Mockinya Consulting

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29 March 2018

Manager Planning and Impact Assessment
Environment Protection Authority
GPO Box 2607
Adelaide, S.A. 5001

RE: OUTER HARBOR CHANNEL DREDGING - POTENTIAL DREDGE SPOIL DISPOSAL TO LAND REVIEW

1. Instructions

This letter provides the findings of a review undertaken in response to your 7 March 2018 email request on behalf of the Environment Protection Authority (EPA) for a high-level review of the options for potential land-based disposal of dredge spoil presented by Flinders Ports in relation to its 2017 Outer Harbor channel dredging development application. The EPA's request sought an independent review of the key technical reports provided by Flinders Ports and its various consultants and specifically asked that the review consider the:

- assumptions and limitations of the assessment undertaken
- options for land-based disposal considered (or omitted)
- challenges and risks of land-based disposal.

2. Information Sources Considered

2.1. Reports Supplied

The following reports were reviewed in preparing this report.

- Outer Harbor Channel Widening Project DA Report - 010 V048 17 - July 17; and
- Appendix B - Dredge Material Placement Options Assessment (Arup 6 July 2017)
- Dredgate Disposal Study - Options Report 2014 (KBR, 2014)
- 20170817_EPA request for further info number 1
- 20170913_Flinders Ports response to EPA further info request number 1
- 20171129_EPA final response to Flinders Ports Outer Harbor channel dredging DA
- 20180219_EPA letter to Flinders Ports dredge spoil disposal to land further info request
- 20180302_Flinders Ports response to EPA land based disposal of dredge spoil questions

2.2. References Considered

I have had regard to the following guidance documents:

- EM 1110-2-5025 ENGINEERING AND DESIGN - Dredging and Dredged Material Management, US Army Corps of Engineers (2015).

2.3. Local Dredging Projects Which Undertook Land Based Disposal or Reuse

The following local projects were identified which re-used dredged materials as fill:

- 300,000 m^3 of silt hydraulically dredged from the Patawalonga in 1995 into drying basins at West Beach. I understand that some material was used in 1996 following accelerated drainage measures for Golf Course landscaping on the West Beach Trust land adjacent the basis and that after drying for many years, 130,000 m^3 of material remaining in the basins at West Beach was reused as engineered fill at the Grand Truckway Gillman on Renewal SA land.
- 180,000 m^3 clay mechanically dredged from the Common User Facility at Outer Harbour between 2007 and 2009 to stockpiles. This material was reused in capping of the Garden Island Landfill after being stockpiled and allowed to drain onsite in 2010. The material used was selectively excavated from stockpiles to exclude unsuitable materials (sand in this case), transported by road then spread in thin layers and mechanically conditioned to further dry to suitable moisture content for placement as an engineered clay barrier layer.

3. History of Investigation of Alternatives

The 2017 Development Application (DA) refers on Page 23 to the 2014 study by KBR (2014) which undertook an assessment of alternatives:

- An Ocean Based Dredged Material Placement Area (DMPA) as utilised in the 2005 dredging project;
- Land based DMPA; and
- Beneficial re-use options for material.

Beneficial re-use options were eliminated following assessment based upon the known material qualities as not suitable for habitat restoration or beach placement projects.

Potential land-based options were identified and the options for the placement of dredge material were considered. Land based options were investigated on Le Fevre Peninsula and Gillman due to the proximity and availability of sizeable land parcels as well as the desire for fill to facilitate potential future uses.

In response to assessment of potential land based and ocean based DMPA against a range of criteria, an ocean based DMPA was recommended as the most appropriate and feasible solution for materials placement or disposal in the DA.

Appendix B of the DA includes a report *DMPA Options Assessment (Arup, 6th July 2017)* that provides additional details on the assessment undertaken for the DA based on the KBR report. This report also makes reference to the following earlier investigations:

- Evaluation of Disposal Options for Dredged Spoil from the Outer Harbor Approach Channel, SKM (2001)
- Deepening of the Outer Harbor Shipping Channel, PPK (2001)
- Spoil use / disposal option study, KBR (2004).

The land based alternatives were discounted in the 2004 DA Report for a range of factors following assessment. These considerations were considered to remain relevant for the 2017 Project and included:

- Sizable settling ponds would be required to contain dredge material and associated slurry (water that is mixed with material as a result of hydraulic dredging), thus increasing the costs of land areas required.
- Significant technical and cost implications associated with transporting dredge material to land based sites including limitations on pumping distances and earthworks to construct settling ponds and managing discharges from the settling ponds to the surrounding environment, which potentially have an adverse impact on water quality and environmentally sensitive areas.
- The long duration to de-water land sites and convert the material into a suitable engineering fill for future commercial development is very cost prohibitive when compared to other sources of material within metropolitan Adelaide.

4. Evaluation of the Assessment Undertaken

4.1. Re-use Options

4.1.1. Options Considered

The KBR (2014) investigations combined with the review by Arup (2017) considered an extensive range of options which have either been tried, used or studied to the extent that they could be considered potential options in appropriate circumstances.

A summary evaluation of the finding of these evaluations is provide in Table 1 - Beneficial Reuse Options.

4.1.2. Summary

There were no viable beneficial re-use options recommended by KBR (2014) and Arup (2017) found the same through a review of the underlying technical, economic and environmental factors associated with each option.

Arup concluded that *"in the absence of a clear, viable option in proximity to the OHCW Project it was considered appropriate to eliminate beneficial re-use from further assessment and to focus on land based alternatives for a more detailed assessment against the ocean based DMPA."*

I concur with this assessment, but also note that it may also be argued that land based DPMA may provide a beneficial use of the material in the longer term. For example, a land based DPMA that forms part of a land reclamation or restoration project in which the poor geotechnical properties, drainage infrastructure and long drying times are aligned with the sites end use. Such an opportunity may exist within portions of the former salt fields where long development timeframes and large areas may allow extended drying times, use in buffer areas and even potential for re-use after drying.

4.2. Land Based Dredged Material Placement Area (DPMA)

4.2.1. Options Considered

KBR (2014) combined with Arup (2017) consider an extensive range of locations for a DMPA.

KBR (2014) reasonably excluded:

- the nearby landfills which no longer have demand for capping materials or ability to accept fill
- short lived sites due to insufficient capacity, and
- the "Northern Breakwater" option due to insufficient capacity.

The identified options which were evaluated at a high level by KBR (2014) and further considered by Arup (2017) included the:

- Ridley Salt Fields
- Cheetham Salt Fields
- Gillman Land

A summary evaluation of the finding of these evaluations is provide in the following Tables:

- Table 2 - Land Based DMPA – Key Assumptions
- Table 3 - Land Based DMPA – Risk Factors

Arup 2017 does not quantify the cost difference or extra costs to construct land based infrastructure in the DA for the current project but provided a summary in response #3 to queries raised by the EPA. In this response they refer to earlier cost examples by KBR (2014) and also outlined the investigations, approvals and steps required for a land based DMPA. These would include:

- Field investigations (surveys (flora & fauna, cultural, geotechnical, topographical etc)
- Detailed soil analysis to inform slurry pipe design which includes determination of booster pump requirements, incorporate final dredge plant pump capacity etc

- Detailed hydrological studies to determine potential impacts of placement on groundwater and downstream water quality/sensitive marine environments.
- Construction of a temporary dredge mooring facility to enable connection to slurry pipe system, comprising potentially piled moorings or barge mooring at a suitable location to avoid operational impacts and appropriate for the final dredge plant parameters
- Site detailed investigations and engineering studies to determine bund wall requirements
- Development Application and associated licenses / permits, including further referral under the Environment Protection and Biodiversity Act 1999
- Construction activities associated with the works, including potentially lay-down area(s) for pipes, access requirements for mechanical plant for construction (access tracks on land, barges for marine based works), and earthworks for pipe access.

4.2.2. Assessment Criteria

Potential land-based options were identified and assessed to identify the potential risks and opportunities associated with them. The key constraints that limit the potential to utilise land-based DMPA sites include:

- Accommodating the required volumes of material (physical land parcel size) – estimated at 1.55 million m3 in-situ for 2018 dredging.
- Meeting environmental and social objectives (achieve environmental targets and minimise potential impact upon sensitive environmental receivers)
- Remaining economically feasible (reasonable total capital cost comparatively to alternatives)
- Being able to be completed within project timeframes (including potential risks to the established priority for OHCW Project to proceed)
- Meeting all legislative requirements.

Once assessed against all these criteria and evaluated against the developed methodology for utilising an ocean-based DMPA, the proponent's advisors have concluded that an ocean DMPA is the most appropriate and feasible solution for material placement.

I am advised by EPA that legislative requirements permit ocean based disposal and that the necessary environmental targets can be met. In this context, a multi criterion analysis is required only to weigh up the alternatives to ocean based disposal on the basis that they are technically feasible, and economically and socially attractive options.

The criteria selected are in my view sufficient for this purpose in regards to technical engineering feasibility, risk and cost factors. Social considerations are not directly considered in the evaluation, but are noted in respect of the proponent's engagement objectives and maintaining its social licence to operate in the DA.

4.2.3. Summary

A land based DPMA is not achievable within the stated project timeframes commencing 2018.

Where an approved ocean disposal pathway exists, the risk assessment and assumptions presented by the proponent are reasonable.

Where an ocean based pathway **does not** exist, the land based options available are likely to be feasible but subject to the risks identified and the additional costs required to undertake the works.

The additional costs presented serve to highlight the order of additional cost for a land based DMPA for disposal or limited beneficial use with limited dewatering and excluding purchase costs and the future site management costs for the DMPA. They do not fully cover the cost of resolving issues of land tenure and long term management and future use of the DMPA also need to be resolved.

5. Limitations

The preparation of this report was undertaken for an agreed purpose and the scope of work undertaken was within time and budgetary constraints and relies in part upon certain data and information made available to Mockinya Consulting. The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

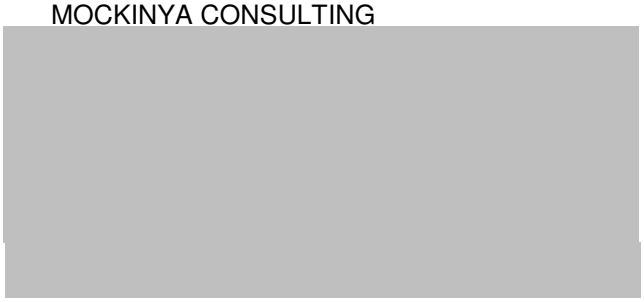
Unless otherwise agreed between us, the report has been prepared for SA EPA, and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendation and should make their own enquiries and obtain independent advice in relation to such matters.

Mockinya Consulting accepts no liability whatsoever to any third party for any loss or damage arising from any interpretation or use of the information contained in this report, or reliance on any views expressed therein.

6. Closure

If you have any queries or require further information, please do not hesitate to contact me on +61 419 840 116 or paul.lightbody@mockinya.com.au.

Yours faithfully
MOCKINYA CONSULTING



Attachment 1 – Tables

Table 1 Beneficial Reuse Options

Item	Assessment Provided		Evaluation
	Reference	Assessment	
Beach nourishment, Shore / Coastal protection / Habitat Creation	Table 3, Arup (2017).	Mixed content of material (sands, clays and gravel) prevents ability to separate significant quantities of any single material. Additional works to material (drying, reinforcing) plus associated infrastructure requirements results in high costs and need for significant retention ponds to achieve (these).	The change and distribution of material types along the dredging alignment make segregation very difficult if not impractical; and therefore un-economic. The dredgate will be a mixed and variable material. Dredged materials can be stabilised in geotubes to form part of coastal defences (i.e. fill behind a hardened sea wall), but is not suitable without armouring as identified by KBR (2014). The demand for materials in coastal defences has not been quantified but is likely limited and distributed given the potential requirement to place 5M tonnes of dredgate.
Engineered Fill (Multiple purposes)	Table 3, Arup (2017).	Material is unsuitable to be directly utilised as an engineering fill, and hence requires additional works to achieve necessary properties. This includes drying and addition of materials such as cement which significantly increases costs and requires retention ponds and land areas to dry and work the material	Alternative materials sources of virgin and recycled materials exist at lower cost than the drying, amendments and handling required for the use of dredgate for engineered fill. The clay content limits the suitability of this material for some engineering purposes, and it should be considered a low grade fill requiring amendment and unsuitable for placement at surface below conventional construction and development. Additional costs would likely be incurred in land development over fill of this type. The salt content of the material may limit its use away from the coastal environment.
Non-Engineered Fill (Rehabilitation, Land restoration and Capping)	Table 3, Arup (2017).	Transport costs are a limiting factor given there are no suitable locations in proximity to Outer Harbor resulting in the material needing to be dried prior to transport. Placement of non-engineered fill also limits future options for any site and hence requires long term certainty on usage of site.	No sufficiently sized established or planned and approved use for dredgate exists within a reasonable distance. Salt content of the dried material may limit beneficial re-use due to limit this imposes on revegetation and leaching of salts to groundwater at a receiving site away from the coastal environment.

Item	Assessment Provided		Evaluation
	Reference	Assessment	
Other Options	KBR (2014).	KBR considered and discarded potential uses in addition to assessing those in Table 3 by Arup (2017) including in agriculture, landfill capping, brickmaking, topsoil.	There is a low potential for viable use in these alternatives given the heterogeneity of the dredgate, its salt content and lack of demand and availability of alternatives.
Land Based DMPA as a Beneficial use	n/a	n/a	Placement on land at Gilman, former Ridley and Cheetham sites may provide a beneficial use where the poor geotechnical properties and long drying times are aligned with development options for the portion of these sites where the materials are placed. This option is considered as a land based DMPA in the latest assessments provided.

Table 2 Land Based DMPA – Key Assumptions

KBR (2014)	ARUP (2017)		Evaluation
	OHCW Project (2017)	Relevance / Comment	
All sites investigated indicated willingness to consider receiving material	No change.	Land tenure and future uses are critical aspects for determining appropriateness to obtain agreement and approvals	There has been a change of potential control and ownership of several sites since 2014. The need to reach agreement and obtain approvals remains. The proposed project timeframe precludes land based disposal in 2018 as the necessary agreements and approvals are not in place.
Assumed total volume of 5 million m^3 over 20 year timeframe (i.e. assumed several capital dredge projects over time for long term DMPA) with volume from any single campaign assumed as between 500,000 to 3,000,000m^3	Assumed total volume of 1.55million m^3 completed in 2018 (i.e. single project defined)	OHCW Project remains within the core assumptions adopted for any single capital project and hence the KBR 2014 study option outcomes remain relevant to 2017 study	It is appropriate to highlight that there is a need to provide a longer term management pathway for dredgate which is produced from capital dredging (expansion of the port facilities) and maintenance. This demand will extend beyond the 2018 project and likely extend beyond the 20 year timeframe though at lesser quantities as expansion ceases and maintenance dominates dredging activities.
Capital dredge material only	No change	As per above	Maintenance activities are not considered. These will result in substantially smaller quantities of dredgate and may require a different management approach.
No contaminated material (all material tested prior to placement and if any contaminants found material is disposed in accordance with EPA requirement to licensed receiving facility)	No change	As per above	This item is not limiting to consideration of land based disposal. PASS has been assessed and neutralising capacity evaluated to exceed the potential acid generated.
Material derived through a “linear” dredge campaign (i.e. use of hydraulic dredge methods)	No change	Impacts water content of the material and hence ability of certain sites to be considered due to the requirements for de-watering, containment works, environmental factors, distance from Outer Harbour and distance from barge tie-in to pipe system for transport of slurry	Hydraulic dredging is appropriate for capital dredging at this scale.

KBR (2014)	ARUP (2017)		Evaluation
	OHCW Project (2017)	Relevance / Comment	
Hydraulic dredge methods produce approx. 20% solids, 80% seawater mixture	No change	As per above	Reasonable Assumption.
Material generated will be piped (as slurry) and dewatered at any land based DMPA	No change	As per above	Reasonable Assumption. Wastewater return from the DMPA to the marine environment requires detention to reduce turbidity and may require further treatment prior to discharge.
Material assessed for land based options will require additional "working" if it is to be utilised as engineering fill in the future (used for costing comparisons and suitability of potential sites)	No change	Consideration noting the time, areas and costs associated with converting this material into suitable engineered fill. Potential for third parties to accept this cost outside of the OHCW Project has been considered and hence excluded where appropriate	The degree of "working" was canvassed for re-use as engineered fill in land development by KBR (2104). There may be potential for other parties to accept some cost, however this is tempered by the risks and lack of a committed site and third party. A Land Based DMPA accepting material for confined disposal to serve the longer term need does not require engineering of the fill to a standard suitable for commercial or industrial development if the site is designated for use as a long term disposal facility. After a sufficiently period of drainage and settlement, areas filled in this manner may be trafficked and used for non-intensive recreational purposes but will not support commercial and industrial development without substantial ground improvement costs, if at all.
Land Based DMPA - Potential Waste Depot Levy	n/a	n/a	A licenced Land Based DMPA may be considered a waste depot and subject to the waste levy. If this was to occur it would be inconsistent with the absence of a levy for marine disposal.

Table 3 Land Based DMPA – Risk Factors

Risk Factor	ARUP (2017)			Evaluation
	Ridley	Cheetham	Gillman	
Pipeline Distance	Shortest Least amount of temporary infrastructure Access for maintenance and refuelling required.	Longest. requiring additional booster pumps along route. Access for maintenance and refuelling required.	Longer. requiring additional booster pumps along route. Access for maintenance and refuelling required.	Risks associated with direct impact, clogging of pipeline, fuel spills and bursts increase with distance. Pumping costs increase with distance. Consideration could be given to reusable infrastructure given the need for future dredging campaigns.
Land Size	Suitable No current constraint on drying time	Suitable No current constraint on drying time	Suitable in aggregate but no single land parcel. No current constraint on drying time	Salt fields in their current form are likely to be inherently more suitable from a containment infrastructure perspective than Gillman.
Land Tenure	Third Party Subject to zoning, approvals future use	Third Party Subject to zoning, approvals future use	Third Party Subject to zoning, approvals future use	State Government holds an interest in portions of the Gillman and Ridley salt fields. The Cheetham salt fields are privately owned.
Final Use	Unknown May require future treatment and removal of fill.	Unknown May require future treatment and removal of fill.	Gilman masterplan suggests future uses require higher standard of engineered fill.	Bulk fill potentially acceptable in salt fields subject to third party plans for sites. Gillman masterplan limits potential economic use due to the requirement for fill of a higher engineering standard.
Pipeline Route	Sensitive intertidal, seagrass and mangrove areas	Sensitive intertidal, seagrass and mangrove areas	Sensitive intertidal, seagrass and mangrove areas	Some impact will occur due to the intrusion and access for pipeline construction. The least impact path is to the Ridley Salt field.
Site Issues	Hypersaline waters in salt pans to be manged prior to placement of dredgate to avoid release. Migratory bird habitat	Hypersaline waters in salt pans to be manged prior to placement of dredgate to avoid release. Migratory bird habitat	Need to construct containment walls / bunds. Protected habitat. Migratory bird habitat	Each site has issues that need to be managed. The time required to manage hypersaline waters in ponds may be a limiting factor.
Tailwater Disposal	Discharge to sensitive estuarine / marine environment	Discharge to sensitive estuarine / marine environment	Discharge to sensitive estuarine / marine environment	There are storm water discharge pathways to the environment from all sites. These are most significant at Gillman.

Risk Factor	ARUP (2017)			Evaluation
	Ridley	Cheetham	Gillman	
				Portions of the Gillman area and adjacent land have historically received dredgate from the inner harbour. Discharge at Gillman is likely to have the least significant impact due to the existing storm water discharges that occur at this locality.
Amenity	Pipeline likely to restrict access to local boating and fishing during project	Pipeline likely to restrict access to local boating and fishing during project	Pipeline likely to restrict access to local boating and fishing during project	These impacts could be avoided at additional cost. Consideration could be given to reusable infrastructure given the need for future dredging campaigns.