Pilbara Iron Ore and Infrastructure Project - Stage A

Port Layout Alternatives
Response to Questions from EPA Service Unit

1 PREAMBLE

Following a meeting held at EPA between representatives of FMG (Laura Todd and Lloyd Townley) and representatives of the EPA Service Unit (Juliet Cole and Ray Mansini), a number of specific questions were sent by the EPA Service Unit by e-mail on 17 February 2005. The purpose of this document is to respond to those questions.

The EPA Service Unit (SU) has asked FMG for further clarification of the following issues:

Evaluation of Alternatives:

1. In order to better understand the evaluation of options to minimise loss of mangroves and the overall footprint of the proposed development, clarification is sought on some of the issues that arose when evaluating a configuration that avoids the rail loop over SW creek, avoids loss of mangroves at the northern end of the stockpile by locating it further southwards and locating the conveyor in the higher-land 'spit' out to Anderson Point (as per the sketch map provided at the meeting).

Dredge Spoil Disposal and Habitat Disturbance Issues:

2. Clarification of sections of the Baggerman Associates report - particularly section 3. Clarification and reconciliation between the 3x volume of spoil requirement (m$^3$) vs the 300 ha (m$^2$). The text states that increasing bund height has some benefits in that it will accelerate the settling of fines.

3. Clarify the amount of land required to undertake the operations in the absence of any dredge-spoil disposal issues (i.e. what area is required for stockpiles and infrastructure?).

4. Can the area of disturbance/impact be reduced by a combination of onshore disposal and offshore disposal?

Habitat Information:

5. With regard to the spatial data provided last week, the EPA SU is unable to reconcile the figure obtained by our analysis of the area of the agreed management unit with that provided in the FMG response to submissions document (161 km$^2$ in FMG vs 154.3 km$^2$ based on our GIS). Similarly the 'largest' management unit in the figure is significantly different (326 km$^2$ in FMG vs 362.9 km$^2$ based on our GIS).

6. To help us evaluate the changes to habitat loss estimates arising from the revised port layout in the response to submission document, a digital copy of the habitat information in a spatially referenced form is requested.
would be helpful if this data includes a layer/information showing the revised configuration of the proposed dredge spoil bunds and the rail and conveyor infrastructure (e.g. Figure 11 on page 34 of Townley and Associates in FMG 2005).

All of these questions except Question 5 relate to work previously performed by Townley & Associates Pty Ltd on behalf of FMG.

2 EVALUATION OF ALTERNATIVES

The EPA Service Unit has requested that FMG consider the port layout shown as Loop 1 in Figure 1. FMG has previously considered similar layouts early in the planning stage, these being depicted in Figure 1 and Figure 8 (rail layouts 2, 3, 4 and 5) of the “Evaluation of Port Layout Alternatives” prepared by Townley & Associates Pty Ltd (December 2004, and revised February 2005).

The exact layout provided as a sketch map by the EPA Service Unit (Loop 1, Figure 1) is considered unsuitable for the development as it does not allow for the required geometric constraints of minimum straight sections before and after the train unloader to reduce wagon indexer loads (nominally 400 m and 100 m, respectively). For this reason FMG has engineered two alternative loops (Loops 2 and 3, Figure 1) which meet geometric constraints and also meet the primary intent of the layout (Loop 1) provided by the EPA Service Unit to FMG, i.e. to avoid mangrove populations.

An evaluation of these three options follows.

Geotechnical Issues

Geotechnical studies have identified a zone of weak unconsolidated mud up to 2.4 m thick located to the east of the proposed stockyards. This is an unsuitable and unstable area on which to build a rail line. Significant excavation (with an associated acid sulphate soils risk) would be required to construct a rail loop on this material due to geotechnical stability. FMG has taken this into account during the positioning of its preferred location.

As one of the design criteria for the rail loop, a distance of 2.8 km is required before the train unloader so that a whole train can wait to enter the dumper. As a result of this requirement the train unloader for Loops 1 and 2 would be located in an area on the edge of mangroves close to South West Creek (Figure 1). Mangroves are generally thickest in areas surrounding creeks. The excavation of this area to RL -15 mAHHD would be required for foundations and would result in additional mangrove clearance during earthworks.
Future Expansion

Locating the stockpile within the middle of the rail loop would mean no prospect of future expansion for FMG and/or third party users. The rail loop would restrict expansion of the stockpiles to the east in the proposed reclamation area.

FMG has committed to being an open access and infrastructure provider assisting other users in the exporting of resources under the recently passed Railway and Port (The Pilbara Infrastructure Pty Ltd) Agreement Act 2004. Whilst FMG’s proposed rail will be designed to transport up to 100 MT of ore, FMG’s current port proposal can only cater for the initial 45 MT proposed. Therefore, once FMG’s customers require storage space at the port, the stockpiles will inevitably need to be expanded.

Whilst this expansion is not part of FMG’s proposal at this time, it remains an issue that must be considered to ensure that current developments allow for expansion with minimal cumulative environmental impacts. Future expansion will require additional reclaimed land at Anderson Point. Using the remaining 200 ha of land reclaimed by FMG’s proposed dredging process, and only sourcing additional fill to raise the level above storm surge, will result in less overall impacts than sourcing the entire 200 ha of fill from elsewhere to reclaim this land at a later date.

PHPA Developments

All three loops in Figure 1 cross the Port Hedland Port Authority's (PHPA's) proposed corridor to Anderson Point, and this would alienate or inconvenience the majority of PHPA areas A and B (Figure 2).

Access to Anderson Point

By locating the stockpiles within the rail loop, access to the ship loading facilities is compromised, in that there would be no road access going to the wharf without two bridge structures crossing the rail loop. This has safety implications for vehicles needing to cross the tracks to access the port and could possibly restrict access to the wharfs/berths in the event of an emergency (i.e. ship fire). It would be possible to have a road around the loop leading to the ship loading facilities, however this would also mean additional mangrove clearing would be required, and could restrict further PHPA development plans.

Conveyors

With any of the three loops shown in Figure 1, the conveyor from the stockpile to the wharf would increase in length by approximately 200 m, relative to FMG’s preferred option. FMG’s preferred option already has a conveyor that is considered long for shiploading. With longer conveyors, there is significant difficulty in control
encountered during ship loading. An operator loading and trimming a ship gives an instruction for gaps in loading to occur, i.e. the belt has empty sections equal to the time it takes to move hatches or trimming load to put into a particular hold. If for whatever reason a stoppage occurs, then problems arise: the longer the conveyor, the larger the operational and safety issues. There are safety issues associated with longer conveyors, as well as issues involving cost, materials handling, noise and dust. The safety issues are due to the large volume of material on the conveyor at any one time, hence the conveyor can be more difficult to manage during an emergency. A longer conveyor carries more material, has more momentum and is more difficult to stop quickly. If the conveyor were any longer, consideration would have to be given to storing the excess material on the conveyor in surge bins on the wharf. These surge bins would be large structures with significant visual impacts, for the residents of Wedgefield and Port Hedland.

Mangrove disturbance

Loop 2 would result in mangrove clearing around South West Creek and clearing would be similar to the amount required for the preferred layout. Loop 3 would result in mangrove clearing around a tributary of South Creek, and again, a similar amount of mangroves would need to be cleared as for the preferred option.

If engineering constraints are taken into account for the design of the rail loop, it is not possible to avoid mangrove loss all together. FMG is committed to minimising impact and has committed to a mangrove rehabilitation program 3 m either side of the rail loop, with a nursery to provide root stock for this rehabilitation. If necessary, FMG will conduct further research to determine the most feasible method of propagating and/or transplanting mangrove seedlings.

FMG has also undertaken significant work to date to reduce mangrove clearing. Initially FMG proposed to clear 22 ha of mangroves. This was reduced to 14.8 ha during the redesign of the project layout. As shown in Table 1, FMG's proposed project results in the lowest amount of mangrove clearing when compared to other major projects in Port Hedland.

<table>
<thead>
<tr>
<th>Project</th>
<th>Area (ha)</th>
<th>Proportion of Loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BHPBIO E Creek</td>
<td>155</td>
<td>43.4</td>
</tr>
<tr>
<td>Cargill Salt condensers and crystallisers</td>
<td>98</td>
<td>27.5</td>
</tr>
<tr>
<td>HDMS</td>
<td>89</td>
<td>25</td>
</tr>
<tr>
<td>FMGL</td>
<td>14.8</td>
<td>4.1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>356.8</td>
<td>100</td>
</tr>
</tbody>
</table>

FMG has assessed every other alternative option and is certain that mangrove loss has been reduced to the smallest area possible for the project.
Figure 1  Consideration of Additional Rail Loops
Figure 2 Proposed port facilities and adjacent PHPA planning areas
3 DREDGE SPOIL DISPOSAL AND HABITAT DISTURBANCE

Dredging

The dredging process that will be utilised for the FMG port development is cutter suction dredging. As the name suggests, this style of dredging utilises a cutter head combined with a suction line to remove material. When undertaking capital dredging where consolidated material and rocks require removal, this is typically the most appropriate form of dredging. The dredge head slowly rotates, loosening the material whilst swinging laterally along the face. A ladder connects the cutter head to the vessel. See Figure 3 below.

![Figure 3](from www.portbris.com.au)

There are two basic options for the disposal of dredged material, namely ocean disposal or placement onshore. Often the onshore placement of dredged material is used to reclaim low lying or tidal areas. The method of placement that FMG has selected is onshore. This has been selected as the area within Anderson Point that has been identified for infrastructure and stockpiles and requires filling before construction can commence. The dredged material will be used for a beneficial purpose (as opposed to ocean disposal which has potential impacts on the ocean floor). Using the dredged material also negates the need to source fill for reclamation from a site elsewhere, thus reducing environmental impact in another area.

Currently the dredging works are out to tender and therefore the vessel that will be used during the project is not known. However, given the size of the project it is likely that the dredge will have a capacity between 10,000 to 20,000 m³ of sediment and water mix per hour.

The dredge will be connected to a pipeline that will be used to place the dredged material directly into the reclamation area. Therefore, once the dredged material
has entered the pipeline there will be no losses until the discharge water is released from the reclamation ponds, through a controlled point. This is a completely closed system and there is a negligible risk of any over-flow or spillage into the marine environment.

**Reclamation**

The reclamation process itself is a basic operation that primarily relies on gravity. The sediment and water mix enters the pond and the larger particles settle out first while the finer particles take longer to settle. Within the reclamation ponds it is important to reduce the velocity (and therefore turbulence) of the water to encourage settling. However, the ponds are required to be relatively shallow in order for the material to dry out and form solids that can be used for structural reclamation. In some instances if the reclamation ponds are too deep, the material may never dry. The footprint required, and therefore the volume of material required for the bund walls dramatically increases as the depth of the pond increases. At the same time the geotechnical stability of the bund walls decreases.

Figure 4 illustrates the reclamation process that is undertaken at the Port of Brisbane Corporation. This figure is used to demonstrate a reclamation process that is currently being undertaken. Dredged material is pumped into the reclamation ponds, flows through a number of reclamation ponds, a dewatering pond and finally the relatively clean water is discharged to the receiving environment.
The Need for 300 ha

FMG proposes to dredge 3.3 Mm$^3$ of material from the area in front of Anderson Point. When designing a reclamation area the generally accepted design within the industry is a volume of ponds which is between 3 and 4.5 times the volume of material to be removed. Therefore, a volume of between 9.9 and 14.85 Mm$^3$ would be required for the reclamation ponds. This volume of reclamation area is required because the \textit{in situ} material expands when it is removed. In addition the volume is required to manage the sediment and water mix to ensure that material settles and the drying time is appropriate. This requires a number of separate “ponds” within the dredging area, through which the sediment and water can pass, so that the sediment load drops out, as described below. If there is not sufficient time for the material to settle, the discharge water would have elevated levels of turbidity and may impact on the receiving environment. It should be noted that approximately 15 to 25 Mm$^3$ of water will be associated with the dredged material that FMG is proposing to remove.

The area over which FMG is proposing to construct the reclamation and dewatering ponds is 300 ha. The bund walls will be approximately 4 m high, with a freeboard of approximately 0.5 m for safety considerations. Therefore, the total storage volume of the reclamation area (excluding the free board) is approximately 10.5 Mm$^3$. Although this is at the lower end of the recommended range, an experienced dredge operator with a well managed reclamation area will be able to undertake the works without undue impacts to Port Hedland Harbour.

To assist in the reclamation process, weir boxes are installed between the ponds. These structures provide a very simple yet effective way to control the level within the ponds. Boards are placed within the weir box to increase the levels within the ponds (see Figures 5 and 6 below). This allows the contractor to increase the level of sediment within the ponds while allowing the water to decant off. In addition, if the quality of water being discharged to the environment is deemed to be unacceptable, the weir box can be used to ‘dam up’ the pond to prevent further release until the quality is acceptable.

Management of the reclamation ponds will be the responsibility of the dredging contractor. However, a number of internal bund walls will be constructed within the external bund wall from the dredged material. These internal bund walls will be used to create reclamation, dewatering and fines ponds (see Figure 4). The reclamation ponds are where the majority of sediment settles. The dewatering ponds act as a ‘polishing’ area where the water is retained to remove the finer fractions prior to discharge. The fines ponds will be used to store the finer fraction material which is not suitable as structural fill. The final layout of the internal bund walls will not be known until dredging commences as the layout will be dependant.
on site experience (how the dredged material behaves). Figure 7 shows an indicative layout.

Figure 5 Typical weir box set-up

Figure 6 Functioning weir box
The final operational area at Anderson point will be approximately 100 ha. This area will need to be established to a level which is safely above storm surge level (up to RL 7.5 mAHD). The amount of fill required within this area will vary as the local topography may vary by a couple of metres (it varies from below 3 mAHd to 6 mAHd). However given what is known about the topography, an average of 3 m of fill will be required across the 100 ha to establish the safe level, and 3 Mm$^3$ of material will be required to achieve this level (100 ha x 10,000 m$^2$/ha x 3 m). As can be seen this accounts for the majority of the material that is proposed to be dredged. The above calculation does not include the fill required for the rail loop so any excess is likely to be used in the construction of the loop. Thus all the material to be dredged will be required to reclaim land in the 100 ha required for operations.

The remaining 200 ha, will not be raised to the required level above storm surge and will effectively become ponds, which can be used for collection of runoff etc. but could be subject to inundation in a major storm event. Therefore if these areas were to be developed in the future, additional fill would need to be sourced to raise them to above the storm surge level.

The remaining 200 ha will be designed and graded to drain to a number of collection areas (see Figure 8 below). These collection areas will be used to supply water for dust suppression, an idea which has been commended by the Karratha office of the

Figure 7  Indicative port layout during construction (for illustration purposes only)
Department of Environment, as it will reduce the need for potable water supply. Rehabilitation techniques within the 200 ha (excluding the collection areas) will be investigated to determine the most appropriate method. However as this area will not be above storm surge level options may be limited.

Figure 8 Indicative final port layout (for illustration purposes only)
The additional 200 ha area within the reclamation ponds (and indeed the surrounding area) that will not be utilised during FMG operations have also been identified as an area that may be developed in the future for port-related activities by the Port Hedland Port Authority (see Figure 2). It is noted that the port’s strategic plan is currently in draft form and is yet to be formally reviewed by the EPA, however in the absence of any other guiding document for the port area, FMG has used this document as a basis for its plans. These plans also match FMG’s corporate philosophy of being an “open access” infrastructure provider. FMG intends to make its port and rail facilities available to other users. As stated previously, whilst FMG’s proposed rail will be designed to transport up to 100 MT of ore, FMG’s current port proposal can only cater for the initial 45 MT proposed by FMG. Therefore, once FMG’s customers require storage space at the port, the stockpiles will inevitably need to be expanded. This will require additional reclaimed land at Anderson Point. Using the remaining 200 ha of land reclaimed by FMG’s proposed dredging process, and only sourcing additional fill to raise the level above storm surge, will result in less overall impacts than sourcing the entire 200 ha of fill from elsewhere to reclaim this land at a later date.

Ocean Disposal

Based on discussions with the Port Hedland Port Authority, it appears that their ocean disposal site is reaching capacity. Therefore, they are reluctant to allow dredged material from the FMG project to be dumped at the existing ocean disposal site. If an additional ocean disposal site was to be established for the FMG project there would be associated loss of ocean habitat. In addition, FMG believes that by using the dredged material for reclamation purposes it is utilising the material in a beneficial manner (that reduces the need to source land-based fill for the area and does not cause impacts to the marine environment).

Partial Ocean Disposal

A question has been raised as to whether partial ocean disposal is feasible for the project. There are a number of factors to consider when assessing this option. The primary consideration is the amount of fill required for the port operation. This fill is required to establish a level which is safely above the flood/storm surge level. As stated above, the final operational area will be 100 ha and the majority of the dredged material will be required to reclaim this area, to a safe level above storm surge.

The second consideration is the geotechnical characterisation of the dredged material. The most desirable material from a geotechnical perspective for construction fill is sands/gravel. Therefore, if consideration is given to partial ocean disposal it would be of the finer fraction of the dredged material. Based on the method of dredging, sediments are well mixed when they are removed by the dredge. As such it is only possible to separate the fine fraction after the reclamation
process, during which fines are directed into the fines pond. This suggests that the reclamation area would still need to be of similar size.

The current proposal is to segregate the finer fraction of the dredged material within dedicated ponds. Provided this material is placed in a thin enough layer there may be potential in the future to place structural fill on top of the fines to establish an area suitable for construction.

Turbidity Modelling

FMG has recently commissioned WorleyParsons Services Pty Ltd to undertake modelling of the proposed dredging works to determine the extent of potential turbidity plumes. WorleyParsons undertook the hydrodynamic modelling of the Anderson Point area as part of the Stage A PER. When the modelling is completed the results will be provided to the Department of Environment. Within the Stage A PER, FMG has committed to completing the modelling prior to the commencement of the dredging operations. The material that is proposed to be dredged at Port Hedland was characterised during a geotechnical investigation that was undertaken at the site. Coffey is currently undertaking settlement tests and the results will be available shortly. This information will be incorporated into the turbidity modelling.

Geraldton Experience

In 2002/2003 dredging works were undertaken at Geraldton to improve the shipping channel. During these works a substantial dredging plume was generated. Some concerns have been expressed that this situation may be repeated by the works FMG is proposing to undertake. FMG does not believe this is the case and believes it is relevant to outline a number of differences between the proposed FMG dredging and the dredging that was undertaken at Geraldton:

- At Geraldton a cutter suction dredge was used, however this was combined with ocean disposal. The material from the dredge was pumped into nearby barges which used the “overflow method”. When the dredged material is delivered to the barge the sediment content is relatively low. The water/sediment mix is allowed to overflow the sides of the barge to increase the concentration of sediments within the barge and therefore improving transport efficiency. However, a plume is generated by the overflow water. An additional plume would be generated when the barges dump the material at the final ocean disposal site. This is generated as the barge splits in the middle and the dredged material drops to the ocean floor. Unlike the process used at Geraldton, all of the material from the FMG project will be placed within the reclamation ponds at Anderson Point through a pipeline and no barges will be used. A pipeline allows control at the discharge point and negligible potential for spillage (i.e. it is a closed system). In addition there is no potential for overflow as no barges will be used.
- The background turbidity is different at the two locations. Geraldton can typically have a background turbidity range of 1 to 15 NTU depending on local conditions while Port Hedland harbour background turbidity can typically be of the order of 30 NTU. Natural levels at Port Hedland are sometimes significantly higher than this value.

Based on the different method of dredging, different site conditions and different background turbidity levels, any turbidity plume that could be generated by the FMG works is expected to be much less than that experienced at Geraldton. This possibility will be further quantified by the turbidity modelling that is currently being undertaken.

**Explanation of Baggerman Associates' Letter**

The first paragraph of Section 3 states that the 3 times multiple (i.e. the storage space required to manage the dredge spoil on land, is 3 times the volume of the material to be disposed) is marginal as a recommendation, and the author would feel more comfortable if a multiple of 4 – 4.5 was adopted. This statement is made because if larger quantities of rock flour and clay were generated, the management of larger ponds to cater for this would be easier.

However the author goes on to state that a “competent contractor” will be able to restrict the works to operate within the 3 times multiple storage criterion if required.

The second paragraph describes “The risks suggesting a larger area...”. This paragraph effectively identifies three issues that in some circumstances would imply a need for larger area. The first dot point highlights the risk associated with reducing the height of bund walls. If the bund height were decreased, wind generated surface currents would disturb the supernatant material at depth and reduce the efficiency of settling. The second and third dot points indicate that higher concentrations of rock flour (super fine sediment) and/or a higher clay component would imply greater settling time and the need for more area for fines disposal (without standing the dredge down).

The third paragraph describes “The opportunities for a smaller area...”. This statement means that a smaller area (i.e. smaller than the 3 times storage area multiple) could only be achieved if all three of the following criteria are possible:

- “The approving Agencies accept the pancake method of reclamation or a combination thereof where the bunds are dozed up from the dredged fill, this would result in the suffocation of considerable areas of mangroves due to the slimes from the fill covering the mangrove pneumatophores, however the total footprint lost would be more than that lost within the bunded areas currently proposed, so this approach is not recommended.
The approving Agencies accept that rich turbid water rather than discoloured water can be directed back into Port Hedland Harbour; and

- The contractor is paid demurrage costs.

4 HABITAT INFORMATION

Management Unit Sizes

The management unit sizes were originally scaled off topographical maps manually, as they were not used to calculate the % historical loss. Hence when using GIS to calculate the management unit sizes there will be some slight discrepancies. These differences will not affect any of the % BPPH loss figures (the key outcome of the GS29 calculations) as these are derived from the mangrove extents within each unit. FMG have amended the management unit sizes (refer to Figure 10 and Table 2).

Request for Spatial Information

This has been provided directly to the EPA Service Unit.

5 ACKNOWLEDGEMENTS

The assistance provided by Nicky Hogarth and Ben Garnett of FMG is gratefully acknowledged.
Figure 10  Mangrove BPPH management unit
Table 2  Cumulative loss calculations for the revised FMG port design

Current Mangrove Areas in each Management Unit

<table>
<thead>
<tr>
<th>Management Unit</th>
<th>Total Area</th>
<th>Management Unit Total Size</th>
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<tbody>
<tr>
<td>Inner harbour total</td>
<td>1,108 ha</td>
<td></td>
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<tr>
<td>Port Hedland Industrial Area total</td>
<td>2,334 ha</td>
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</tr>
<tr>
<td>Regional Geomorphic Unit total</td>
<td>3,869 ha</td>
<td></td>
</tr>
</tbody>
</table>

Inner harbour total: 1,108 ha
Port Hedland Industrial Area total: 2,334 ha
Regional Geomorphic Unit total: 3,869 ha

~Management unit total size = 55.7 km²
~Management unit total size = 154.3 km²
~Management unit total size = 362.9 km²

1960 Mangrove Extent

<table>
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<th>Management Unit</th>
<th>Total Area</th>
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<td>Inner harbour</td>
<td>1,263 ha</td>
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<tr>
<td>Port Hedland Industrial Area Unit</td>
<td>2,676 ha</td>
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<tr>
<td>Regional Geomorphic unit total</td>
<td>4,211 ha</td>
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Historical Losses

<table>
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<th>Loss Source</th>
<th>Total Loss</th>
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<td>BHP E Creek et al</td>
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<td>Hope Downs:</td>
<td>89 ha</td>
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<tr>
<td>Cargill Salt condensors:</td>
<td>86 ha</td>
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<tr>
<td>Cargill Salt crystallisers:</td>
<td>12 ha</td>
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<tr>
<td>Total BPPH loss</td>
<td>342 ha</td>
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> Cumulative loss % to date

<table>
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<th>Management Unit</th>
<th>Cumulative Loss %</th>
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<tr>
<td>Inner harbour</td>
<td>19.3%</td>
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<tr>
<td>Port Hedland Industrial Area Unit</td>
<td>12.8%</td>
</tr>
<tr>
<td>Regional Geomorphic unit</td>
<td>8.1%</td>
</tr>
</tbody>
</table>

Considering loss of true mangrove BPPH (associations 1-5; which includes the open canopy' mangrove cover (association 5)), additional clearing of mangrove associations totals:

14.8 ha

FMG proposal cumulative loss - Revised Spoil Basin Design

Considering loss of true mangrove BPPH (associations 1-5; which includes the open canopy' mangrove cover (association 5)), total cumulative loss would be:

<table>
<thead>
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<th>Total Area</th>
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<tr>
<td>Port Hedland Industrial Area Unit</td>
<td>356.8 ha</td>
</tr>
<tr>
<td>Regional geomorphic unit</td>
<td>356.8 ha</td>
</tr>
</tbody>
</table>

Inner harbour: 20.5%
Port Hedland Industrial Area: 13.3%
Regional geomorphic unit: 8.5%