International Coastal Management

Aaron Salyer & Sam King
Australia

RE:BEACH

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EST. 1989 | QLD, AUSTRALIA

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PUBLIC WORKSHOP 3

THE LIVING SPEED BUMPS | CONCEPT DESIGN

December 13th, 2023

OCEANSIDE RE:BEACH GOALS

ACCESS TO SAFE & USABLE BEACHES

EXISTING PROBLEM # 1

1. No Beach

- No access
- Not safe
- Not usable
- Property damage

EXISTING PROBLEM # 2

SOS Oceanside

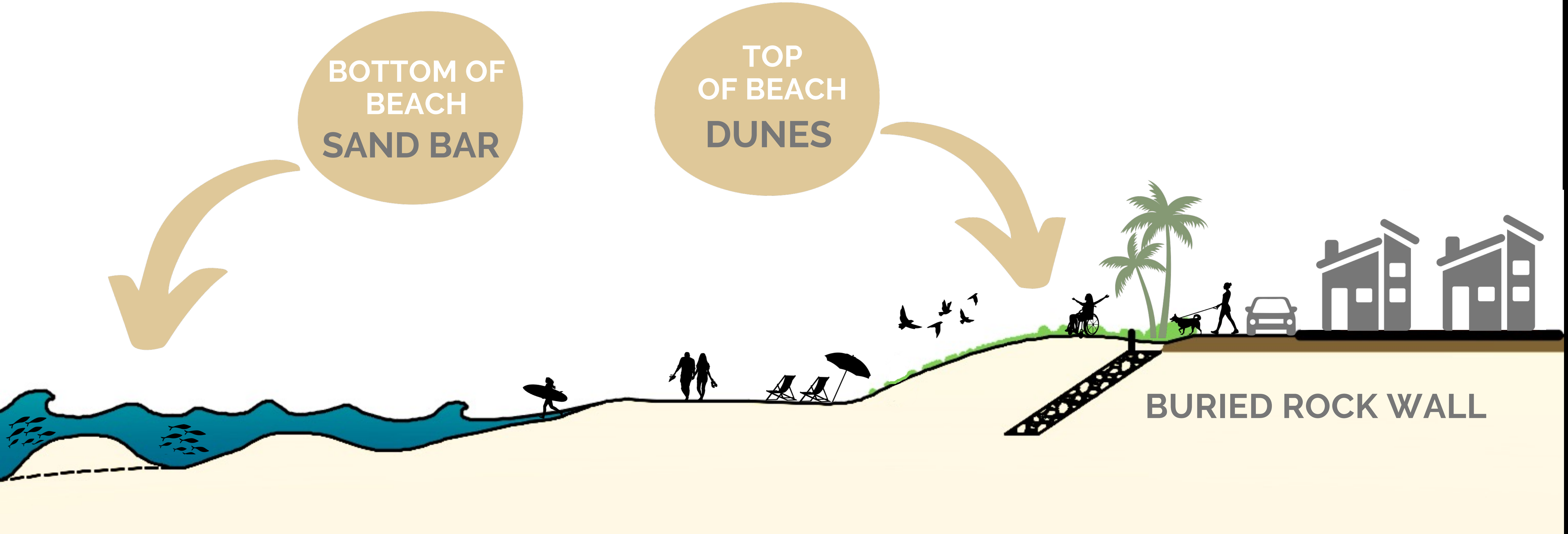
2. Limited Beach

- Limited access to the beach/ocean over cobble ("**the cobble wobble**")
- Safety concerns
- Visually undesirable
- Disruptive to Grunion (which requires sandy intertidal beach for spawning)
- Negative impacts downdrift (no sand to naturally move downdrift)

WHAT DOES RE:BEACH MEAN?

✓ **CREATE A HEALTHY BEACH PROFILE**
("LIVING SHORELINE")

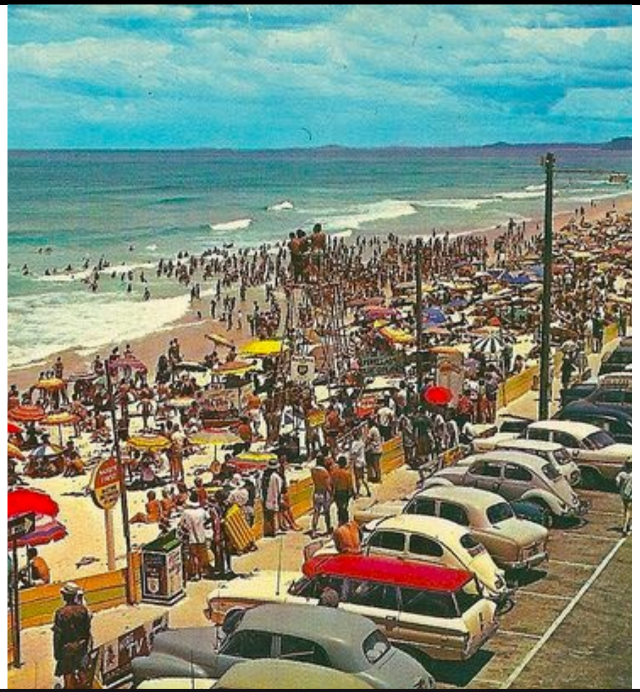
✓ **RETAIN & MANAGE A LIVING SHORELINE**
(FOR AN EXTENDED TIMEFRAME)



TOP & BOTTOM OF THE BEACH ADDRESSED ON THE GOLD COAST, AUSTRALIA

BRINGING OUR RE:BEACH EXPERIENCE

GOLD COAST, AUS. (THEN)



CONDITIONS CHANGED

Rock wall along the beach, minimal access

GOLD COAST, AUS. (NOW)

Successes

- Implemented pilot projects
- Developed sand management strategies
- Delivered monitoring programs
- Dune development & vegetation
- Surf enhancement

BRINGING OUR RE:BEACH EXPERIENCE

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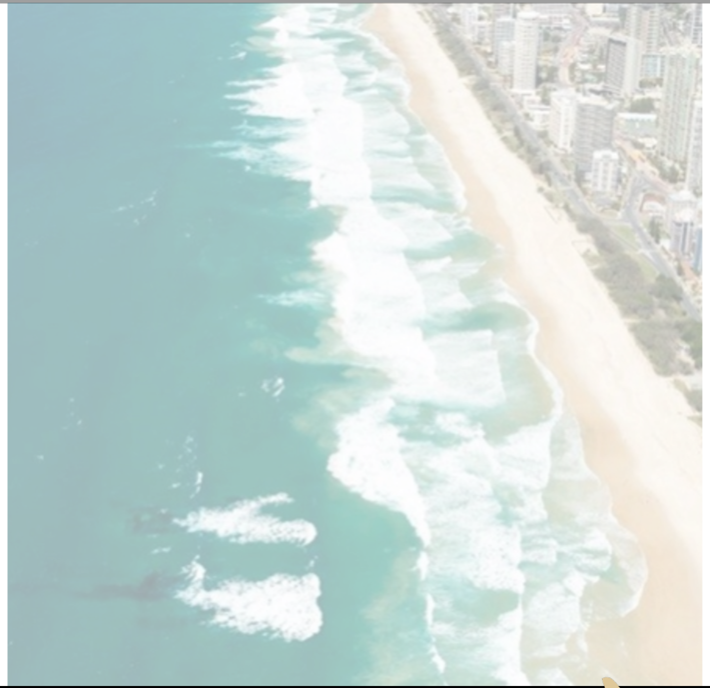
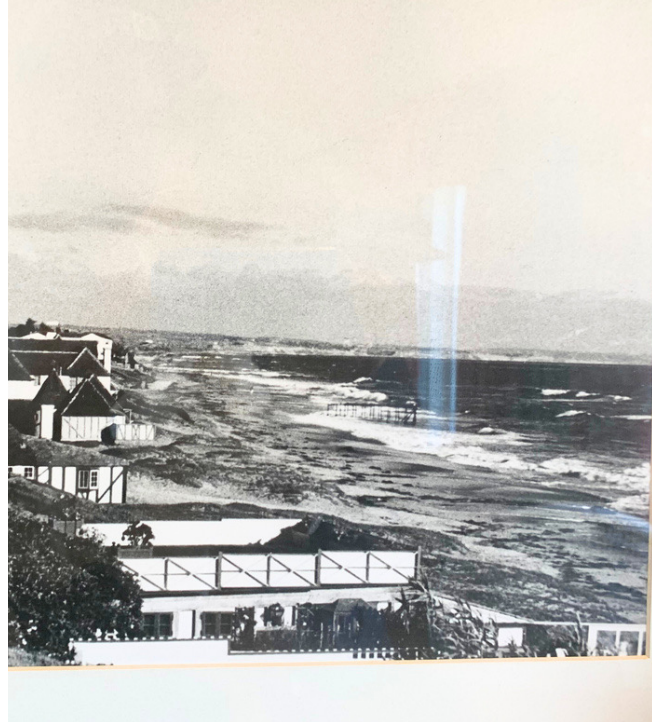
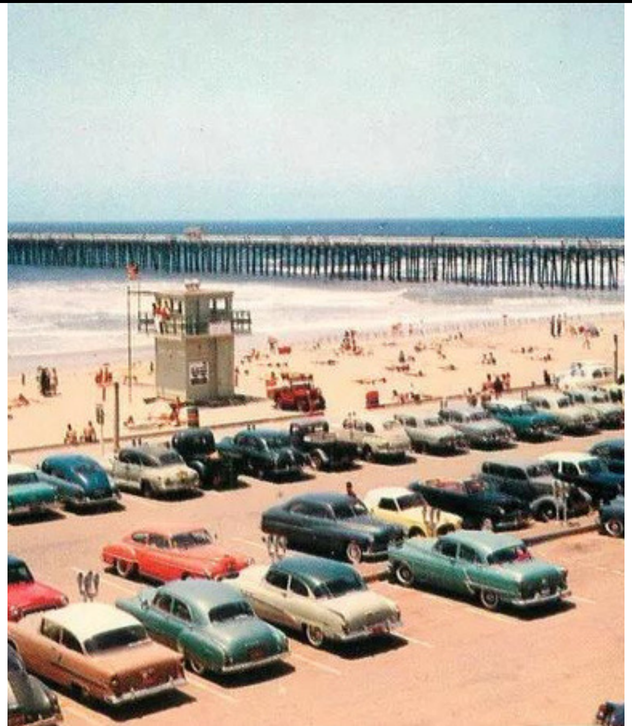


OCEANSIDE, CA. (THEN)





Rock wall along the beach, minimal access

RE BEACH (Oceanside)

- Bring experience, relevant working concepts and strategies for similar conditions and goals

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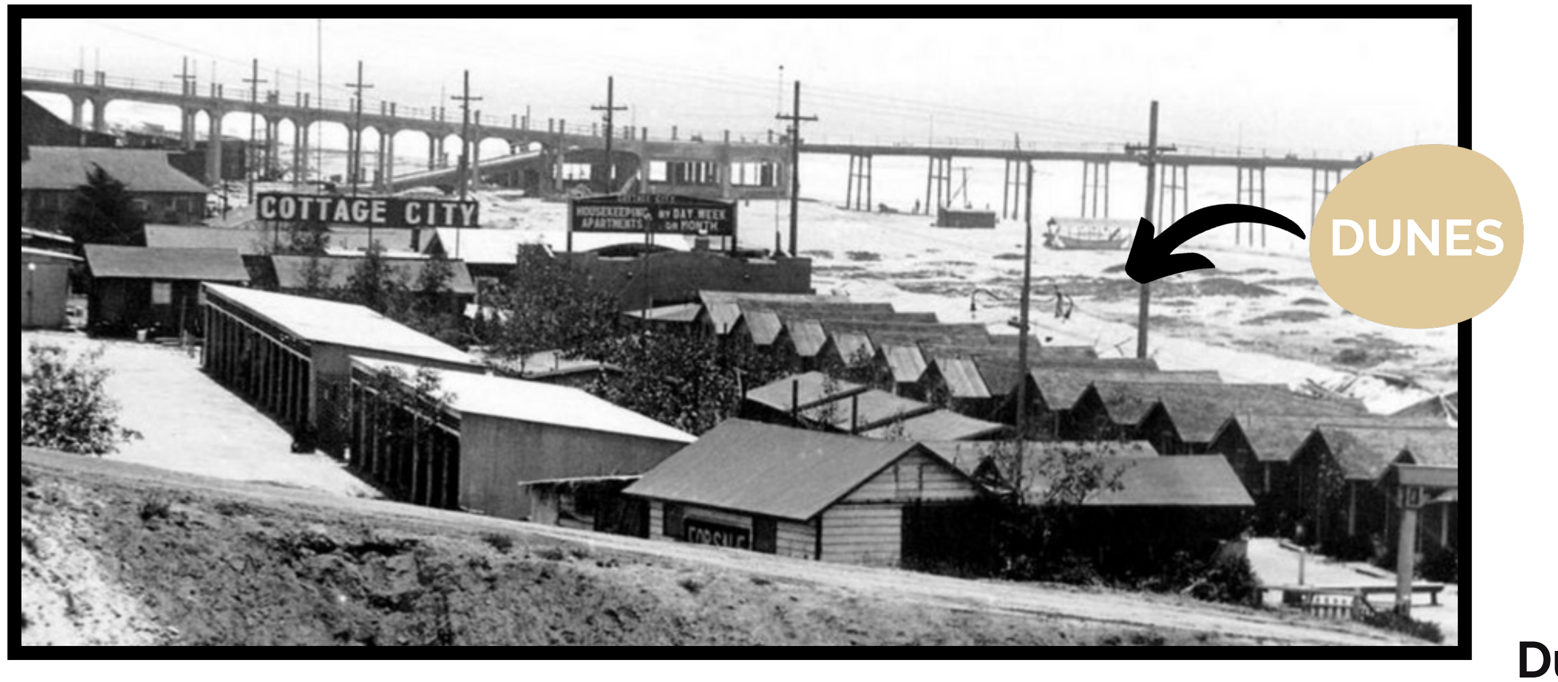
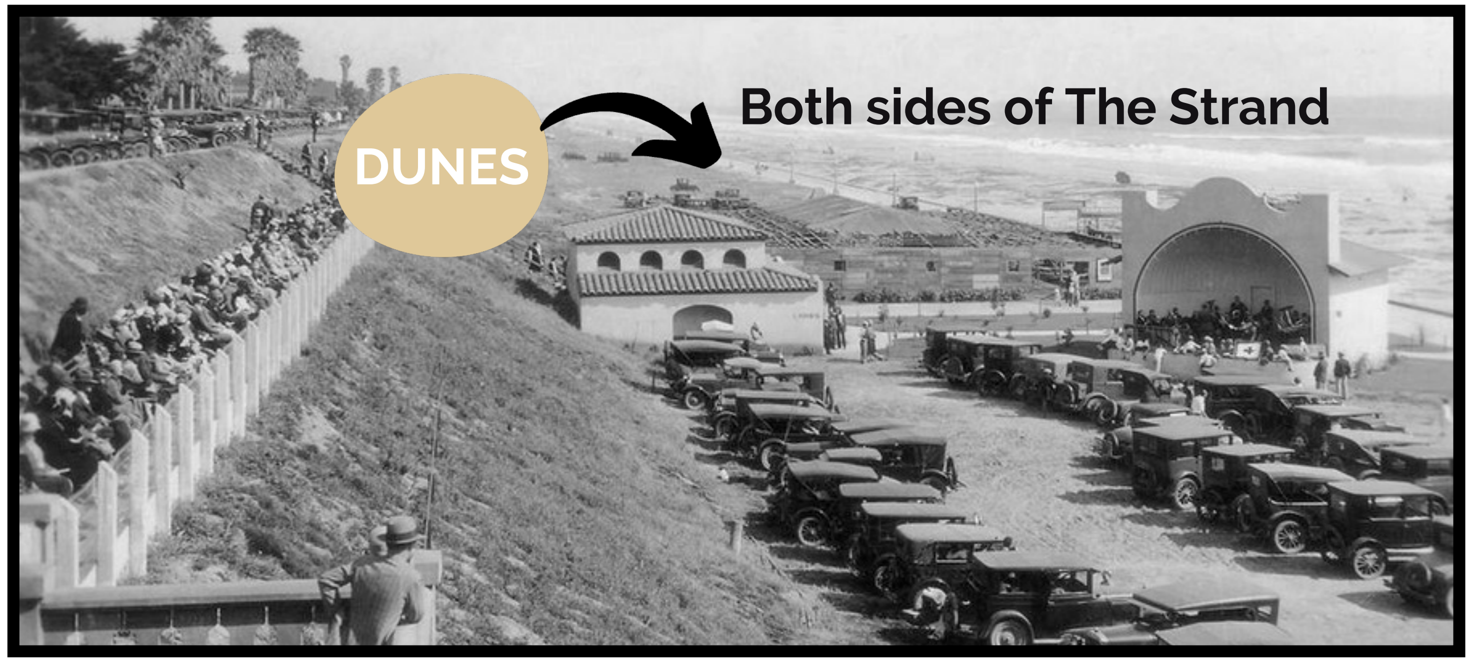
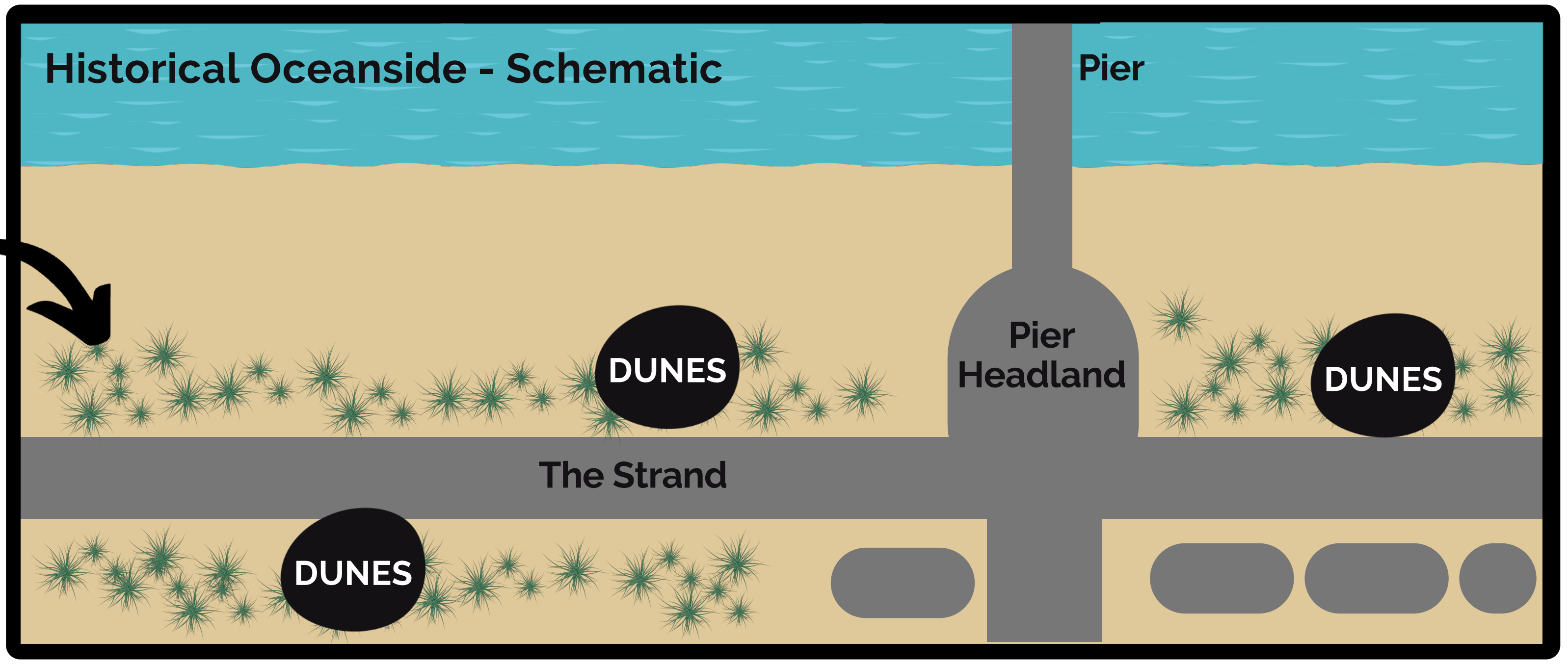
DID OCEANSIDE HAVE A HEALTHY BEACH PROFILE?
YES, WITH DUNES.





Dunes out to the Pier Headland



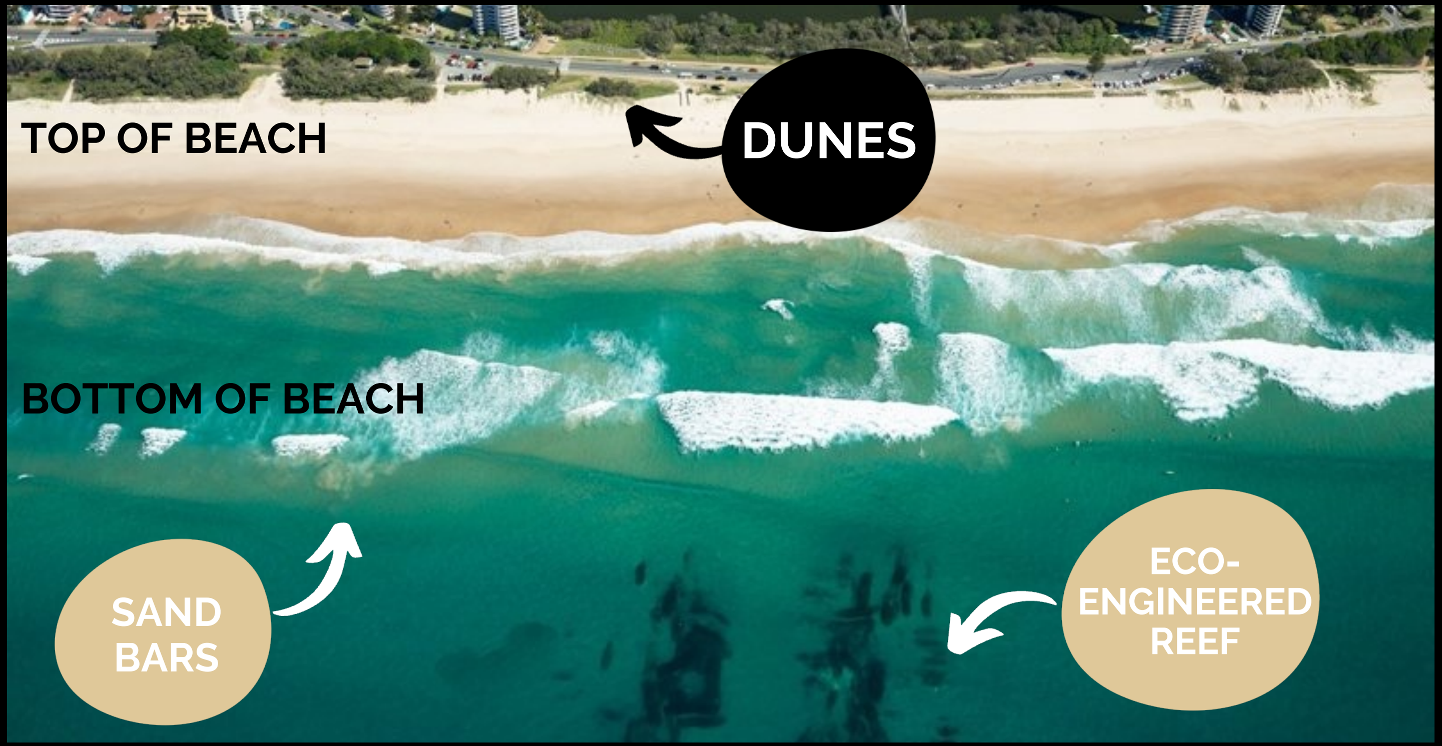
Source: Historical images by Oceanside Historical Society

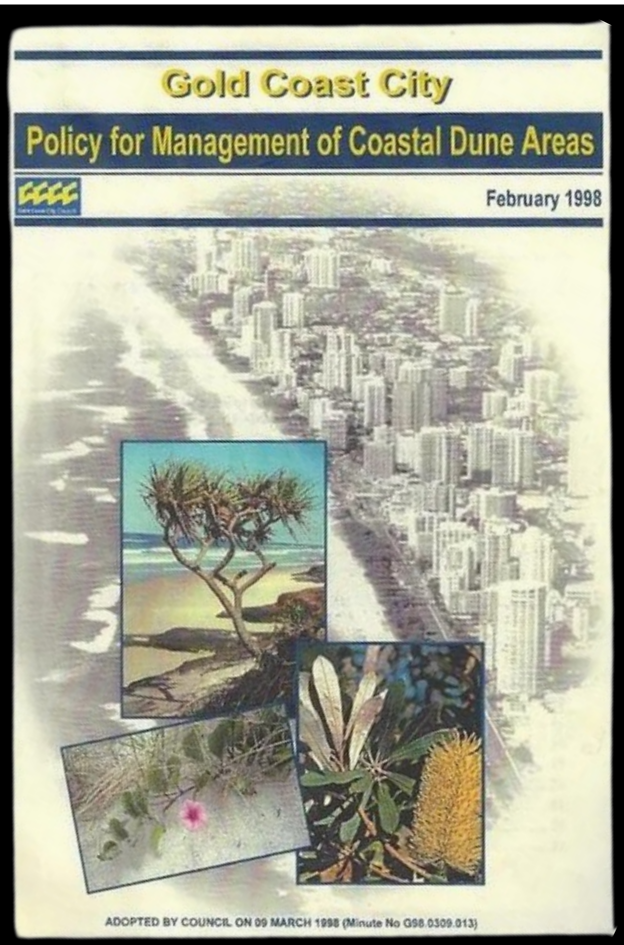
DESIGN GOALS

ADDRESS TOP AND BOTTOM OF BEACH

✓ **Nourish and stabilize top of beach**

✓ **Nourish and stabilize the bottom of the beach**




Gold Coast City

Policy for Management of Coastal Dune Areas

February 1998

ADOPTED BY COUNCIL ON 09 MARCH 1998 (Minute No G98.0309.013)

Our team has significant experience developing and implementing dune management and monitoring on the Gold Coast.

Successful "urban dunes" along Gold Coast beaches

OUR RE:BEACH TEAM

Angus Jackson
Executive Engineer & Director, ICM

Aaron Salyer
Principal Engineer & Director, ICM

Bobbie Corbett
Senior Principal Engineer, ICM

Martin Mulcahy
Principal Coastal Engineer, ICM

Sam King
Senior Coastal Engineer, ICM

Zack Lindenberg
Coastal Engineer, ICM

Rodger Tomlinson
Director of Center for Coastal Management, Griffith University

International Coastal Management (ICM)

- ICM founder, Angus Jackson, ran the Gold Coast City Council's coastal and waterways department from the early '80s
  - Responsible for Gold Coast Re Beach pilot projects
    - Sand bypass system for beach nourishment
    - Nearshore nourishment pilots and trials
    - The first artificial, multifunctional reef pilot
    - Dune management plans
    - Dredge management and sand management plans

World Leading Coastal Engineering Specialists

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Griffith University, Coastal and Marine Research Centre

- Development of sand monitoring programs
- Advising council on sand and beach management for decades
- Knowledge Hub development for coastal studies, research and development for coastal processes, climate change impacts and coastal environmental protection
- Ongoing monitoring and modeling of coastline programs

Monitoring and Technological Knowledge Hub

Griffith UNIVERSITY
Queensland, Australia

Fundamental to the Gold Coast's RE BEACH project & ongoing success

POTENTIAL APPROACHES

FOR RE:BEACH OBJECTIVES

Protect /Defend

A. Harder

Big structure = trap sand/groyne effect

Breakwater = stop waves offshore

✓ Protects coastline / retains sand

✗ Various levels of disturbance to natural flow/visual impact

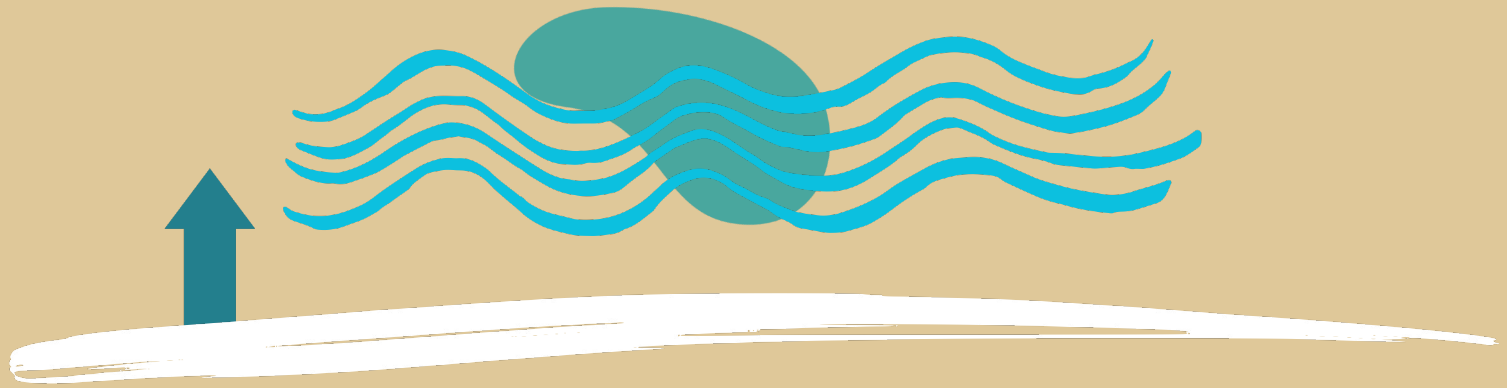
Protect /Defend

✓ Recommended

B. Softer

Small structure = slow sand movement

Reef = reduce wave energy on beach



✓ Protects coastline / retains sand

Lower disruption to natural flow and visual impact

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OUR RECOMMENDED APPROACH

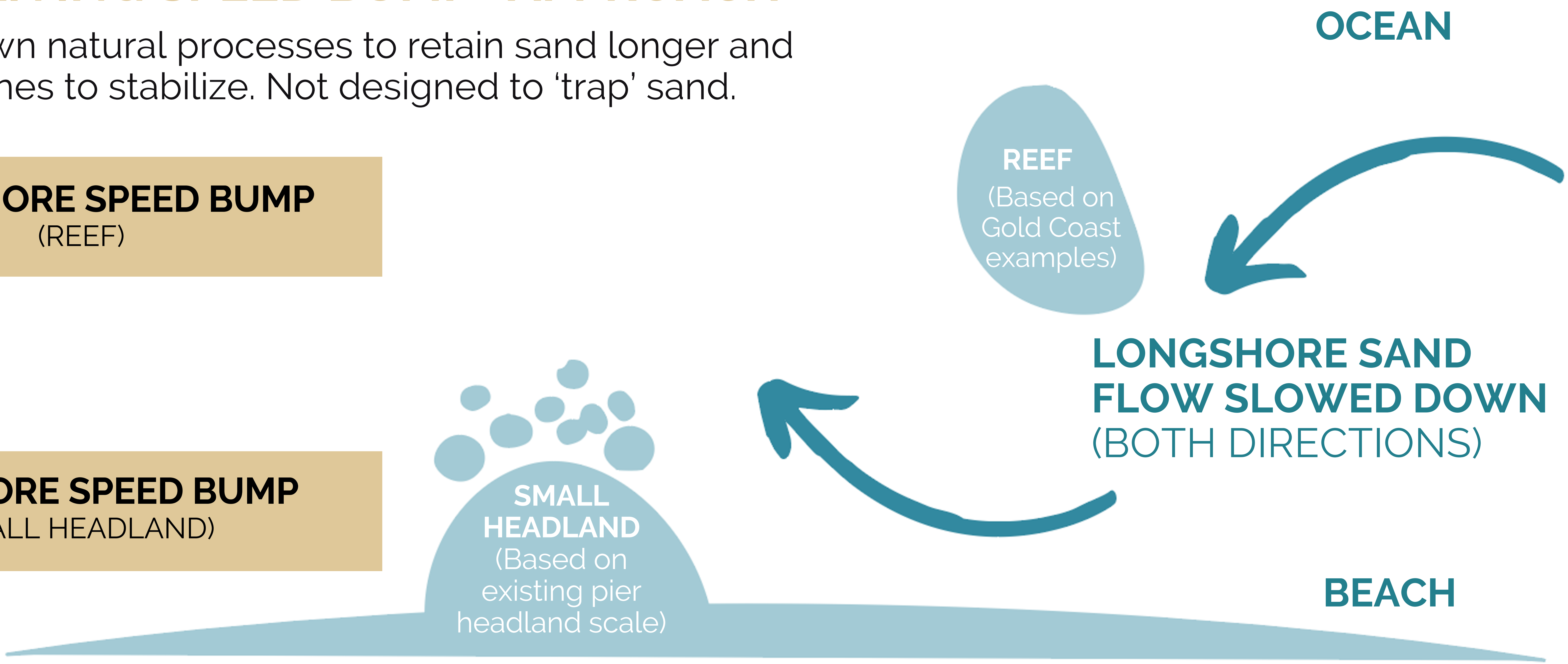
B) PROTECT/ DEFEND - "SOFTER" APPROACH

THE "LIVING SPEED BUMP" APPROACH

Slow down natural processes to retain sand longer and allow dunes to stabilize. Not designed to 'trap' sand.

1. OFFSHORE SPEED BUMP
(REEF)

2.ONSHORE SPEED BUMP
(SMALL HEADLAND)



THE DESIGN BREAKDOWN

TOP OF BEACH STABILIZATION

1. ONSHORE SPEED BUMPS

2. DUNE VEGETATION

BOTTOM OF BEACH STABILIZATION

3. NEARSHORE NOURISHMENT

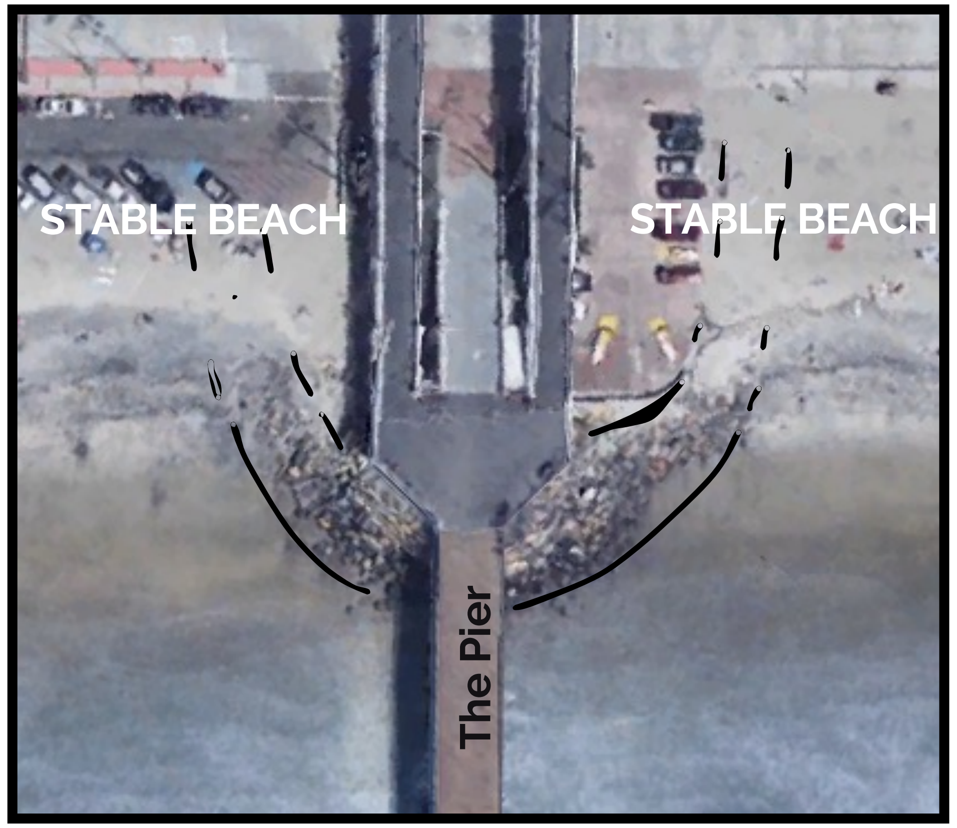
4. ECO-ENGINEERED REEFS

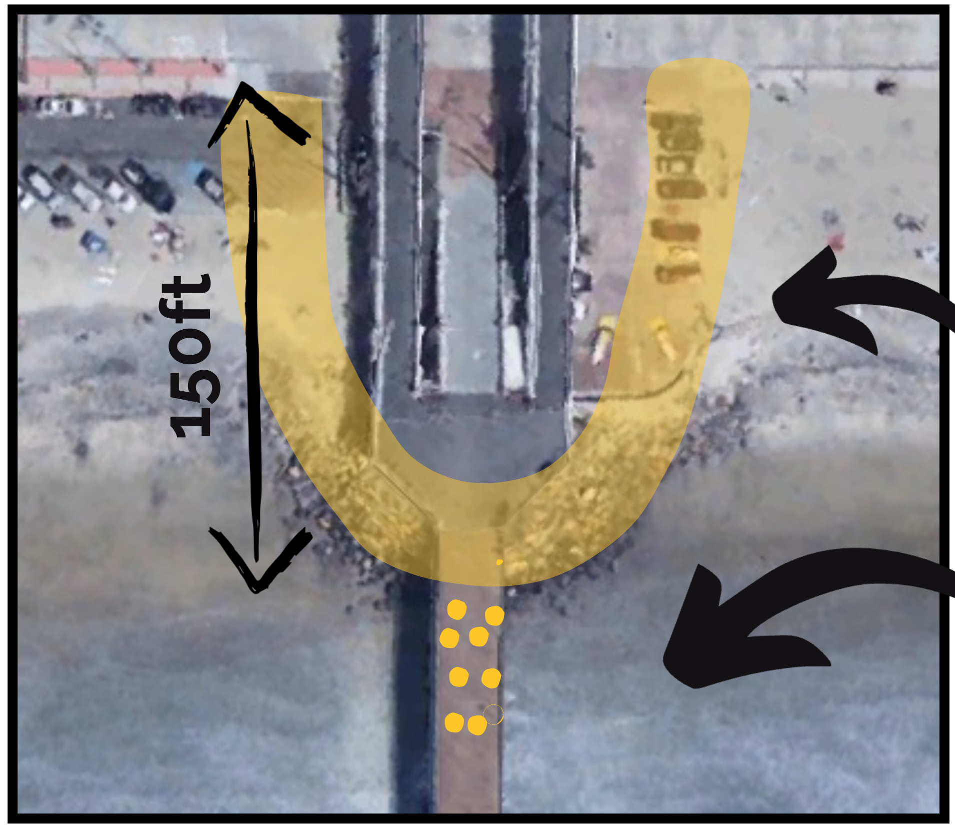
TOP OF BEACH STABILIZATION

CONCEPT VISUAL

TOP OF BEACH STABILIZATION

1. BUILD ONSHORE SPEED BUMPS





SCALED FROM THE EXISTING PIER HEADLAND

Existing Pier Headland
(usable space)

Existing Piles (permeable end)
Can reduce wave breaking & sand flow in intertidal zone

EXISTING PIER HEADLAND → NEW HEADLAND & PERMEABLE END #1 → NEW HEADLAND & PERMEABLE END #2

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TOP OF BEACH STABILIZATION

1. BUILD ONSHORE SPEED BUMPS

EXISTING

NEW

NEW

Benefits

- Stabilizes the top of the beach, allowing for the development of dunes
- Allows natural sand bypass/flow
- Retains nourished sand for longer
- New public space created

However, with this solution alone

- The intertidal beach is still subject to erosion
- Increasing storm severity (climate change) is likely to increase the extent of erosion
- Expect seasonal shifts in beach alignment

Recommended

- Add a mechanism to **stabilize bottom of beach**
  - to reduce wave impact/erosion
  - & retain sand in the nearshore area

TOP OF BEACH STABILIZATION & **BOTTOM OF BEACH STABILIZATION**

BOTTOM OF BEACH STABILIZATION

CONCEPT VISUAL

BOTTOM OF BEACH STABILIZATION

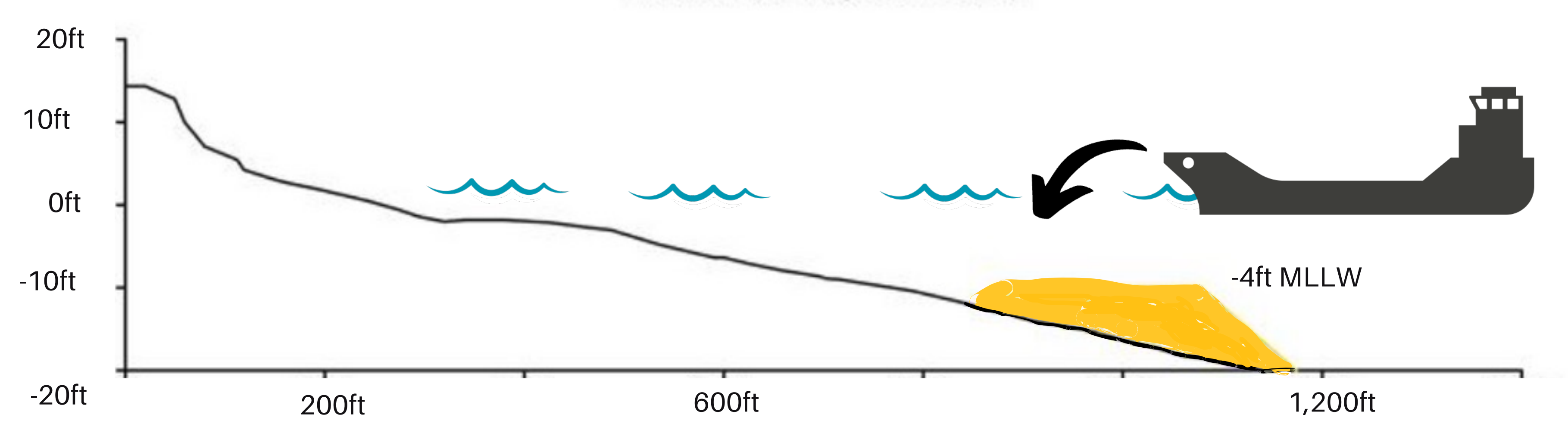
3. NEARSHORE NOURISHMENT

NEARSHORE NOURISHMENT

- Builds up the sand bar
- A system piloted and proven on the Gold Coast and now used around the globe
- Either "rainbow" or bottom dump sand in offshore zone

CONCEPT FOR OCEANSIDE

NEARSHORE NOURISHMENT PLACEMENT



TYPICAL X SECTION (MLLW)

Quality of sand is less crucial

1/2 the price of onshore nourishment

Moves onshore naturally - proven

Scan for more nearshore nourishment info & examples

BOTTOM OF BEACH STABILIZATION

4. ECO-ENGINEERED REEF

ECO-ENGINEERED REEFS

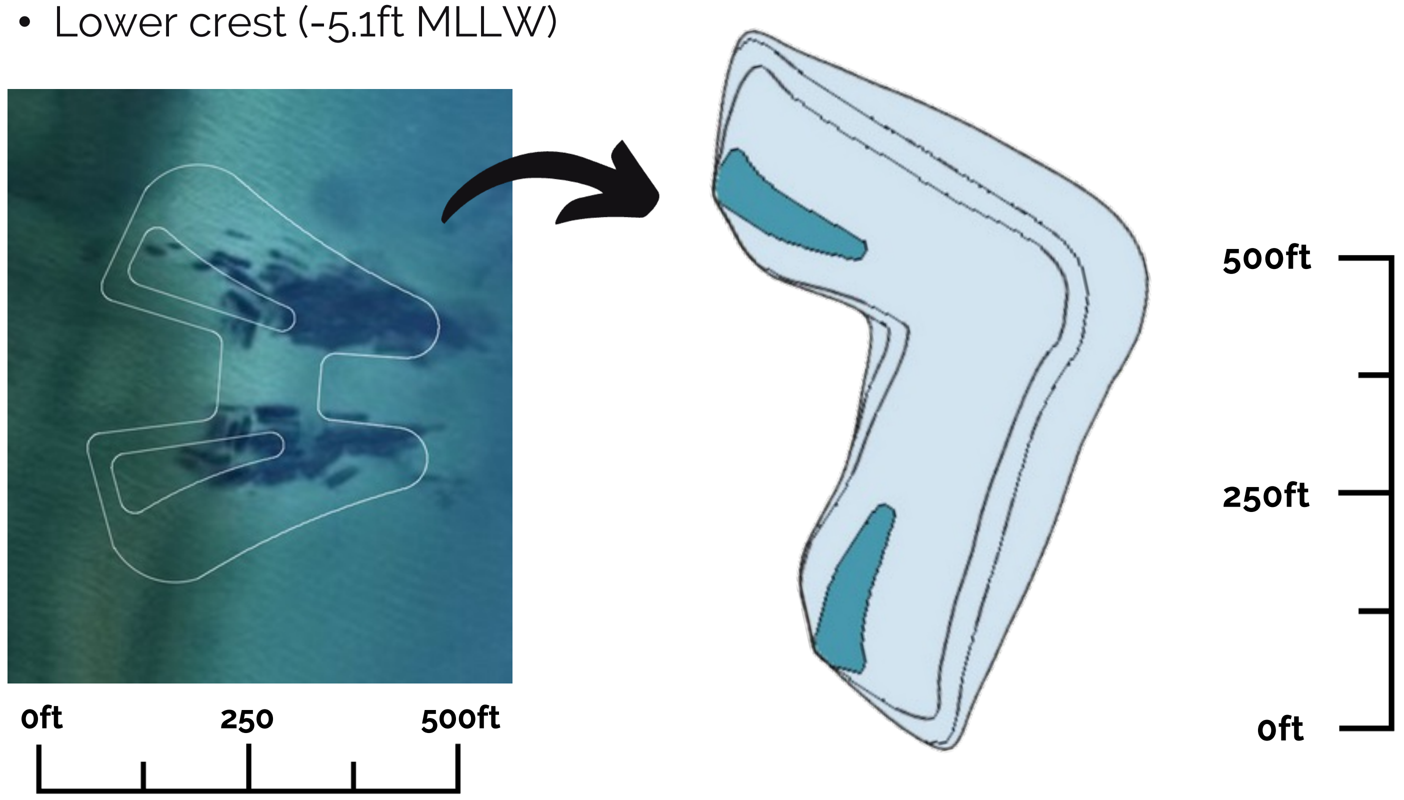
- Proven successful over 20+ years on Gold Coast for improved beach volume retention
- Reduction in beach erosion severity during storm events
- Additional ‘multifunctional’ benefits (social & ecological)

CONCEPT FOR OCEANSIDE

TWO APPROACHES CONSIDERED

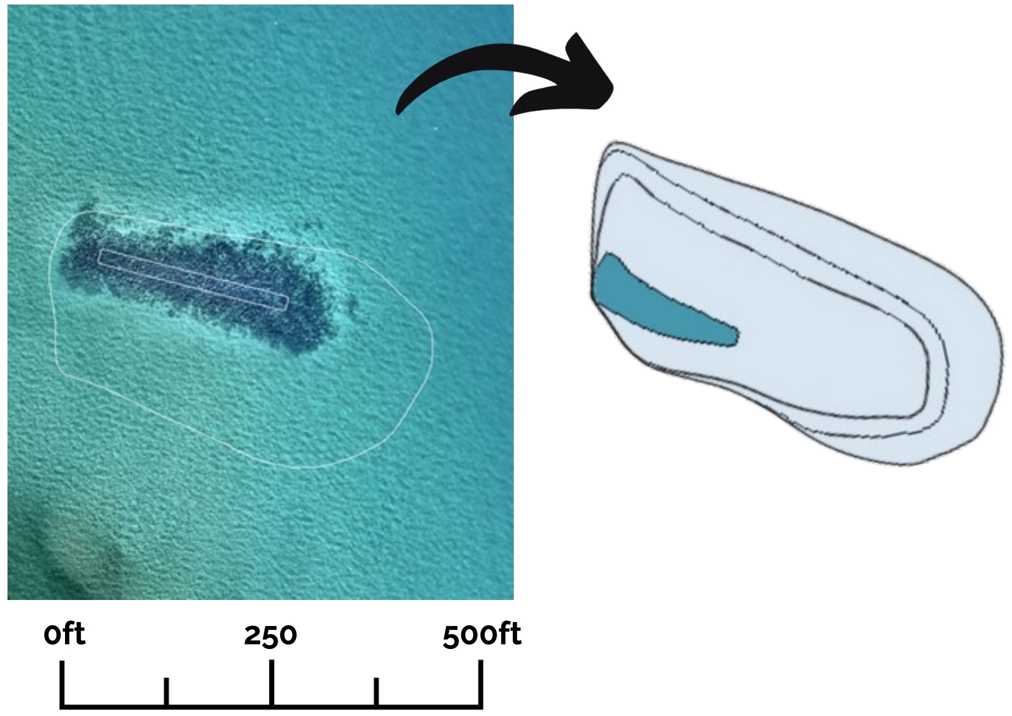
SAND-FILLED GEO CONTAINERS

- Wider footprint
- Lower crest (-5.1ft MLLW)



ROCK

- Smaller footprint
- Higher crest (-3.8ft MLLW)



BOTH HAVE POSITIVES & NEGATIVES

- Safety
- Cost
- Constructability
- Longevity
- Removability
- Environmental

DETAILED DESIGN (BOTH OPTIONS)

- Numerical & physical modeling
- Consultation
- Cost-benefit analysis
- Environmental analysis

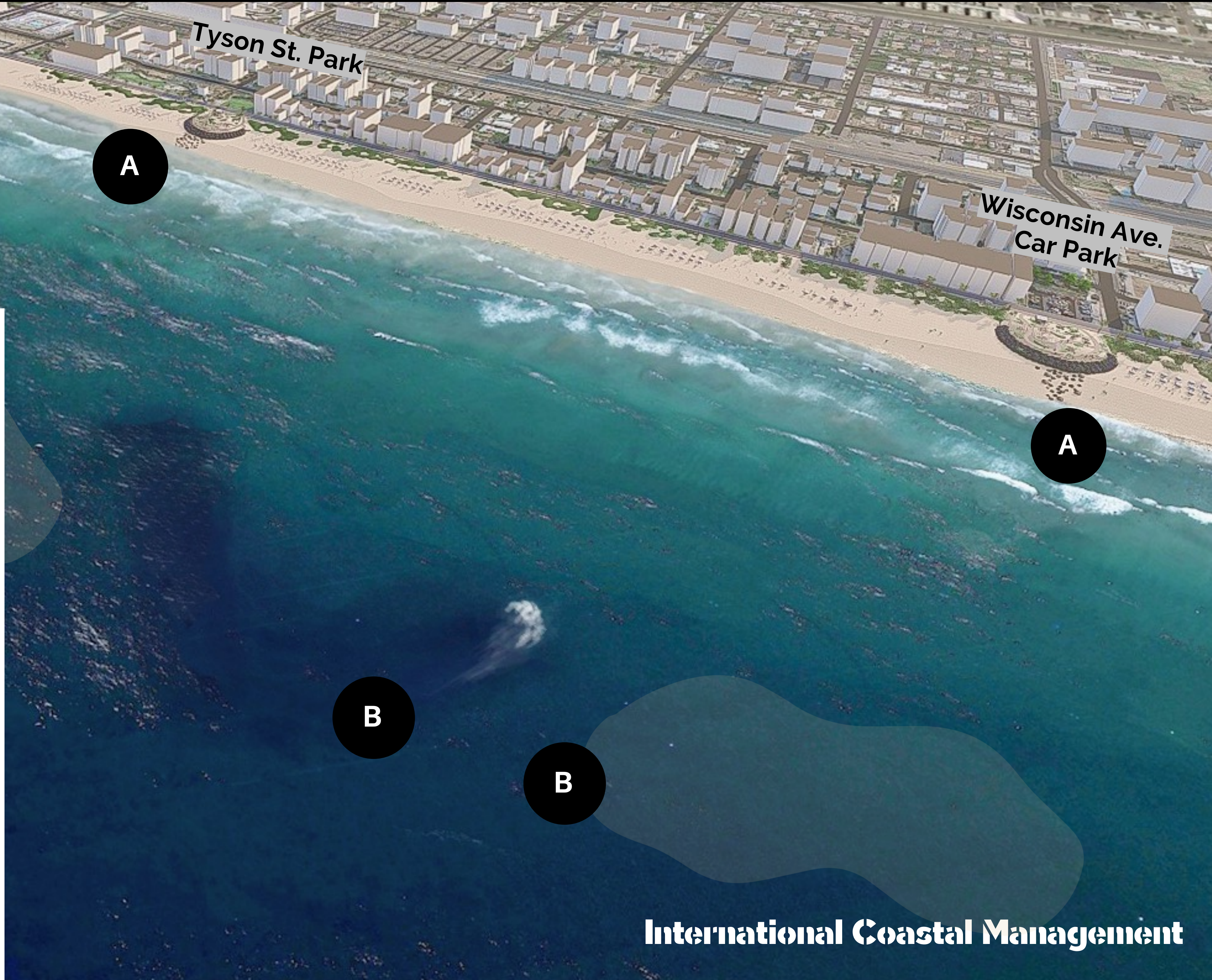
INSTALL & MONITOR

- Construction windows
- AI cameras, surveys

Scan for more reef info & examples

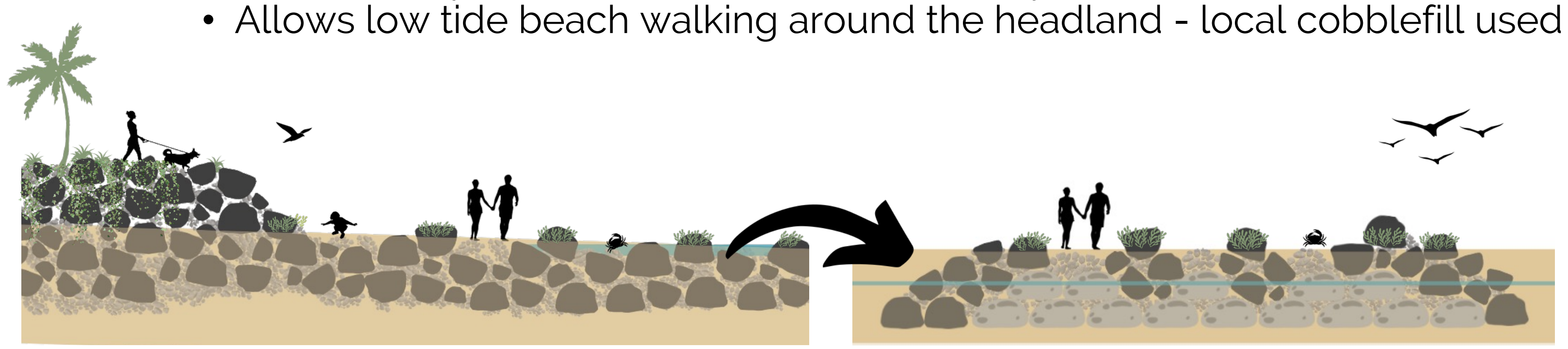
TOP & BOTTOM OF BEACH STABILIZATION

CONCEPT VISUAL



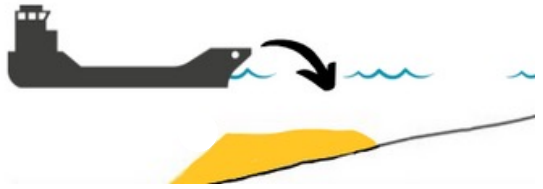
A Living Headland & Low Permeable Berm

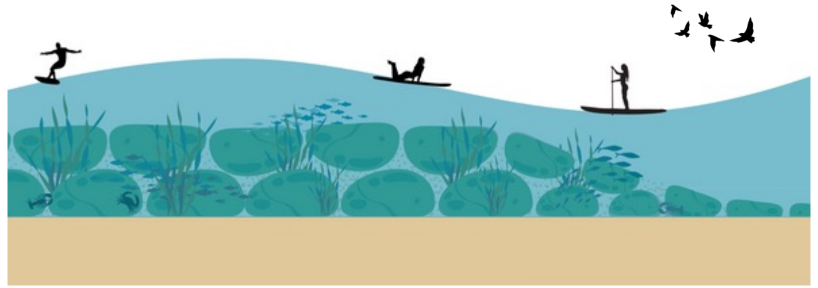
- Based on the existing pier headland scale & permeable extension into the surf zone (piles)
- Stabilizes top of beach to allow dune development
- Allows low tide beach walking around the headland - local cobblefill used



B Nearshore Sand Nourishment & Eco-Engineered Reef (Submerged)

- Based on proven Gold Coast examples (20 years+ in similar conditions)
- Improves sandbar retention & reduces beach erosion
- Ecological and surf benefits





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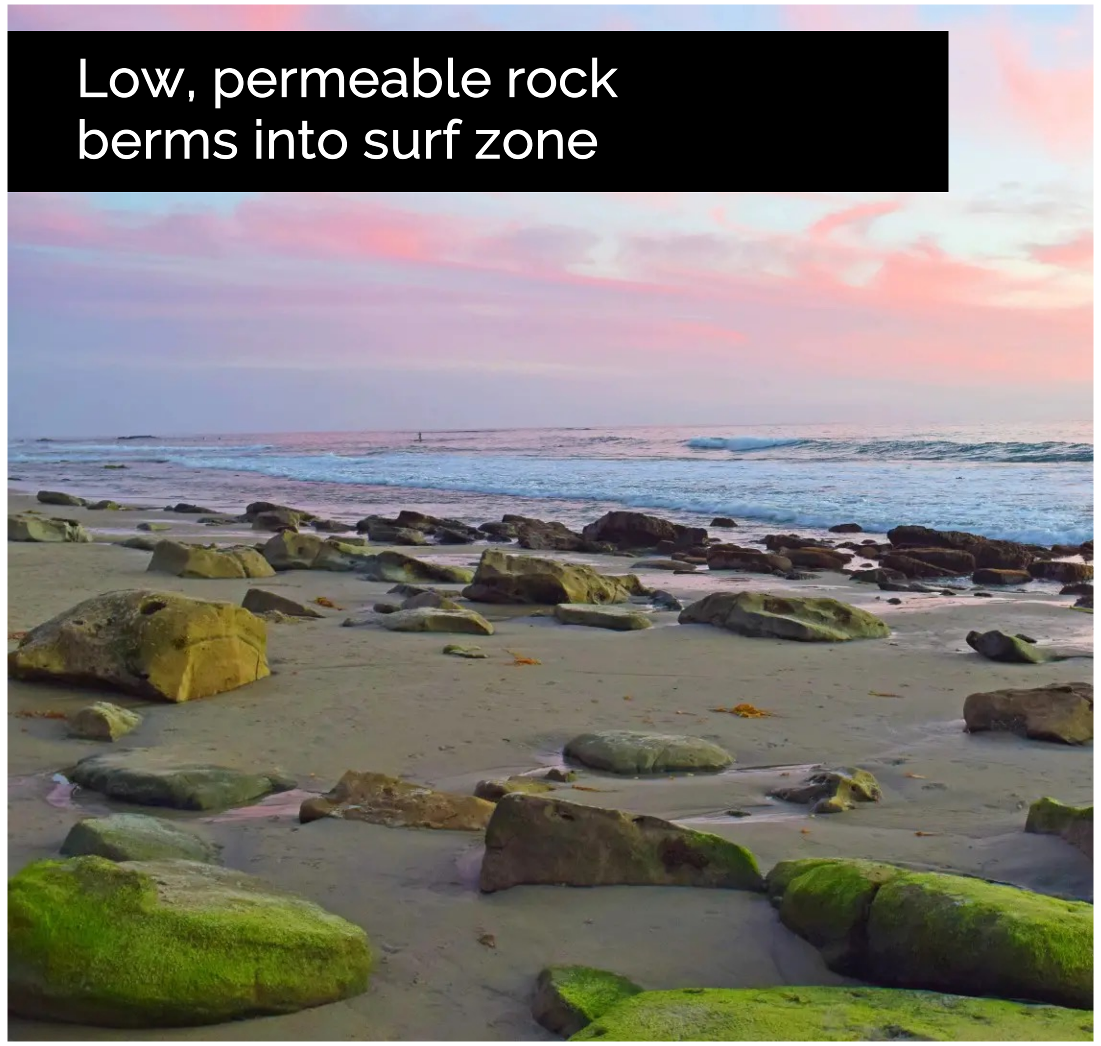
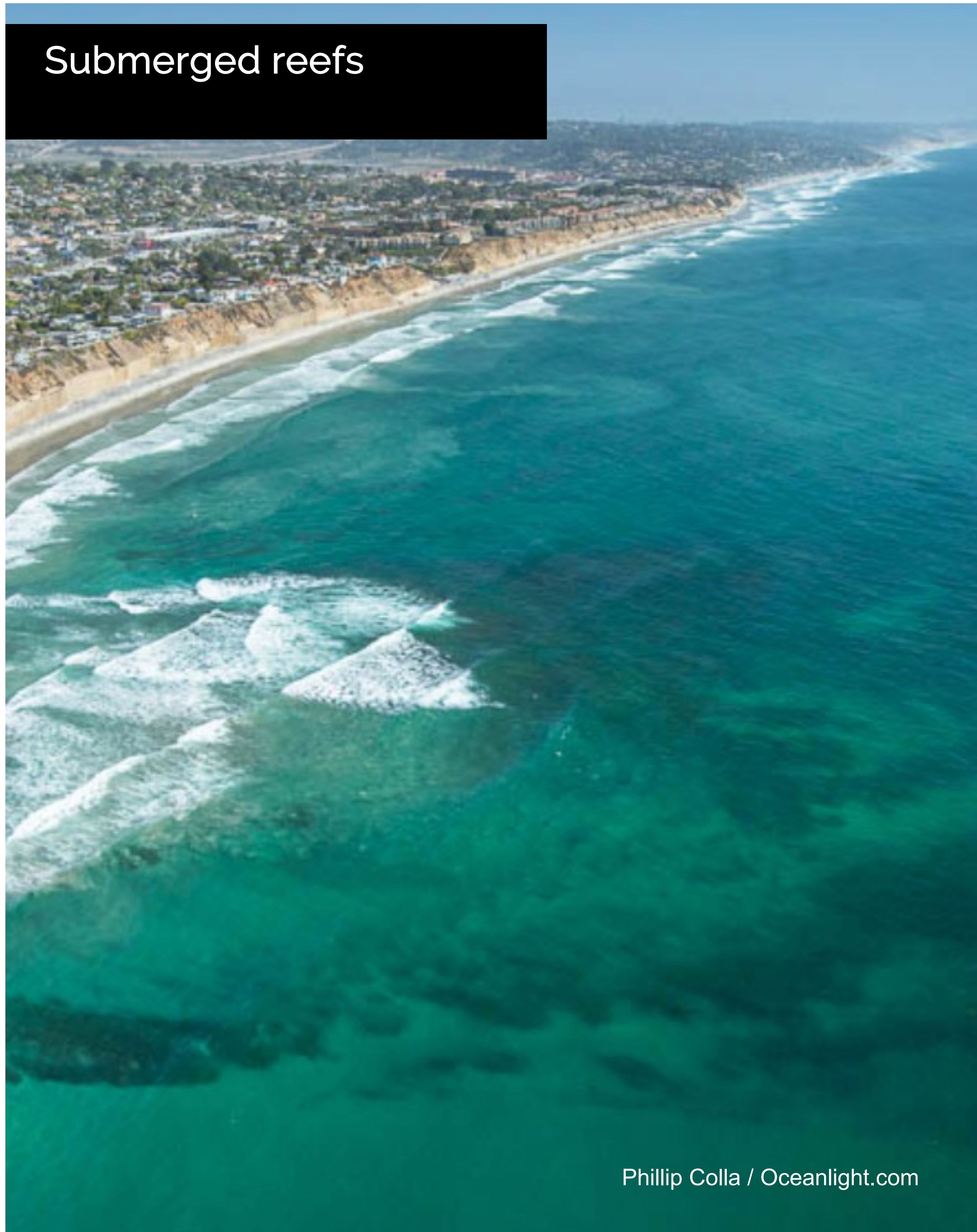
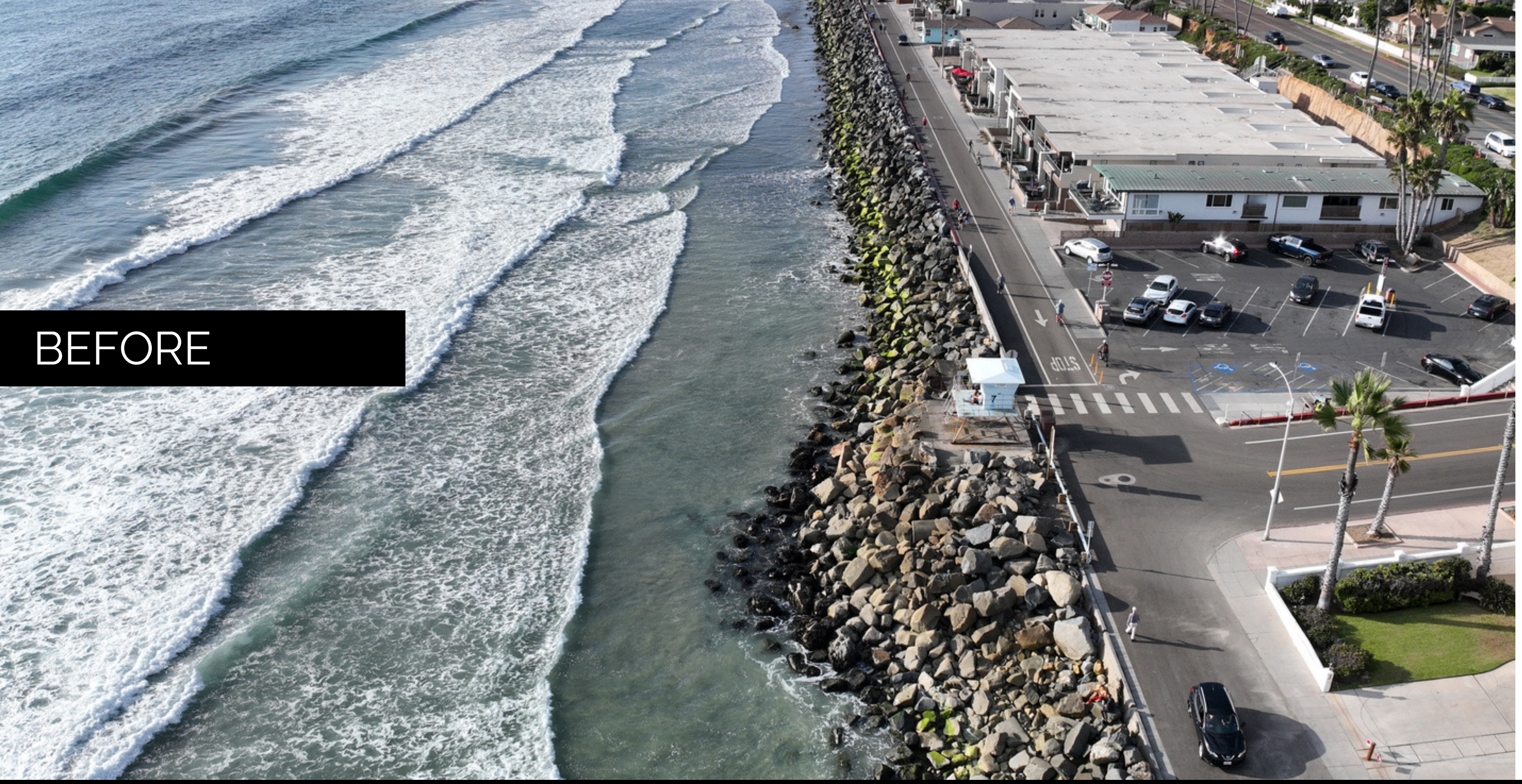
LOCAL INSPIRATION

SOUTHERN CALIFORNIA'S COASTAL ELEMENTS







THE CONCEPT

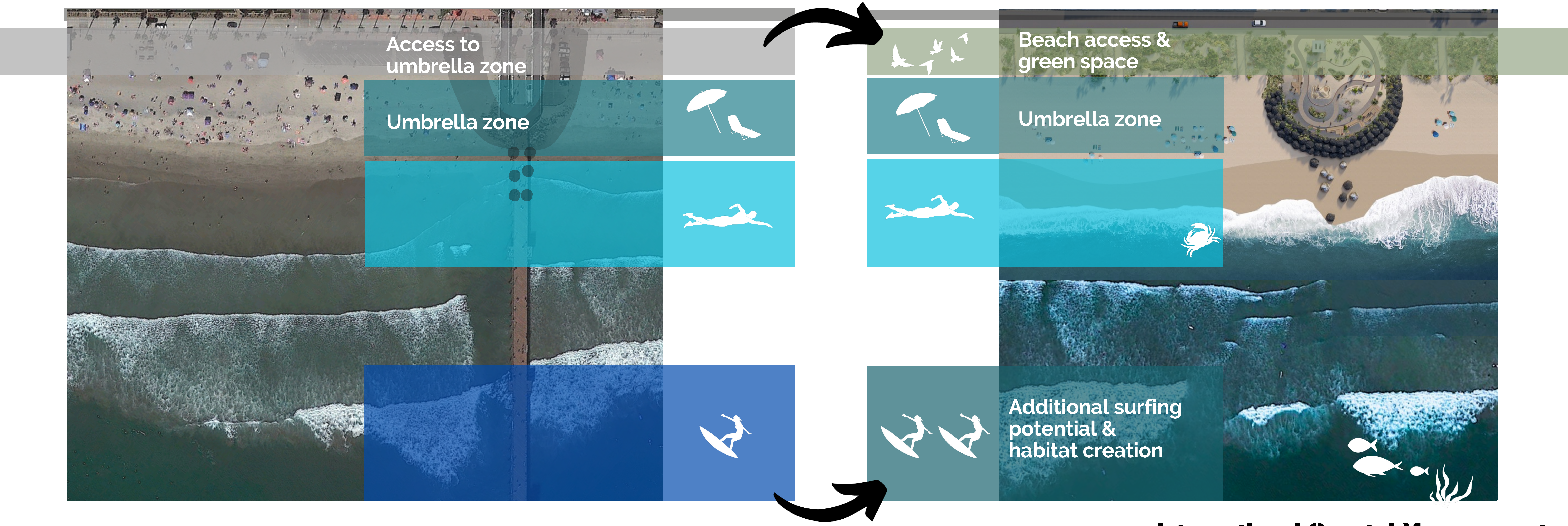

BEACH USABILITY

SCHEMATIC CONCEPT LAYOUT

BEACH USABILITY
EXISTING HEADLAND VS NEW HEADLAND

Existing Stable Beach (next to existing headland)

New Stable Beach (next to new headland)



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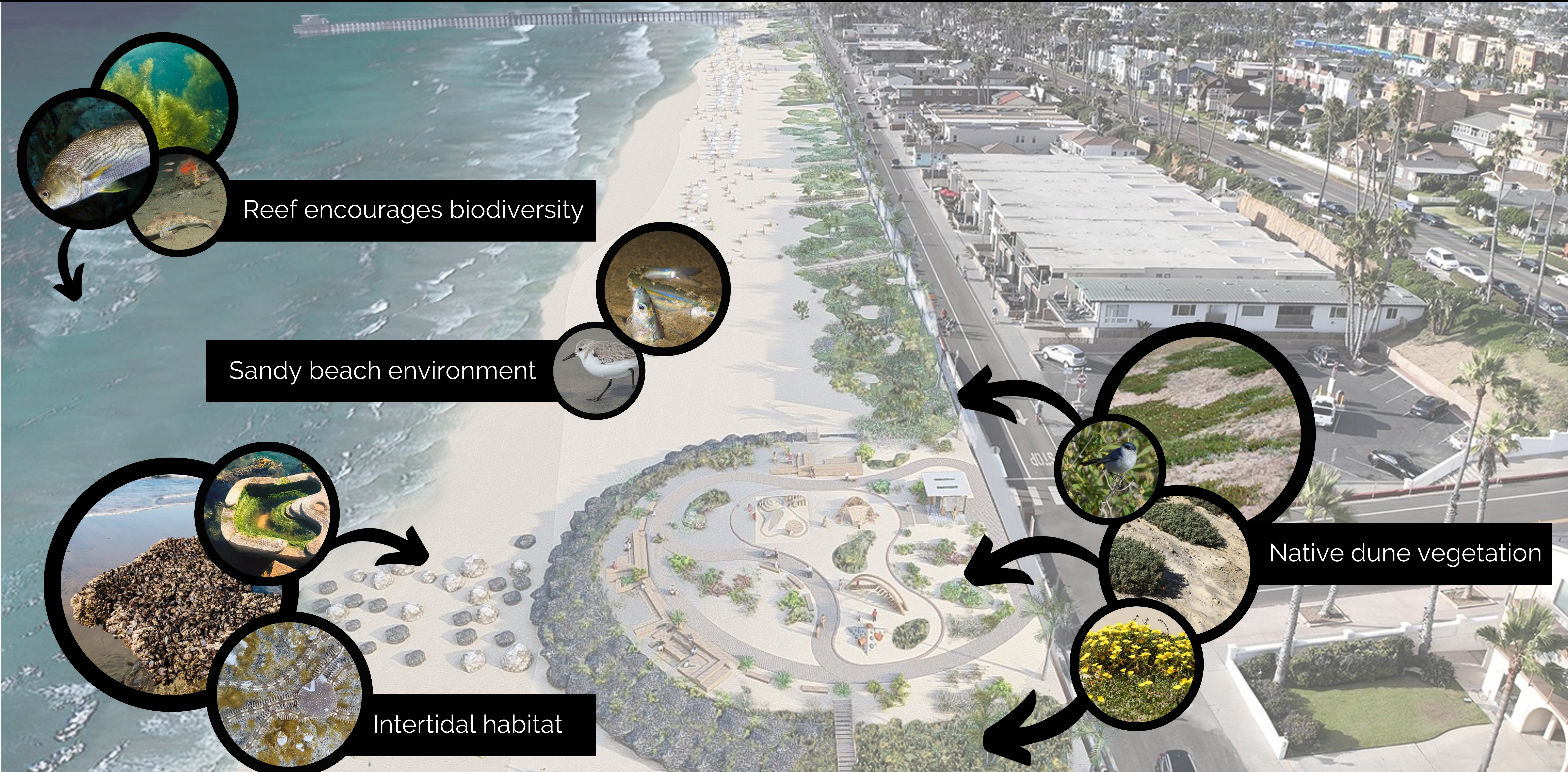
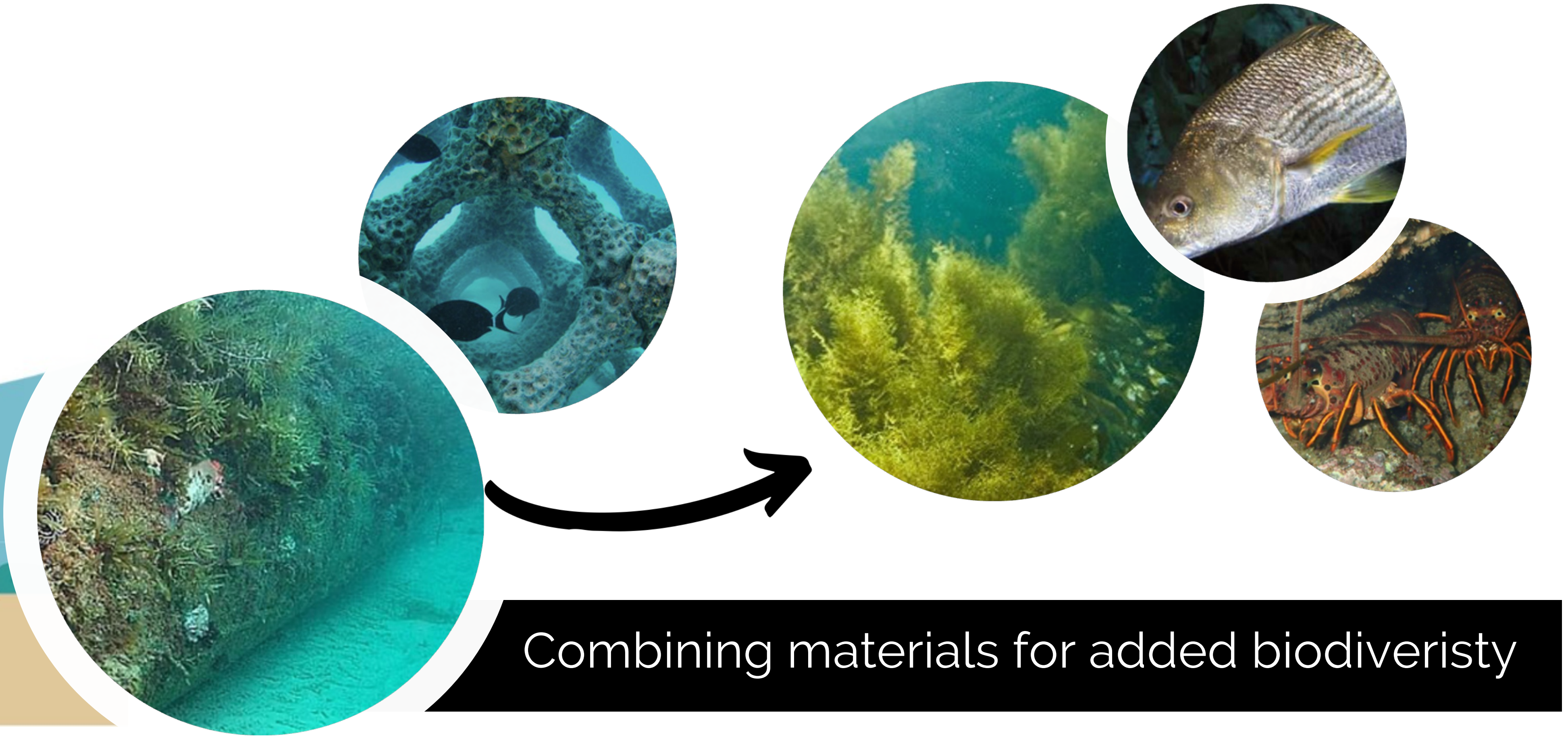
ENVIRONMENTAL BENEFITS



ENVIRONMENTAL BENEFITS OF AN ECO ENGINEERED REEF

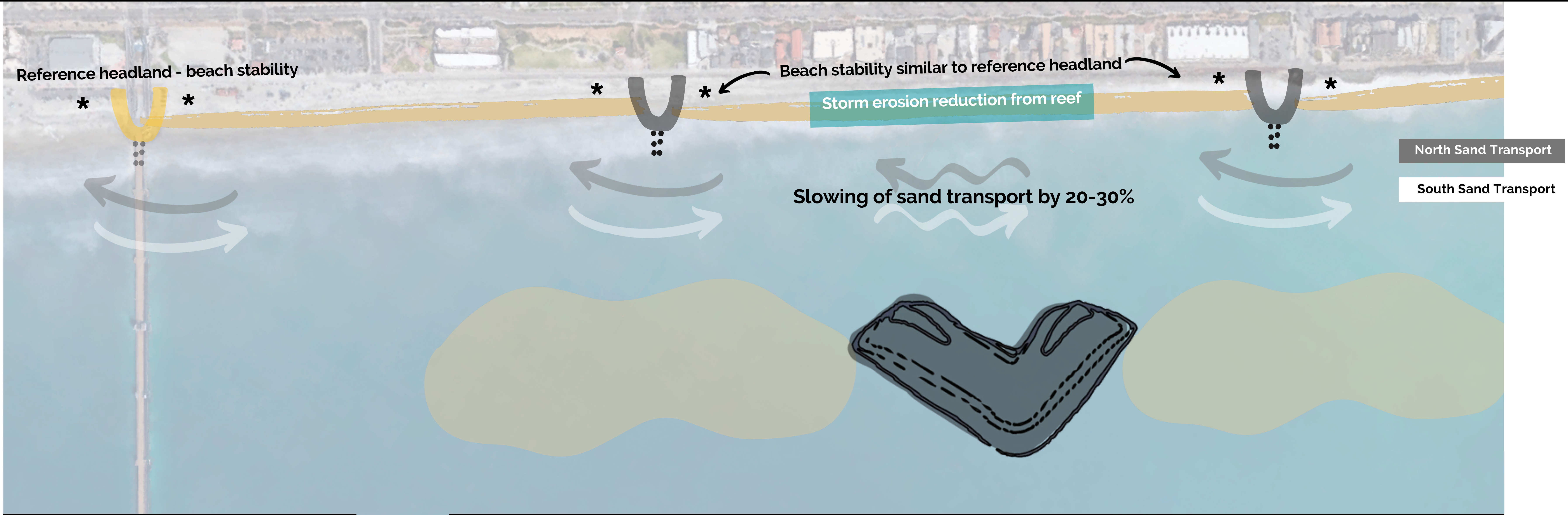
BASED ON REAL WORLD RESULTS

OCEANSIDE EXPECTATIONS



EXPECTED PERFORMANCE

Slow down natural processes to retain sand longer and allow dunes to stabilize.
Not designed to 'trap' sand.



Performance of Structures

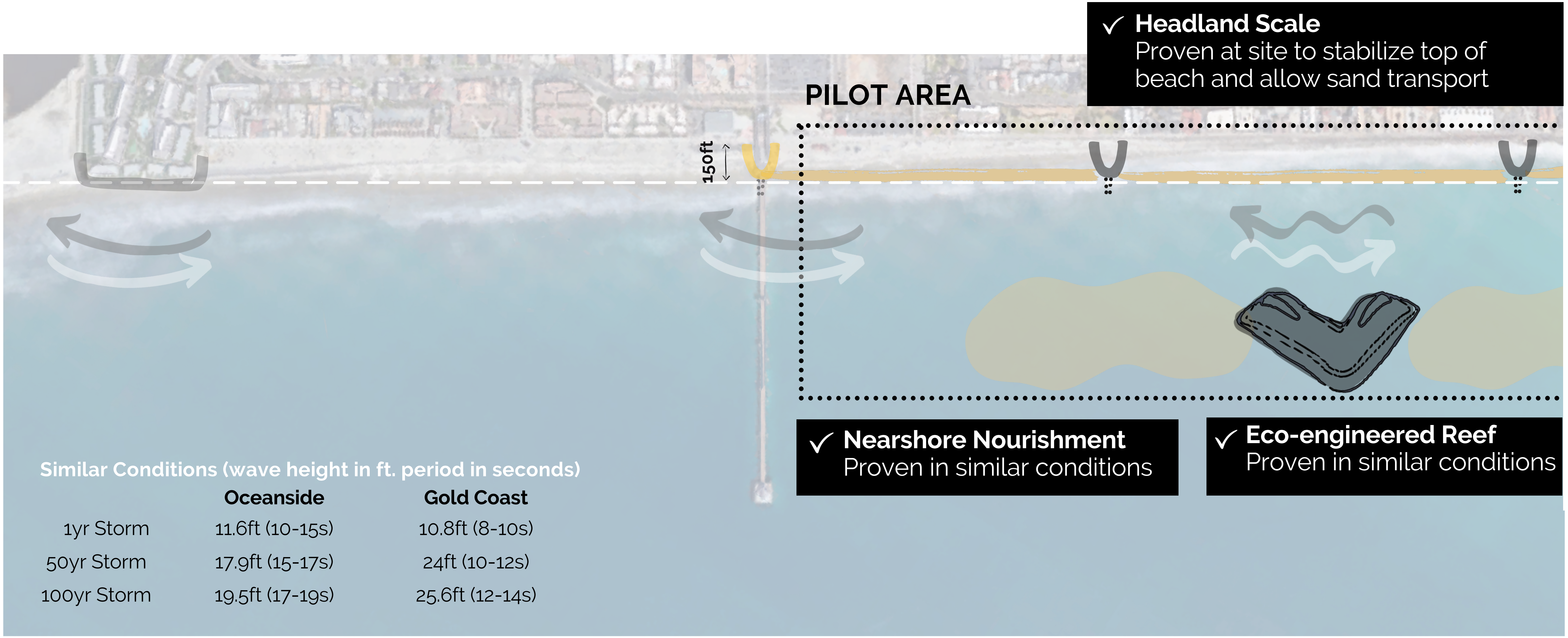
- ✓ Stable during storms
- ✓ Vandal resistant
- ✓ 30+ year material life
- ✓ Real-world tested
- ✓ Adaptable for climate change

Beach Performance

- ✓ Targets a slowing of the longshore transport rate of about 20%-30%.
- ✓ With an assumed net longshore rate of about 250,000cy/year at Oceanside, and a sand supply deficit of about 90,000cy/year. This slowing is expected to halve the sediment deficit at the pilot beach.
- ✓ The assumed 300,000cy every 5 years would support a sandy beach at the pilot site.

DE-RISKING INNOVATION

Based on known and tested coastal engineering principles and design elements



Similar Conditions (wave height in ft. period in seconds)

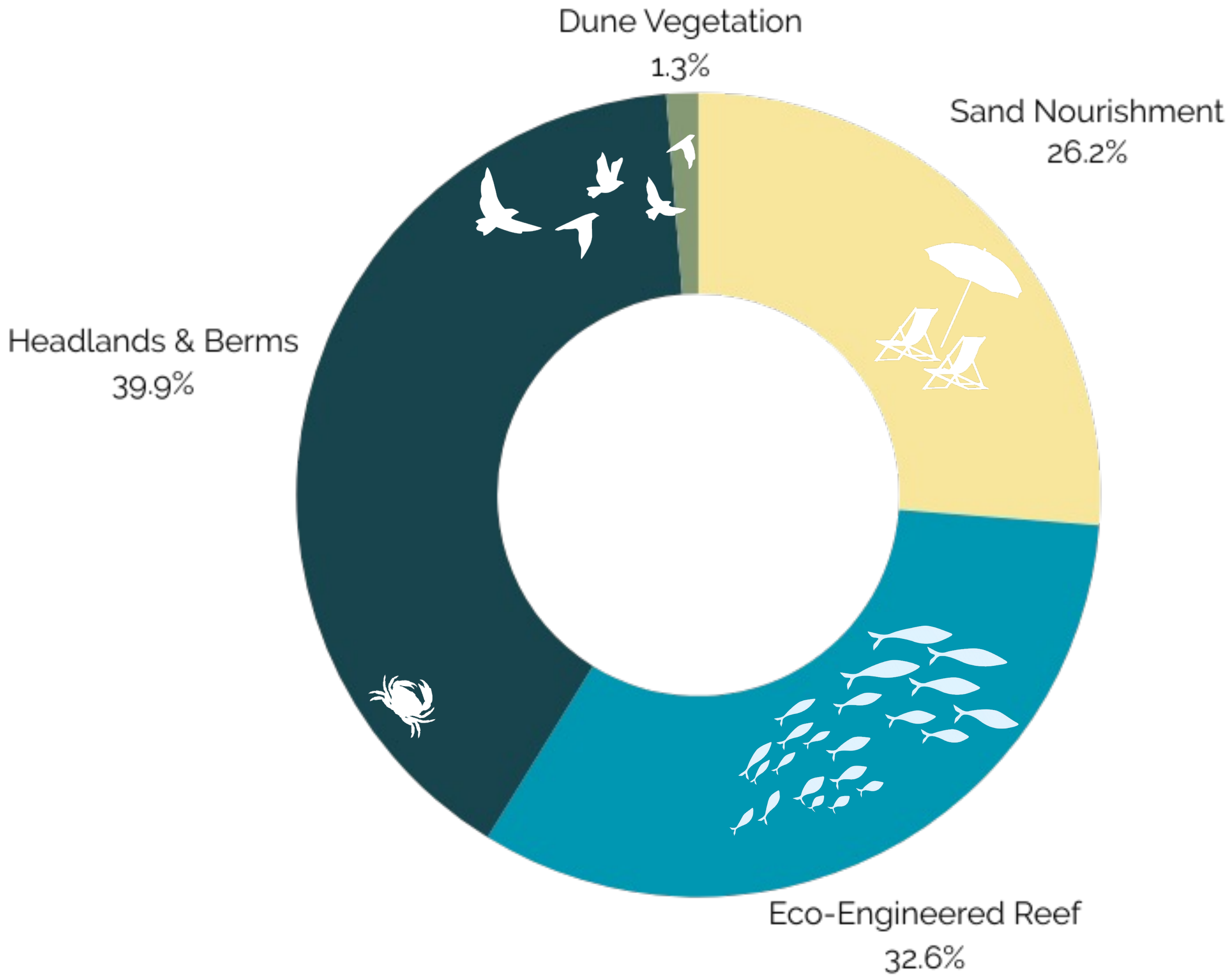
	Oceanside	Gold Coast
1yr Storm	11.6ft (10-15s)	10.8ft (8-10s)
50yr Storm	17.9ft (15-17s)	24ft (10-12s)
100yr Storm	19.5ft (17-19s)	25.6ft (12-14s)

CONCEPT COST AND SCALABILITY

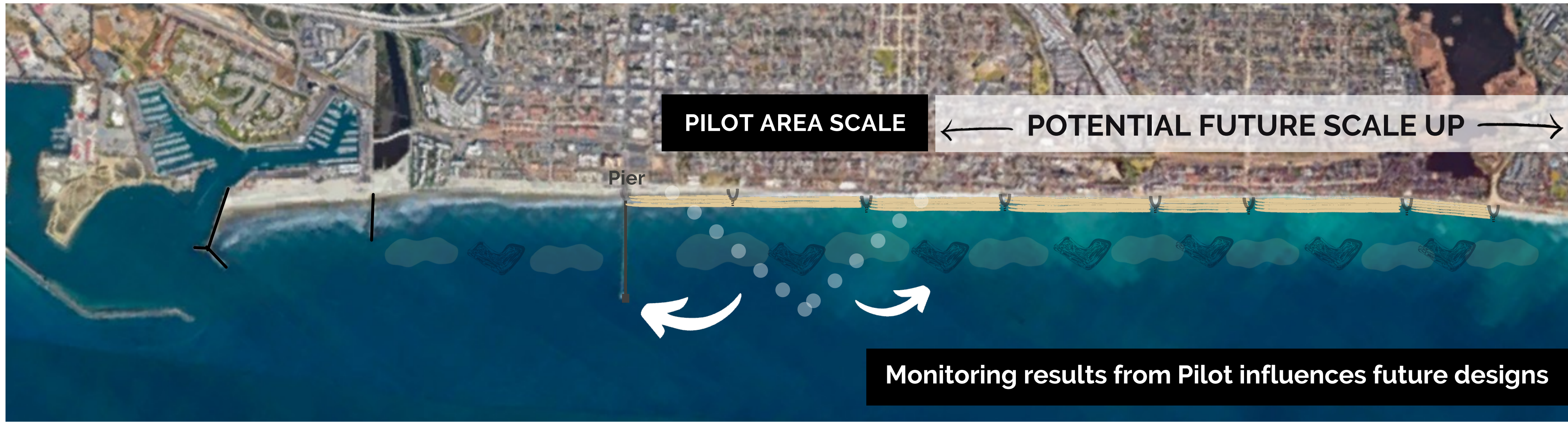
FOR PILOT PROJECT SITE (APPROX 4,000ft LENGTH)

Initial cost est. **$31.4M**

- Annual maintenance est. $500k
- Removal cost est. $4.7M



OCEANSIDE 'REEF CITY'



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LIVING SPEED BUMPS
& COASTAL RESILIENCE

CITY OF OCEANSIDE

KEEP BUILDING ON DECADES OF REAL-WORLD, COASTAL RESILIENCE DEVELOPMENT

FOR A GREENER, SANDIER OCEANSIDE INTO THE FUTURE

IN ADDITION TO DESIGN, ICM BRINGS:

- MONITORING
- TECHNOLOGY
- MANAGEMENT
- MATERIALS R&D

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CITY OF OCEANSIDE

THANK YOU!

THESE SLIDES & MORE INFO AVAILABLE
ON THE RE:BEACH WEBSITE

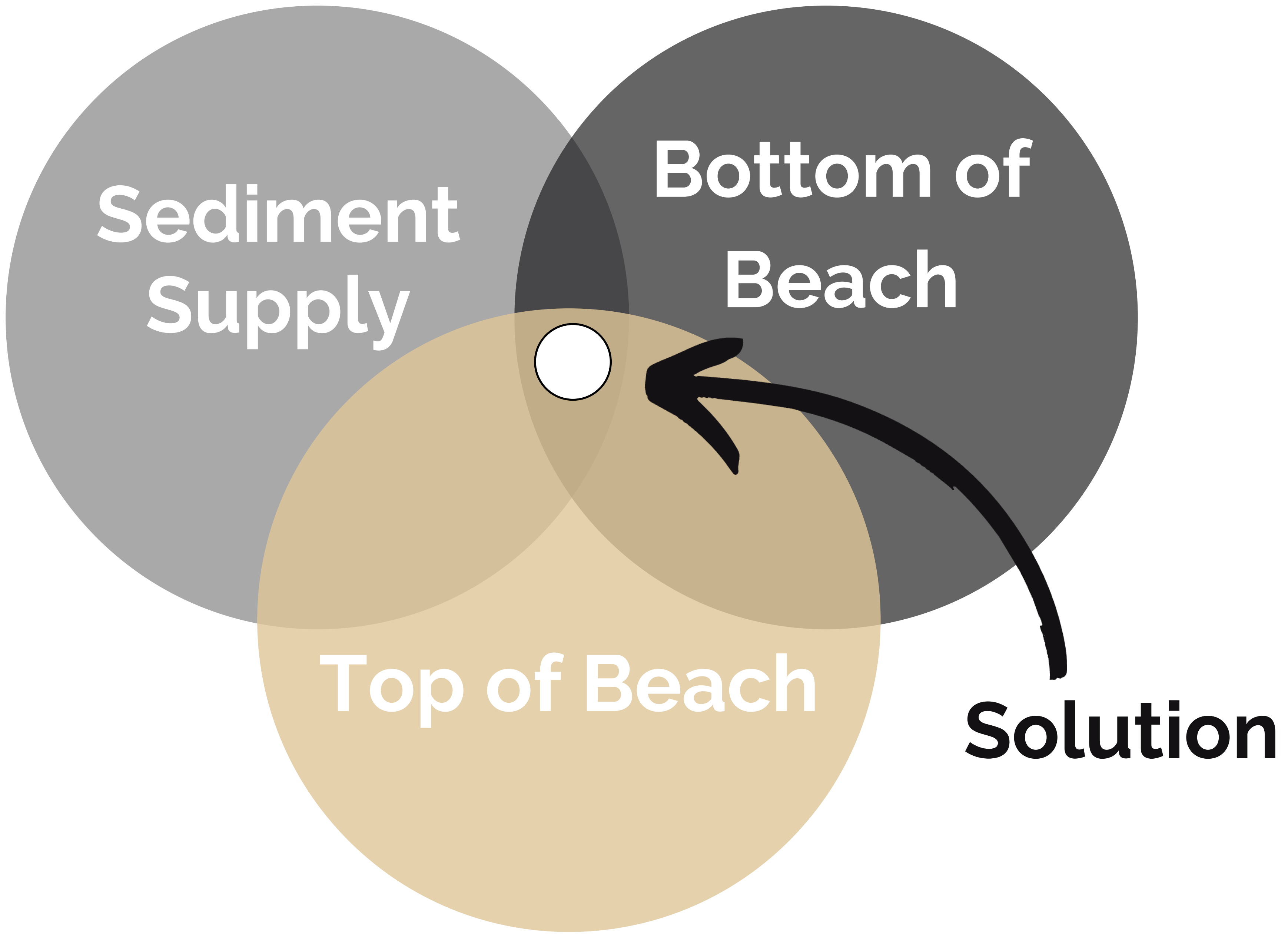
RE:BEACH LIVING SPEED BUMPS

ADDITIONAL INFO

OUR RE:BEACH DESIGN APPROACH

In all of our Re:Beach projects, we need to address the following key points:

1. Address Sediment **Supply Deficiency**
   - Easy integration into future bypass or nourishment campaigns
     - ICM recommends and can assist in bypassing system for the future of Oceanside
   - Providing novel nourishment (nearshore) for cost-effective sediment supply
2. Improve **Bottom of Beach** Sand Retention
3. Improve **Top of Beach** Sand Retention & Enhance Foreshore Amenities



CONCEPT SCHEMATIC ECO-ENGINEERED REEF

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Conceptual Schematic Cross Section of Eco-engineered Reef at Oceanside

CONCEPT SCHEMATIC LIVING HEADLAND & LOW BERM

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Conceptual Schematic Cross Section of Living Headland and Low Permeable Berm

RE:BEACH DESIGN OBJECTIVES | NOURISHMENT

Design Criteria 1 Physical	Design Criteria 2 Financial	Design Criteria 3 Environmental	Design Criteria 4 Social	Design Criteria 5 Regional
Performance Goals *0 – 3 years.* Stabilize top of beach to allow a chance for dune vegetation to establish. Beach width initial variation with loss of fine material in nourishment. Seasonal variation, but less than previous (without retention structures). *5 – 10 years*. Beach volume reduction (without bypass) at a slower rate than historical, with monitoring to consider the next mass nourishment campaign (subject to climate conditions and performance of reef and headlands). Assume next mass nourishment in 10-20 years. **Positioning.** Nourishment targets both upper beach for public users and nearshore for cost-effective sand placement. Nourishment placed to maximize the benefit to public access sections of the beach. Provides sufficient sand and buffer for several years. Supports beach and sand retention structures at Oceanside.	**Cost Estimate.** Approx. **$2.5** for onshore nourishment Approx. **$5.6** for nearshore nourishment. Need for additional mass nourishment campaigns dependent on performance of sand retention structures, and construction of bypass system. The volume of onshore nourishment could be reduced cost. Or tied into other sand source/nourishment projects. Cost-benefit analysis is required to determine what volume placed in nearshore and left to move onshore naturally over time.	Focus is on allowing **sand to provide a coastal protection buffer** to the shoreline rather than structure. Dune vegetation along the top of beach (held in place by headland) to allow for natural build up. Does not require removal following the pilot. Nearshore nourishment via rainbow dredging done with environmental standards in mind.	Supports **wide, sandy beach** and beach aesthetic for Oceanside. Provides consistent beach accessibility in high-use areas. Allows for beach modifications for accessibility (e.g. wheelchair beach ramps).	Provides sand supply to downdrift beaches. Mass nourishment campaigns can be expanded to include other beaches along Oceanside with nearshore nourishment to reduce costs.

*Cost estimates are high level for comparative discussion only and not for quotation purposes. Subject to the detailed design stage.

RE:BEACH DESIGN OBJECTIVES MET | HEADLANDS & LOW PERMEABLE BERM

Design Criteria 1 Physical	Design Criteria 2 Financial	Design Criteria 3 Environmental	Design Criteria 4 Social	Design Criteria 5 Regional
Performance Goals. target 20-30% reduction of net sand transport rate *0 to 3 years.* Minimal impact on the beach following construction and nourishment (to create a wide beach). *3 to 15 years.* Stabilization of the upper beach to allow for dune development **Positioning.** Locations focused on providing maximum benefit to the beach with the greatest public access and usage. **Design.** 30+ years of design life based on materials, crest height and experience. Replicates natural headland features throughout the Southern Californian coastline. Rock shelf can incorporate local cobble into rock bags.	**Initial Construction.** **$12M for both headlands and landscaping.** Low maintenance requirements if properly designed and constructed, including annual inspection and removal of debris, vegetation or rubbish. Adjustable berm works as required during the pilot stage Rock armor may require re-stacking or topping up of rock within 10 to 20 years or after severe storm conditions. .	Designed not to impact existing nearshore habitats and to improve beach ecosystems. Helps to restore natural beach sand to Oceanside. Rock shelf provides substrate and structure for marine habitat. Potential for on-land designated green areas on headland, with flora for targeted species.	Provides improved beach stability and wider beach at areas of greatest public usage and access at Oceanside. Provides transformative opportunities for additional public amenities (parks, hospitality, services etc) Provides opportunities for increased access to the beach for the public. Provides 180-degree viewing opportunities of the beach and surf for the public.	Easily replicable concept with multiple transformative opportunities for public benefit. Headland space can be designed to provide specific benefits to the local area (ie. a surf museum display at Oceanside). Low impacts to longshore transport and improved bypassing around rounded headland.

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RE:BEACH DESIGN OBJECTIVES MET | ECO-ENGINEERED REEF

Design Criteria 1 Physical	Design Criteria 2 Financial	Design Criteria 3 Environmental	Design Criteria 4 Social	Design Criteria 5 Regional
Performance Goals. *0 to 3 years.* Development of temporary salient in the lee of the reef using sand from nourishment program. Establishment of habitat growth and initial settlement. *3 to 15 years.* Assists in beach volume retention. **Positioning.** Reef positioned to provide beach stability between headlands along sections of eroded beach. Reefs positioned to avoid existing surf spots as much as practical, whilst remaining accessible from the beach. **Design.** Artificial reefs provide coastal protection and beach stabiliation benefits irrespective of net sediment transport direction. 20 – 30-year design life based on materials, crest height, similar scale projects and experience.	**Initial Construction.** **$10.2M Reef** Maintenance. $100k (1~2% annual allowance). For the pilot project, a more cost-effective option is to use SFGC mega-containers, however, a rock option will also be considered. It is assumed conceptually to be an extra $6M cost.	Location of reef to avoid existing nearshore ecologies as much as practical. Reef provides excellent structure and substrate for nearshore habitat and marine ecologies.	Opportunities for surfing aspects align with the surfing culture and character of Oceanside. (on the reef during the right conditions - but also around the reef as the reef will encourage sand bars). Designed to not impact beach aesthetics (submerged at all tides). In calmer wave conditions, new reef habitat provides diving and fishing opportunities.	Easily replicable concept with opportunities to adjust design to suit specific sites i.e., focus on surfing amenity vs coastal protection. Offers improvement to stability of nourished sand, particularly in the nearshore. Does not significantly obstruct longshore sediment transport.

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RE:BEACH DESIGN KPI'S

COASTAL PROTECTION

- **Beach volume:**
  - Improves sand retention around the reef and along the beach
- **Downdrift impact:**
  - Changes downdrift within historical levels

AMENITY

- **Beach width:**
  - Usable beach width maintained
- **Surf amenity:**
  - Increase rideable waves in the area of the reef (sometimes on the reef, most times around the reef on sand banks)

SAFETY

- **Swimmer safety:**
  - Rip currents over & and around the reef should not occur 200yards from the shore
- **Surf safety:**
  - Reportable safety incident frequency rate consistent with other breaks in the area

*Note - design KPI's at concept level only, subject to detailed design stage.

PILOT MONITORING & ADAPTABILITY

Pilot Monitoring Targets & KPI's	Method of Measurement	Design Adaptability
Beach Volume & Width	Bathymetric Survey Hydrographic Survey	• Low cobble berm adaptable in length and porosity
Downdrift Impacts	Bathymetric Survey Hydrographic Survey	• Low cobble berm adaptable in length and porosity • Compartments filled with nourishment so additional sand naturally bypasses downdrift
Surf	Cameras (with AI) Consultations - Surf Groups	• Reef crest can be adjusted - in height by adding or removing material • Reef length - extended or shortened - adding or removing material
Safety	Cameras (with AI) Consultations - Lifeguards	• Reef crest can be adjusted - in height by adding or removing material • Reef length - extended or shortened - adding or removing material
Environment	Investigations & Studies comparative to Historic & Other Sites	• Materials can be adapted (either modified or replaced) or removed as required

NATURE BASED SOLUTIONS

Our design concept has focused on delivering a sustainable Nature-Based approach by keeping things as natural as possible, using design elements that mimic those that occur naturally in the region, working with natural coastal processes at Oceanside, as well as encouraging further eco-enhancement with design materials such as tidepool units in the intertidal zone of the low permeable berm and bio-reef units in the eco-engineered reef footprint.

WORKING WITH NATURAL PROCESSES

- Nearshore nourishment
- Dune vegetation

MIMICKING NATURAL COASTAL FEATURES

- Headlands holds top beach to support dunes
- Reef influences wave field and coastal circulation to benefit the beach

HABITAT CREATION & ENHANCEMENT

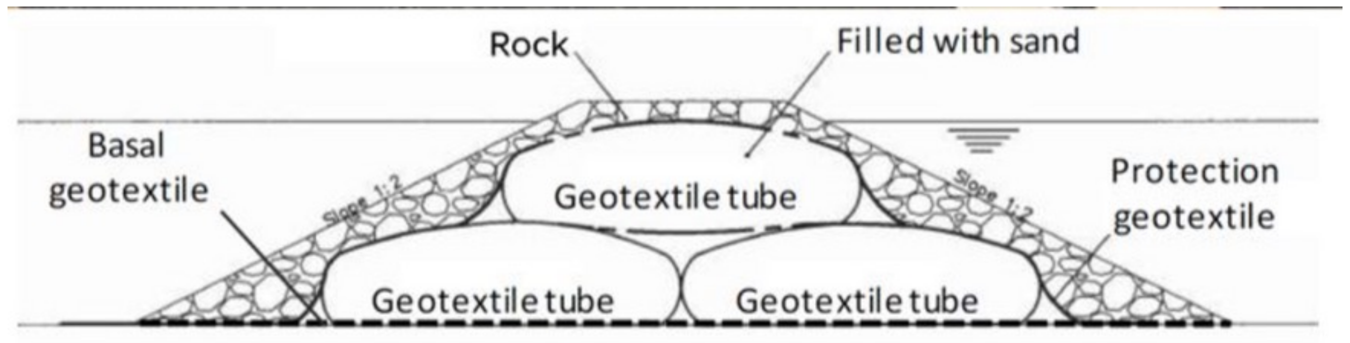
- New habitat onshore (dune), intertidal (berm) and offshore (reef)
- Eco-units at the berm and reef encourage new and diverse habitat
- Multi-beneficial - ecosystem + eco-tourism & recreation

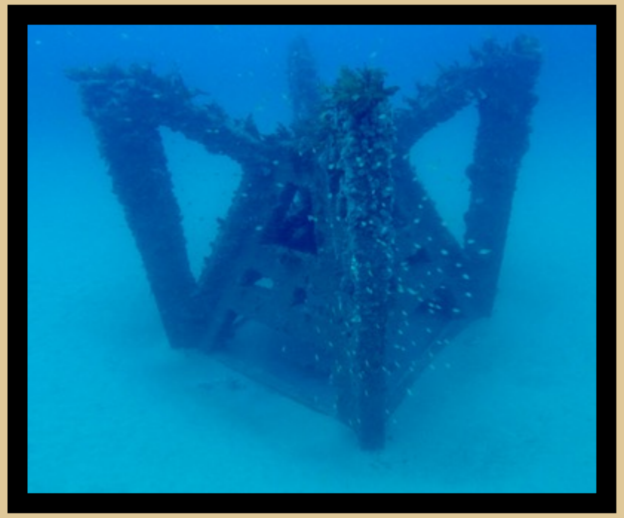
PILOT MATERIALS & FUTURE CONSIDERATIONS

Flexibility in material use for pilot vs. ongoing project works.

*Geofabrics Australia

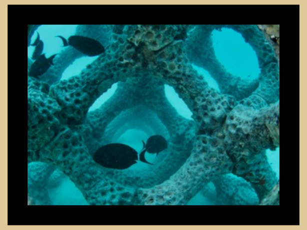
Potential to start with large sand-filled containers. Monitor and armor at a later date (if required).





Reef add-ons for ecological benefit:

- Different habitat-creating modules to trial during the pilot
- Monitoring technology
- Longer term - underwater surf museum additions



*Project Material Pty Ltd

Rock bags allow small cobble to be contained into large volumes for stability

ROUGH ORDER OF MAGNITUDE (ROM) BREAKDOWN $USD

No.	Item	ROM (Cost $USD)
1.1	Mobilization (5%)	$1,.15M
1.2	Sand nourishment (onshore and nearshore)	$6.21M
1.3	Eco-engineered reef (sand filled Geocontainers with additional biomaterial for ecological diversity)	$7.45M
1.4	Two headlands and landscaping	$9.0M
1.5	Dune vegetation and fencing	$0.3M
1.6	Contingency (30%)	$7.24M
1.7	**Total Cost Estimate (Capital Costs)**	$31.4M

RE:BEACH OBJECTIVE SUMMARY VS. TIME

Design Criteria	Outcomes Short Term (3-5 Yrs)	Outcomes Longer Term (20-30 Yrs)
Physical	• Stabilization of upper flat beach for a chance of dune vegetation establishment • Sand is retained in the compartment significantly more than without retaining structures but still allows for natural downdrift flow	• Mass nourishment likely required at approx. 20+ years • Likely maintenance on reef/headland
Financial	Pilot Size 1 - approx $31M capital costs	• Potential moderate upgrades in the 30-year period based on experience (cost dependent on requirement)
Environmental	• Location of elements to reduce impact • Providing habitat and opportunity for marine and terrestrial	• Significant habitat created offshore, potential for similar at onshore headlands
Social	• Accessible, usable beach in high-density public areas • Significant public space created by the beachfront with amenities	• Potential new commercial space on headlands for city benefit. New nature reserves on headlands
Regional	• Downdrift is considered with adaptable berms, nearshore nourishment. The compartment filled but some sand will move downdrift over time • The approach could be replicated by others	• Adapt the approach as necessary and replicate

*Cost estimates are high level for comparative discussion only and not for quotation purposes. Subject to the detailed design stage.

RE:BEACH OVERALL OBJECTIVES | CHECKLIST ✓

RE:BEACH OVERALL OBJECTIVE CHECKLIST

Design Criteria One: Physical

1	Design Criteria One: Physical	ICM DESIGN SOLUTION	CRITERIA MET?
1.1	Located in the coastal zone south of the Oceanside Pier, focusing on the City's most highly eroded beaches.	• Our design concept creates a healthy, living beach profile from the Pier south the Wisconsin Avenue, with the installation of an eco-engineered reef and two 'living headlands' (similar scale to existing Pier headland at Oceanside), which is designed to mimic natural processes that improve sand retention and beach resilience at the City's most highly eroded beaches.	✔
1.2	Accommodates or can be adapted to 2-3ft of sea level rise, with minimal maintenance.	• Headland concept can either be constructed to initially accommodate at least 3.3ft of projected sea level rise by selecting a suitable crest level or raising the crest level as required as part of future adaption. • The eco-engineering reef will continue to perform with 2-3ft of sea level rise but with reduced performance. The crest level of the reef can be raised as part of future maintenance to accommodate the greater sea level. • Dunes will develop and grow at similar rate to SLR	✔

RE:BEACH OVERALL OBJECTIVE CHECKLIST

Design Criteria One: Physical

1	Design Criteria One: Physical	ICM DESIGN SOLUTION	CRITERIA MET?
1.3	Identify a clear pathway for scaling of the pilot if it succeeds in its intention.	• Our reef and headland concept, with a nearshore nourishment strategy, are not only ideal for the pilot site to meet the requirements of this design competition but can easily be implemented at other locations along the Oceanside beach and the broader region, bringing similar benefits and outcomes to those locations, and improvements based on the outcomes of this pilot projects. • The addition of new reefs and headlands along the coastline also provides a new 'green' marine corridor along the coast.	✔
1.4	Performs sand retention and retains structural integrity under impacts from existing and projected future coastal conditions.	• With the benefit of additional nearshore nourishment, our concept is expected to initially provide a wide sandy beach at the pilot site of about 100ft, with a nominal 1:25 slope to seaward. • Our 'speed bump' approach is targeting a slowing of longshore transport by about 20% to 30%, which we expect will halve the sediment deficit at the pilot site and support a more stable sandy beach width in conjunction with the planned nourishment every 5 years. • During extreme storms, our retained sandy beach acts as a buffer, significantly lessening wave impact on The Strand/seawall, while the reef influences the wave field and reduces wave energy to improve beach resilience. • The headland and reef can both be designed to retain structural integrity under present and projected coastal conditions.	✔

RE:BEACH OVERALL OBJECTIVE CHECKLIST

Design Criteria One: Physical

1	Design Criteria One: Physical	ICM DESIGN SOLUTION	CRITERIA MET?
1.5	Includes natural and nature-based features.	• Our design approach includes a strategy of nearshore nourishment, which is a well-established nature-based option for open coastlines with high energy wave climates. Sand is constantly being shifted throughout the beach profile by wave energy, including sand that is placed in the nearshore, which is driven onshore by natural processes to support wider sandier beaches. • Allows for the continuation of natural coastal processes at Oceanside as much as possible, whilst delivering on the other objectives of the design brief. Supporting on-going longshore transport and natural coastal processes is not only essential to a healthy littoral cell and minimizing negative downdrift impacts but minimizes the risk of negative impacts to native marine flora and fauna, such as Grunion and surf grasses, that are dependent on a sandy beach profile. • Establishment of vegetation onto the sandy upper beach (dune vegetation) is a well-established coastal management practice on the Gold Coast which has led to the development of more resilient dunes and beaches, healthier dunal habitats and greater beach aesthetics.	✔

RE:BEACH OVERALL OBJECTIVE CHECKLIST

Design Criteria Two: Financial

2	Design Criteria Two: Financial	ICM DESIGN SOLUTION	CRITERIA MET?
2.1	Construction estimates for designs should be presented for initial construction costs, annual operation and maintenance costs, and removal costs.	• All estimated costs have been included in the ROM Cost Spreadsheet. • Includes initial construction, annual operations, maintenance removal costs. • Suggested cost saving benefit from staged nourishment with nearshore nourishment approach	✔
2.2	Creative use or reuse of materials to lower costs.	• Utilises cost-effective materials appropriate for the pilot project, including Sand-Filled Geotextile Mega-Containers for the artificial reefs and usage of local cobble rock for the low-crested cobble berm. • Utilizes local cobble rock as part of the low-crested cobble berm, as well as use of Rock Bags to improve the hydraulic stability of the cobble rock. • Includes use of significantly more cost-effective nearshore nourishment that allows for use of finer & poorer quality offshore sediment sources than would typically be suitable for onshore beach nourishment. • Dune vegetation and fencing reduces loss of wind-blown sand onto landward road and paths and supports sustainable growth of the dunes	✔
2.3	Articulates maintenance activities and cost for design to maintain key functions.	• Includes recommended monitoring, management and maintenance activities and estimate costs.	✔

RE:BEACH OVERALL OBJECTIVE CHECKLIST

Design Criteria Three: Environmental

3	Design Criteria Three: Environmental	ICM DESIGN SOLUTION	CRITERIA MET?
3.1	Encourages rehabilitation of sandy beach habitat.	• Design approach focuses on maintaining a sandy beach at Oceanside, with improved sand retention and a more cost-effective strategy for nourishment of the beach profile.	✔
3.2	Minimizes impacts to sandy beach ecosystems and nearshore marine ecology.	• Design approach focuses on retaining sand by slowing existing sediment transport but not trapping large volumes of sand or dramatically changing the shoreline position. • Supports marine ecologies dependent on a sandy beach, such as native Grunion and Pismo Clams. • Submerged reef allows waves to continue to break at the beach, which Grunion rely on for spawning. • Provides new opportunities for marine habitat by providing substrate, rugosity and structure suitable for marine habitat development from the beach (low-crested cobble berm) to offshore (artificial reef). • Encourages dune vegetation and establishment of greenspaces providing habitat for onshore species, such as nesting grounds for Western Snow Plover or California Least Tern.	✔
3.3	Sensitive to where and which habitats may be converted as part of the design, what enhancements to ecology may occur, and where restoration of historic ecosystems may occur.	• Timing of onshore and nearshore nourishment managed to limit spawning of local Grunion (February to March) but could be refined further with the potential for nourishment to enhance suitability for Grunion spawning. • Previous studies as part of the CRSMP (2009) indicated limited sensitive habitats at the location of the proposed reef. An ecological survey of the site is recommended as part of the detailed design to confirm no sensitive habitats would be impacted, with the reef location adjusted as required to avoid impacts. The artificial reef itself has been designed to provide significant new stable substrate and structure for marine habitat.	✔

RE:BEACH OVERALL OBJECTIVE CHECKLIST

Design Criteria Four: Social

4	Design Criteria Four: Social	ICM DESIGN SOLUTION	CRITERIA MET?
4.1	Increases usable beach space supporting coastal access and multiple opportunities for recreation.	• Concept slows longshore transport processes along Oceanside, improving the benefit of sand nourishment practices and retaining usable beach space. • Installation of headlands provides enhanced beach access at key locations along the beach to improve recreational and beach engagement opportunities. • The artificial reef has been designed to be a multi-functional reef that, in addition to coastal protection benefits, provides improved surf amenity, recreational diving and fishing opportunities.	✔
4.2	Prioritizes preserving or enhancing surfing resources and minimizing impacts to existing surf resources.	• The scale and location of the headlands and artificial reef have been selected to avoid impacts to the existing surf resources at Oceanside. • Artificial reef designed to provide surf amenity to the beach.	✔
4.3	Seeks to increase or maintain the existing aesthetic of the beach.	• Maintains sandy beach aesthetic with surfing character at Oceanside. • Establishment of dune vegetation improves beach aesthetic.	✔
4.4	Prioritizes public safety and low-cost recreational user experiences.	• Submerged reef design based on decades of research and experience with previous artificial reefs on the Gold Coast and globally. While surf amenity is considered as part of the multi-functional reef, safety is a key element of the design with crest levels and reef shape to be refined though physical modeling to minimize surfing hazards and rip currents at the reef. • Dune vegetation and fencing reduces loss of wind-blown sand onto landward road and paths.	✔
4.5	Maximizes public benefit.	• Provides improved surf amenity at Oceanside. • Increases public access the beach. • Provides new public areas along Oceanside with a range of potential future uses for the city to consider.	✔

RE:BEACH OVERALL OBJECTIVE CHECKLIST

Design Criteria Five: Regional

5	Design Criteria Five: Regional	ICM DESIGN SOLUTION	CRITERIA MET?
5.1	Provides regional and statewide opportunities to pilot, test and evaluate novel sand retention solutions.	• Improves Oceanside and Californian site-specific knowledge and research for reef design, construction and management, leading to increased confidence for future implementation multi-functional artificial reefs. • Concept can be readily scaled along the regional coastline. • Includes a range of beneficial public use opportunities for headland areas, such as greenspace vegetation, beach access or other public amenities desired by the city.	✔
5.2	Strives to positively impact the region.	• Encourages more cost-effective placement of finer sands as nearshore nourishment to improve beach volumes (directly benefits littoral cell) and can be readily undertaken at other beaches. • Provides marine and dune habitats that produce can produce 'green pathways' of habitat along the coastline when scaled.	✔
5.3	Sensitive to the potential for sand retention strategies to impact the flow of sediment through littoral systems and be designed to eliminate or mitigate potential negative impacts to downdrift sand supply.	• Maintains a sandy beach and longshore transport coastal processes along Oceanside Beach. A sandy beach allows sand to continue to flow to downdrift beaches. • Encourages more cost-effective placement of finer sands as nearshore nourishment to improve beach volumes. • Slows longshore transport but allows significant bypassing through porous low-crested cobble berm and short headland.	✔

RE:BEACH OVERALL OBJECTIVE CHECKLIST

Beyond Design Criteria

6	Beyond Design Criteria	ICM DESIGN SOLUTION
6.1	Supports future integrated coastal management strategy	• Our design approach at Oceanside is supportive of the development of an integrated coastal management strategy, including management of coastal resources, coastal protection assets, consultation with local life-savers, adaptation pathways for sea level rise and climate change. • Our experience with coastal management on the Gold Coast and internationally.
6.2	Supports opportunity for future sand bypassing infrastructure	• While not included as part of our proposed concept, our concept has been designed to accommodate the opportunity for future bypassing infrastructure to be installed along Oceanside with outfall locations to improve beach volumes and provide the City with additional options for sand management and mitigation of downdrift impacts.
6.3	Our team can bring siginificant monitoting expereince and develop program	• Prior to the pilot project start, a monitoring program should be set up to create baselines for a series of not only physical attributes. Our team has a significant amount of experience with development and implementation of monitoring programs specifically for RE:BEACH projects.
6.4	Significant knowledge hub sharing potential	• With Griffith University's coastal department involved in our design team, there are great opportunities for knowledge sharing at design, monitoring and management levels with opportunity for potential exchange programs and significant student involvement.