



Government of Western Australia  
Department of Transport

# Beneficial Reuse of Dredged Material for Beach Nourishment in WA

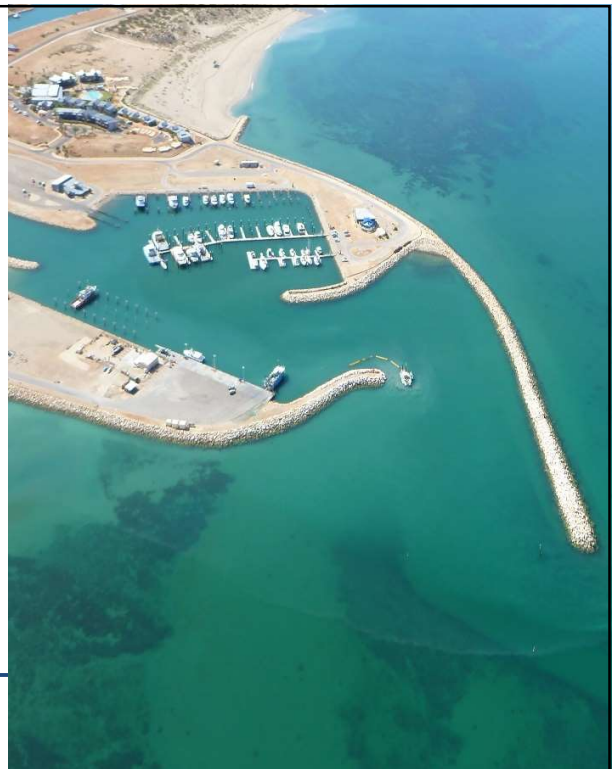
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## Objective

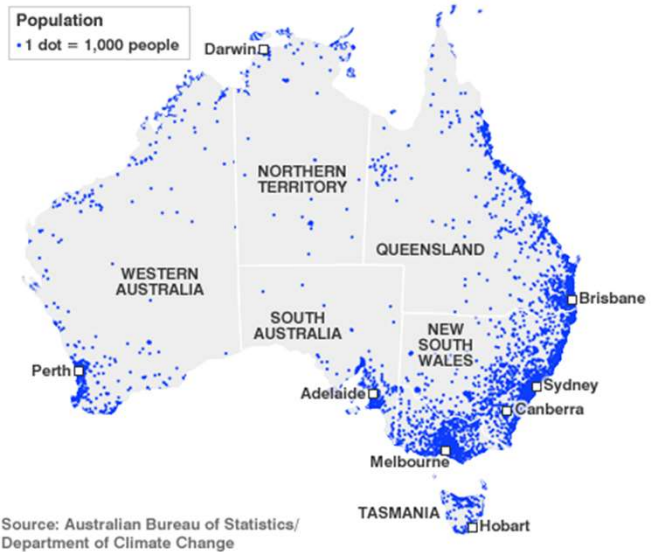
Share experiences gained in managing projects that beneficially reused maintenance dredging sediments for beach nourishment in Western Australia in the period 2012-2022.



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## Context for Beach Nourishment

- Australia has the 6<sup>th</sup> longest coastal line globally: >30,000 km coastline
- 85% population live in the coastal region
- Significant economic, social and environmental importance
- Climate change and sea level rise pose risks of inundation and reduction of popular beach amenities to residential communities and tourism industries
- Trend of increasing demand for coastal hazard adaptation strategies and supply of both soft and hard engineering solutions
- Beach re-nourishment as a soft engineering measure is an artificial process where sand lost through coastal erosion is replaced from other sources to combat erosion and improve beach amenity
- Nourishment sand can be sourced from dredging of nearby waterways



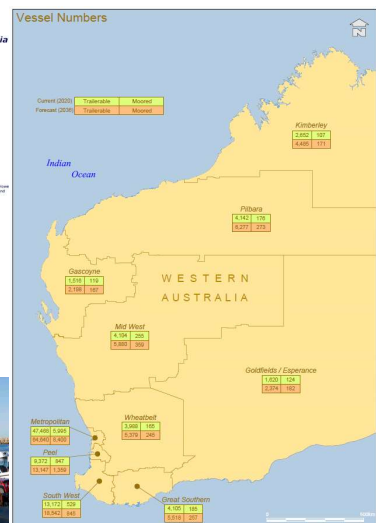
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## Context for Maintenance Dredging

- Ports within Australia: seventeen-fold increase in activity in the last half of the 20<sup>th</sup> century. Continued growth in the 21<sup>st</sup> century with larger trade volume, and potential growth as future renewable energy hubs(?)
- Smaller boat harbours and ramps are also growing. Recreational fleet is expected to increase by 37% in the Perth Region and 41% in WA Southwest Region in the period 2020 -2036
- The development of new, the upgrading and maintenance of existing waterways will continue to require dredging of seabed material to deepen and maintain safe navigable depths. Some of this dredged material can be beneficially reused to nourish local beaches in need



Ports Australia



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## WA DoT Maintenance Dredging Program

- WA DoT waterway management responsibility
- Manager of waterways, boat harbours, maritime facilities and ocean entrance channels at 35 locations statewide from Esperance in the Southeast to Johns Creek in the far north (~4,000km)
- Management under long term contracts with engineering, environmental consultants and dredging contractor
- Dredging and local beach nourishment of ~3.1Mm<sup>3</sup> of sediments in 9 of these locations over 38 small scale frequent campaigns from 2012-2022



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## Planning: Inter-Governmental Collaboration and Commitments

- Key to execution of these multi-site and multi-proponent projects
- Funding
  - Shared funding under long term deed agreements.
  - Shared funding through Coastal Adaptation and Protection (CAP) grants
  - Local governments contribution through funding project services such as survey services, drones, coastal monitoring, community consultation
- Management and delivery of works by WA DoT
- Monitoring by local governments



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## Planning: Stakeholder Consultation

- Local government
- Harbour users
- Local surf clubs and schools
- Local communities
- Environmental regulators
- Cultural and Heritage assessment and consultation



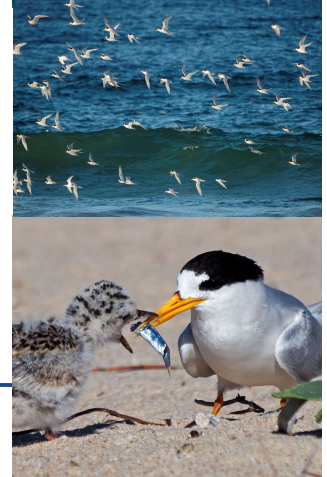
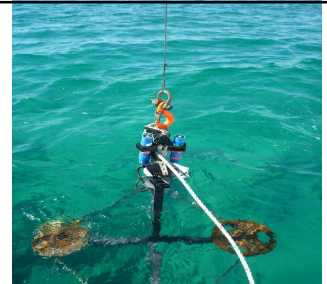
Department of Biodiversity, Conservation and Attractions



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## Planning: Environmental Management Framework

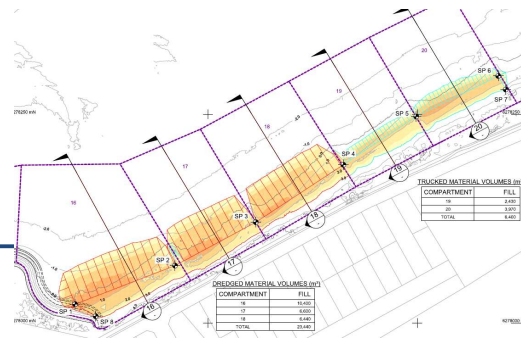
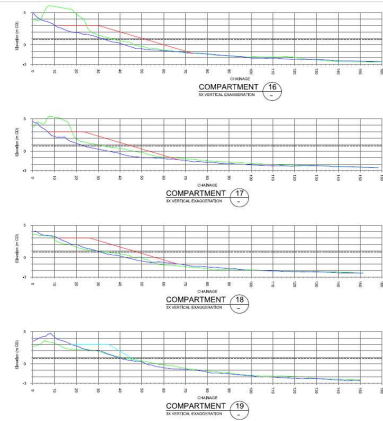
- Establishment of Environmental Management Framework (EMF) to govern the EIA and EMP at all sites
- Statewide recognition and adoption of DoT EMF as a standard for both State, Local Governments
- Long-term application of EMF and buildup of data sets provided confidence to State Regulatory bodies
- Revision of the EMF to a flexible risk-based approach allowing significant reduction in cost and effort of sampling, analysis, monitoring and management



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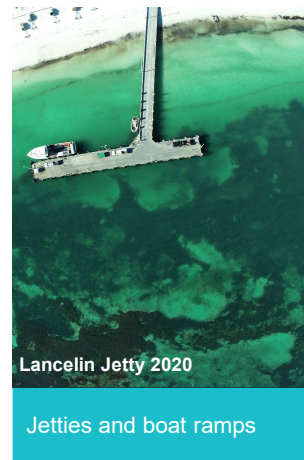
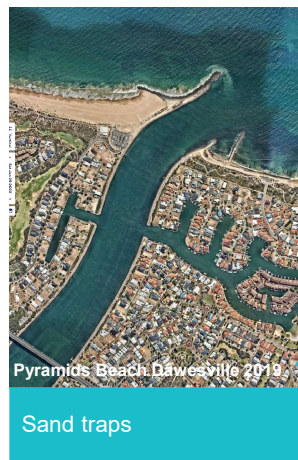
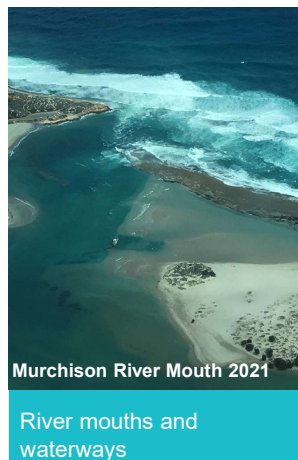
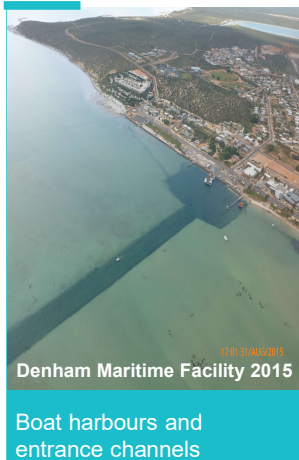
## Planning: Beach Design Considerations

- Beach setting; physical geography, metocean conditions, coastal morphology, sediment transport
- Dredging sediment characteristics
- Dredging volumes versus beach sand deficit
- Constructability, disposal methods and timing
- Stakeholder expectations
- Budget



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## Dredging Scope Sediment Collection Locations



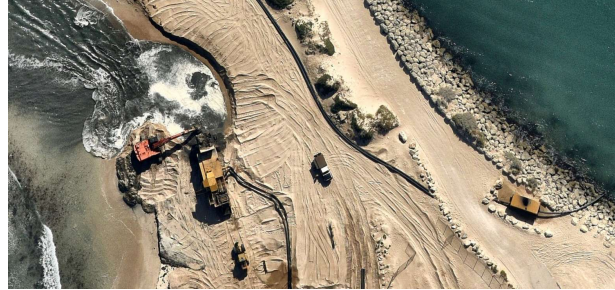
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## Dredging Scope Sediment Collection Methods



### Hydraulic methods: small cutter suction dredges

- Different sizes and capacities
- Supported by auxiliary equipment, series of different types of pipeline sets (up to 5km) and booster pumps
- Suits works in the waterways and harbours



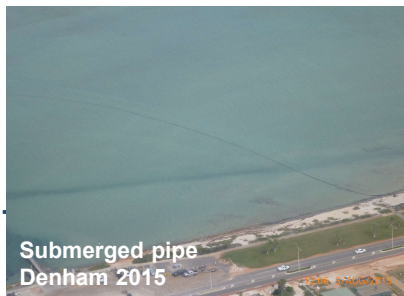
### Hybrid mechanical and hydraulic : Slurrification Unit

- Land based excavators
- Mobile hydraulic slurry plant
- Series of pipelines
- Suits sand trap management works



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## Dredging Scope Sediment Transportation



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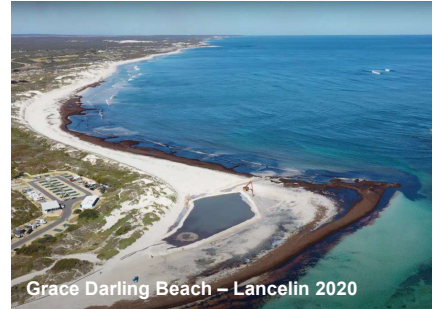
## Planning: Scope Sediment Disposal and Beach Construction Methods



Town Beach – Mandurah 2021  
Nearshore disposal and natural dispersion to gradually feed downstream beaches



Castletown Beach – Esperance 2021  
Onshore disposal, sacrificial bunding for temporary protection and artificial wide swale to assist settlement of larger particles and overflow of fines. Assisted by earthmoving equipment



Grace Darling Beach – Lancelin 2020  
Onshore banded low-height stockpile as a future reserve to naturally feed eroding beach downstream



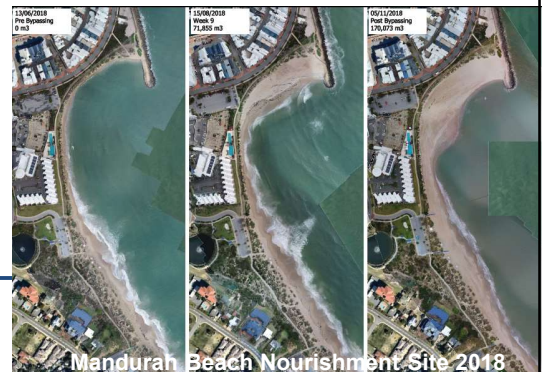
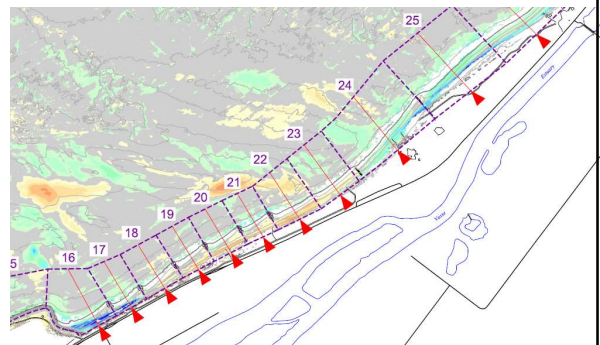
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## Beach Profile Monitoring

Survey Requirement	Survey Requirement	Hydrographic MBS	Topographic (transects) survey
Planning	Baseline	✓	✓
Execution	Pre-nourishment	✓	✓
Execution	Progress / verification (weekly)		✓
Execution	Post-storm (when needed)		✓
Execution	Post Nourishment	✓	✓
Monitoring	Post winter (annual)	✓	✓

### Drone

- Ideally pre, mid and post orthomosaic map (georeferenced imagery)



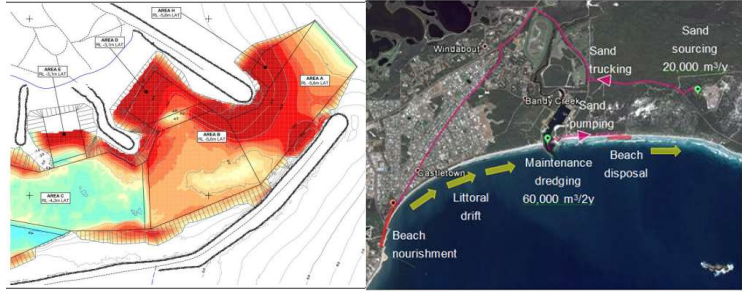
Mandurah Beach Nourishment Site 2018



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## Project Execution Bandy Creek BH Dredging

- History: harbour constructed in 1983. Maintenance Dredging by DoT since 1995 every two years.
- Dredging volume: ~ 60,000m<sup>3</sup>
- Dredging method: cutter suction dredge
- Historical dredging disposal to outer eastern beaches. Pumping distance approximately 1.5km
- Castletown Beach sand nourishment has been managed by SoE since 2013 and involved sourcing of ~20,000m<sup>3</sup> /year from sand dunes and carting 8km
- Shire of Esperance (SOE) received CAP grant from State in 2020 to fund the additional works required to pump the dredged material from the harbour to the 4km distant Beach for beneficial nourishment reuse



Bandy Creek Boat Harbour 2021



## Project Execution Castletown Beach Nourishment

### Planning considerations:

- The design objective is to reduce the expectation of foreshore erosion within a two-year timeframe, and thus reducing need to import sand from external pits (20,000m<sup>3</sup> per annum)
- Available dredging volume ~40,000m<sup>3</sup>
- Available historical beach surveys and coastal studies
- Castletown Beach modelled sand nourishment design profile required total nourishment volume ~34,000m<sup>3</sup>
- Target volume placed in a single campaign, intended every two years to align with dredging frequency and could mitigate the foreshore erosion risk over the two years on average
- PSD and sediment quality
- Timing

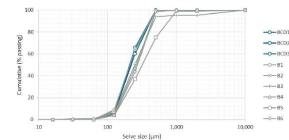
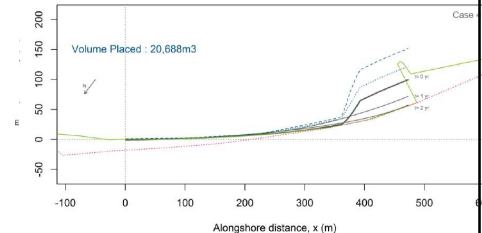
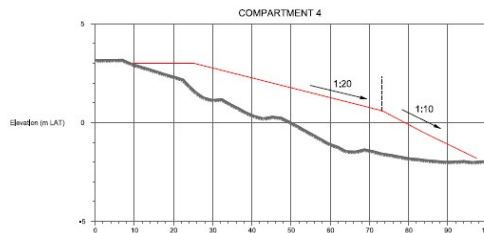


Figure 44: Particle size distribution in the harbour (channel area, B) and beach (disposal area, BCD).





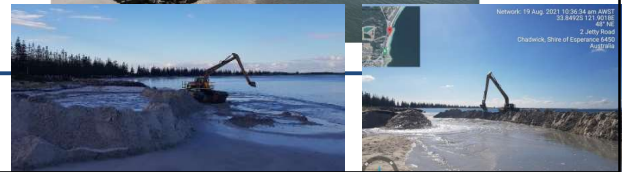
## Project Execution Castletown Beach Nourishment

### Construction considerations Pipeline

- 4km pipeline and 3 booster pumps
- Impacts to Aboriginal and European Heritage sites
- Native vegetation
- Dune erosion
- Noise monitoring

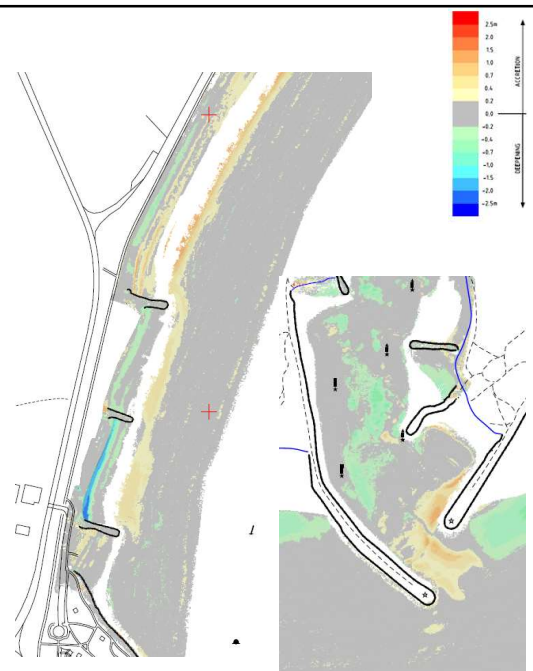
### Beach construction

- Wide swale and sacrificial bunding method to retain sand
- Diffuser to spread material
- Amphibious earthmoving equipment
- Extensive monitoring and adaptive construction management
- Careful placement to avoid impacts to benthic seagrass habitat



## Project Execution Castletown Beach Nourishment

- 6-monthly post survey results are promising
- Based on initial monitoring results and pending further monitoring in 2022/23, the Shire is seeking funding to make the pipeline infrastructure permanent
- Cost benefit study informs on better value for money over 20 years
- MCA study results show back passing of dredged material to nourish Castletown outranks all other soft options (such as trucking sand) and hard options (such as groins) on environmental, public perception and economical, and inter-government collaboration fronts



## Future Prospects

- Port Beach. An excellent example of collaboration between Fremantle Ports (FP), City of Fremantle (CoF), Department of Transport to beneficially reuse maintenance dredged material for beach nourishment works
- First use of TSHD to nourish a WA beach by rainbowing method
- Win-win situation for the FP to restore navigation depth in shipping channel and CoF to restore amenity in Port Beach
- Can we see more of these works in WA and more inter-Government collaboration Australia wide to plan and execute this kind of projects in the future?



Port Beach Nourishment 2022



# Thank you