
PHASE 2

SALTON FILL UP

1. Salt water intake north of San Diego
2. A second 75 mile gravity fed seawater tunnel & pipeline to Salton Sea
3. Tunnel outlet at Salton Sea ~60 meters below sea level

COST

Fixed costs = $750M
Operating INCOME = $0.6M/yr

TIME

90 weeks

*Courtesy of google.com/maps
THROUGHPUT PER TUNNEL

Hazen-Williams Equation

\[ v = k \cdot C \cdot R^{0.63} \cdot S^{0.54} \]

<table>
<thead>
<tr>
<th></th>
<th>m</th>
<th>ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>0.849</td>
<td>1.318</td>
</tr>
</tbody>
</table>

| Material          | 120  |
| Roughness Coefficient (C) | 3    |
| Hydraulic Radius (R)   | 120,701 | 396,000 |
| Pipe Length           | 230  |
| Drop                  | 0.000580 |
| Slope (S)             |      |

Flow Velocity (v)

<table>
<thead>
<tr>
<th>m/s</th>
<th>ft/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.721</td>
<td>5.648</td>
</tr>
</tbody>
</table>

Flow Discharge

<table>
<thead>
<tr>
<th>m³/s</th>
<th>ft³/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>639</td>
</tr>
</tbody>
</table>
TUNNELS

Net Natural Water Loss (per year)
785 ft³/s

Throughput per 12ft Diameter Pipe
639 ft³/s

Pipeline Tunnels Needed
2

Total Capacity
1278 ft³/s

Total Tunneling Cost
$1,200M

Assuming that we target to refill the sea by 5m (15ft) – and hold it there

*surplus until steady state when flow is reduced to maintain equilibrium
PHASE 3

EXTACTING THE BRINE

1. Salt water intake at Salton Sea
2. Pumping station to return water to sea level for brine removal
3. Tunnel outlet at Pacific Ocean

COST

Fixed costs = $3,300M
Operating Costs = $15M/yr

TIME

200 weeks
CHEAPER THAN DESALINATING THE SALTON

The majority of solutions submitted to the state did not solve for salt/brine removal, and when they did, due to the long route and massive pumping capacity, did so at substantial op ex costs.

Leveraging existing tunnels to **PUMP OUT** the salty sea, and create circulation with the ocean would be far simpler option than expensively desalinating water only to dump it into the Salton Sea. It would stabilize salinity levels at that of sea water.

A pumped hydro battery could be inserted to create new utility and a revenue source for this return journey – which would anyways require energy to pump the Salton Sea brine to a higher elevation to reach the Pacific.

Even pumping in fresh waster – if not removed, salt inevitably accumulates to toxic levels

**VS**

Salt is simply pumped out and away, and replenished with Pacific Ocean water
TUNNELS

Net Natural Water Loss (per year)
785 ft³/s

Throughput per 12ft Diameter Pipe
639 ft³/s

Pipeline Tunnels Needed
4 total inbound
3 total outbound

Total Capacity
2,468 ft³/s inbound
1,851 ft³/s outbound

Total Tunneling Cost
$1,200M Phase 1
$3,200M Phase 2

36% % of Current Lake Volume Cycled / yr
22% % of Filled Lake Volume Cycled / yr

To bring down salinity further, add more pipeline capacity through (a) more tunnels, (b) larger diameter tunnels, or (c) smoother tunnels

Assuming that we target to refill the sea by 5m (15ft) – and hold it there
Hydropower systems and Pumping technologies are things California has plenty of know-how in.
HYDRO ENERGY

Water Head to sea level
70m (230ft)

Turbine Energy Efficiency
90%

Flow Capacity
69.9m³/s (2,468 ft³/s)

Generation Capacity
69.9m³/s * 1035kg/m³ * 9.81m/s² * 70m * 90% turbine efficiency * 29% remaining head = 13.0 MW

Energy Production
13.0MW * 24h/day * 365 days/yr
= 114,263 MWh/yr

Average Wholesale Electricity Price
$20/MWh

Energy Production
$2,285,266/yr
# Pumping Energy

\[ U = m \times g \times h \]

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Head to sea level</td>
<td>70m (230ft)</td>
</tr>
<tr>
<td>Max Water Head for gravity conveyance to Ocean</td>
<td>140m (460ft)</td>
</tr>
<tr>
<td>Pump Energy Efficiency</td>
<td>95%</td>
</tr>
<tr>
<td>Flow Capacity</td>
<td>52.4m³/s (1851 ft³/s)</td>
</tr>
<tr>
<td>Pumping Capacity</td>
<td>74.1 MW</td>
</tr>
<tr>
<td>Energy Use</td>
<td>648,851 MWh/yr</td>
</tr>
<tr>
<td>Average Electricity Cost</td>
<td>$20/MWh</td>
</tr>
<tr>
<td>Energy Cost</td>
<td>$12,977,017/yr</td>
</tr>
</tbody>
</table>
THE PRICE OF THE FUTURE

TO BUILD ~ $5 Billion
TO RUN ~ 15 Million/yr

*Actual quote to state may vary depending on contingency costs, financing costs, and other assumptions required in CA State RFI submission format
PERSPECTIVE ON THE PRICE

This will be an expensive and difficult undertaking. What is worth doing, and at what price?
WHO DO YOU PICK?

What do we value?

What are we willing to risk to achieve it?
LEGACY APPROACHES

CORE VALUES
- Longevity matters
- Size matters
- Resumes matter

The focus is on OUR past

V

The focus in on YOUR future

INNOVATIVE APPROACHES

CORE VALUES
- Vision & Insight matter
- Speed matters
- Results matter

S
THE IDEA TEAM

Guy Nadler
Design, Marketing, Management
Semiconductors, Israeli Air Force
• MIT, Boston MA – MBA
• Technion, Israel – B.S Physics

Jason McBride
Operations, Design
Semiconductors, Delivery Startups
• Georgia Tech, Atlanta GA – B.S. Industrial & Systems Engineering

THE INNOVATION APPROACH

1. PEOPLE BEFORE THE PROBLEM
Who we help is key to how we help

2. PROBLEM BEFORE THE SOLUTION
We care that we solve it, more than how we solve it

3. VISION BEFORE EXECUTION
Executing well to a bad plan, is worse than not starting at all

4. SOLUTION BEFORE THE TEAM
We build the team to solve the problem, not fit the solution to the team
SUCCEED & PAVE THE WAY FOR OTHERS

Save the Salton and inspire the world
SAVE NOT ONLY THE SALTON, BUT THE DRIED UP SEAS AROUND THE WORLD

Lake Eyre, Australia
Qattara Depression, Egypt
SIMILARLY SITUATED CHALLENGES IN NEED OF INNOVATION

Areas below sea level, by ocean sources

Source: https://en-gb.topographic-map.com/
...ONE OF WHICH IS CONTINENTAL IN SCALE

Imagine a water source driving an ecological dynamo, deep in the dry interior

Source: https://en-gb.topographic-map.com/
Should this approach prove successful, significant geo-engineering opportunities exist in deserts worldwide.

**Egypt & Algeria** offer depressions of considerable magnitude near population centers where the benefits would be most acute.

**Australia** offers an opportunity to introduce a body of water in the arid desert interior. At 60mi X 130mi the evaporative effects would be transformational on the regional climate.

Source: https://en-gb.topographic-map.com/
CONTACT INFO

www.engineeringtoeden.com

THE FOUNDING TEAM

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