# DREDGING AND SUSTAINABLE SEDIMENT MANAGEMENT

## AT THE PORT OF GERALDTON


MID WEST PORTS

OVERVIEW

# Why is dredging needed?

Sediment is suspended, resuspended and transported across ocean waters every day as a result of natural coastal processes driven by wind, waves and swell.

Managing sediment that accumulates and becomes trapped in navigational channels and other port areas is an important and essential practice for ports across the globe.

For us in the mid west, maintaining safe and efficient navigation is vital to supporting national and international trade, regional economic development and our continued connection with global markets.

Left unmanaged, our port's capability would be significantly reduced, with the flow on effect impacting local businesses and our community.

At the Port of Geraldton, sediment is predominantly managed through the practice of maintenance dredging, which involves periodically removing accumulated sediment from within our channels to return these areas to their original design depth.

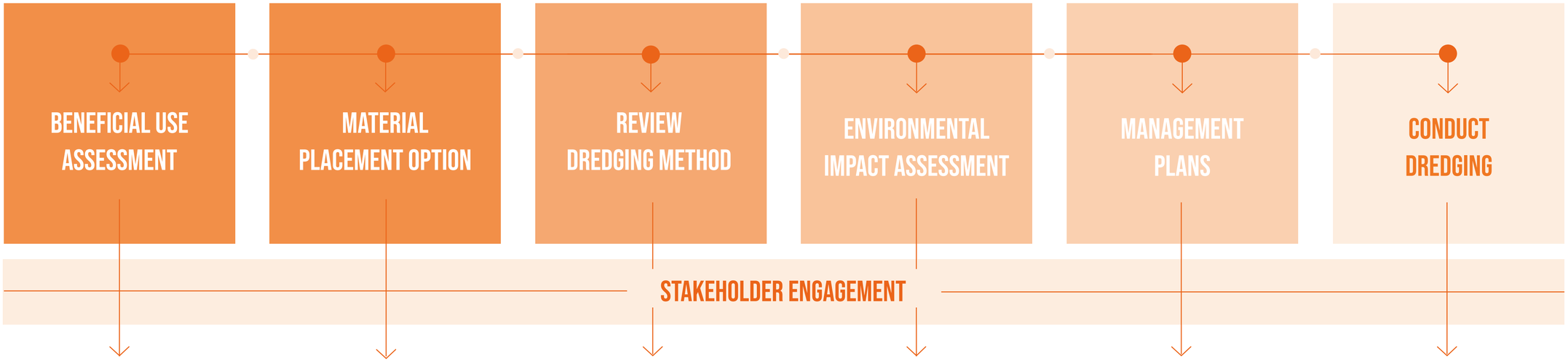
Sustainable sediment management is about maintaining the balance between effectively managing these underwater assets and the continued development of a world-class port, while protecting the unique marine and coastal environment in which we operate.

**We've compiled this information to share with our stakeholders, and our community, our approach to managing sediment, sustainably.**

# Our approach

A comprehensive framework guides our decision making around the sustainable management of marine sediment at the Port of Geraldton.

It starts with better understanding our environment, with detailed studies conducted to determine the source of natural sediment accumulation, and identifying ways in which sediment material can be beneficially reused.




Prior to any decision to conduct dredging, we evaluate how sediment material can be beneficially reused. Our assessment uses multiple criteria that considers a range of social, environmental and economic values relevant and important to the local area and mid west region

Next, we determine the most suitable and feasible placement options; those that provide the greatest benefit and least impact

Our assessment helps to define the scope, and therefore, the dredging method we'll use to manage sediment

Environmental impact assessments underpin dredging activity and are developed in accordance with state and commonwealth regulatory requirements and supported by detailed technical studies

Environmental management plans are developed according to national frameworks and legislation

Once it can be demonstrated that all necessary management measures are in place dredging can occur. Ongoing environmental monitoring extends beyond the completion of dredging

OVERVIEW

# An introduction to the Port of Geraldton

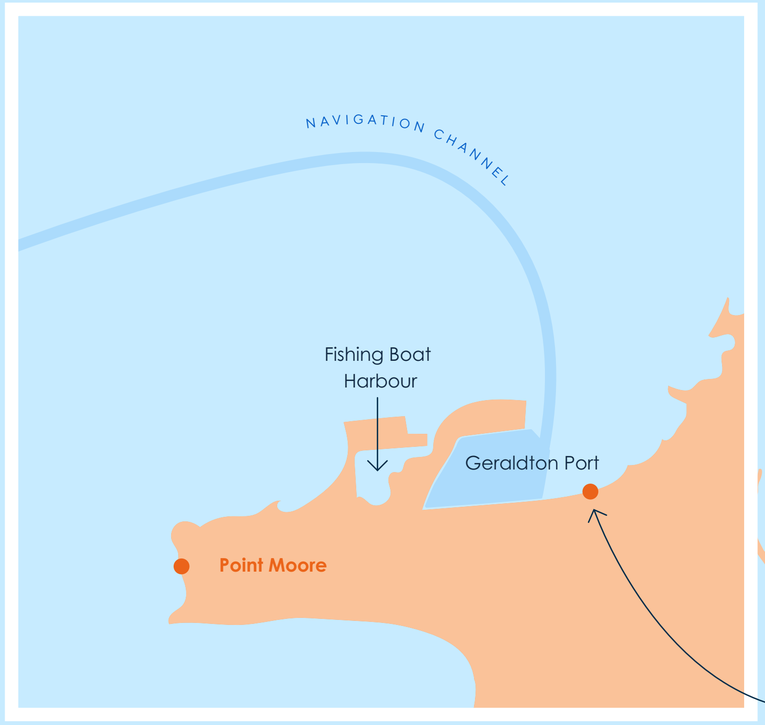
Mid West Ports Authority is one of Australia's most diverse ports, providing a gateway for both trade and tourism. We play an essential role in planning, facilitating and building sustainable trade in the mid west region.

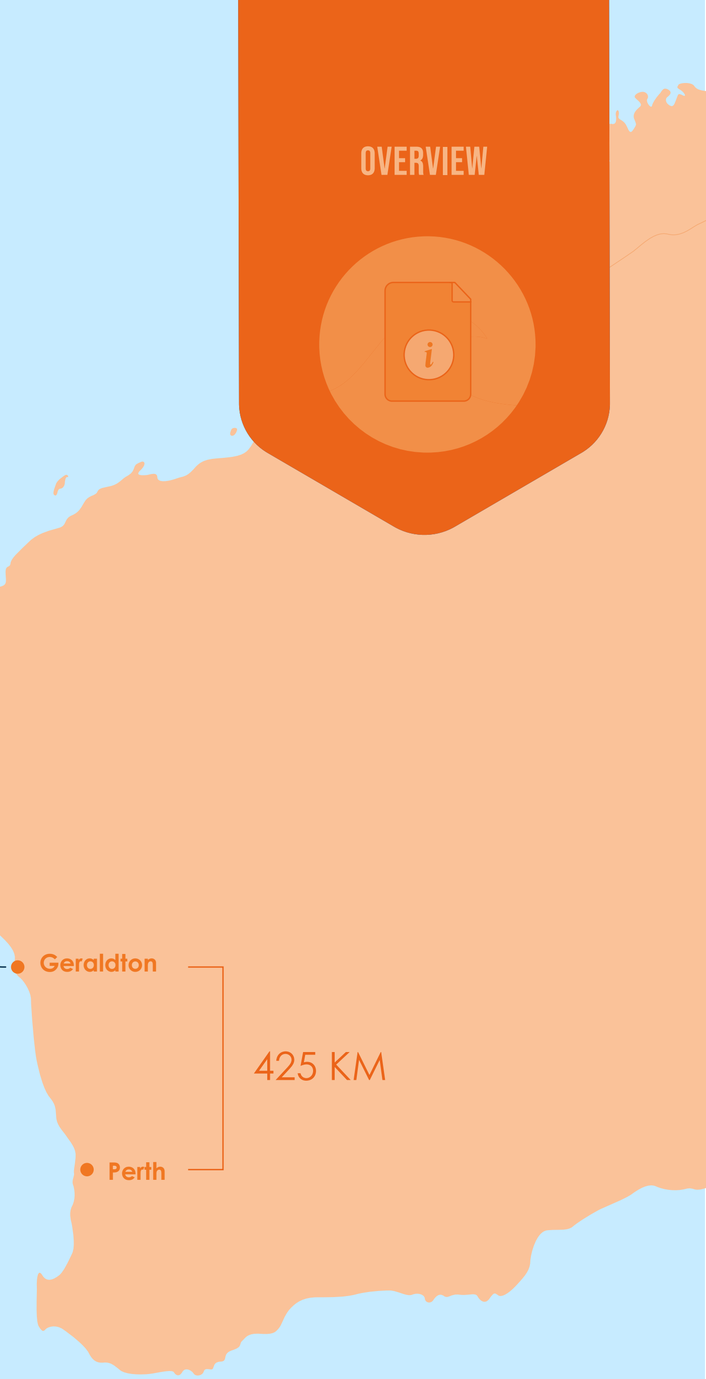
**MWPA operates:**

- 7 commercial berths, associated circuits and ship loading infrastructure
- Harbour basin and channel
- Fishing Boat Harbour
- Rail terminal, associated railway tracks and unloading infrastructure

MWPA holds and manages environmental licences for commodities exported and imported through the Port of Geraldton.

Unique to MWPA, is the management of the Geraldton Fishing Boat Harbour, which supports the region's largest fishing industry.




## TRADE

**Exports**

- GRAIN
- MINERALS
- SANDS
- LIVESTOCK

**Imports**

- FUEL
- FERTILISER
- MINERALS
- BULK CARGO

# Our role in the region

Each year, our port facilitates around 350 ship visits and a trade volume of 15 million plus tonnes. The channel, commercial harbour and fishing boat harbour are critical pieces of infrastructure that support regional industries such as agriculture, aquaculture, mining, transport and logistics, as well as tourism.

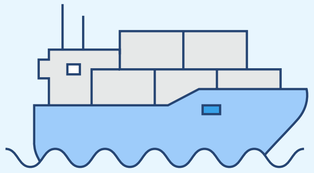
## DID YOU KNOW?

**The Geraldton Port channel is 3.2km long and has a design depth of:**

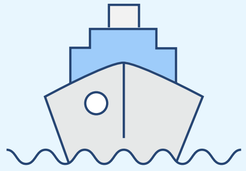
-12.8 -14.5
Lowest Astronomical Tide (LAT)

240-180m
WIDE

**These depths are required to accommodate current vessels including:**



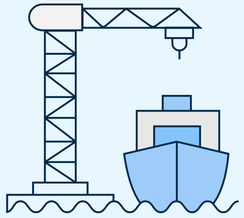
BULK CARRIERS
Up to 253m Length Overall (LOA) x 43m beam



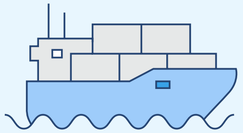
CRUISE SHIPS
Up to 293m LOA x 32m berth

## 2020/2021 PORT HIGHLIGHTS

**During this period, MWPA facilitated:**



15,074
Total Trade Throughput '000 T



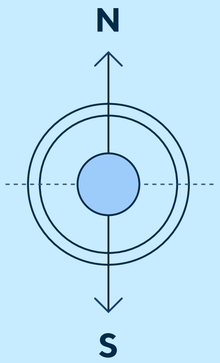
351
Ship visits

# MANAGING SEDIMENT SUSTAINABLY, STARTS WITH UNDERSTANDING OUR ENVIRONMENT AND THE COASTAL PROCESSES THAT DRIVE SEDIMENT TRANSPORT IN THE MID WEST REGION.

# Where does sediment come from?

## AND HOW DOES IT MOVE?

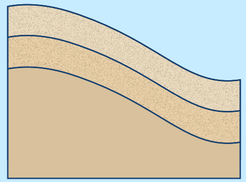
Sediment resuspension and transport occurs as a result of natural processes like wind and waves. How, and in which direction sediment travels, will depend on the characteristics of the coastline and its coastal processes.



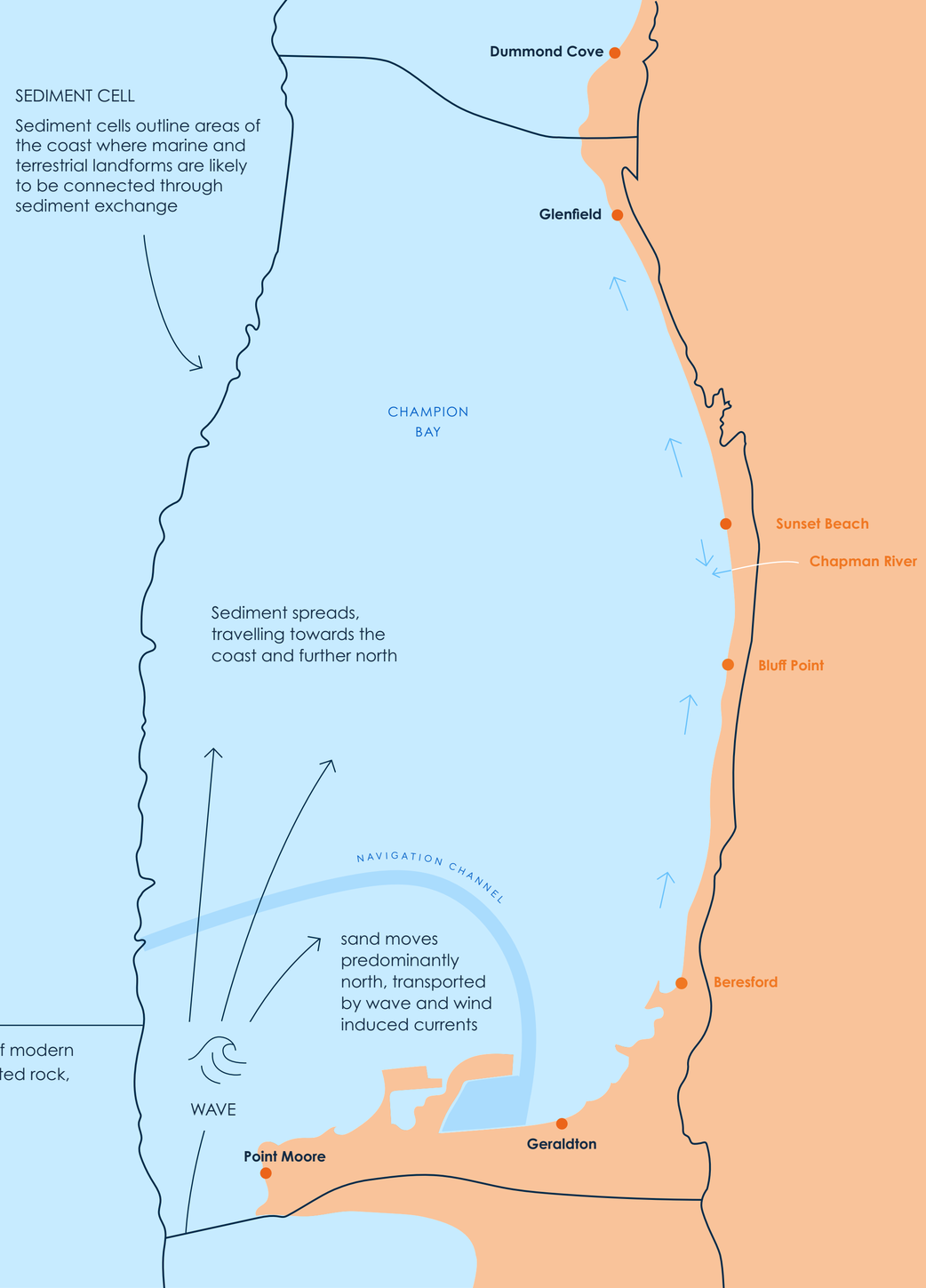

Sediment resuspension occurs along the mid west coastline as a result of

WIND | WAVE | SWELL

with sediment typically moving from **south** to **north**



Sediment material is primarily made of sand, which consists of modern bioclastics - small shells that grow on seagrass - and fragmented rock, with some sand also derived from river catchments



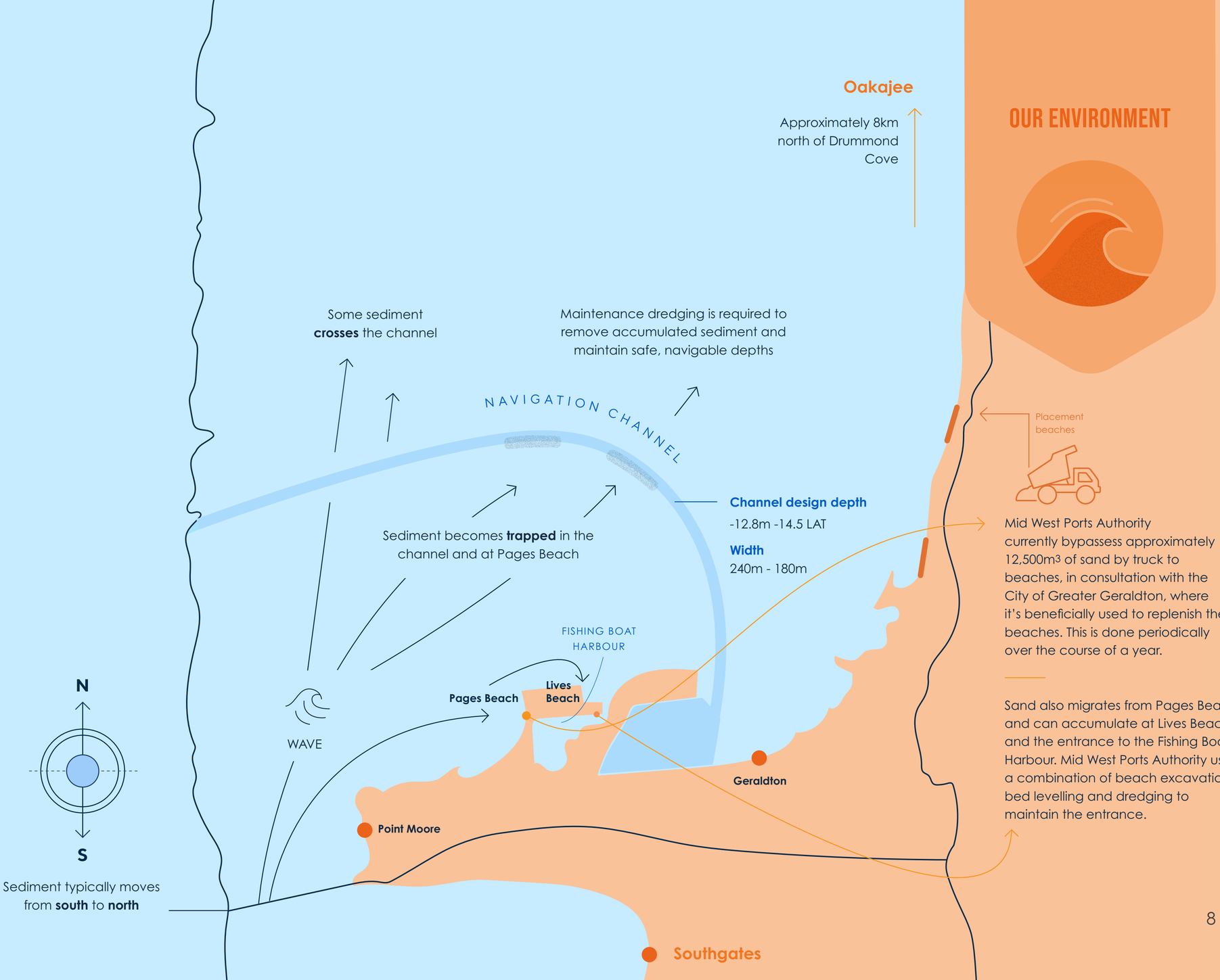

WESTERN AUSTRALIA
MID WEST REGION

# Where does sediment accumulate in port areas?

In 2020, MWPA invested in the development of a coastal sediment model to determine how natural sediment cycles occur between Southgates through to Oakajee.

Modelling confirmed that natural sediment transport at the Port of Geraldton occurs as a result of wind and wave energy moving sediment predominantly in a northerly direction.

While some sediment crosses the channel, it also becomes trapped in the navigational channel and at Pages Beach.




## OUR ENVIRONMENT

Mid West Ports Authority currently bypassess approximately 12,500m3 of sand by truck to beaches, in consultation with the City of Greater Geraldton, where it's beneficially used to replenish the beaches. This is done periodically over the course of a year.

Sand also migrates from Pages Beach and can accumulate at Lives Beach and the entrance to the Fishing Boat Harbour. Mid West Ports Authority uses a combination of beach excavation, bed levelling and dredging to maintain the entrance.

# Monitoring our port environment

In addition to targeted environmental and technical studies, Mid West Ports Authority has a range of programs in place to monitor and better understand the environment in and around the port. We currently monitor seagrass, marine fauna and marine pest populations and undertake routine sediment and water quality samples.

Initiatives to manage sediment are also underpinned by extensive and ongoing environmental monitoring. This sees us collect and analyse data on environmental indicators such as light, temperature, salinity, turbidity and sediment resuspension.


OUR ENVIRONMENT

## UNDERSTANDING OUR PORT ENVIRONMENT

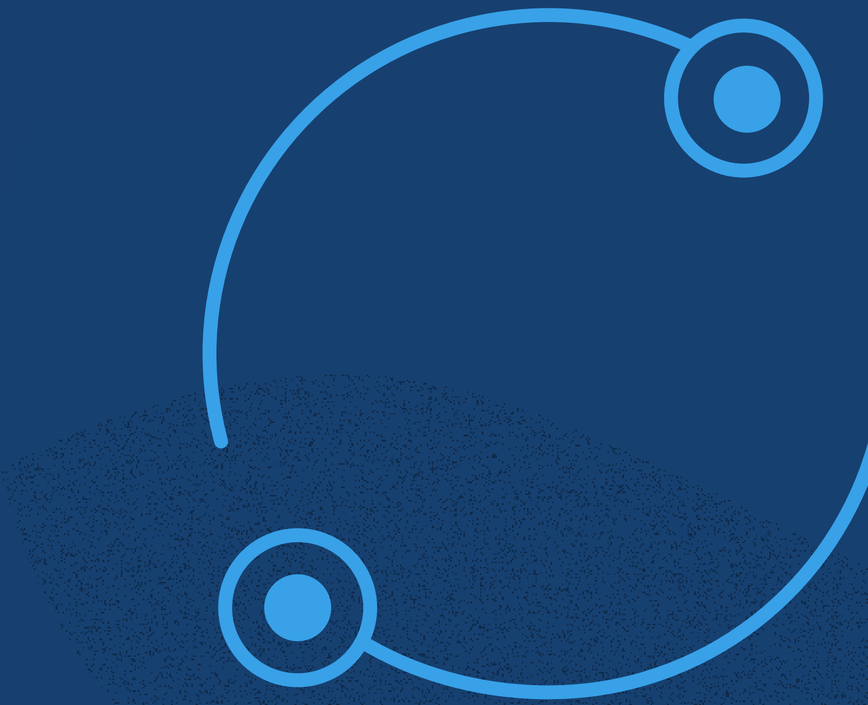
**We regularly monitor**

- SEDIMENT + WATER QUALITY
- WATER DEPTH
- AIR QUALITY
- SEAGRASS POPULATIONS
- MARINE FAUNA
- MARINE PESTS
- METEOROLOGICAL + SEA CONDITIONS

**Following initiatives to manage sediment we monitor**

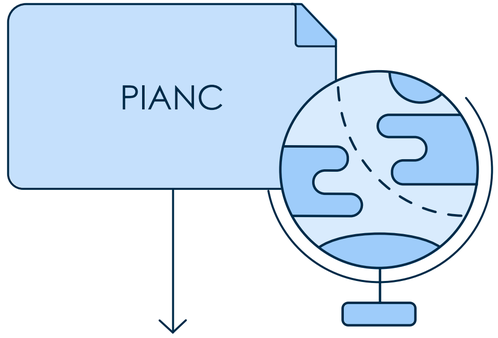
- LIGHT
- TEMPERATURE
- SALINITY
- TURBIDITY
- SEDIMENT RESUSPENSION

# BEFORE DETERMINING THE METHOD WE'LL USE TO MANAGE SEDIMENT, WE IDENTIFY AND EVALUATE  BENEFICIAL REUSE OPPORTUNITIES AND APPROPRIATE PLACEMENT OPTIONS.

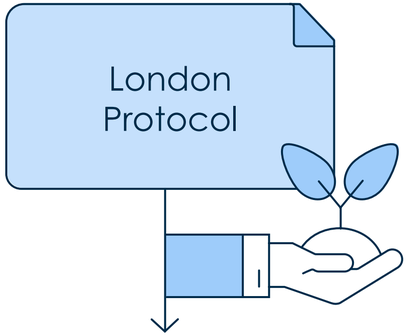


OUR APPROACH

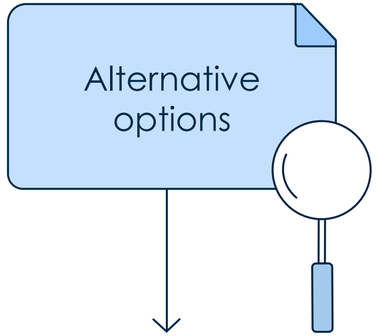
# Best practice frameworks guide our approach




To identify and evaluate beneficial reuse opportunities, we utilise internationally recognised frameworks created by PIANC, the world association for waterborne transport infrastructure.




This supports the implementation of the London Protocol - an international treaty to protect and preserve the marine environment.




Where possible, alternatives to off-shore at-sea disposal, known as sea dumping, are preferred. These options are explored as part of our assessment.

+ **Activities to manage marine sediments in ports are highly regulated with dredging and material placement subject to detailed regulatory processes under international conventions, national and state legislation.**

+ **The National Assessment Guidelines for Dredging (NAGD) set out the framework for the environmental impact assessment and permitting of ocean placement of dredged material.**

## WHAT DO BENEFICIAL REUSE OPPORTUNITIES LOOK LIKE?

Beneficial reuse opportunities may include both environmental and engineering applications such as:

1 ENVIRONMENTAL

- **AGRICULTURAL AND HORTICULTURAL**
- **SAND REPLENISHMENT (RETAINING SEDIMENT IN CELL, PROVIDING AN ONGOING SOURCE OF SEDIMENT)**
- **ENHANCING COASTAL RESILIENCE**
- **ARTIFICIAL REEFS**

2 ENGINEERING

- **LAND RECLAMATION**
- **EXPORT**
- **CONSTRUCTION MATERIAL**

# A clear and consistent approach

The PIANC framework for dredge material reuse is focused on matching the supply of dredged material with beneficial use demand. It does this by considering the following factors:

- **Quality of material** (physical and chemical properties of dredged and required material)
- **Quantity of material** (volume of dredged and required material)
- **Location of material** (is it technically feasible to move/place material)

**First, we determine if sedimentation can be managed at the port to avoid or reduce the need for dredging?**

**If dredging is required we determine if it can be beneficially reused:**

START WITH SUPPLY

Identify dredging requirements, quantities and locations

Evaluate sediment properties

IDENTIFY OPTIONS

Consider all potential material placement options and uses, including environmental and engineering re-uses

IDENTIFY FATAL FLAWS

ENVIRONMENTAL

Exclude options that are not possible, even after treatment, due to the sediment characteristics / properties

DEMAND

Exclude options for which there is no economic / environmental / social demand

ENGINEERING

Exclude options that cannot be achieved with available technology / equipment

MULTI CRITERIA ANALYSIS

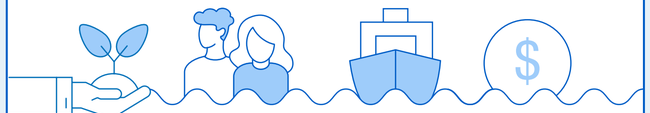
Evaluate all feasible options through application of a multi-criteria analysis (MCA)

SELECT OPTION(S)

Preferred option(s) identified

Sea dumping only considered where there are no available re-use options

+ Criteria is established in consultation with our stakeholders and considers a range of social, environmental and economic values relevant and important to our region. For example:




Protecting the environment and our future + Keeping the port operational + Financial constraints

SUSTAINABLE DEVELOPMENT GOALS

We also aim to align our approach with UN Sustainable Development Goals

# IF DREDGING IS REQUIRED TO MANAGE ACCUMULATED SEDIMENT, OUR ASSESSMENT HELPS TO DEFINE THE METHOD OF DREDGING WE'LL USE.

# What is dredging?

Just like roads and rail, underwater port infrastructure requires maintenance, and at times upgrading, to ensure vessels can safely enter and manoeuvre into port.

Dredging is conducted to either maintain existing design depths, or in some cases, expand them.

## MAINTENANCE DREDGING

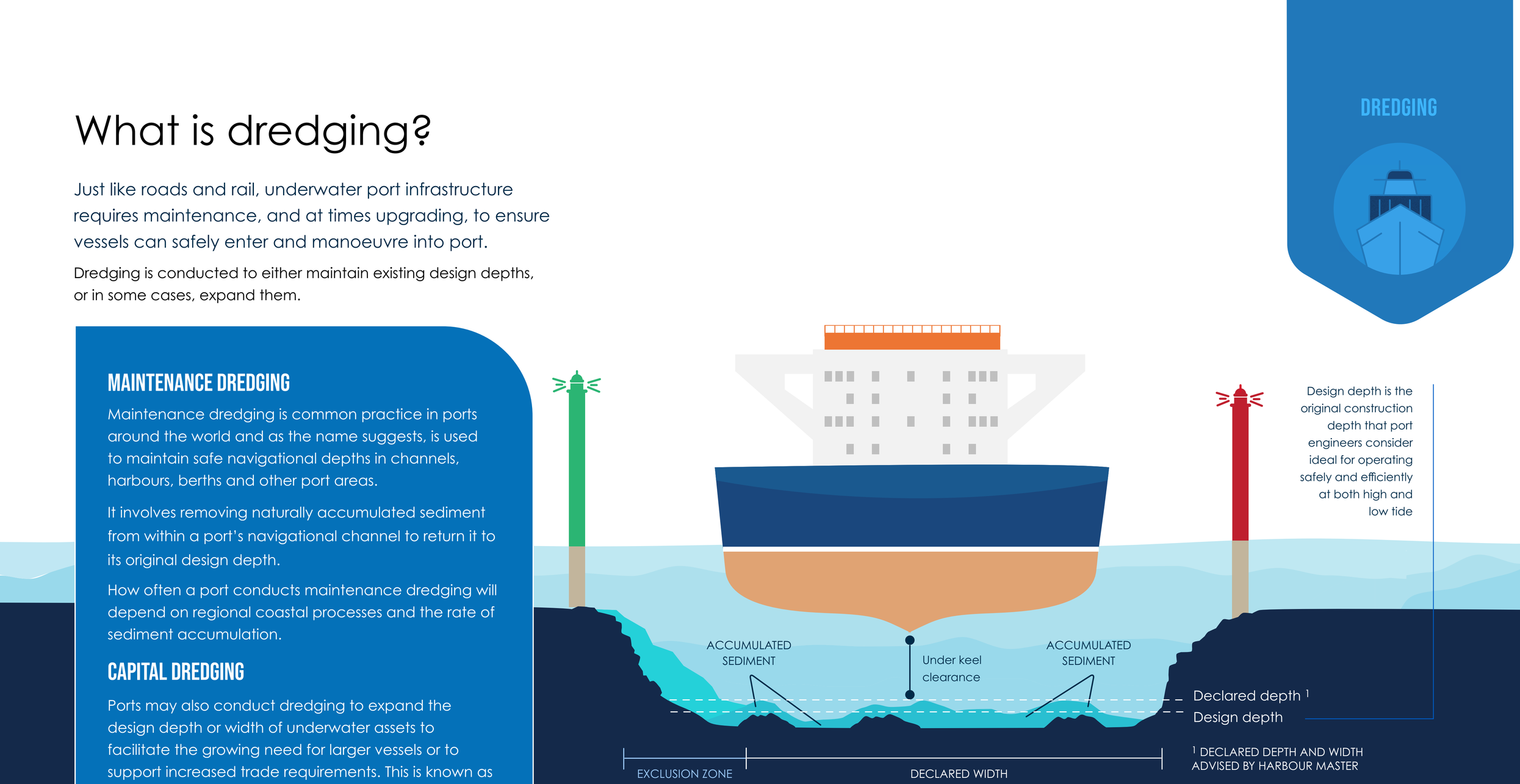
Maintenance dredging is common practice in ports around the world and as the name suggests, is used to maintain safe navigational depths in channels, harbours, berths and other port areas.

It involves removing naturally accumulated sediment from within a port's navigational channel to return it to its original design depth.

How often a port conducts maintenance dredging will depend on regional coastal processes and the rate of sediment accumulation.

## CAPITAL DREDGING

Ports may also conduct dredging to expand the design depth or width of underwater assets to facilitate the growing need for larger vessels or to support increased trade requirements. This is known as capital dredging.

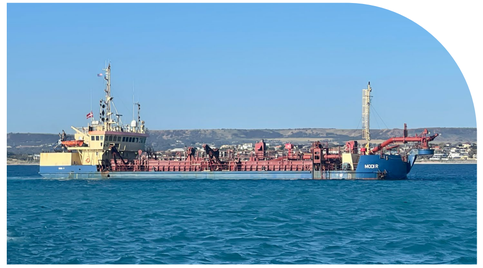


DREDGING

# How is dredging performed?

There are several ways ports can manage sediment via dredging. The technique, or type of vessel used, will depend on the volume of accumulated sediment, where it needs to be removed from and the placement solution.

At Mid West Ports Authority, we draw on a number of dredging methods to manage accumulated sediment.



## TRAILING SUCTION HOPPER DREDGE (TSHD)

Mainly used for dredging loose and soft material such as sand, gravel and silt. Accumulated sediment is collected via a suction pipe. Material is then placed at an approved location by opening doors on the base of the vessel or pumped ashore into specified reclamation areas via a pipeline.

USED AT MWPA FOR: MAINTENANCE DREDGING IN THE CHANNEL AND INNER HARBOUR

## CUTTER SUCTION DREDGE (CSD)

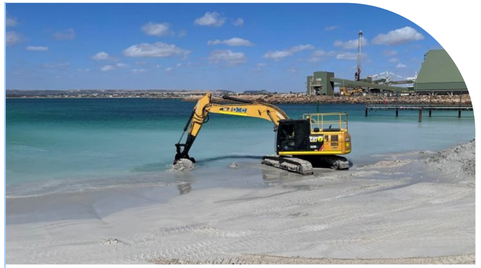
This vessel uses a cutter suction head to loosen accumulated sediment, which is then pumped through a pipeline. The vessel is anchored in a way that allows it to pivot from side-to-side of the dredging area to effectively remove sediment material.

MAINTENANCE OF THE FISHING BOAT HARBOUR AND INNER HARBOUR

## BED LEVELLING

Bed levelling, also known as ploughing, sees a levelling bar at the rear of the vessel lowered to redistribute accumulated sediment to deeper adjacent waters. This technique can also be used to level the channel floor after dredging.

THE CHANNEL AND FISHING BOAT HARBOUR ENTRANCE AS PART OF MAINTENANCE DREDGING



## BACKHOE DREDGE (BHD) AND EXCAVATORS

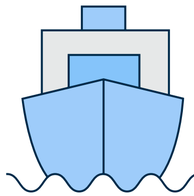
This technique involves the use of an backhoe (which is similar to a floating excavator) to remove accumulated sediment. Sediment is loaded onto barges and transported to an approved placement site. In some cases, a standalone excavator can access the accumulated sediment directly from the beach, with material loaded onto and transported to the placement area via truck.

PAGES AND LIVES BEACH AS PART OF THE NORTHERN BEACHES STABILISATION PROGRAM

# What measures are in place to protect the environment?

Environmental monitoring informs our approach and guides our decision making.

Prior to conducting any dredging, management plans to protect the environment are developed in consultation with technical experts. Beyond providing us with baseline data for sediment management initiatives, regular and continuous monitoring allows us to analyse and assess environmental conditions over the long-term.




## A CONTINUOUS APPROACH

### ONGOING MONITORING

**Benthic habitat mapping**

Seagrass health assessment

**Hydrographic surveys**

Sediment characterisation and quality

**Water quality and light levels**

Wind, waves, currents

**Marine fanua**

Groundwater monitoring

### TARGETED MONITORING

During dredging, targeted, more frequent, monitoring occurs. In addition to regular monitoring techniques this can include:

Aerial surveillance conducted by drone to monitor turbidity

**Monitoring of weather conditions**

Marine fanua observers

PRE-DREDGE
BASELINE DATA

DURING DREDGE
MONITOR + MANAGE

POST-DREDGE
ANALYSE + ASSESS

CONTINUOUS APPROACH

# OUR APPROACH IN ACTION

OUR APPROACH IN ACTION

# 2021 maintenance dredging campaign

In 2021 Mid West Ports Authority removed approximately 145,000m3 of naturally accumulated sediment from within the commercial harbour and shipping channel in order to maintain safe navigational depths.

Our assessment and evaluation identified a combination of nearshore placement and land reclamation as the strongest performing placement options, enabling 100 percent of material to be beneficially reused.

While off-shore sea dumping was considered (and deemed the most cost effective option) the selected nearshore placement option was found to deliver far greater social and environmental value.

Placement to the Berth 7 reclamation was found to provide the greater net benefit for sediments not suitable for ocean placement.

## SNAPSHOT

### VOLUMES

| 145,000m$^3$ | 130,000m$^3$ | 15,000m$^3$ |
|---|---|---|
| TOTAL VOLUME | NAVIGATION CHANNEL | INNER HARBOUR |
| PLACEMENT | ENVIRONMENTAL BENEFICIAL REUSE | ENGINEERING BENEFICIAL REUSE |
| | PIANC BEST PRACTICE | |
| | Sediment material placed at nearshore location adjacent to Bluff Point | Sediment material placed onshore at Berth 7 reclamation |
| | ✓ Sediment remains within natural sediment cell | ✓ Creation of new infrastructure |
| | ✓ Sediments can continue to migrate north along the coast by natural processes | ✓ Supportive of long-term vision identified in Port Master Plan |
| | | ✓ Increased storm surge protection |

# Nearshore placement

BLUFF POINT

**1km - 1.6km**
DISTANCE FROM THE SHORELINE

**8-10m**
WATER DEPTH

NATURAL CONDITIONS

WIND | WAVE | SWELL

Coastline is naturally turbid with wind and wave energy supporting sand migration

| | |
|---|---|
| Placement area is bare sand | 1.4km long - 0.4km wide \| 530,000m$^2$ |

APPROACH AIMS TO:

- Build coastal resilience by supplementing sediment supply to nearshore natural processes
- Provide ongoing source of sand nourishment required for healthy seagrass growth


# Contact us

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