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Synopsis: The report presents an overview of the documentation that relates to the Lakes Entrance Sand Management Program. .	
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PREAMBLE

A key task for the Lake Entrance Sand Management Program Independent Review Panel members was to become conversant with the nature of the sand management program and the background work already undertaken up to October 2006. The Panel has reviewed all of the available documentation, and this report presents an overview of the LESMP from the panel's perspective. The report addresses the coastal regime in which the LESMP must operate; an assessment of the modelling work undertaken to determine dredging parameters; an assessment of the proposed strategy for long term management of the entrance, including the economic justification, and aspects of the upcoming trials.

1.0 INTRODUCTION

Lakes Entrance has been an operational port for over 100 years, with a trained entrance being constructed during the late 1800s and completed in 1889. For most of the time since then, the entrance has been navigable without major dredging being required. By the 1970s, it was clear that sand build-up at the entrance needed to be controlled and the *April Hamer* was commissioned in 1977 and, along with the implementation of internal channel dredging and sand transfer systems, has maintained the entrance navigability for some time. It is now apparent that the current approach to channel maintenance is not adequate for the future development of the port, and the Lakes Entrance Sand Management Program has been implemented to deliver a new approach most likely involving the replacement of the *April Hamer* and an upgrade of the sand transfer system.

A range of studies have been undertaken by a number of engineering and project management consultants, and along with other documents prepared by Gippsland Ports these studies form the body of work which has been reviewed in this report.

2.0 COASTAL PROCESSES

The historical background provided by Butler & Assoc. (1993) suggests that prior to the 1860s; the lake system had an intermittent opening to the ocean and one which was constantly migrating in response to the wave climate. From recent work[1] it is known that the period of the late 1800s had a distinctly different climate which may have resulted in an extended period of persistent swell from the SW. This would explain the usual location of the entrance near Red Bluff during this period. It would also explain the ongoing confusion over the direction of nett littoral drift, as this location suggests a west to east nett direction. The historical evidence as presented in recent aerial photographs clearly shows however that the direction has been from east to west since the 1890s.

Fryer (1973) provides an overview of the coastal processes acting on the Lakes Entrance section of coastline. Prior to the construction of the current Lake Entrance training walls in 1889, the entrance to the lakes system was further to the east and was known to migrate over a distance of +/- 3km. The current entrance site was chosen in the mid-1800s and is some 8km west of the entrance location at the time of construction. The observations presented by Fryer include that there has been more sand on the eastern side of the entrance than on the west, with recession rates of 2.2m p.a. up to 1900 and on average 1.7m p.a. up to 1966 measured, and with noticeable recession occurring up to 2km west of the entrance and apparent influence of the entrance to around 5km west. The depth over the new bar was around 2 to 3m at low water.

The total drift was estimated at around 300,000m^3pa and the sand is typically d_{50} = 0.4mm. Fryer concludes that the nett drift is from the east under storm conditions, but that similar rates are from the west due to the predominant SW swell. Fryer also suggests that the trapping rate at the entrance has reduced since around 1927, and that the entrance and new beach alignments where in equilibrium by 1970.

Coastal Engineering Solutions (2003) included an assessment of the coastal processes which is summarised as follows.

[1] Helman, P. (2006) PhD Thesis Southern Cross University Lismore

- The volume of sediment accumulated at the entrance since 1889 is 15 million m^3.
- There is ongoing accumulation at around 100,000m^3 p.a.
- The gross longshore transport rate is of the order of 1 million m^3 pa.
- Nett movement direction is still uncertain.

Lawson & Treloar (2004) undertook modelling using DELFT3D MOR which is considered state of the art in morphological models. The modelling work – although uncalibrated – was well presented and should give reliable indicative transport rates and distribution patterns. They also assessed the volume of the ebb delta (bar) using well-tried methodologies which compare current bathymetry and straight coastline bathymetry, and determined a bar volume of 14.6 million m^3, with around 3 million m^3 above the 5m contour and seaward of the 0m contour. A number of management option scenarios were tested which provided sand movement rates and responses. Lawson &Treloar determined that the nett longshore drift was to the east.

Jesz Fleming & Associates (2004) quote a bar growth rate of 130,000 m^3 pa which is consistent with the total estimated accumulation since 1889. They point out that the bar will continue to grow regardless of the dredging. They suggest that 3 million m^3 needs to be removed and be deposited in water depths of 18 to 19m. They highlight the risk being due to not knowing what channel infilling and side slope slumping rates will occur during dredging.

3.0 DEVELOPMENT OF A SAND MANAGEMENT SYSTEM

In response to growing concerns that the dredging program, based around the *April Hamer*, was not coping, a study was commenced to determine the options for improvement of the entrance to allow larger recreational and commercial vessels.

A workshop was held in December 2002 which defined the scope of the study (Kohlman 2003) to include a number of sand management options, namely:

- Phase out sand management at the entrance all together – i.e. do nothing
- Maintain a status quo –i.e. continue dredging and the Sand Transfer System as at present
- Install a bypassing system outside the entrance
- Dredge and maintain a 5m deep X 80m wide trench through the bar
- Remove the bar, in part or full.

What followed was a series of studies and reports, many of which are discussed throughout this overview. A number of specialist consultants were engaged to do this work, and a summary of the outcomes was presented by Kohlman, (2004). These findings appear to be appropriate, and are consistent with the knowledge base for the behaviour of Lakes Entrance and other tidal entrances.

As an outcome of the studies, and subsequent community discussion, the Victorian Government allocated $31.5 million in 2005 to establish a Sand Management Program including upgrading of the sand transfer system, replacement of the *Sandpiper*, and the trialling of a trailing suction dredge and sand bypassing system in preparation for the replacement of the *April Hamer* (Gippsland Ports, 2005).

4.0 CURRENT SAND MANAGEMENT STRATEGIES

The Coastal Engineering Solutions (2003) report provides a succinct summary of the current sand management strategies. The interesting points identified are that the bar and channel were not routinely dredged until 1977 when the *April Hamer* commenced, and that as early as 1990 the dredging was not coping with deposition in the channel. There has been some improvement in recent years with the practice of using the ebb tide to gain deeper deposition, but it would appear that the fundamental problem is that side casting only redistributes the sand from the channel to the linear bars either side of the channel from whence it rapidly is transported back into the channel as quickly as it is removed. The only effective component of the current management strategy is the process of dredging and disposing of sand in the channels inside the entrance.

The problems being faced simply reflect the character of tidal entrances in that they tend toward a natural dynamic equilibrium, and regardless of intervention such as dredging they will continue to do so. Hence it is pointless disposing sand in deeper water, for example, as the processes by which sand is approaching the entrance are not affected by the removal of sand from the system.

5.0 PROPOSED MANAGEMENT STRATEGIES

Preliminary design and costing for the proposed options as set out above have been prepared by a number of consultants.

The Coastal Engineering Solutions (2003) report addresses the entrance channel and bar. They draw a number of conclusions and make recommendations. In general the following of their assessments are supported;

- There is a strong likelihood of sand accumulation and reduction in bar depths if dredging is discontinued. There is even a risk of closure of the entrance based on the evidence from the 1800s which suggested that the lake system was intermittently closed.
- Pumping sand to a point beyond the extent of the bar system will not reduce the amount of sand supply to the bar and channel.
- The capacity to deposit sand to the west or east of the entrance depends on prevailing wave conditions.
- As the natural channel is approximately 3 metres deep it would be difficult to maintain one 5 m deep. Entrance behaviour elsewhere supports the idea that the bar will rapidly return to its ruling depth[2] and that constant dredging would be required.
- If 3 million m^3 is removed, the bar will still reform.

The CES report suggests that a bi-directional sand bypassing system could help with channel maintenance. From studies of the Tweed and Gold Coast Seaway entrance dynamics[3,4] it is apparent that the use of the fixed bypass systems does little to help

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[2]Tomlinson, R.B. (1991), "Processes of Sediment Transport and Ebb Tidal Delta Development at a Jettied Inlet", in *Coastal Sediments* '91, Eds. Kraus, N.C. Gingerich, K.J. & Kriebel, D.L., ASCE.

[3]Mirfenderesk, H. and Tomlinson, R.B. (2006), "Observations of Hydrodynamic Parameters in Tidal Inlets in a Predominantly Semidiurnal Regime", Accepted for *Jnl. Coastal Research.*

maintain navigation channels. They are configured for littoral drift bypassing, and do that task well, however, the processes controlling the bar depth are more closely linked to tidal flow dynamics. The use of the technology to create localized sand traps may be effective in keeping the channel clear.

CES (2003) also suggests the concept of configuration dredging which is used at the Tweed entrance and has proven to be effective. The components of such an approach as set out by CES would seem to be appropriate.
The Evers Consult (2003) and the Jesz Flemming & Associates (2004) reports primarily investigated the costs of a range of bar and channel dredging options. The assumptions made in these reports about sand transport rates, deposition sites etc are considered appropriate. The cost estimates for the various options appear to be realistic compared with other similar sites.

Of particular interest is the comment in highlighted in the Evers Consult report (Upper Case and Underlined on page 15) that "If Gippsland Ports want to get a grip on the problem at the bar then surveys at great regularity must be done". A major problem that appears throughout all of the available reports is that the understanding of the coastal processes at work at the entrance is limited at a level of detail necessary for dredging operations. The close monitoring of the entrance either by traditional survey or other techniques is considered essential in developing a better understanding of coastal dynamics and hence the development of a "learn-on-the-job" approach to the operational dredging plan.

Slurry Systems (2003) also present a design and cost report for the sand bypass system which s difficult to assess in detail but again appears to be competently prepared and requires no further comment.

6.0 ECONOMIC ASSESSMENT

Noakes (2004) presents a business case for sand management Business case for sand management at Lakes Entrance: Economic and social investment study report. In general, the economic evaluation techniques used in the report are appropriate to the project and appear to have been applied without technical error.

However, studies of this type are frequently conducted with limited historical information available and then they attempt to predict what will happen in the future. As such they are heavily dependent on assumptions about how the local economy will respond to the proposed changes. This study is typical of this approach and some of the assumptions made in it should be treated with caution.

Major concerns are outlined below.

Range of options modelled

- Only options 4 and 5 (and variations of these) appear to have been subjected to detailed benefit-cost modelling. There are no reported results of economic modelling for option 1 (cease all interventions), option 2 (maintaining current activities), or option 3 (additional investment in sand transfer / by-pass operations).

[4] Voisey, C., Tomlinson, R.B. and Robinson, D. (2003) "Investigation of Ebb Delta Development and Response Using a Moveable Bed Physical Model", Proc. Int. Conf. Coastal Sediments 2003. CD-ROM Published by World Scientific Publishing Corp. and East meets West Productions, Corpus Christi, Texas, 9pp.

- Given the scale of proposed capital investment in options 4 and 5 for this project, the 'do nothing' and minimalist options should also be modelled. Failure to do this might be interpreted as simply an attempt to justify a predetermined course of action.

Estimates and assumptions about project benefits

Savings in avoided maritime boating accidents / costs (marine safety): The report describes this benefit category as being related to 'deaths at sea due to access problems to/from the Bar' which have occurred every two years on average (p. 19). This benefit category represents a substantial proportion of the total project benefits (around 15 per cent of the total) but there are high levels of uncertainty in the assumptions made.

Table 6.2 indicates that recreational boat crossings of the bar are expected to increase by 50 per cent over the life of the project. However, the project benefits related to marine safety indicate that the project is expected to reduce accidental deaths to zero. This assumption seems highly optimistic. Given the unpredictable conditions it is unfeasible for the project to reduce the risk associated with bar crossings to zero and, with 50 per cent more vessels making the crossing, it is conceivable that the number of accidents may actually increase.

Increased recreational expenditures (yachting / pleasure craft): The benefit schedules indicate that expenditure related to recreational boating is expected to increase 300 per cent in five years and then not grow at all for the next 15 years. No justification for the extraordinary level of predicted growth in the first five years is provided.

Growth of this type of recreational activity is likely to be constrained by supply of infrastructure such as marina services and tourist accommodation. Even if demand was as strong as suggested, it seems unlikely that local tourism infrastructure could respond as quickly as suggested in the benefit schedules. Why is zero growth assumed between years 5 and 20? Recreation / tourism destinations would normally be expected to grow (or decline) slowly unless development is capped for some reason.

Increased ocean charter fishing expeditions: The assumptions underlying the very rapid growth in ocean charter fishing expenditures also require further explanation. According to Table 6.2 the number of operators is assumed to grow from two in 2003 to five in 2005. According to the benefit schedules the additional three operators are expected to generate an additional $60,000 in related expenditure by 2005 (i.e. $20,000 per operator). If additional expenditures associated with each operator are only $20,000 per annum it seems unlikely that more operators would be drawn into the region.

In 2006 it is assumed that the number of operators will grow by one to a total of six and that net additional expenditures related to this sector will increase from $60,000 to $360,000 (i.e. a growth of $300,000 for the addition of one extra operator). This doesn't seem to be consistent with the data provided for the 2003-2005 period. Again, growth of this type of recreational activity is likely to be constrained by supply of infrastructure such as marina services and tourist accommodation. Can local infrastructure supply respond as quickly as indicated in the schedules?

Initial benefits and annual savings from disinvestment in April Hamer: The single biggest benefit category associated with the project relates to savings from decommissioning the *April Hamer* dredge vessel. This cost saving represents over 30 per cent of the total benefits and is recognised in the schedules for the full 20 year life of the project until 2023.

However, The Lakes Entrance Sand Management Program 2006-2010 Draft Implementation Plan (2006, March 30, p. 1) indicates that the vessel has a life expectancy only until around 2011. Thus, cost savings associated with decommissioning this vessel should not be counted as a benefit of the proposed project after 2011 since the vessel will be decommissioned around this time with or without the project.

7. 0 LONG TERM MANAGEMENT PLAN AND IMPREMENTATION PLAN FOR THE LESMP

Based on the outcomes of the various studies of coastal processes, management options, financial and environmental costs and risks (summarized by Martin (2004)), and a process of consultation, Gippsland Ports has adopted a preferred strategy of:

- keeping the *April Hamer* for approximately 5 years
- undertaking a trial of a TSHD with view of this as a replacement for the *April Hamer*, and
- possibly deploying sand-transfer systems at the ends of each breakwater and connecting them to the existing system inside the entrance.

The long term management plan developed by John Kowarsky & Assoc (2005) based on the preferred options was prepared to meet the Commonwealth requirements for sea-dumping. This document provides the most complete description available of the environmental status of the region, the current dredging practice and proposed management strategies. The document relies on past studies and data collection, and requires no further comment.

CorpSupport P/L (2006) developed an implementation plan for the LESMP which sets out timelines and management actions for the delivery of the program. The key components being expressed in terms of specific projects, namely: Project A – replacement of the *Sandpiper*; Project B – Trial of the sand by-pass system and extension of sand transfer pipelines; Project C - Trial of a TSHD and inner channel maintenance; Project D – specifications for *April Hamer* replacement; and Project E – refit of the existing sand transfer system

Communication Strategies.
As a supplement to the implementation plan, CM Communications (2006) present a communication strategy for the LESMP. This plan appears to be appropriate and follows similar plans for other major public infrastructure and environmental management projects. The plan requires no further comment.

8. 0 TRIAL DREDGING

The last report reviewed and the first of the reports addressing specific aspects of the LESMP is the Coastal Engineering Solutions (2006) report on the proposed TSHD trials. In the context of the specific nature of this report it is noted that the previous extensive studies have provided considerable data, but due to variability and lack of regular and long-term surveying, there is still significant uncertainty regarding the sand transport rates [both gross and nett]. The net sand transport is from east to west but depends of the intensity and number of storms generating waves from the east. [In some years it could be west to east].

There is agreement with CES (2006) that *"The natural processes influencing the supply and movement of coastal sediments in the vicinity of Lakes Entrance are extremely complex."* This is important from a risk analysis perspective as it means that strategies and plant equipment will need to have some operational flexibility. There are also significant risks that trials will not be representative of average and certainly not all probable conditions. In the report, CES noted that the Tweed River sand bypassing system "is augmented from time to time by supplementary dredging." In reality, dredging has been required every year to conform to the minimum depth and channel alignment specifications in the contract – however, a less rigorous depth and alignment specification would have reduced the need for dredging as has been the case at the Gold Coast Seaway entrance where minimum depths of -4m to -4.5m are generally maintained [c/f -5.5m at Tweed] without dredging. Short term shoaling can occur after storms. It is emphasised that trials of this nature need to be flexible.

Specific Comments Regarding Trials

CES Recommendations [Jul 06]		Comment
Sequence		
	Dredging, then sand shifters after monitoring	agree
Monitoring		
	Need directional wave measurements	agree
Bathymetric surveys		
	Pre-dredging	agree
	Monthly during and after dredging	could space out after 1st month after completion of dredging, when not much change??
	Survey after significant events	agree
Aerial photography		
	4 [min 2] / yr	could possibly reduce to 2 / year and use a fixed video camera system and undertake image analysis to define bar conditions
	About same time as surveys	agree
Capital dredging		
	Fan shaped , depth to -4m	Possibly taper depth as well
	Deposit nearshore [-5 to -8m], at least 1km away	agree
	Deposit downdrift [bi-directional, in response to sand transport direction]	agree
Sand by-passing		
	Bi-directional system	agree
	Locate in about 3m water depth to seaward of walls	agree
	Discharge about 1km either side of entrance	agree

9.0 SUMMARY OF ISSUES

The development of the LESMP has come about primarily due to the increased pressures of development in the Gippsland Lakes region and the inadequacy of the current Lakes Entrance dredging program to cope with current and future navigational requirements. An excellent summary of the various studies, reports and deliberations that inform the LESMP is given by Martin (2004).

The documents listed in the Bibliography have been reviewed by the Independent Review Panel and the assessment of this body of work and resulting actions of Gippsland Ports is summarised as follows:

- Lakes Entrance has behaved historically as would be expected for a tidal entrance of this nature. As such it is a major trap for marine sand being worked in the littoral zone. The trapping processes are due to ebb jet hydrodynamics resulting in deposition on the bar, and flood tidal flow and wave refraction moving sand back towards the entrance from all directions resulting in any sand which is removed from the bar or channels by dredging being replaced by natural processes.
- It is not possible to create a permanent one-off solution, but a navigable entrance can be sustained with an appropriate dredging program. The current strategy is not working primarily due to the operational characteristics of the *April Hamer*.
- In general, the economic evaluation of the LESMP was appropriate to nature of the project and appears to have been applied without technical error.
- Despite the volume of studies previously undertaken, there are still considerable gaps in the understanding of the dynamics of the entrance, and there is a need to develop an adaptive management approach to future entrance management. The studies have however, provided adequate background to support the preferred options for a long term management plan.
- The use of a range of consultants to undertake various studies is appropriate, but will require tight program management to ensure coherent outcomes.
- There is some concern over the specific configuration of the bar dredging and over the usefulness of the sand bypassing system for channel maintenance. Both of these concerns should be addressed during the trials.
- The environmental impact assessment, communication strategy, and LESMP implementation plan are satisfactory.

In general, the processes adopted by Gippsland Ports are appropriate for a program of this scale.

10.0 BIBLIOGRAPHY

1. Butler, G. et al (1993), "New Works Conservation Analysis – Analysis of the engineering works, buildings and landscape surrounding the creation of the new artificial entrance at Cunninghame", Graeme Butler & Associates.
2. CM Communications and Scarlet Consulting (2006), "LESMP Final Communication Plan 2006-2007".
3. Coastal Engineering Solutions (2003), "Lakes Entrance bar and Cannel Dynamics", Sand Management Study Final *Report* for Gippsland Ports.
4. Coastal Engineering Solutions (2006), "LESMP Trial Dredging Sequencing Final Report". Report for Gippsland Ports.

5. CorpSupport P/L (2006), "LESMP 2006-2010 Draft Implementation Plan – Subject to Agency Endorsement" Report for Gippsland Ports.

6. Evers Consult (2003), "Removal/Reduction of the Bar – Budget Prices. Lakes Entrance Sand Management Study. Report for Gippsland Ports.

7. Fryer, J.J. (1973), "Development of the Gippsland lakes Entrance Since 1851", Proc. Roy. Soc. Vic., 85, pp125-131.

8. Gippsland Ports (2005), "Update on Sand Management Program for Lakes Entrance".

9. Jesz Fleming and Associates (2004), "Gippsland Port – Lakes Entrance Sand Management Study".

10. John Kowarsky & Associates (2005), "Long term management plan for dredging lakes Entrance 2005-2015" Report for Gippsland Ports.

11. Kohlman, G. (2003), "Gippsland Lakes Entrance Sand Management Study – Study Brief" Gippsland Ports

12. Lawson and Treloar (2004), "Lakes Entrance Sand Management Study", Report RM2072/J5371.

13. Martin, B.J. (2004), "Sand Management Study Summary Report and recommendations"

14. Slurry Systems P/L (2003), "Definitive Design and Cost for lakes Entrance Sand Transfer System Upgrade to Sandbypass operation" Report for Gippsland Ports.