Deep Sea Tailings Placement (DSTP) in the Huon Gulf

Common Questions and Answers about the Marine Environment and Oceanographic Studies

August 2018

WAFI-GOLPU
JOINT VENTURE

What is the Wafi-Golpu Project?

The Wafi-Golpu Project (the Project) is a proposed underground copper and gold mine located 65km southwest of Lae in Morobe Province of Papua New Guinea.

The Wafi-Golpu Joint Venture has offices at Wafi, 11 Mile near Lae and in Brisbane.

There is also a website at: www.wafigolpujv.com

What are mine tailings and why do they need to be managed?

- Mining involves digging up valuable minerals (ore). Wafi-Golpu Project will do this by underground mining.
- Once mined, the ore is ground into a fine sand and mixed with water (see Figure 1).
- The valuable minerals are separated from the rest and made into a concentrate. Separation of the valuable minerals is achieved by frothing the ore using reagents similar to detergents (see Figure 2). No cyanide is used in this process.
- The worthless left-over fine sands are "tailings" (see Figure 3). These fine sands must be managed safely because if they are exposed to air for a long period of time they would change and may become a risk to the surrounding environment.

Figure 1 – Ball mill used to grind ore

Figure 2 – Concentrate production

What are the options for managing mine tailings?

Options for managing tailings include:

- On land:
    - In tailings storage facilities (TSFs) (storage dams).
    - Dry stacking (removing as much water as possible and stacking up the moist tailings).
- Deep under the sea, using a method known as deep sea tailings placement (DSTP).

Tailings Storage Facilities (TSFs)

- A TSF is a large, man-made dam that is used to store tailings.
- Many mines around the world successfully use TSFs but they are not common in PNG due to engineering and environmental conditions.
- The storage of large tailings volumes for the Wafi-Golpu Project would require clearing of large areas (>600 ha, approximately 1200 football fields), which could affect community livelihoods, ecosystems and cultural values.
- The WGJV has completed an extensive assessment program of 45 potential sites for TSFs.
- The studies revealed challenges from high seismicity, liquefiable soils and high rainfall.
- A TSF structure would be permanent and would remain after mine closure as a permanent lake.

Deep Sea Tailings Placement (DSTP)

- DSTP puts tailings directly into the very deep sea, well below surface productive areas of the sea where light penetrates.
- DSTP systems currently operate in PNG and other countries (see Figure 4).

Figure 3 – An example of fine sand tailings

Q Why is DSTP preferred for the Wafi-Golpu Project?

- The WGJV has extensively investigated options, both on-land and utilising DSTP, for life of mine tailings management for the Project.
- Compared to a TSF, DSTP has fewer impacts on subsistence communities, biodiversity and cultural heritage values (DSTP is initially a more expensive option for WGJV due to the lengthy pipeline to the coast).
- TSF options considered heightened engineering, safety and rehabilitation challenges due to high seismicity, liquefiable soils and high rainfall. Collectively these resulted in an increased risk of potential dam failure that would need to be managed well after eventual mine closure.
- The WGJV has completed a range of studies in the Huon Gulf to identify the optimal location to place a DSTP system, considering seabed mapping, ocean currents and existing large amounts of sand, mud and gravels that the Markham, Busu and other rivers are naturally depositing in the Huon Gulf each year.

An example of an operating DSTP facility

Figure 4 – Batu Hijau Copper Gold Mine in Indonesia

Q How does DSTP work?

- Tailings are mixed with seawater in an on-land mixing tank so that the discharged mixture is heavier than seawater and sinks.
- The tailings mixture is discharged from the pipeline deep below the surface (approximately 200m is proposed).
- As the tailings mixture is heavy, it flows along the bottom of the sea floor down to great depths where the tailings solids deposit (see Figure 5).

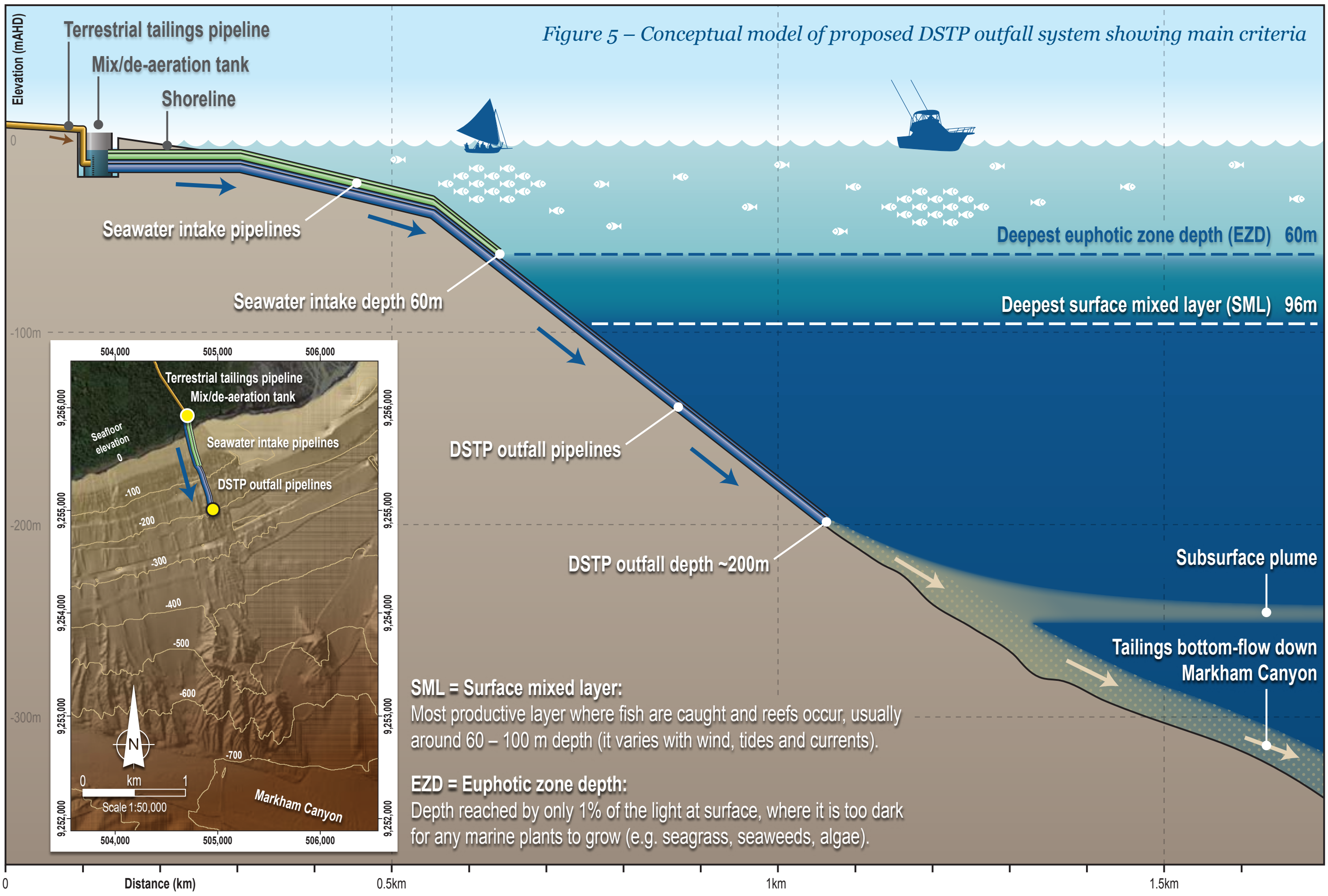


Figure 5 – Conceptual model of proposed DSTP outfall system showing main criteria

Figure 6 – River sediment plumes in the north-west Huon Gulf

Why is DSTP feasible in the Huon Gulf?

The Huon Gulf is WGJV's preferred location for a DSTP system due to:

- Very deep water close to the proposed tailings outfall point.
- The large volume of natural sediment deposited by local rivers (estimated to be at least four times the quantity of tailings proposed to be discharged each year), which will mix with, and ultimately bury the tailings.
- The presence of the Markham Canyon, a large subsea canyon to assist in the transport of mine tailings to very deep water over 1,000m deep.
- Low marine biodiversity on the seafloor in the canyon and main areas where the tailings are predicted to deposit.
- When mining stops, the high rate of deposition of natural sediment will continue and progressively bury the tailings and return the seafloor to its natural state.

Natural sediment in the Huon Gulf

- Large amounts of mud, sand, gravel and some large rocks are carried into the Huon Gulf by rivers (see Figure 6), including the Markham and Busu (Figure 7).
- Surface plumes of muddy water are an existing feature of the gulf.
- An estimated 60 million tonnes of suspended sediment are carried into the Huon Gulf from the rivers each year (Table 1), which is at least four times the quantity of tailings that is proposed to be discharged each year.
- Note that Table 1 only estimates the suspended sediment load, not the sand, gravel and boulders that are transported along the river bed into the Markham Canyon.

Table 1 – Estimated amount of suspended sediment discharged into the Huon Gulf from rivers

Period	Mean flow (m^3/s)	Mean daily load (t/d)	Estimated annual load (Mt/a)
Markham River gauging station			
2016 – 2017	545	117,970	**43**
Busu River gauging station			
Oct16 – Sep17	105	12,300	**4.5**
Estimated load for all rivers*			**60**

** Markham, Bumbu, Busu, Sitem, Bunga, Buiem, Buso, Bulu, Buhem, Busa, Bukang and Mongi*


Figure 7 – Markham River (left) and Busu River (right)

What does the seafloor look like?

- Pictures of the seafloor taken by an underwater video camera using strong lights have been taken at many locations (see Figure 8 and pictures below).
- The canyon floor is not visible at most locations investigated because of the flow of muddy water and sediment clouds up to 150m high above the seafloor.
- Where the water is clear, it can be observed that the seafloor is mostly fine sand and mud. Some rounded stones and boulders are swept into the Huon Gulf from the rivers.
- Apart from the occasional fish and shrimp, very few animals, or tracks and burrows of animals, can be seen on the canyon seafloor where most of the tailings are likely to settle.
- The exception is the reference site, outside the canyon near to Salamaua. This shows a typical deep sedimentary seafloor with many burrows and tracks of seafloor animals (higher biodiversity).

The Markham Canyon

Figure 8 shows the map of the bottom of the Huon Gulf, which is highly suitable to accommodate a DSTP system:

- Deep water (more than 200m) is close to the shore.
- The canyon wall slopes are steep (20º) along the Huon Gulf coast to the north of Lae. Engineering and modelling studies show that these slopes are sufficiently steep to ensure that tailings flow downslope and do not block the pipeline.
- Very deep water is present for final deposition of tailings – typically more than 1,000m in the Markham Canyon and up to 9,000m deep in the New Britain Trench downgradient of the Markham Canyon. The Markham Canyon acts as a transport pathway for river sediments from the surface into very deep water (shown by arrows on Figure 8).

Figure 8 – Map of the video camera sampling locations on the seafloor of the Huon Gulf and images from four locations as shown

How was the outfall location selected?

The PNG Government's draft DSTP guidelines require a discharge depth that is:

- Below the surface mixed layer – the most productive layer where fish are caught and reefs occur – usually around 60-100m depth (it varies with wind, tides and currents).
- Below the sunlit (euphotic) zone – the depth reached by only 1% of the light at surface – where it is too dark for marine plants (e.g. seagrass, seaweeds, algae) to grow.
- Below the depth of any upwelling currents (if these occur) which could potentially carry the tailings back into surface waters. Upwelling currents may occur if offshore winds are strong and constant enough to move the surface waters further out to sea, which are then replaced by cooler, deeper waters from below (see Figure 9 and 10).

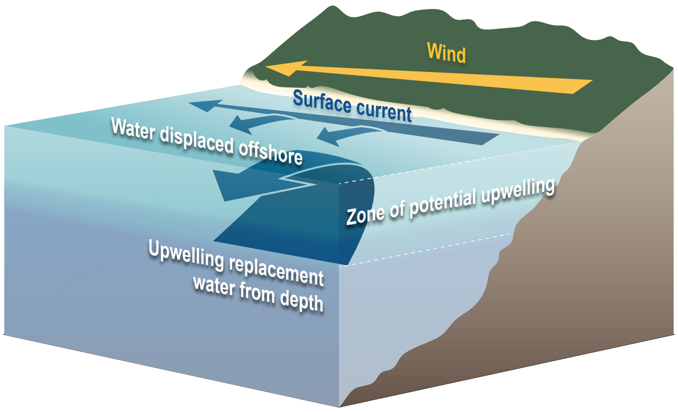


Figure 9 – Diagram of coastal processes that have the potential to lead to upwelling

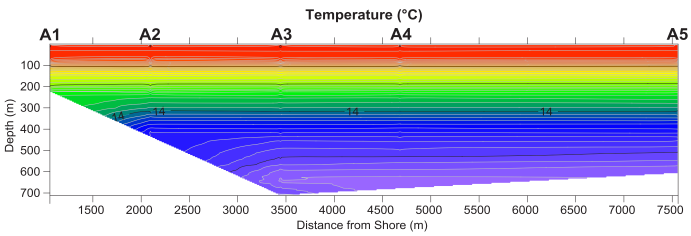


Figure 10 – Temperature profile Transect A, 8 August 2017

If upwelling occurred, cooler water (yellow, green or blue, depending on depth of upwelling) would rise towards the surface and replace the warmer (red) coastal waters at the surface (around A1 and A2).]

Figure 11 – Oceanographic vessel MV Xiang Jian

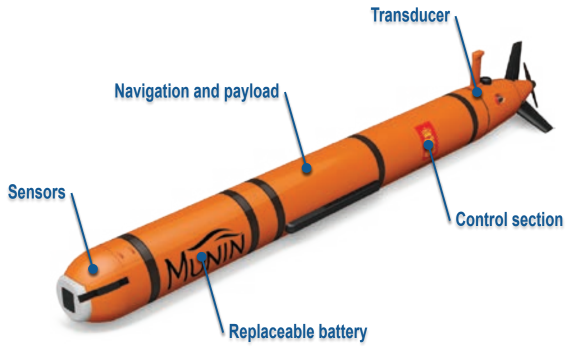


Figure 12 – The Munin – an Autonomous Underwater Vehicle (AUV), which is about 3.5m in length and was used for very high resolution seabed mapping

The studies that were performed

The WGJV carried out preliminary seafloor mapping in 2012 and commenced detailed studies for the Environmental Impact Statement (EIS) in August 2016 to provide high definition oceanographic data to determine if DSTP is feasible and to identify the preferred location and depth of outfall. This has included:

- Commissioning the Chinese oceanographic research ship, MV Xiang Jian (see Figure 11) and an Autonomous Underwater Vehicle (see Figure 12) to carry out detailed seafloor mapping using sonar (sound waves).
- Measuring temperature, salinity and light from the sea surface to the seafloor using conductivity, temperature, depth (CTD) instruments since October 2016 (see sampling locations in Figure 13 and instrument pack in Figure 14).
- In the case of upwelling, WGJV has investigated upwelling by measuring temperatures from sea surface to the seafloor at the 10 transect sites across the canyon over at least 12 months.
- Figure 10 shows conditions on 8 August 2017 that are consistent with other measurements made during the studies. No upwelling has been detected at any time or location during the studies.

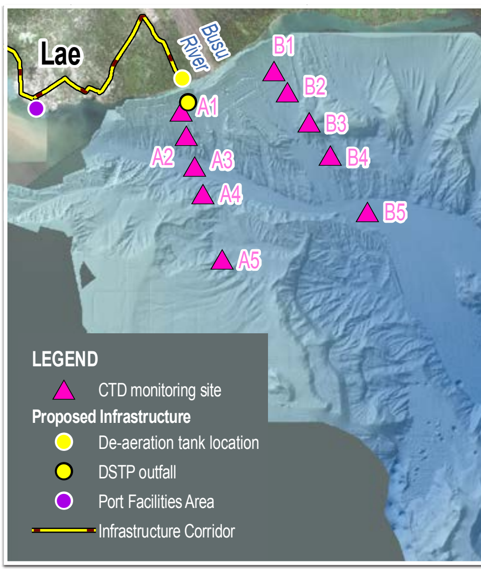


Figure 13 – CTD sampling transects A and B

Figure 14 – CTD instrument pack

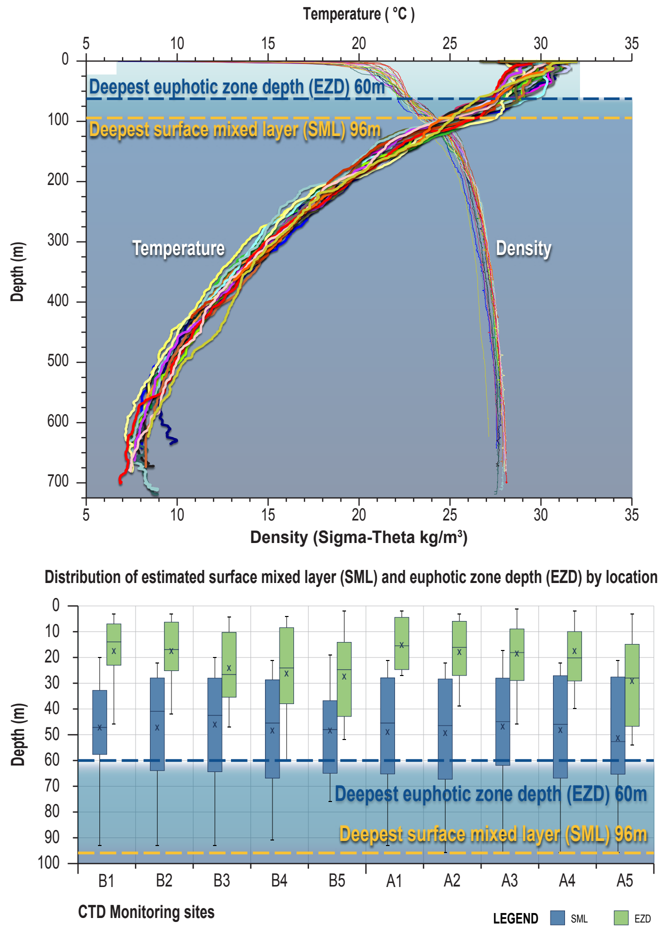


Figure 15 – CTD temperature and density profiles and ranges of surface mixed layer (SML) (top graph) and the associated calculated ranges for the SML depth (blue) and euphotic zone depth (EZD)(Green) in the bottom graph at the ten transect locations.

The graphs in Figure 15 give the results from 25 profiles taken from October 2016 to December 2017 which show:

- The deepest observed surface mixed layer (SML) is 96m.
- The deepest observed depth of the euphotic zone (depth reached by only 1% of light) (EZD) is 60m.
- The the PNG Government's draft DSTP guidelines state that the outfall depth has to be at least 120m or the maximum observed depth of SML or EZD (whichever is deeper) +50%.
- According to this requirement, the outfall depth must be at least 144m.
- The deepest surface mixed layer and depth reached by light is shallower than other DSTP systems in PNG because of the naturally turbid water (see Figure 15).
- There has been no evidence of upwelling at any time of year at any data measurement location.
- On the basis of these studies, the outfall near Wagang meets the the PNG Government's draft DSTP guidelines and is the preferred location for DSTP.

Proposed tailings discharge depth

Based on these studies WGJV proposes to construct the pipeline to discharge tailings at approximately 200m depth, more than twice as deep as the SML (see Figure 16).

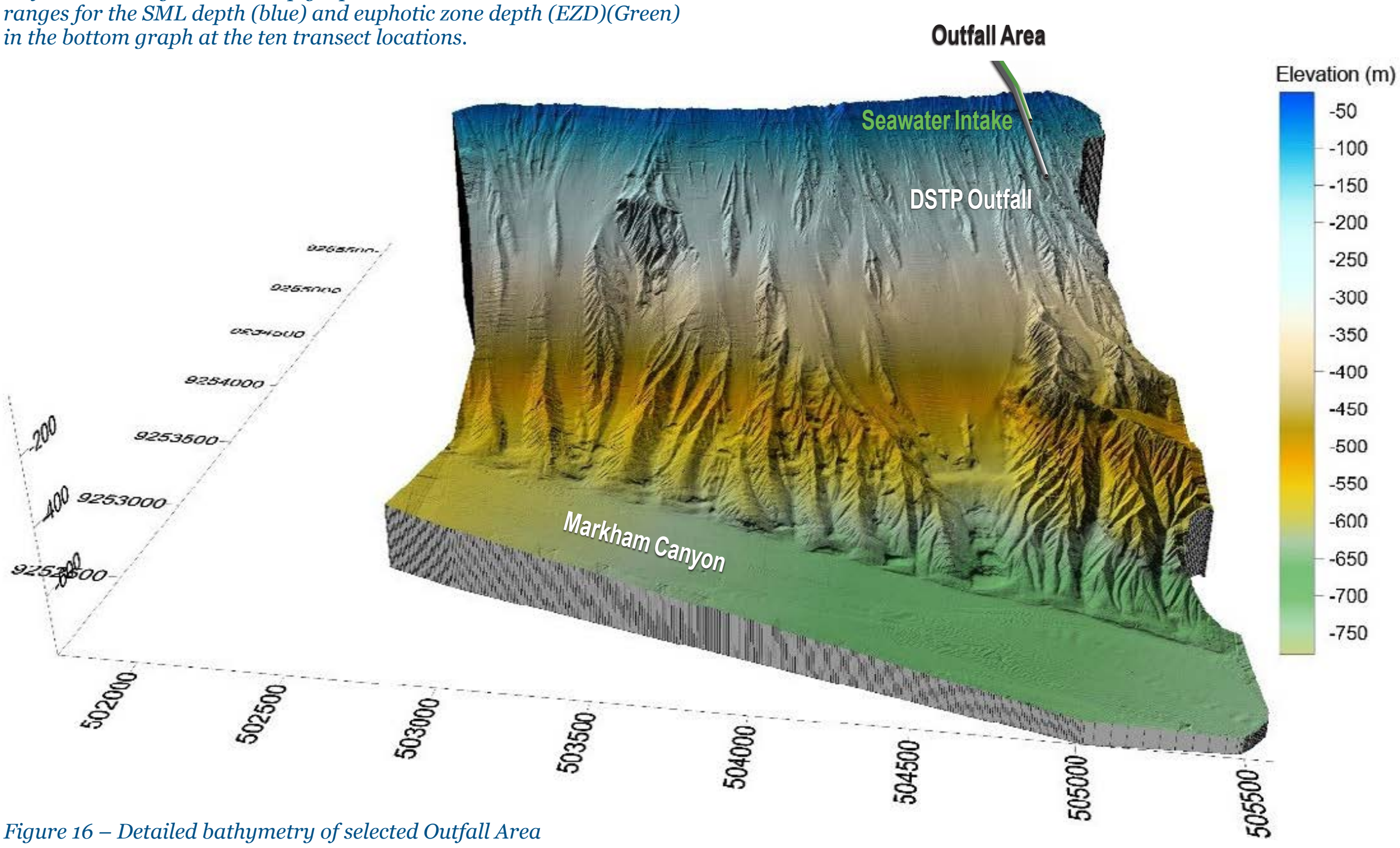


Figure 16 – Detailed bathymetry of selected Outfall Area

Q Where will the tailings go?

- A computer model has been developed that uses information from the studies to predict the distribution of the tailings as well as the natural sediment that enters the Huon Gulf from rivers.
- Most tailings will flow down the steep Markham Canyon wall to the canyon floor and then flow towards the east along the seabed, mixing with the sediment from the rivers.
- Some of the finer tailings will separate from the density current and move into the water column as plumes before settling on the seabed.

Mass movement of sediment down the Markham Canyon

- There are several monitoring stations established through the Markham Canyon, including the Outfall, Wave, Canyon A, B and C, Basin A and B, Far Field and Trench (see Figure 17). Measurements are collected from these monitoring stations with an ADCP (Acoustic Doppler Current Profiler) instrument pack (see Figure 19).
- At the Canyon and Basin sites, sudden sub-sea landslides of sediment from the canyon walls resulting in the rapid flow of natural sediment down the floor of the canyon have been observed.
- This is good for DSTP, as these landslides are predicted to help transport the tailings down the canyon into deeper water.
- Table 2 shows some examples of landslides that have been recorded by the current meters.
- Some of the sub-sea landslides have reached speeds of over 8m/s (about the speed of an Olympic sprinter) and been strong enough to move the 900kg anchor moorings up to 15km (9 nautical miles) down the canyon.
- These sub-sea landslides move large volumes of natural sediment through the Markham Canyon towards the deeper waters of the New Britain Trench (see Figure 18).
- Around 50 landslide/turbidity events, including very minor ones, were measured between October 2016 and December 2017.
- These landslides create a very challenging environment for marine life in the canyon due to the turbidity plumes and the dynamic erosion and deposition of sediments.

Table 2 – Speeds of the turbidity currents (up to 8m/sec), calculated from the timing of the recorded current bursts between sequential moorings

Date	Canyon section	Time of travel (min)	Distance (km)	Estimated turbidity current speed (m/s)
8 Jan 2017	Canyon A to Basin A	40	18.7	7.8
3 Jun 2017	Canyon B to Basin B Basin B to Trench	87 262	43.9 60.0	8.4 3.8
1 Aug 2017	Canyon C to Basin B	302	32.7	1.8
2 Sep 2017	Canyon C to Basin B Basin B to Trench	188 857	32.5 59.7	2.9 1.1

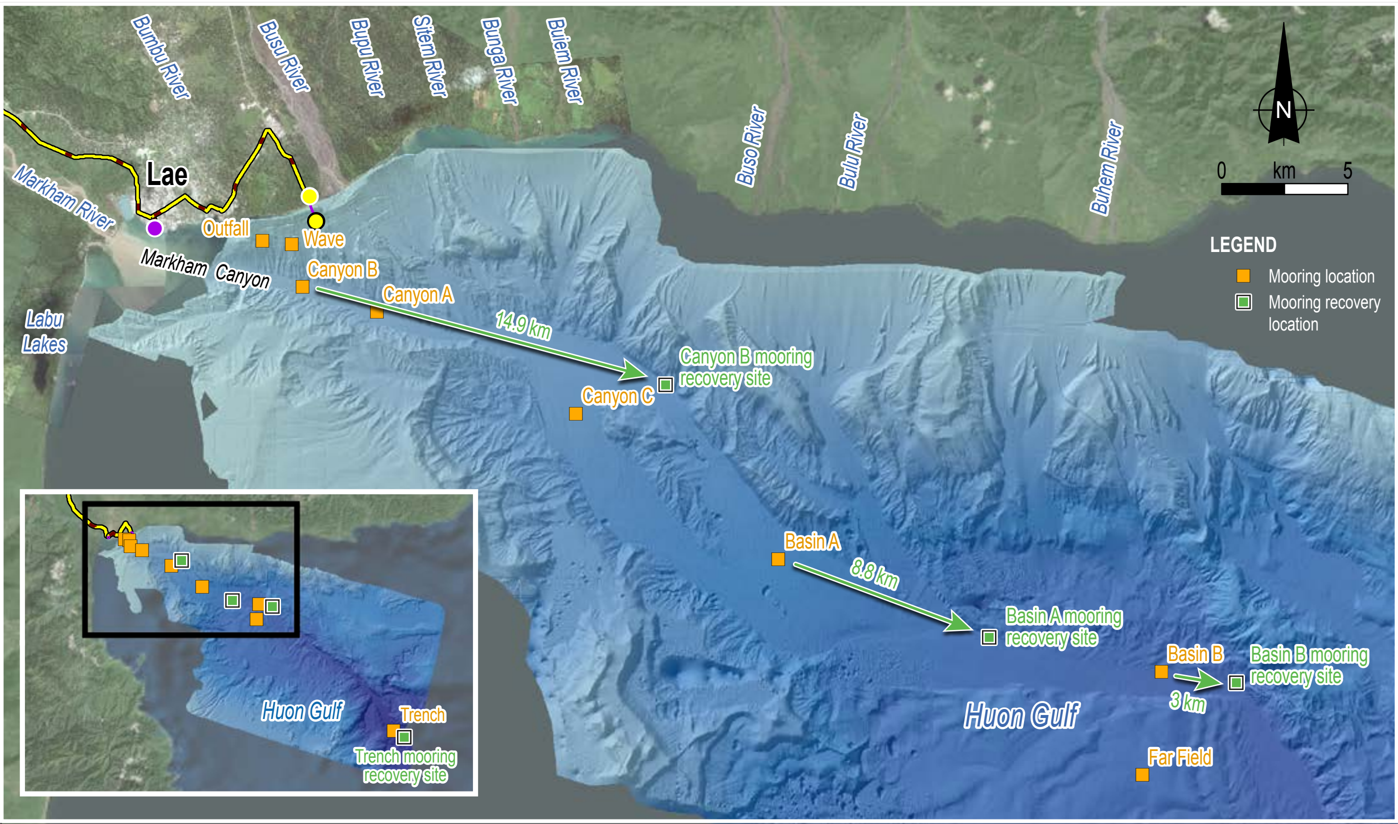


Figure 17 – Current monitoring locations. Arrows show locations where subsea landslides have been recorded

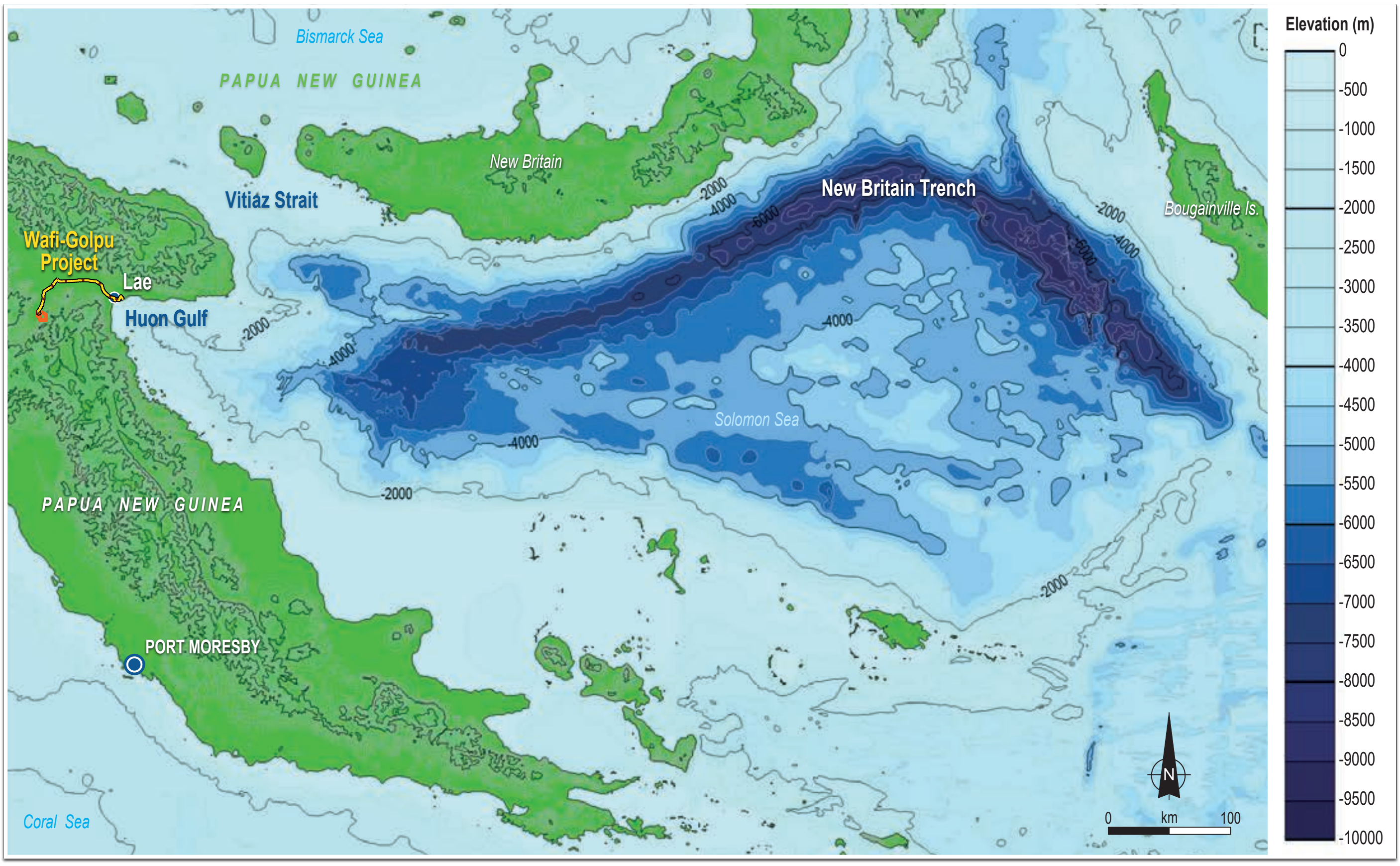


Figure 18 – Water depth in the Huon Gulf and Solomon Sea

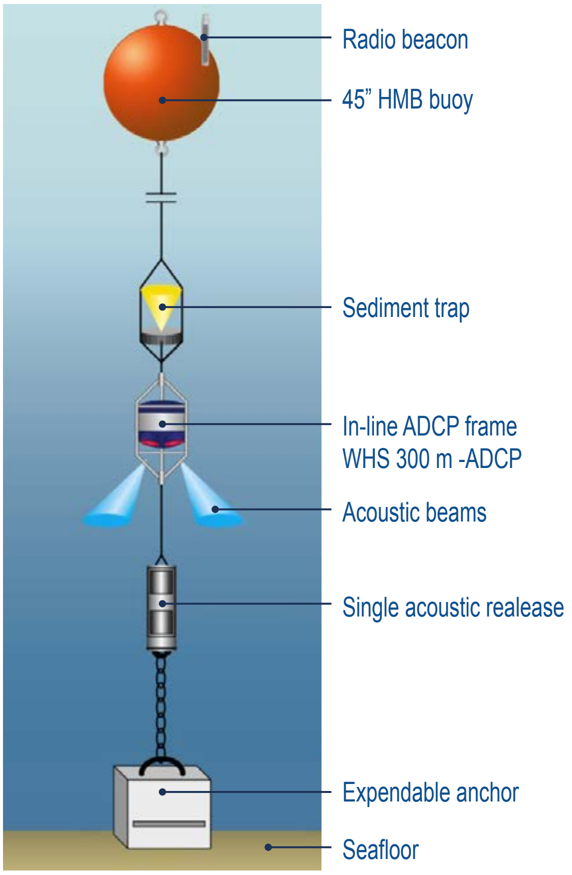


Figure 19 – ADCP (Acoustic Doppler Current Profiler) instrument pack

Sea bottom sand waves

- Profiles from echo sounding along the canyon floor show the presence of large sediment waves (see white arrows on Figure 20) extending down to 3,000m.
- Some of these waves are up to 80m high and 700m long.
- The mass sediment movement events provide the main mechanisms of natural sediment transport (and tailings transport during the life of mine) into deeper water of the Huon Gulf, towards the New Britain Trench.

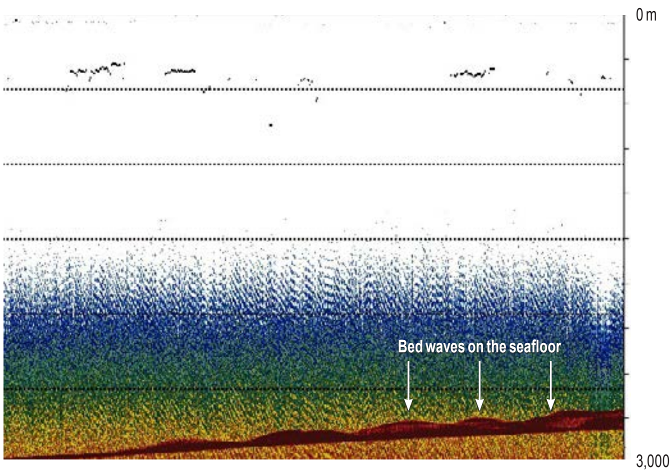


Figure 20 – Sand waves on Markham Canyon floor

Computer modelling of sediment transport in the Huon Gulf

Computer modelling uses all the information from the studies, particularly:

- The bathymetry.
- The amount of tailings and suspended river sediment entering the Huon Gulf.
- The measurement of currents, water temperature, salinity, wind and tides and their effect on movement of tailings and natural sediment.
- The mass movement events that frequently transport sediments down the Markham Canyon into very deep water.

Figures 21 and 22 show the predicted footprint after I year and 27 years respectively. Figure 22, also includes the effect of one landslide event per year for tailings and also natural sediment from the rivers.

These figures show:

- Some tailings (approximately 38%) are predicted to form sub-sea plumes below the surfaced mixed layer, and mostly between 300 to 500m depth.
- These subsurface plumes are predicted to remain below the discharge depth before settling within about 5 -6km of the discharge point within the same area as settlement from the river sediment plumes.
- Periodic mass movement events around the flanks of the Markham Canyon will continue to transport accumulated sediment and tailings into deeper water
- The modelling has confirmed what is indicated in the detailed bathymetric surveys; the vast majority of the tailings will flow down the Markham Canyon and into deeper water as part of the existing natural sediment flows.

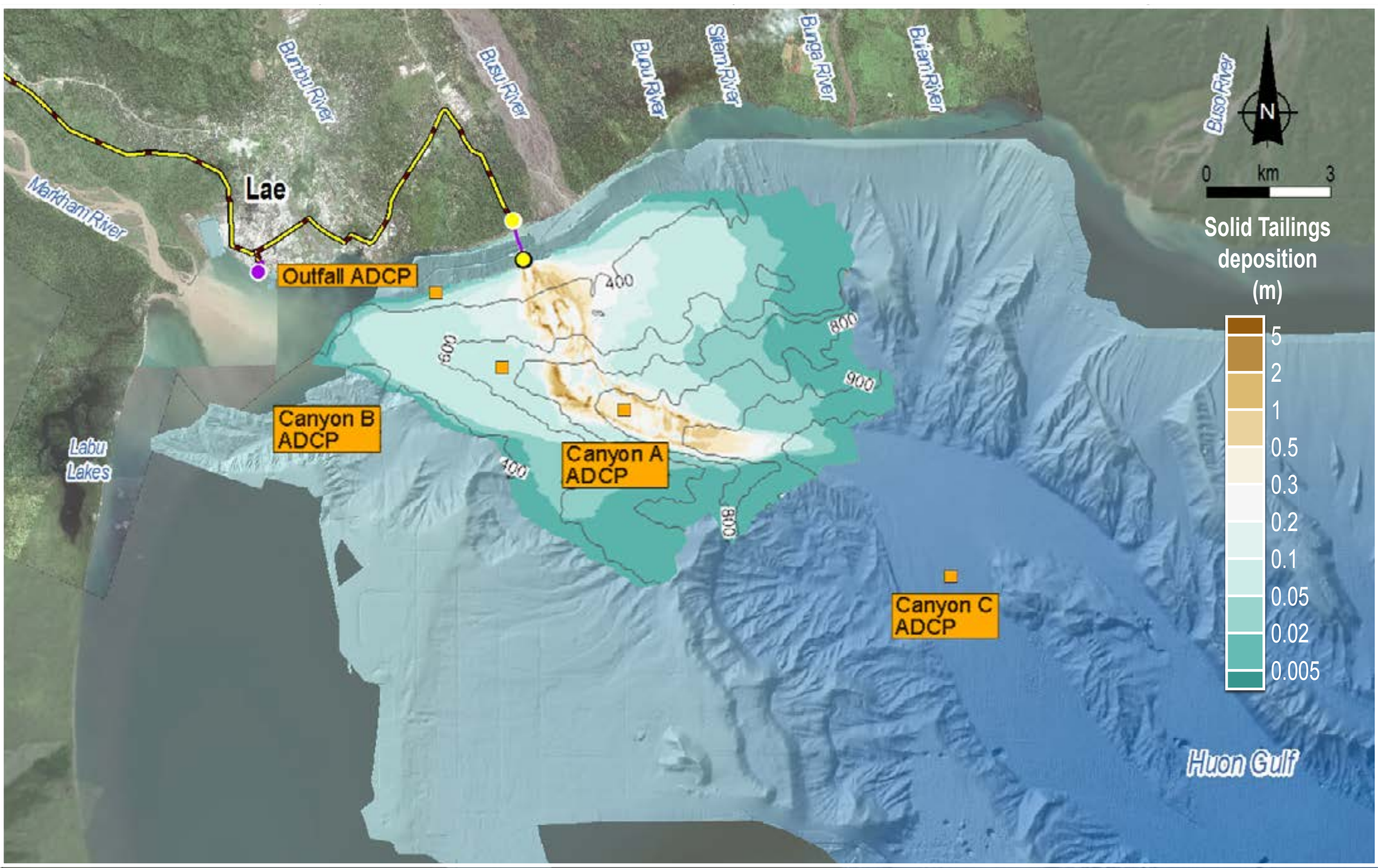


Figure 21 – Modelled total tailings footprint after 1 year of DSTP operation (cut-off at 5mm)

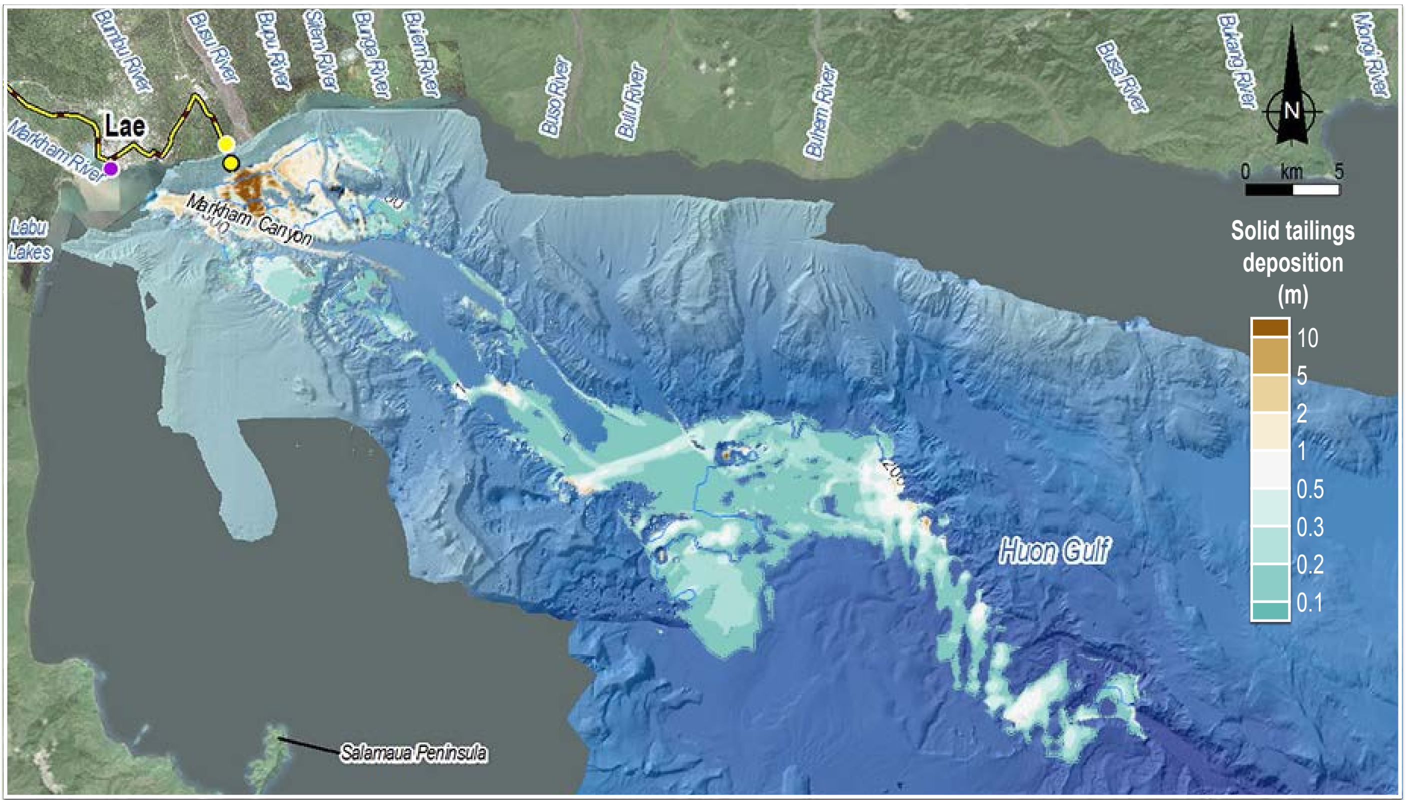


Figure 22 – Modelled total tailings footprint after 27 years of DSTP operation (~450Mt) and inclusive of one mass movement event per year (cut-off at 10cm)

Q Will DSTP affect fish and fishing in the Huon Gulf?

- The main fisheries operating in the Huon Gulf are:
  1. Local fishing from coastal villages for home consumption or for sale at market.
  2. Game fishing for species such as marlin and Spanish mackerel.

Will local fishing be affected?

- Local fishing provides an important source of food and income for the people who live along the coast. A wide variety of fish are caught from the shallow (<100m) coastal areas, beaches, Labu Lakes and reefs around Salamaua. Fishing also includes catching prawns, mud crabs and mud lobsters around the mangroves of the Labu Lakes (see Figures 23 to 26 on following page).
- Interviews and surveys show that local fishing is limited to depths less than 100m. The types of fish caught by local communities live in the coastal environment and therefore are not predicted to be affected by the 200m deep discharge of tailings into the deep-sea environment. The main methods of fishing include:
  - Beach fishing by rod and line and beach seine netting.
  - Fishing from outrigger canoes and banana boats using hand reels and drop lines.
  - Trolling for baitfish and mackerel.
  - Fish trapping.
- Due to the large sediment discharge from local rivers, there are no coral reefs in the turbid waters near the proposed tailings outfall site. The nearest coral reefs and reef-dependent fish are at Salamaua on the south coast more than 20km away, where reef fishing is not expected to be affected.
- A monitoring program will be implemented to record the different species caught during the year and also to gather baseline information on background metal content in edible fish.

Will commercial fishing be affected?

- There are predicted to be no impacts from DSTP to commercial tuna fisheries because these fisheries are not located within the Huon Gulf.
- Lae hosts a major port and processing facilities, including four operating tuna canneries (tuna and mackerel) with another two under construction at the Malahang Industrial Centre. These facilities support a fleet of 27 tuna purse seining vessels, however the commercial fishery operates a long way outside the Huon Gulf, in PNG's 200nm Economic Exclusion Zone (EEZ) and beyond the 12nm limit of territorial waters.
- The main species are skipjack and yellowfin tuna, caught by the purse seiners operating in the Western and Central Pacific Fishery, far away from the proposed deep sea tailings deposition into the Markham Canyon. Breeding grounds are widespread through the western central Pacific (see Figure 31 on following page). Commercial tuna purse seining will not be affected by DSTP.

Figure 23 – Typical outrigger canoe

Figure 24 – Shallow estuarine lakes at Labu

Figure 25 – Foreshore near Wagang

Figure 26 – Examples of fish sold at DCA Point fish market

Will game fishing be affected?

- The Lae Game Fishing Club is the main recreational fishing club in the Huon Gulf. Game fishing vessels use lures from rod and line and target species such as wahoo, black and blue marlin, sailfish, dolphinfish, trevallies, Spanish mackerel and tuna.
- The main fishing areas are in clear open waters and remote from the potential Outfall Area. Game fishing is not predicted to be affected by DSTP.

Q What fish live in deep water in the Huon Gulf?

- WGJV has completed studies to see what types of fish live below the depths that people fish, and below the depth that tailings will be discharged.
- Battery-powered electric reels (see Figure 27) were used to fish with baited hooks and lines from 100 to 800m depth at 30 sites (see fishing sampling sites in Figure 30).
- Although people don't fish at these depths in the DSTP area, it is important to know what lives there.
- Observations from the western Huon Gulf study showed much lower catch rates and far fewer species compared to similar studies at other deep-slope locations in PNG, which have observed many species of snappers, emperors and groupers that were absent in this study.
- In WGJV studies, a total of 58 fish were caught between 100m and 540m depth and these were dominated by sharks (94%), mainly the gulper sharks (see Figures 28 and 29). The Wagang community have occasionally seen this shark species, but do not fish at the depths this shark species mostly lives.

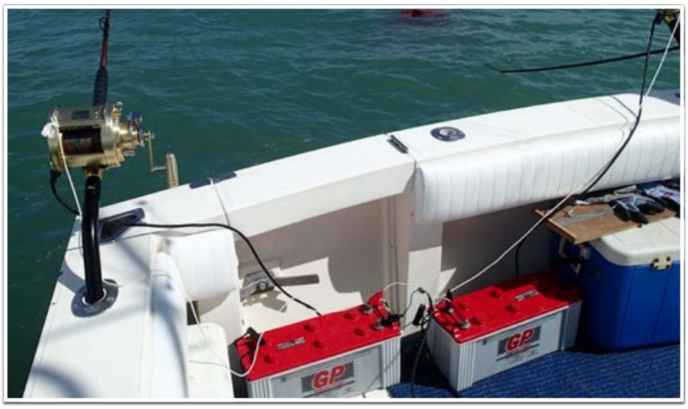


Figure 27 – Deep water fishing gear

Figure 28 – Dwarf Gulper Shark

- Except for a single saddletail snapper, no other fish families commonly recorded in PNG were found along the deep slopes.
- This is likely due to the deep canyon slopes being affected by natural river sediment transport and deposition, which removes the rocky wall and cliff habitat often found in the offshore canyons in other parts of PNG.

Figure 29 – Long-finned Gulper Shark (note the longer dorsal fin)

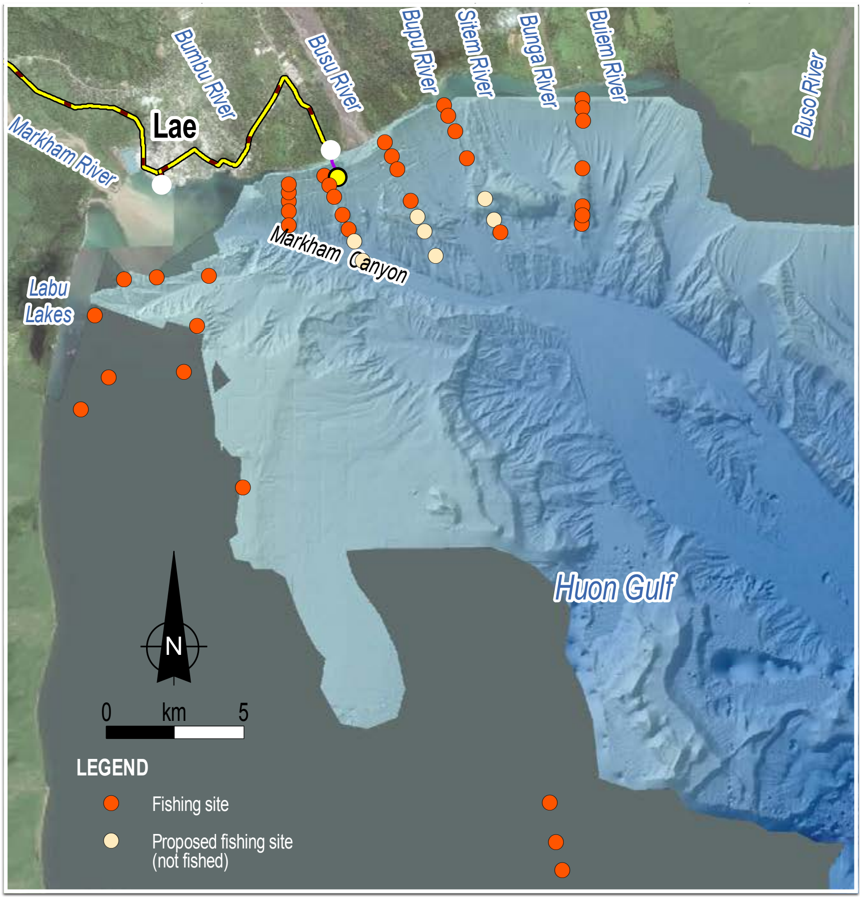


Figure 30 – Fishing sampling sites

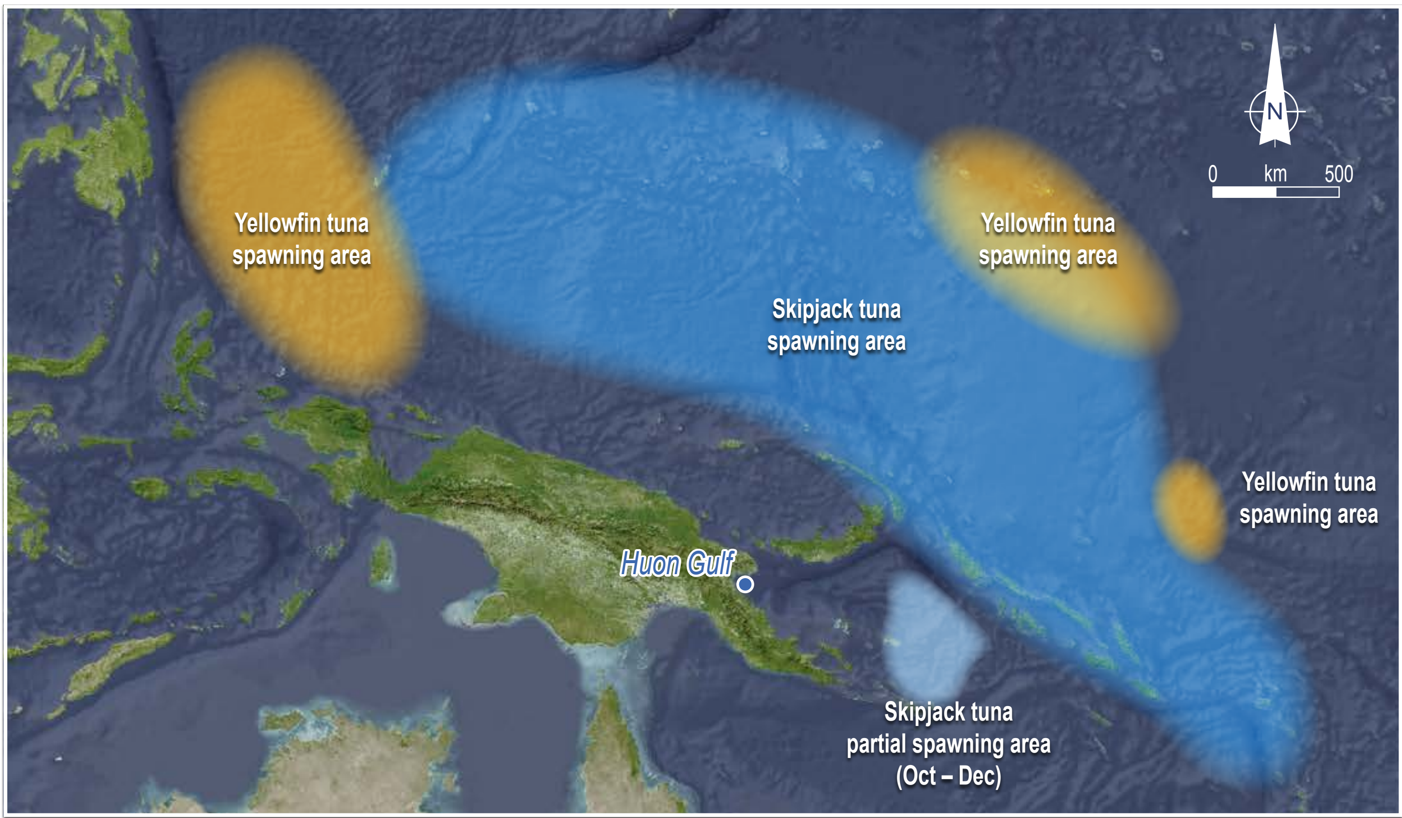


Figure 31 – Skipjack and yellowfin tuna spawning areas (taken from Figure 3.15 in Appendix S to the EIS)

Are the tailings toxic?

- The DSTP system has been designed to be protective of the biologically productive surface waters, the coastal marine environment and the communities that use these, including community fisheries.
- Toxicity testing has been conducted by Australia's premier independent government research institution (CSIRO) and the report is available in the EIS.
- This testing involved the examination of 8 species, including microalgae, crustaceans and fish, and also included tests of hatching success of copepods (very small microscopic crustaceans) when exposed to tailings (see Figure 32).
- Studies show the tailings are likely to release some dissolved metals, which are predicted to have low significance for toxicity in the open ocean and the seafloor outside of the deep-water Markham Canyon.
- In areas of high tailings deposition - downslope of the DSTP outfall and on the seafloor inside the Markham Canyon - the tailings may be toxic to some organisms. But importantly, this area of the canyon already has low biodiversity due to the high volume of natural sediment coming from the rivers.
- CSIRO studies show that potential toxicity reduces as the tailings mixes with river sediments and deposits at depths over 1000m.
- The seafloor ecology impacts are predicted to be reversible and will progressively recover once tailings discharge ceases and natural sedimentation dilutes and buries deposited tailings.
- No toxicity impacts are predicted for the larger more mobile species such as fish, sea turtles or marine mammals.

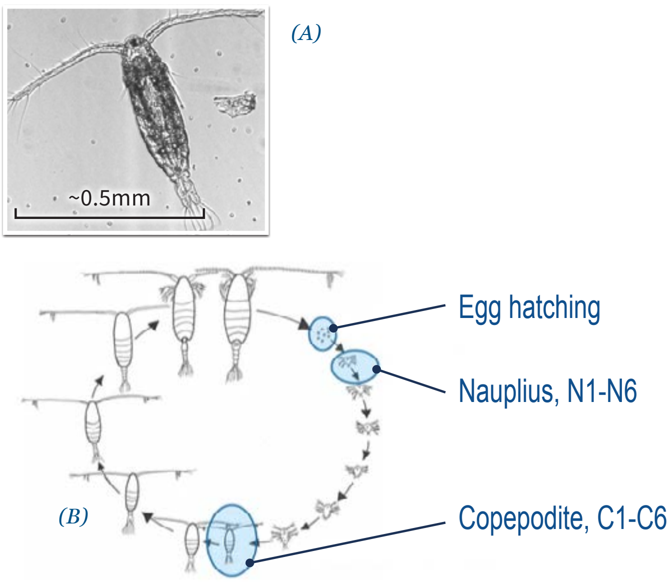


Figure 32 – Marine copepod adult (A) and life cycle (B). The copepod toxicity test measured copepod survival and hatching success from egg to juveniles (from CSIRO report: EIS Appendix L)
Source CSIRO report to GDA Consult and IHA Consult October 2017.

Will fish be safe to eat after tailings are discharged?

Yes. The WGJV understands that this may be a concern for the community and has studied this as well as reviewed actual results obtained from a number of active DSTP operations. The conclusion of the assessment is that the deep sea tailings discharge into the Huon Gulf is not expected to affect the communities' fish catch and that the fish will remain safe to eat.

- None of the locally-caught species of fish come from depths where direct contact with tailings could occur (i.e., below 200m).
- None of the fish (sharks) caught at depths where they could be in contact with tailings (>200m) have been observed in local or market surveys.
- Commercial tuna fishing and game fishing is distant from the DSTP area.
- Monitoring of fish catches and community health at other DSTP operations for periods of over 15 years have demonstrated no metal uptake from the deep sea tailings discharge.
- WGJV has commenced and will maintain a rigorous baseline and monitoring program that will include community participation, to provide the necessary verification and confidence.

Could tailings affect fish via the food chain?

- WGJV has completed a study of the species of plankton in the water column and observed that many kinds of zooplankton and small fish show typical day/night migration down to depths of around 350m. (Plankton sampling sites, equipment and typical species are shown in Figures 33 to 35).
- Studies show that plankton exposure to dilute tailings plumes is short-term and temporary if they descend below 300m in the vicinity of the outfall and was assessed as having a low bioaccumulation potential.
- The results of pathway modelling and comparative studies indicate that there is limited biomagnification of most metals into fish in the higher levels of the food chain (Appendix N of the EIS). One exception is for manganese, but concentrations are well below levels for health considerations.
- These studies predict very low likelihood of any DSTP-derived trace metals accumulating up the foodchain that could pose any risk to people consuming fish. WGJV has commenced and will maintain a rigorous monitoring program to demonstrate this.

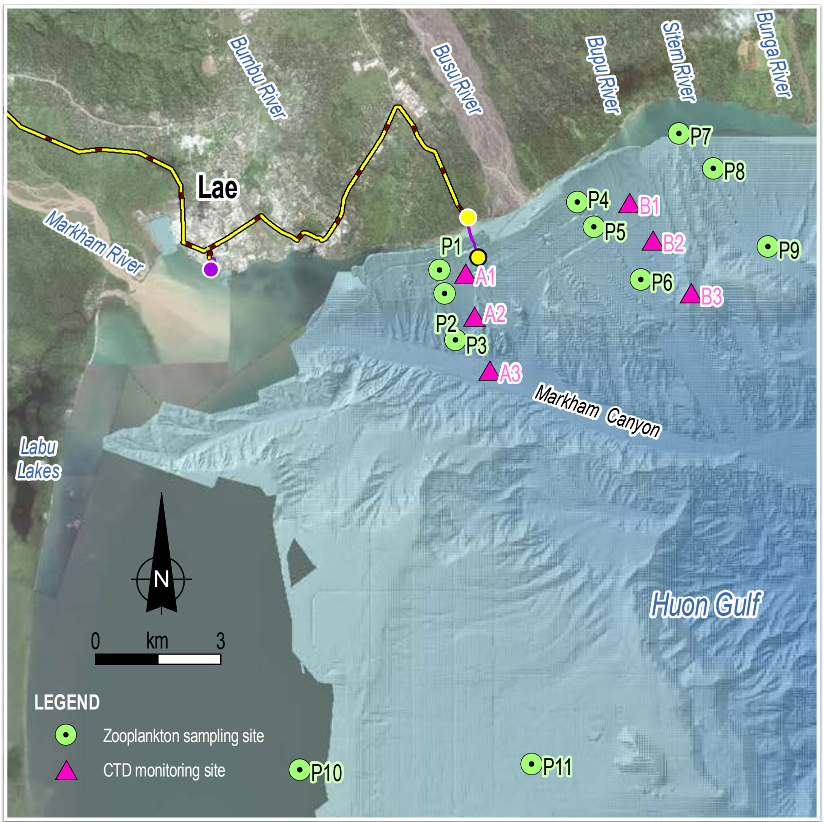


Figure 33 – Plankton sampling locations

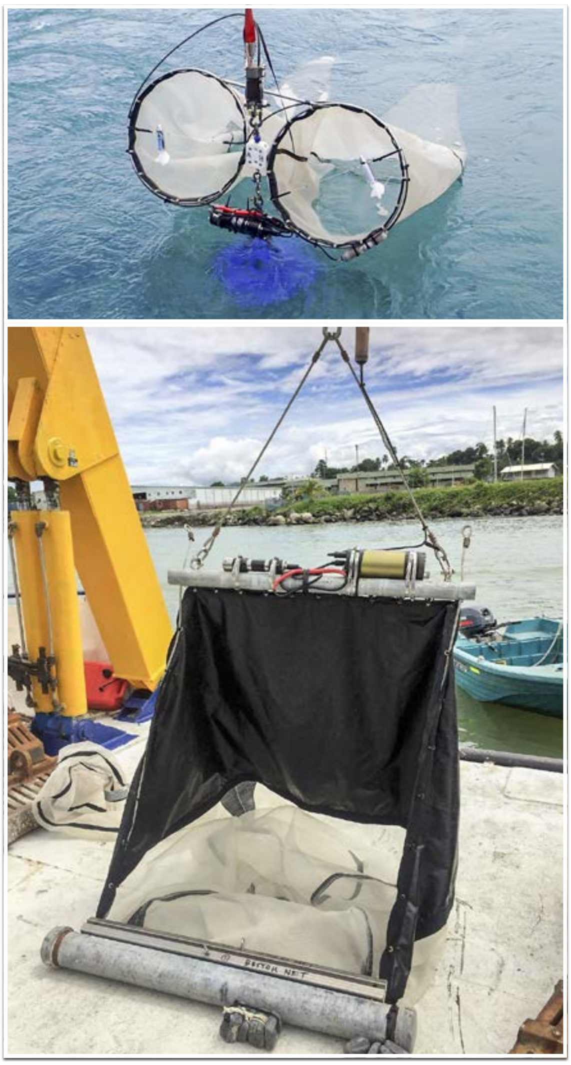


Figure 34 – Different nets used in the plankton sampling program

Squid (cephalopod; phylum Mollusca, class Cephalopoda)

Thalia democratica (salp; phylum Chordata, subphylum Tunicata)

Rhincalanus (copepod; subphylum Crustacea, class Maxillopoda)

Sagitta (chaetognathid; phylum Chaetognatha)

Larva of slimehead fish (family Trachichthyidae)

Figure 35 – Some typical planktonic animals (zooplankton) caught in the Huon Gulf

Q Will turtles be affected?

- WGJV is aware of the small population of leatherback turtles that occasionally nest along the beaches around the inner Huon Gulf. It is most important that these beaches remain clean and free of obstacles for turtles to nest, and that the nests remain undisturbed for the hatchlings to emerge to find their way back to the sea.
- The tailings outfall and seawater intake pipelines will be buried under the beach area and will not be visible or accessible to the public or wildlife. Apart from the brief construction phase to bury the pipeline at a beach with very rare nesting, it will pose no threat to the turtles that might otherwise use the general area. Steps will be taken during the short construction phase to minimise any impacts.
- There is not predicted to be any harmful effects from DSTP-derived trace metal bioaccumulation up the food chain to turtles because these turtles have large foraging areas outside the inner Huon Gulf and there is low predicted trace metal exposure to jellyfish, which are the key prey of the leatherback turtle.

What lives in the sediment?

- The WGJV studies of the seafloor using both video and benthic sediment samples have identified a general absence of large animals living in, on or near the seafloor within and in the vicinity of the Markham Canyon.
- Figures 36 and 37 show pictures of the box and multicorers used to collect the sediment from which the small animals were collected.
- Studies of Huon Gulf sediments in February and December 2017 looked mostly at the communities of microscopic animals (those less than half a millimetre are called meiofauna), because these are still quite abundant in the deep sea sediments. Even so, numbers vary from less than 10 to almost 500 per 10 cm^2. The most dominant species are nematode worms and copepods, but this has varied between sampling periods.
- Figure 38 shows some microscope pictures of nematode worms (around 10mm long) in the top picture and copepods (around 0.2mm or less than the size of a pin-head) in the lower picture.
- These microscopic animals are more abundant than larger shrimps, crabs etc. and are useful for monitoring changes during and after mining.
- The high variation between locations and between samples likely reflects the dynamic effect of the large amount of natural sediments flowing down the canyon, which are depositing and eroding and making it a challenging environment for marine life to live.

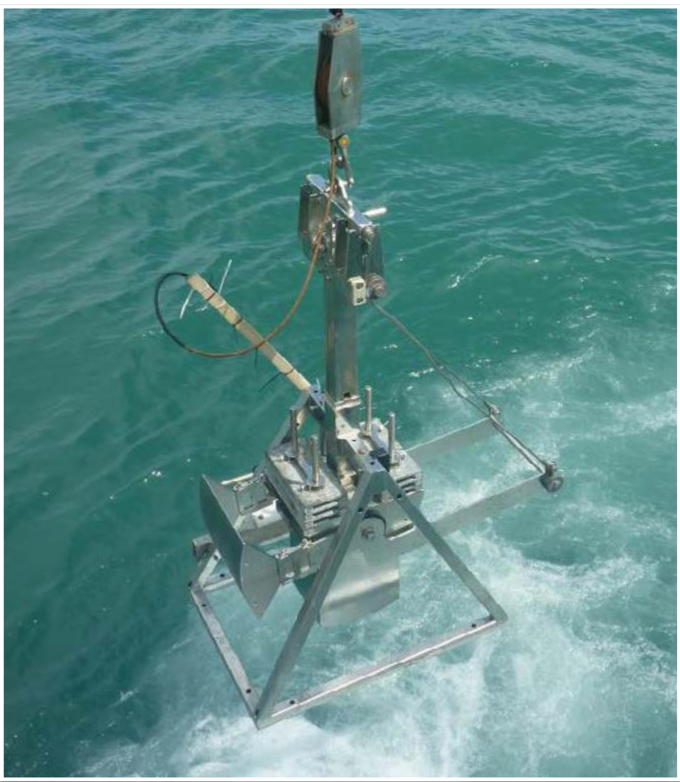


Figure 36 – A box corer

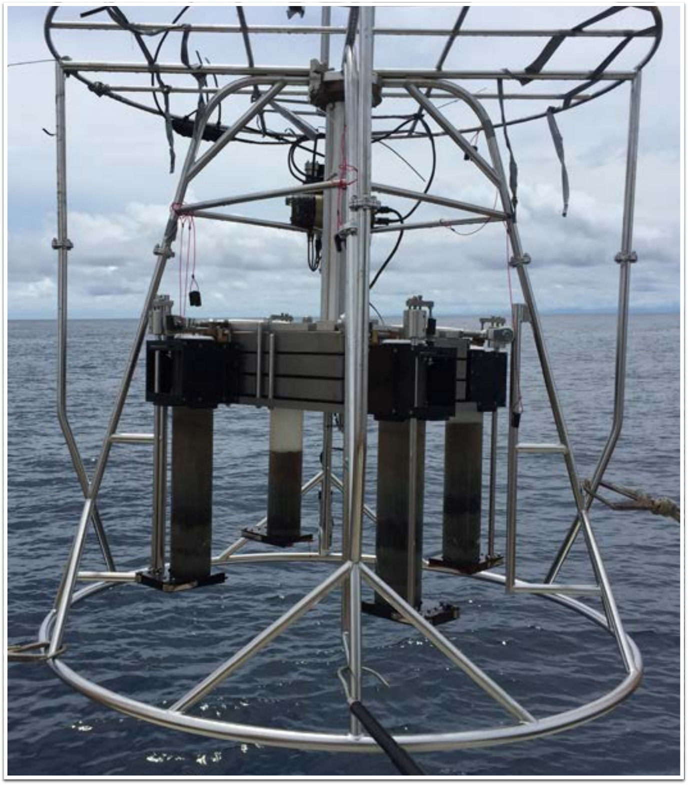


Figure 37 – A multicorer

Figure 38 – Microscope pictures of nematode worms (top) and a copepod (below)

What are the conclusions of the studies?

- The conditions of the Huon Gulf are favourable to meet requirements for safe disposal of tailings by DSTP method.
- The proposed depth of outfall (200m) satisfies several requirements for safe disposal of tailings by DSTP.
  - It is more conservative than the PNG Government's draft DSTP guidelines with a depth exceeding the maximum mixing zone depth +50%.
  - No evidence of upwelling currents have been observed.
  - The steep gradient will prevent build-up of tailings at the pipeline terminus and will promote gravity flow to the floor of the Markham Canyon.
  - Low impacts to ecosystems of concern.
- The large amount of natural sediments from the rivers (about four times as much as the tailings per year) will help to mix and transport tailings into very deep water.
- Frequent natural submarine landslides will also transport material down the canyon towards the 9,000m deep New Britain Trench.
- The risks of tailings affecting the food chain for fish are extremely low.
- The conclusion is that DSTP is not predicted to affect the coastal environment, productive surface waters, community health and fisheries.
- DSTP is proposed as the environmentally safest and most socially responsible option for managing tailings for the Wafi-Golpu Project.

Where can I get further information?

An environmental impact statement containing a wide-ranging assessment of environmental, social and cultural heritage studies in relation to Wafi-Golpu Project (including deep sea tailings placement and the Huon Gulf) has been prepared by the Wafi-Golpu Joint Venture.

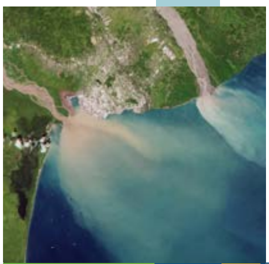
It and other information can be found on the Wafi-Golpu Joint Venture website: www.wafigolpujv.com

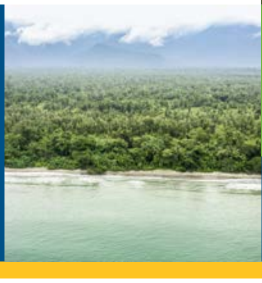
Figure sources

Photos and figures are sourced from Coffey / Coffey's supporting studies, unless otherwise cited

WAFI-GOLPU JOINT VENTURE

Notes






Deep Sea Tailings Placement (DSTP) in the Huon Gulf

Common Questions and Answers about the Marine Environment and Oceanographic Studies

August 2018

Please contact WGJV for further information as follows:

Environmental Impact Statement – EISquestions@wafigolpujv.com
General enquiries – Communityquestions@wafigolpujv.com

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