Memorandum

22 January 2024

To	Kimberley Technology Solutions Pty Ltd		
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From	Jose Romero	Tel	+61 8 6222 8992
Subject	Desktop BCH LAU Assessment and Bay 1 Visual Assessment	Job no.	6135178

1 Introduction and Scope

A meeting was held on 11 October 2017 regarding the proposed wharf development on Cockatoo Island for the Kimberley Supply Chain Cluster (KSCC) project with representatives from the Western Australia Environmental Protection Authority (EPA), Kimberley Technology Solutions Pty Ltd (KTS) and GHD Pty Ltd (GHD). The EPA's view was that additional marine ecological surveys were not warranted if existing information demonstrates that construction and operations of the proposed wharf development will have minimal effects on the local and regional existing Benthic Community Habitat (BCH).

The scope of this memorandum is to amalgamate existing information to quantitatively demonstrate that construction and operational impacts to BCH from the proposed wharf development are minimal and of an acceptable nature on local and regional spatial scales on the basis of the following (as discussed with the EPA during the 11 October 2017 meeting):

- Evaluate the percentage of BCH loss in a regional context through a desktop determination with the EPA's Local Assessment Unit (LAU) concept.
- Provide recent photographic and survey evidence that direct and indirect losses from the proposed wharf development are low because of the highly degraded nature of the BCH from recent mining-related practices.

2 BCH LAU Assessment

2.1 EPA LAU Guidance

A summary of EPA's (2016)[1] guidance in regards to BCH characterisation is as follows:

- An LAU should consider aspects of the local environment such as bathymetry, position of islands, substrate type, water circulation, wave exposure and habitat types. LAU's are typically ~50 km^2 in area, ~10 km along the coastline and extend 5 km offshore to the boundary of state waters, though they can be defined on a case-by-case basis.

[1] EPA (2016) Technical Guidance – Protection of Benthic Communities and Habitats, EPA, Western Australia, December 2016.

- Once the LAU is defined, three (3) key areal BCH aestimates are needed:
  - Benthic communities and/or their habitats prior to European habitation (~200 years ago).
  - Extent of historic and approved losses.
  - Predictions of additional losses associated with the proposal (i.e. the proposed wharf development).

2.2 LAU Evaluation

2.2.1 Spatial Definition of the LAU and Justification

MScience (2007)[2] previously defined an LAU to include Cockatoo, Irvine and Bathurst islands as shown in Figure 1, which is adopted here.

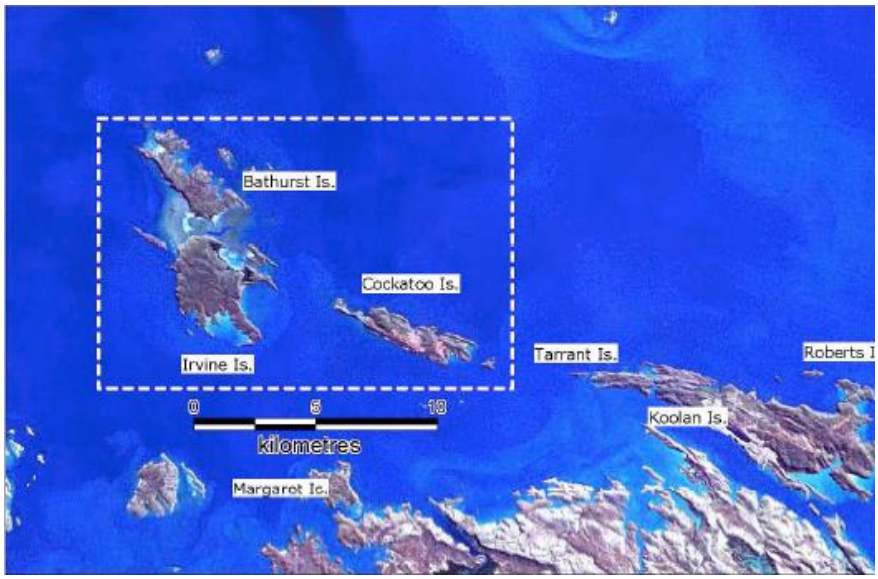

Figure 1 Spatial illustration of LAU from MScience (2007)

The selection of this LAU by MScience (2007) was on the basis of:

- Geomorphic similarity among the three islands in the LAU with substantial wide coral reef flats fringing the shorelines, as well as a narrow reef crest with adjacent slope areas. In contrast, Koolan Island generally only has coral growth along the narrow strips of the reef crest.
- Ecological continuity due to dispersal of coral larvae (and thereby gene flow) between coral populations of the adjacent islands in the LAU.
- Further, Cockatoo, Irvine and Bathurst islands have similar weather and water current climates, and are likely to be similarly affected by cyclones and bleaching events.

The nominated LAU has the following areal characteristics:

[2] MScience (2007) Cockatoo Island Regional Marine Survey: Benthic Primary Producer Habitats April 2007. Report No. MSA84R1, 24 April 2007.

- Total area of ~200 km^2 of which ~40 km^2 is land.
- The area of Benthic Primary Producer Habitat (BPPH) (a subset of BCH) between the low tide mark and the 30 m depth contour is ~25 km^2.

2.2.2 BCH Existing Data

MScience (2007) generated BPPH maps of Cockatoo Island, and Bathurst and Irvine islands, as illustrated in Figure 2, and estimated the areas of two (2) BCH categories (coral and macroalgae) with a GIS-based methodology.

GHD (2017)[3] carried out recent (November 2016) surveys of the bay to be impacted by the proposed wharf development (Bay 1), and the two bays immediately to the east (Bay 2 and Bay 3) whereby:

- The benthic substrate was primarily comprised of sand in all three bays (Bays 1, 2 and 3 had 91%, 71% and 98% benthic areal cover, respectively) with elevated levels of rocky substrate in Bay 2 (Bays 1, 2 and 3 had 8%, 21% and 1% benthic areal cover, respectively) (Figure 3).
- Most of the BCH in these three (3) bays (Figure 4) is comprised of hard coral cover (Figure 5) along the drop-off from the coastal shelves. There was low areal coverage of macroalgae on the coastal shelfs (particularly in Bay 3).

2.2.3 BCH Areal Estimates in LAU (Pre-European, Historic Loss, Proposed Development Losses)

BCH areal estimates of hard coral and macroalgae include:

- **Historic losses** (primarily from mining activities) have been estimated by MScience (2007) as:
  - Direct losses from the construction of the mine seawall occurred onto the adjacent reef flat. There is also evidence that a historic waste dump (from historical BHP mining-related activities) to the east of the wharf resulted in some reclaimed shoreline (part of Bay 1).
  - Indirect losses in proximity to the seawall occurred through modifications to the patterns of currents and sedimentation, and the effects of mine dewatering discharge. Further, sedimentation from the waste dump in Bay 1 has likely caused historic benthic habitat losses.
- **Pre-European habitation estimates** of macroalgae and hard coral in the LAU were estimated by adding historical loss estimates to the existing areal habitat estimates.

Proposed wharf development losses are assumed to be 100% of the existing GHD (2017) coral and macroalgae areas in Bay 1 from direct and/or indirect impacts from construction and operations.

The pre-European BCH area, historic losses and proposed wharf development losses are summarised in Table 1.

[3] GHD (2017) Cockatoo Island Multi-User Supply Base: Technical Study – Marine Flora and Fauna. Report No 6135178-68078 for KTSS.

Table 1 BCH (hard coral and macroalgae) pre-European BCH areal estimates, and historic and proposed development areal and percentage loss estimates

BCH Type	MScience (2007)					GHD (2017)	
	Pre-Euro Cockatoo (ha)	Pre-Euro Irvine & Bathurst (ha)	Pre-Euro LAU (ha)	Historic Losses for Cockatoo (ha)	% Historic Losses	Proposed Direct and Indirect Losses in Bay 1 (ha)	% Proposed Losses
Coral	65	969	1034	1.2	**0.1%**	0.2	**0.02%**
Macroalgae	54	369	423	3.5	**0.8%**	0.2	**0.05%**
Other	55	412	467	NA	NA	NA	NA
Total	174	1750	1923	NA	NA	NA	NA

2.2.4 LAU Conclusion

MScience (2007) estimated that only 0.1% and 0.8% of the hard coral and macroalgae areas, respectively, have been lost in the LAU, primarily because of historic mining-related activities on Cockatoo Island.

On the basis of recent GHD (2017) BCH surveys, only 0.02% and 0.05% of the existing hard coral and macroalgae areas, respectively, in the LAU are predicted to be lost to direct and/or indirect impacts from the proposed wharf development.

3 Existing Visual Record of Bay 1

3.1 Shoreline Photographs of Intertidal Habitat on the Coastal Shelf during Low Tide

A selection photographs on 8 August 2017 during low tide (Figure 6) illustrates the sandy nature of the substrate and the influence of the adjacent mining-related operations on the shoreline and intertidal benthic habitat. The photographs illustrate that the shoreline and intertidal benthic habitat is primarily comprised of sand with a mosaic of black and rust coloured patterns.

3.2 GHD (2017) Underwater Images of Subtidal and Intertidal Environments

As described in GHD (2017) and illustrated in Figure 7, Bay 1 was characterised via underwater imagery (drop camera) as follows:

- The bay is shallow (>0 m LAT) for approximately 120 m from the HAT shoreline and steeply descends to -20 m LAT depth thereafter.
- Of the 110 survey images, 67% were bare substrate, 21% had sparse to very sparse macroalgae primarily in the range of -1 to -15 m LAT depth, and 15% had moderate to dense hard coral coverage in the southeastern sector of the bay in the range of -5 to -10 m LAT.

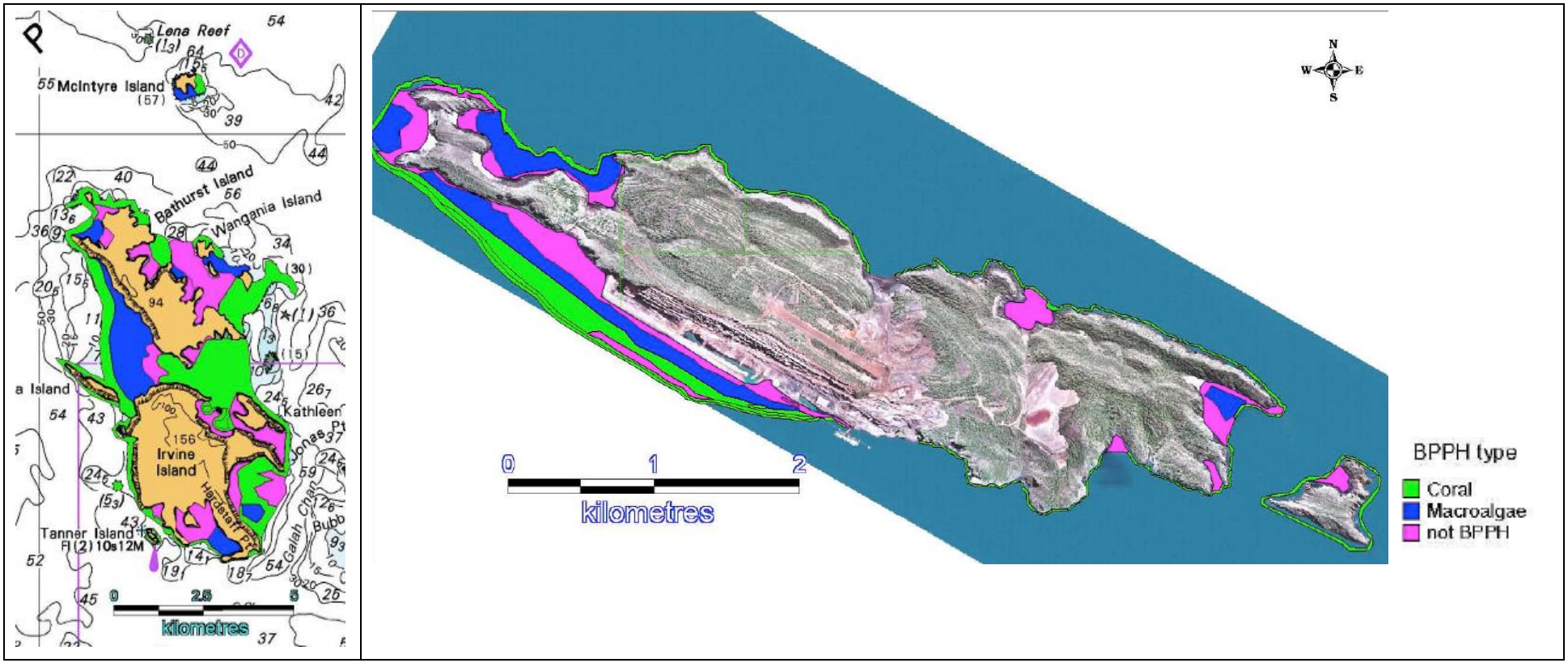

Figure 2 Spatial illustration of LAU and BPPH areal distributions from MScience (2007)

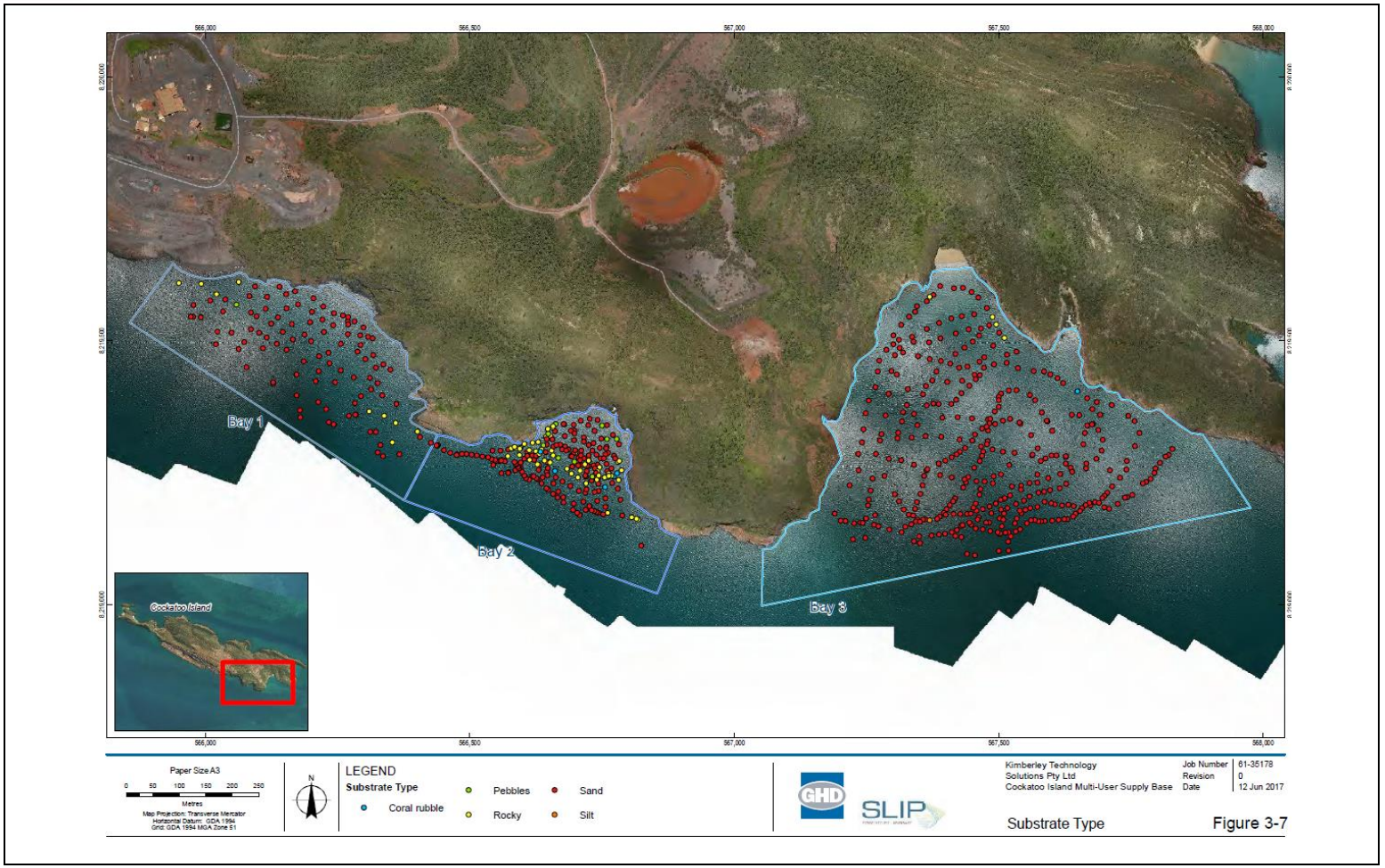

Figure 3 Substrate type in Bays 1-3 along southeastern shoreline of Cockatoo Island from GHD (2017)

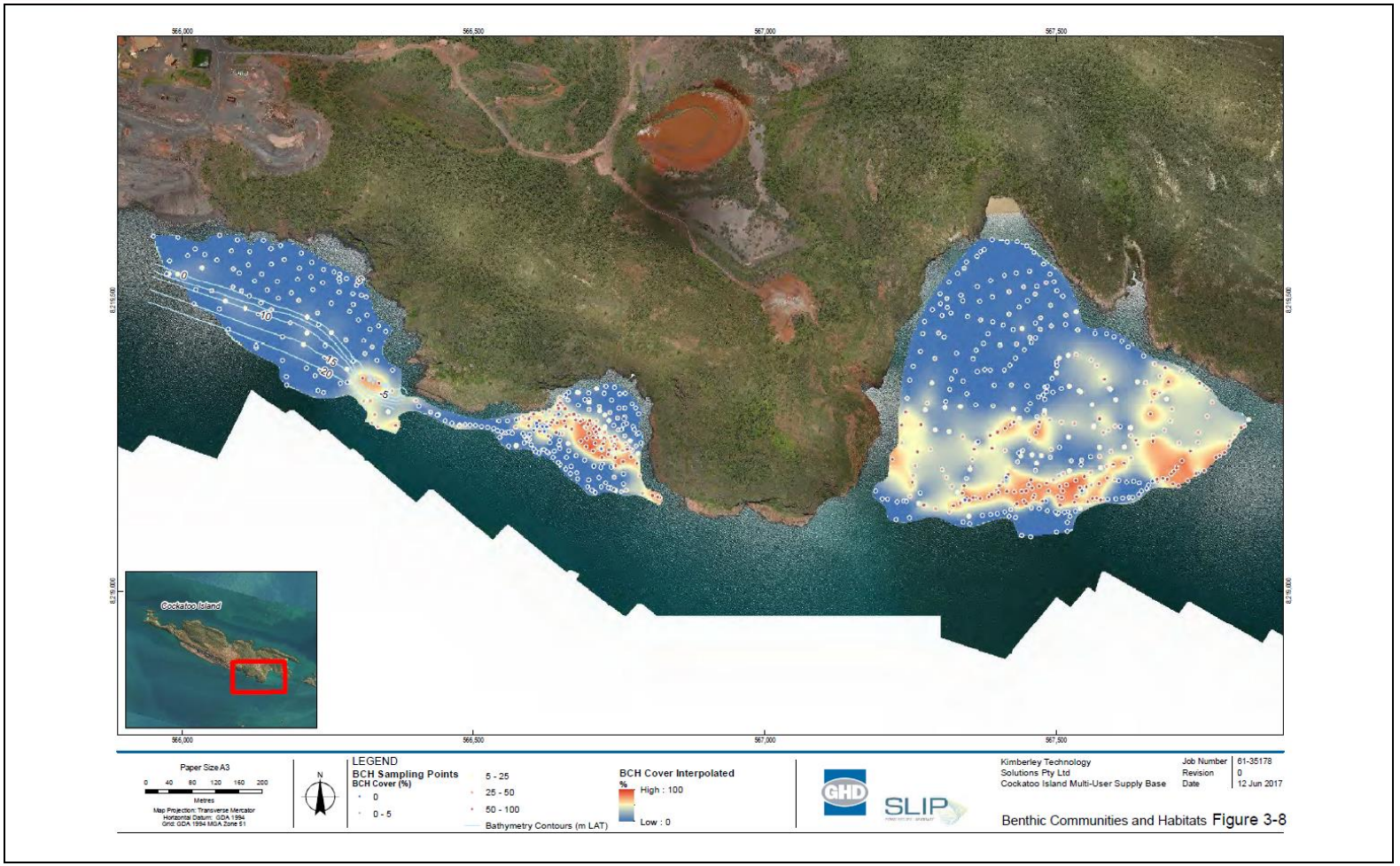

Figure 4 BCH cover in Bays 1-3 along southeastern shoreline of Cockatoo Island from GHD (2017)

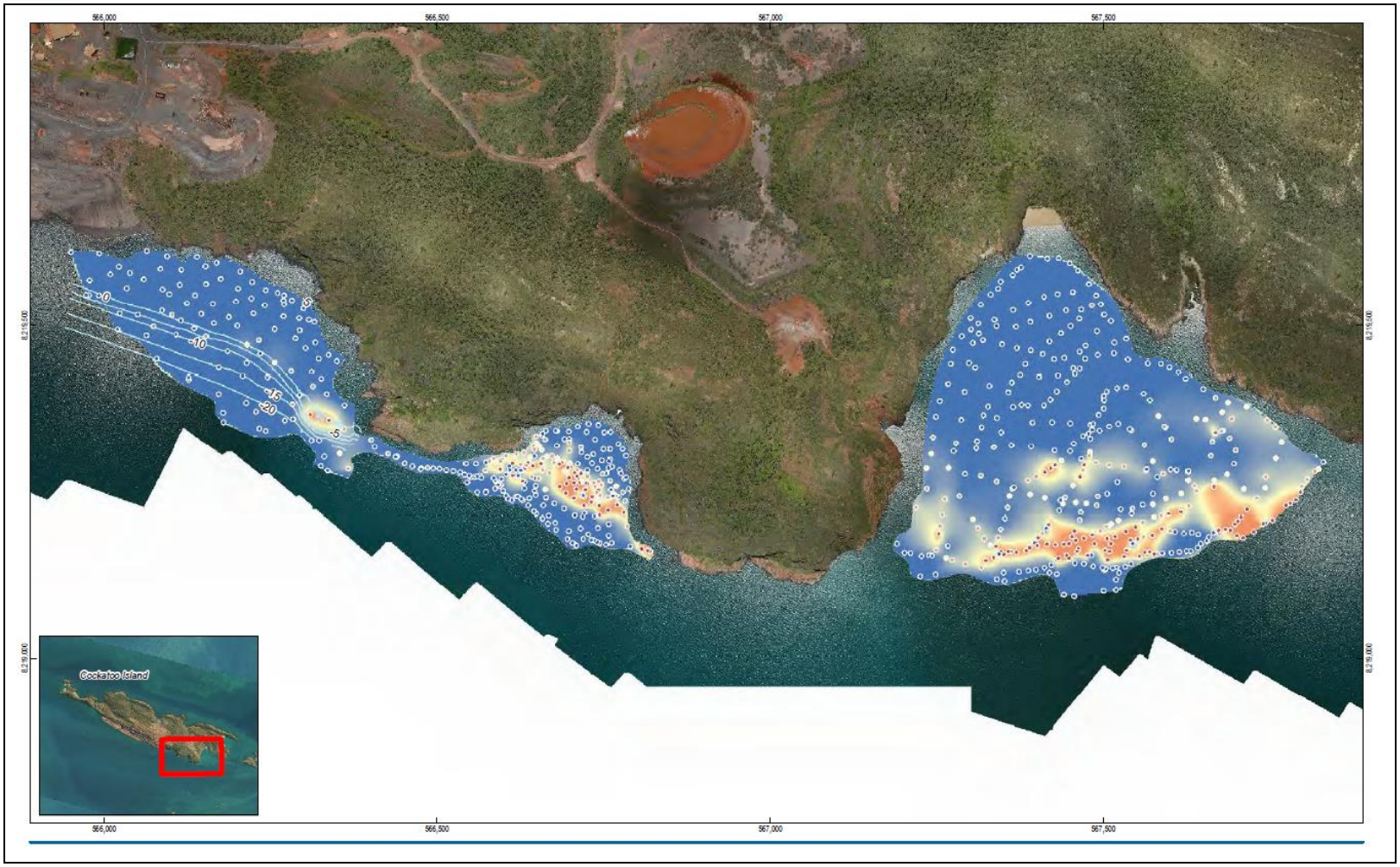

Figure 5 Hard coral cover in Bays 1-3 along southeastern shoreline of Cockatoo Island from GHD (2017)

Figure 6 Photos during low tide on 8 August 2017 of intertidal habitat of Bay 1 (taken by J. Bower)

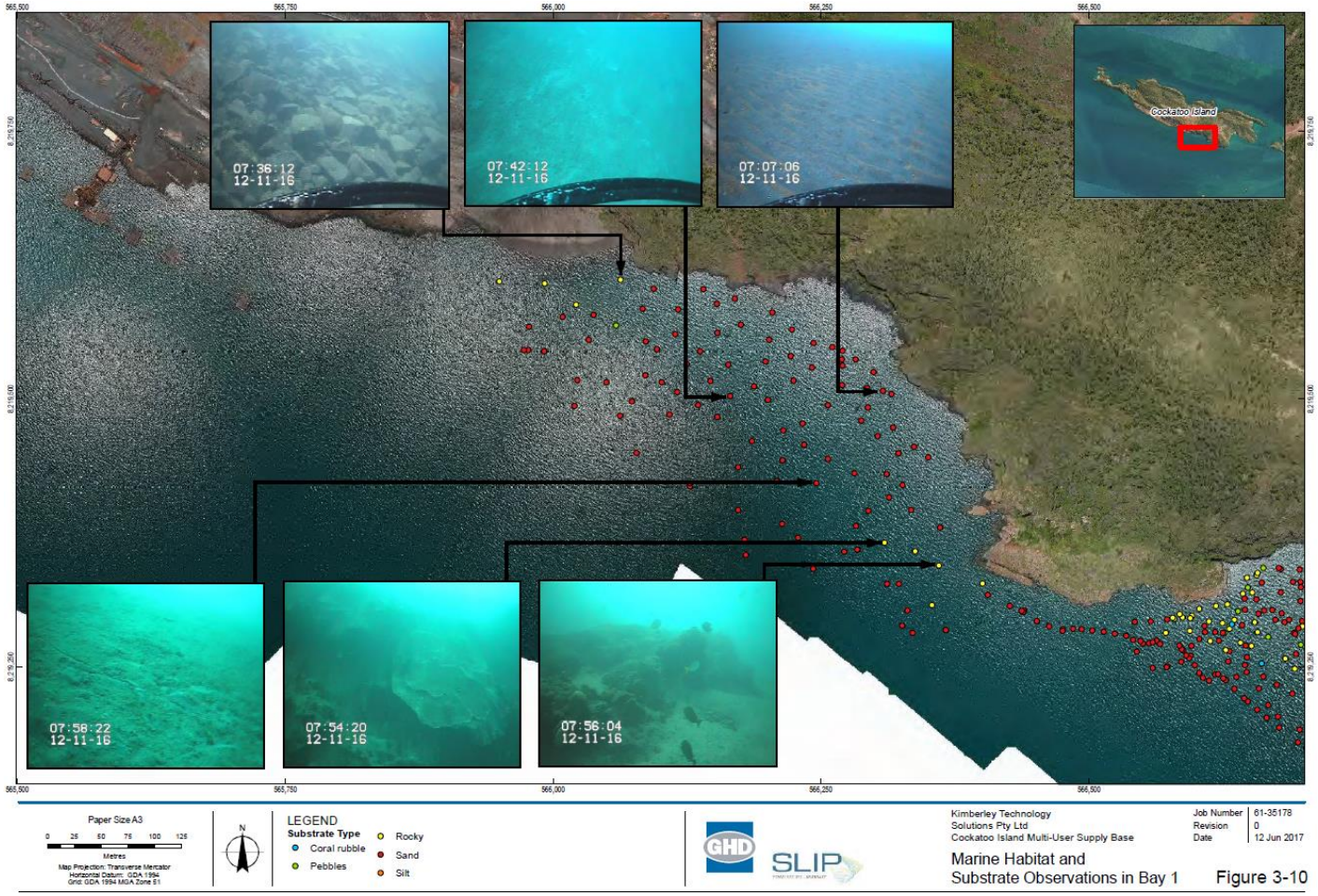

Figure 7 Subtidal and intertidal habitat underwater observations from Bay 1 (GHD 2017)

3.3 Visual Record Conclusion

The proposed wharf development in Bay 1 is an area that has been highly disturbed by decades of mining (and shipping) operations as evidenced by the visual record. Only a small percentage of sensitive habitats occur in the development footprint (southeastern corner of Bay 1). As concluded in Section 2.2.4, the percentage of areal loss of BCH habitat in the LAU from the proposed wharf development is very small. Hence, the proposed wharf development by KTS will not significantly impact BCH in the LAU (0.02% and 0.05% of the existing hard coral and macroalgae areas, respectively).

Regards

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