ICM
COASTAL SPECIALISTS | EST.1989

rps MAKING COMPLEX EASY
A TETRA TECH COMPANY

BRIBIE ISLAND EROSION AND BREAKTHROUGH

Independent expert review pursuant to the Terms of Reference

PART 1 – DESKTOP REVIEW

387576
14 May 2025
2

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
0	Draft desktop review	Brian McRae	Aaron Salyer	Brian McRae	06/05/2025
1	Technical review	Brian McRae	QG TWG + SCC	Brian McRae	12/05/2025
2	Client review	Brian McRae	DSDIP	Brian McRae	14/05/2025

Approval for issue

Brian McRae  14 May 2025

Prepared by:

RPS

Brian McRae
Principal Consultant (Environmental Management & Remediation QLD)

ICM

Aaron Salyer
Director & Coastal Engineer

Prepared for:

Queensland Department of State Development, Infrastructure and Planning

Judith Rowell
Executive Director
Strategic Policy and Insights

Level 39
1 William Street
QLD, 4000

Contents

Figures

Appendices

We acknowledge the Traditional Owners throughout Australia and recognise their continuing connection to land, waters, and community. We pay our respect to them and their cultures and to Elders past and present.

ACKNOWLEDGEMENT OF COUNTRY

PREFACE

This report is “Part 1” of an independent review regarding Bribie Island Erosion and Breakthrough, undertaken pursuant to Terms of Reference (**ToR**) issued by the Queensland Government (**Appendix A**).

The initial breakthrough occurred in 2022, followed by a second breakthrough in 2025. The Queensland Government (**QG**) committed to commission a review on 25/03/2025, followed by announcement of the appointed team, RPS and ICM, on 11/04/2025, and commencement of public consultation on 17/04/2025. The final report is to be delivered by 29/08/2025, approximately 20-weeks from the date of commencement, a relatively short period of time given the complexity of this undertaking.

The Department of State Development, Infrastructure and Planning (**DSDIP**) is funding the review and issued a Request for Proposals that included the draft ToR. RPS and ICM (‘**we**’/’**our**’) submitted a proposal that outlined our suggested approach to fulfilling the intent of the ToR. Those suggestions included an ‘agile’ approach, founded on a general structure, but designed to respond to evolving circumstances. Whilst this is an independent review, we also suggested early engagement of technical experts from QG departments and Sunshine Coast Regional Council (**SCC**). We appreciate the cooperation of those QG departments and SCC, and particularly the individual officers for their contributions, acknowledge that this review is dependent on their collective knowledge base, and independently accept responsibility for the final content. A reader deserves to know something about the ‘authors’, so we have included information about the RPS/ICM team, as well as the agencies that contributed information and advice (**Appendix B**).

Bribie Island (**BI**) and Pumicestone Passage (**PP**) have a rich history, documented by a significant body of knowledge, including investigations and reports regarding erosion and predictions that a breakthrough was likely. Planning regarding appropriate responses to a breakthrough has been progressing for over a decade. The context for this review includes two facets that are atypical of this extended history. One is that the anticipated breakthrough occurred. Following the event, the Department of Environment and Science (**DES**) did commission a *Review of Causes of Northern Bribie Island Erosion* [172], but the second distinguishing characteristic of our review is that the ToR specifically call for solutions. Whilst potential causal factors is relevant to our review, the focus is to identify appropriate solutions.

The breakthrough in this context has the characteristics of a ‘wicked problem’, including lots of reports, but relatively little historical action, absent a relatively consistent policy to not intervene with natural coastal processes, and management actions such as monitoring. That response is consistent with QG policy regarding coastal processes, as well as other regulatory considerations relevant to this site. Whilst that approach has strong merit as an acceptable solution, we accept that the ToR require consideration and presentation of alternative approaches, including works to reinstate the eroded island and former bar.

The intended audience for this report is broad, including residents and businesses that have been directly affected by the breakthrough, the larger community, including marine rescue volunteers, local residents, and others with an interest, whether personal and/or professional, in this place and its broader context. Importantly, as their assistance is fundamental to realising solutions, the audience also includes technical officers, and elected representatives. We will attempt to strike a balance between technical accuracy and accessibility, including appropriately concise and targeted distillation of a complex matter.

Regarding scope, whilst the focus is on the breakthrough, we extend our framework of consideration southwards to the Gold Coast Seaway for at least several reasons, including that the Seaway and the Pumicestone Passage bar are the southern and northern termini of the Moreton Bay estuary – hydraulically connected and hydrodynamically interdependent – and that this spatial relationship is also approximated in the boundaries of the Moreton Bay Ramsar wetland area, and the Moreton Bay Marine Park.

Whilst we feel it necessary to include consideration of this broader environment, the solutions will be focused on the immediate area of the breakthrough. In a similar fashion, whilst the mainland foreshore, including Golden Beach, is within the areas impacted by the breakthrough and in need of solutions, much of the responsibility for that area resides with SCC, so our intent is to integrate with the considerable amount of planning they have undertaken and augment it where possible.

The overall intent of this review is to provide a roadmap that transitions from past to present, so as to properly found debate regarding options, and enable decisions regarding the forward path. To support that, this report (Part 1 – Desktop Review) adopts a narrative style to facilitate distillation and effective communication of matters that include significant technical detail, and nuanced social dimensions. We will attempt to apply this approach as well to the presentation of solutions – including technical design considerations, as well as relevant regulatory dimensions – balanced with appropriate consideration of the inherent complexities arising from these two elements, as well as other aspects of this issue/opportunity.

The proposed format for this review – at the outset -- is as follows:

1. Desktop Review – '***where have we been; what do we know?***'
2. Problems & Opportunities – '***what are the issues; what could be done; what can we action now?***'
3. Stakeholder Consultation – '***what do WE think, need, want, feel, value, believe…?***'
4. Proposed Solution – '***what is the forward plan that best integrates all of these learnings?***'
5. Final report – '***how will we align our collective actions to realise OUR agreed future?***'

As noted above, we proposed, and DSDIP agreed, that this review would be progressed in an agile manner, to allow us to respond to evolving circumstances, including physical changes in the environment, as well as integrating the findings that arise as we progress the review, from both the literature and data that we identify and consider, and, importantly, the conversations we have with our technical reviewers (QG+SCC), and the stakeholder feedback we receive. The physical environment has continued to evolve, not just between the first and second breakthrough, but also during the time between the QG commitment to this review and 'today', the day that we are finalising this first report – Part 1.

Similarly, our approach to how this review will progress has evolved during the brief time it has been underway. We identified 'early engagement' as a necessary element at the outset. That has been implemented in the form of our Technical Working group (**TWG** – QG+SCC), who reviewed a draft version of this report and provided comments within a strict and short response window. This final *draft* report incorporates our response to their feedback; the schedule did not permit an extended dialogue. The QG responded to our early engagement strategy by extending that to the community as well, opening the first round of consultation within a week of announcing our appointment.

Having finalised this Part 1 report, we have recommended that it be released publicly so that the broader community of stakeholders has an opportunity to learn what we have discovered and have time to consider, discuss and debate what it means. In essence, we believe that the path to a feasible solution requires more than technical excellence; the 'best' solution will be the one that can be implemented, which in this case requires reasonable consensus. As we are also required to realise that outcome in a short time, we want and need to involve 'everyone' during the process, not just at the end.

We have been progressing Part 2 – Problems & Opportunities – in parallel with Part 1, integrating the discoveries discussed in this report into our approach to Part 2. As noted above, stakeholder consultation (Part 3) has commenced for this project, and as discussed later in this report, SCC has undertaken recent consultation on relevant matters. The perspectives arising from those exercises is informing our work on Part 2. The nuances of how we finalise Parts 3, 4 and 5, will be influenced by the destination we arrive at when we've completed Part 2. We look forward to sharing that progress.

As a final introductory note, we'd like to offer a perspective on 'subjective versus objective'. As this review is primarily concerned with erosional processes in a coastal environment and possible solutions to the breakthrough, the relevant literature is technical and can be characterised as objective and factually derived. Stakeholder concerns, needs, and desires are equally relevant to this review, and typically span the spectrum of objective to subjective.

We'd suggest that environmental values similarly sit on this spectrum, founded in a regulatory context that promotes rational objective criteria and evaluation, yet ultimately reflective of human sentiment. We collectively choose as a society to view some plants as weeds, others as crops, and some as worthy of special protection. Nature is, arguably, relatively impartial, inherently and integrally allowing competition ('survival of the fittest'), communalism, parasitism, predation and extinction to co-exist. The decisions we collectively make as a society to protect certain species or ecosystems often reflect recognised detrimental anthropogenic impacts – that our actions have had and/or could have consequences that we wish to mitigate; a subjective decision.

We hope this review will facilitate productive discussion about the future management of this area and provide a valuable addition to the extensive contributions made by our predecessors.

Bribie Island Erosion and Breakthrough Review

Terms of reference – April 2025

Background

Ongoing erosion, has severely narrowed the width of the northern tip of Bribie Island, creating several weak points. In 2022, large waves cut a new channel through the weakest part of the northern tip of Bribie Island opposite Nelson Street, Golden Beach. This channel rapidly widened and became a new opening to the ocean. Soon after, the original Caloundra Bar closed over. This body of water has constrained the Caloundra Coast Guard, preventing access to the southern passage and open ocean.

Further severe weather caused by Tropical Cyclone Alfred in 2025 has further widened the 2022 breakthrough and caused more damage, including extensive erosion to the foredune at Lions Park. This event also created a second breakthrough south of Lions Park. These events have heightened residents' and businesses' concerns about future risk and impacts, given the Northern tip of Bribie Island has traditionally shielded Caloundra from effects of severe weather.

The Queensland Government committed to conducting an expert, independent review to investigate ongoing erosion, previous break through events and the impacts these have had on Bribie Island. Immediate and long-term recommendations will be developed and consultation with the Local Government, community organisations and local community will occur to assure that their concerns have been heard and are being actioned.

Figure 1: Excerpt from the Terms of Reference (fully provided in Appendix A)

EXECUTIVE SUMMARY

This report concludes each section with “suggested messages”, based on the evidence and discussion provided in that section. Those messages are presented below to provide a succinct summary of this report, perhaps analogous to holiday snapshots. If you are a ‘destination person’, hopefully the content below will encourage you to further explore parts, or all of the journey. If you are more of a ‘journey person’, you may want to save this summary for the end.

‘Pre-history’ (s.2)

- **Nature is dynamic, including short-term changes that may be familiar, such as seasonal weather patterns, or the cycling of sand from shorelines to offshore bars, as well as longer-term changes, such as fluctuations in sea levels.**
- **Whilst those longer-term changes can seem quite remote, and/or difficult to comprehend, it is now broadly accepted that sea levels have been and will continue to change during our lifetimes.**

Settlement (s.3)

- **The ways in which we use natural resources contributes to natural dynamics.**
- **Dredging for navigational access, including most likely parts of the North West channel based on its early identification as the “only permanent approach” to Moreton Bay, commenced prior to the earliest detailed chart we were able to source (1865 with updates to 1897).**
- **Adverse environmental impacts from resource use (‘abuse’) resulted in early legislative action (late 1800s) to regulate activities and protect resource values.**
- **In the case of our predecessors, those impacts were significant, particularly during the last ~250 years, and are likely to have exacerbated and accelerated Neil’s observed trend of ‘natural degradation’ occurring over the preceding ~5,000 years.**

Exploration (s.4)

- **Erosion issues of the northern Bribie spit and Kings Beach, as well as shoaling of Pumicestone Passage were a community concern from at least the early 1960’s.**
- **The community took actions that included forming an association, developing a relatively thorough proposal to stabilise the entrance, including engineering and financing considerations, with expert advice from technical professionals.**
- **These erosion and shoaling concerns were part of the record at the time government was considering and took actions to form the BPA (in 1968) and advice from the local community may have actually been foundational to the BPA’s creation and/or formulation.**
- **The Delft Hydraulics Institute provided advice in relation to the northern end of the Moreton Bay estuary at the time when the Delft report of 1970, which provides the foundation for the Gold Coast Seaway and Sand Bypass System, as well as the overall City of Gold Coast beach management strategy, including nourishment, was being formulated.**
- **A BECD had yet to be established for this area by mid-1968 and there was disagreement between LSC and members of the community regarding foreshore management.**
- **The community proposal to stabilise the entrance was considered by the State government with DHM concerns including cost-effectiveness relative to other proposals being considered at the time (including Moffats Beach and Mooloolaba).**

Investigations (s.5)

- **Current coastal process, water quality and protected areas and land use policies and regulatory structures were preceded by investigations that were multi-disciplinary, with inter-agency collaboration, and stakeholder consultation.**
- **Those investigations appear to have been both robustly objective in methodology, within the limitations of available information at the time, provide transparent assumptions and uncertainties, and had both improvement and correction of historical practices as a fundamental goal.**
- **This focus was balanced, or perhaps governed, by a focus on stakeholder needs – providing high quality opportunities for recreation, notably in 'natural' outdoor settings – including an awareness of the need to ensure that demand was sustainable, and would not unacceptably degrade the quality of the environment.**
- **This segment also reports awareness of erosional processes in this location, and a second instance (at least), of a proposal to construct a trained entrance in an attempt to stabilise the issue, concurrent with construction of the Nerang River Seaway, but also amidst significant cautions about potential adverse effects on the environment in this area, notably fisheries resources.**

Protection (s.6)

- **Existing protected area designations took substantial time to enact following adoption of recommendations from preceding studies, including further concept refinement.**
- **Declining water quality in the Passage was identified as a concern, with integrated catchment management recommended (possibly adopted) but the record is unclear regarding whether circulation, e.g. due to changes to the bar, may have been a contributing factor.**
- **The conceptual sand transport model for this area is complex, with the Caloundra Headland forming a N/S divide, some potentially interaction between Kings Beach and the bar/entrance, and the North West Channel, as well as other factors, separating the large sand deposits west of the Channel from the Island foreshore, such that there is limited sand transport along the foreshore, potentially a net 15,000 m3/yr southwards from the bar/headland.**

Management (s.7)

- **Despite a number of investigations, uncertainties remain regarding sand transport processes in this area, as well as debate, an inherent element of the scientific process, regarding the most appropriate models for predicting likely future changes arising from climate change.**
- **SCC has progressed planning in relation to coastal hazards in accordance with Queensland Government coastal policies, as well as specific investigations related to a potential breakthrough since at least 2013.**

Response (s.8)

- **SCC has progressed plans, in partnership with the community, relevant to concerns that this review is intended to address, and the success of any solutions we propose is dependent on their support in both development of appropriate solutions, as well as, no doubt, contributing to the coordinated implementation of any actions that the QG may choose to adopt.**
- **Accordingly, this review will progress collaboratively, with SCC officers and QG officers asked to contribute as appropriate throughout the review process.**
- **The previous review to this one had ToR that were limited to causes of the erosion and is therefore complementary, as is other work by QG departments to understand changes to tidal dynamics and options for ensuring navigational access. We will seek to integrate those contributions as we fulfill the broader scope of our ToR, which specifically includes solutions, as well as community consultation.**

1 INTRODUCTION

This report – Part 1 – of the Review primarily responds to the following Scope item from the ToR:

- *Undertaking a desktop review of previous reports and studies relating to the cause and impacts of the long-term erosion of the island and the breakthroughs in 2022 and 2025*

Whilst that describes the primary focus for the Desktop Review, the consideration of search parameters for relevant source material, as well as how to succinctly summarise the collected sources, progressed with an awareness of other components of the ToR that we are required to address, notably:

- *Identifying causes for the ongoing erosion of the island and subsequent wash overs and breakthroughs.*
- *Identifying impacts of the breakthroughs on the natural protection of Caloundra including residents, business, recreational boating, and the Coast Guard.*
- *Assessing the impact of dredging and shipping channel operations in Moreton Bay that affect Bribie Island including on sand migration.*
- *Considering natural and anthropogenic changes contributing to island erosion across mainland catchment areas and Moreton Bay that affect Bribie Island.*

In a relatively short time, we identified ~200 relevant sources and obtained electronic copies of most of these. This represents our initial scan, and does not include data relevant to the design of solutions, such as bathymetric and terrestrial surveys, or other potentially relevant data such as water quality monitoring results, dredging approvals, etc. Whilst this report is limited to consideration of those materials we could readily identify and obtain, as the review progresses additional relevant data will be included. The majority of these ~200 sources are government reports, plans, policies, regulations, fact sheets, etc. A smaller portion, no less important, are academic in nature. The complete source list is provided in **Appendix C**.

Whilst our initial scan was generally broad, it is not exhaustive, for example the relevant academic literature regarding coastal processes is extensive, and our source list largely excludes matters worthy of consideration, such as the rich cultural history of this area. We acknowledge these intentional filters, apologise to the dedicated community of local historians, as well as others that may feel we left out important or essential material, and respectfully acknowledge the Traditional Owners and throughout Australia and their continuing connection to land, waters, and community.

This component of the review – 'what do we know?' – is generally chronological, to illustrate evolving understanding, as well as use and management of this area, such as it is reflected by the source material we collected. Accordingly, this desktop review is biased towards knowledge that is potentially relevant to solutions, including a platform – hopefully a reasonably representative point of truth – that effectively supports productive dialogue and promotes consensus, including, if necessary, mutual agreement regarding differences of opinion.

2 'PRE-HISTORY'

Consideration of coastal processes, as well as many other aspects of environmental science, involves a temporal component, including geological time scales. Understanding erosion, deposition and other observable changes at the shoreline, includes more apparent influences such as tides, waves, and weather, and long-term factors such as historical fluctuations in sea level, which influences coastal surface geology.

An excellent 'environmental history' of the Moreton Bay was provided by David T. Neil in *Moreton Bay and Catchment*, the proceedings of the Moreton Bay and Catchment conference [104]. Interested readers are highly encouraged to include this vignette on their short list, as well as an accompanying chapter by Simon Lang, et al, that provides a deeper dive into geological processes. The following highlights attempt to extract and present the 'essentials', noting that a lengthier discussion would allow for subtleties that would also reflect points of dissent:

- The Moreton Bay represents an ecotone – the boundary between ecological communities, which is typically characterised by high biodiversity – not just as a coastal environment where the land and the sea meet, but also as the meeting of temperate and tropical waters.
- The coastal landforms are largely the result of physical processes during the Quaternary period (the last ~2.6M years) including tectonic and orogenic processes (land masses moving 'sideways' and 'up') and changes to ocean circulation, the earth's orbit, effective radiant solar energy and temperature (air, land and oceans, with resultant effects on weather, etc.).
- Sea levels fluctuated during this time by ~150m, with the last peak ~6,500 years ago, which was sustained until levels began to fall ~3000 years ago; present sea levels are ~1.5m below that peak.
- Dune-island barriers, such as Bribie, Moreton, and North Stradbroke Island, were formed during this period and are fundamental to the nature of the Bay, modifying the coastline in ways that distinguish it from the relatively high energy coastlines to the south, as well as north.
- The formation of a system such as the Bay is likely to occur for a few thousand years every 100,000 years (or so), as the 'Bay' is dry at lower sea levels, refer to Figure 2 and Figure 3.
- Evidence from various records supports a view that a 'climatic optimum' or hypsithermal existed ~6,000 years ago (during the Holocene epoch, which includes the last ~12k years and forms the recent part of the Quaternary period) during which sea levels, temperatures and rainfall were all higher than present day conditions.
- Under those conditions, the catchment was densely vegetated, with runoff from the catchment ~60% higher than present day, but suspended sediment content ~40% lower than conditions prior to European land-use intensification (due to the vegetative cover).
- The river estuaries would have typically been broad and funnel-shaped with few impediments to restrict tidal circulation. Features such as Bribie Island are largely Holocene sediments deposited in those embayments prior to sea levels falling by ~1.5m. Pleistocene epoch (the latter part of the Quaternary, ~12k-2.6M years before present) materials that have been reworked – moved by wave energy from offshore to onshore – are also noted in records related to Bribie Island.
- Greater tidal exchange, reduced sediment input, deeper depths and fewer mudflats were likely to have resulted in relatively high water quality and possibly marine life conditions similar to Hervey Bay today, more suitable for dugong, possibly a breeding area for humpback whales, and generally more tropical species assemblages including coral.
- Since that time, the climate has been less stable, fluctuating between 'droughts and floods', resulting in higher erosion, channel incision, increased turbidity, infilling of the Bay with fine sediments that are more likely to be resuspended, with water volumes further reduced by falling sea levels, correspondingly greater water temperature fluctuations, and reduced tidal circulation due to exposure of the dune-barrier islands.
- Pumicestone Passage geology (large scale bedforms in the deeper parts of the channel) is indicative of an ebb tide delta system, with net sand transport from the ocean/bar, into the passage (in contrast to the net northerly transport of suspended sediment loads within the passage).

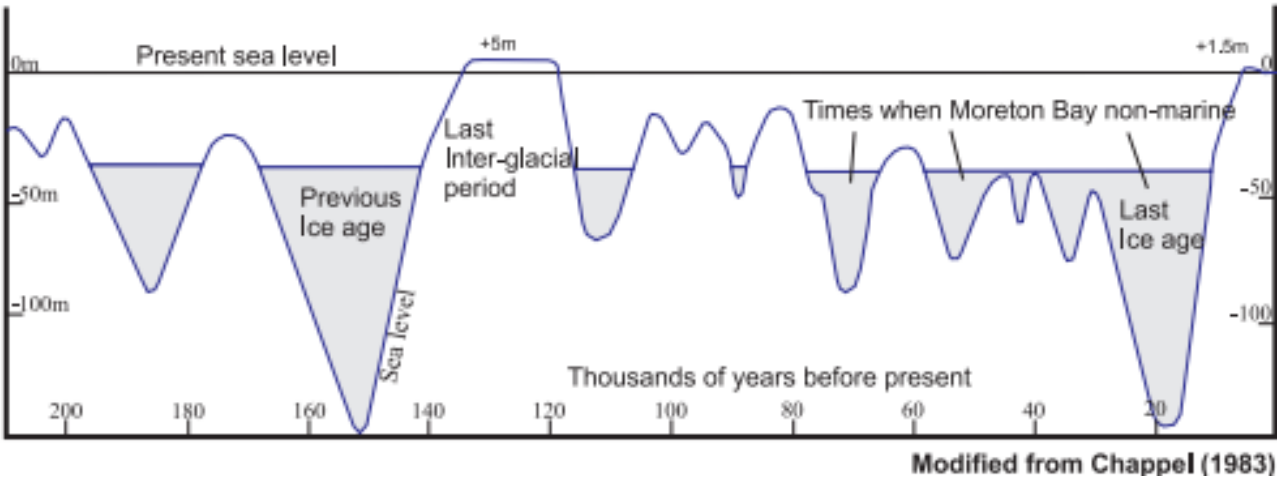


Figure 2: Late Quaternary sea level changes and times when the Bay was 'dry' (Lang, Fig.2 [104])

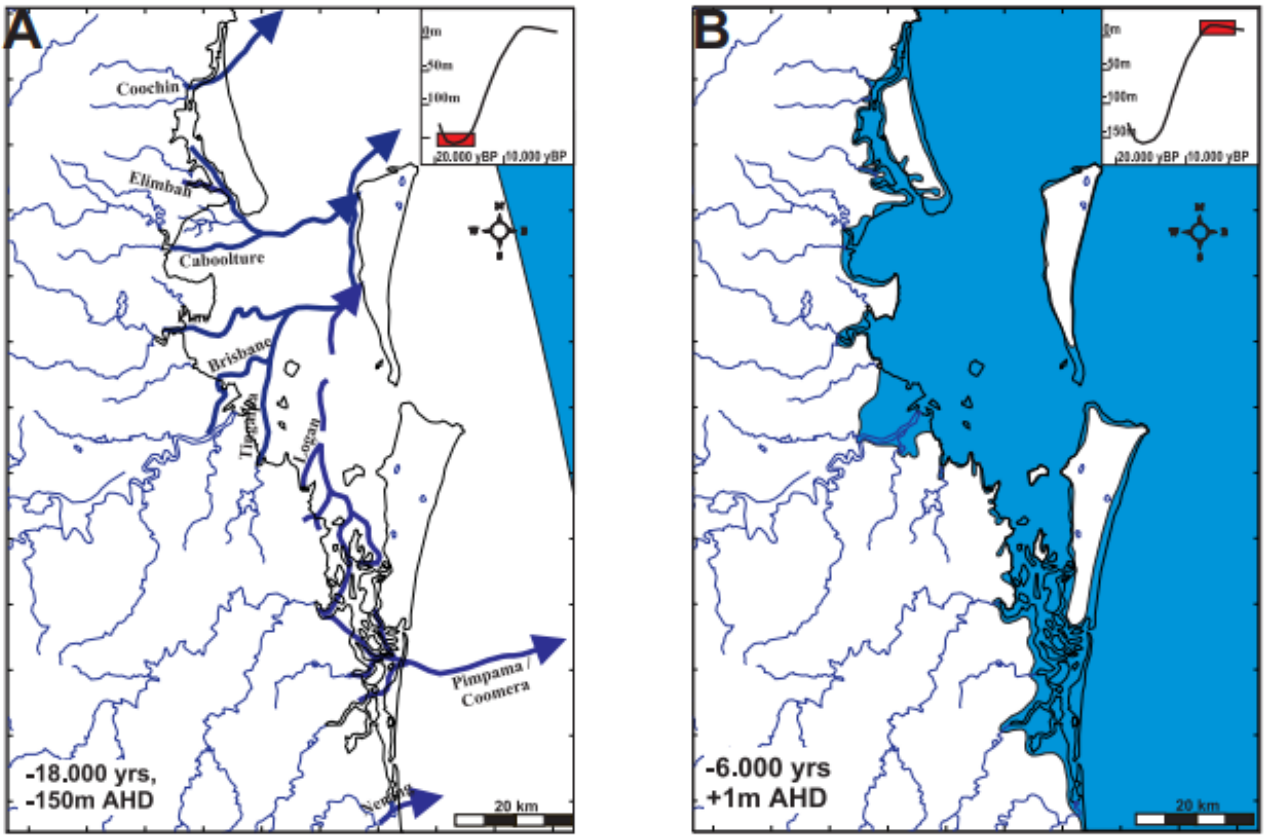


Figure 3: Sea level extremes, including submerged river valleys at peak height (Lang, Fig.5 [104])

2.1 Suggested messages

The suggested messages from this very brief overview of a complex topic are that:

- **Nature is dynamic, including short-term changes that may be familiar, such as seasonal weather patterns, or the cycling of sand from shorelines to offshore bars, as well as longer-term changes, such as fluctuations in sea levels.**
- **Whilst those longer-term changes can seem quite remote, and/or difficult to comprehend, it is now broadly accepted that sea levels have been and will continue to change during our lifetimes.**

3 SETTLEMENT

Neil characterises the period from 5,000 to 200 years ago as one of gradual degradation of the Bay, due to both natural processes (sea levels falling, changes to temperatures and precipitation, and estuaries infilling with sediments) and anthropogenic activity. His discussion includes debate about the how Aboriginal inhabitants may have altered the environment and following a thorough review he suggests that pre-European anthropogenic burning of the landscape probably increased natural sediment input, but by <10%.

3.1 Resource use

European land management spans a relatively short period of time, but has included practices that have been relatively impactful, notably within the catchment, such as harvesting timber and introducing livestock, as well as agriculture, refer to Figure 4. The indirect impacts from these land use activities are complemented by direct impacts on marine resources, including the clearing of mangroves, and the harvesting of significant numbers of marine mammals, particularly dugong.

He documents records of soil fertility issues as early as 1798 in Sydney, and the challenge of droughts and floods in southeast Queensland in the 1820s. He opines that:

"It seems, therefore, that European land management in Australia was based not on ignorance (not knowing, unaware), but on
ignore – (to pretend not to see, to set aside) -ance.
In spite of the warning signs from elsewhere in eastern Australia, destructive exploitation of the resources of the Moreton Bay catchment proceeded at a rapid rate."

He also documents the collapse of the Moreton Bay oyster fishery, from the largest in Southern Queensland to the smallest by the early 1900s, as well as fish stock, with early legislation to address these matters including the Oyster Act of 1863 (banning the burning of live oysters for lime) and the Queensland Fisheries Act of 1887 (to preserve/protect breeding and feeding grounds).

Interestingly, he advises water quality monitoring commenced in 1917, in response to concerns regarding sediment concentrations in the lower Brisbane River, but was discontinued after only 3-years, despite an initial intent for a long-term program. He notes that the turbidity (lack of clarity) was visibly evident and attributed to movement of sediments upstream (with the tide). He posits that disposal of dredge spoil in the western bay could logically be the source of fines that would be likely to remain in suspension.

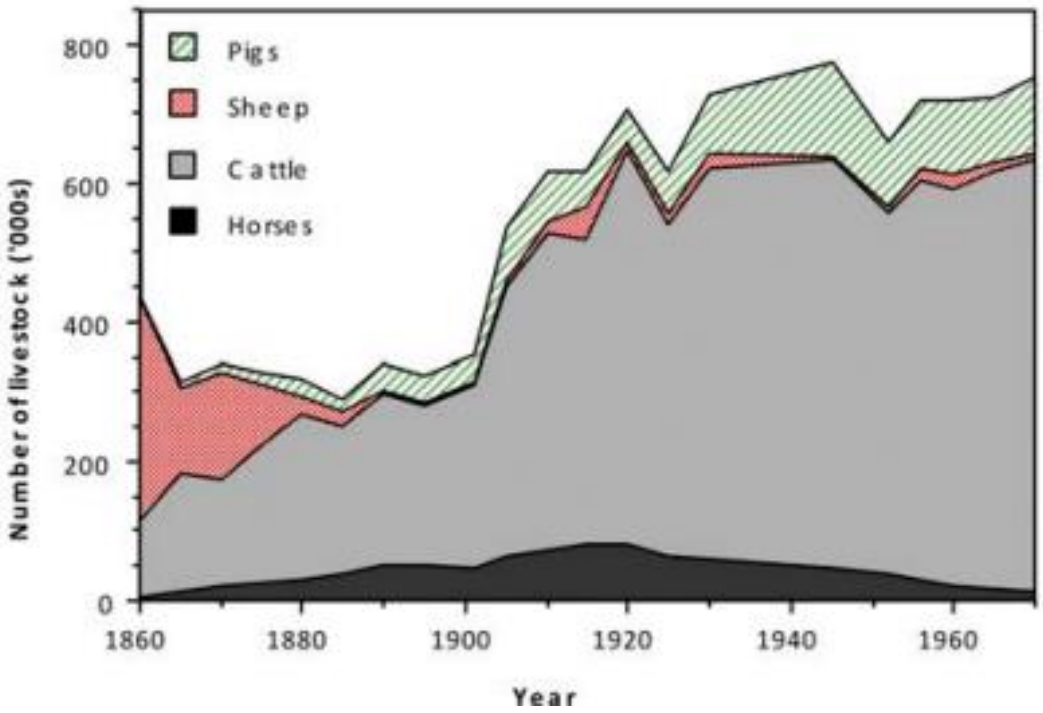


Figure 4: Livestock numbers in the Moreton region (Neil, Fig. 4 in [104])

3.2 Navigation

The earliest sources we were able to collect are navigational charts, including an 1825 chart of the coast from Byron to Bribie [001], and a more detailed and better-quality chart from 1865 as revised through to 1897 [004]. This chart shows a lighthouse on the Caloundra headland, as well as lights on the northern end of Bribie Island. The North West Channel is shown running along the foreshore of Bribie and lit by the lighthouse to indicate both safe passage and the hazard provided by the Hamilton Patches. Depths within "Pumice Stone Strait" are also included (the Passage was originally thought to be a river mouth, with discovery of the connection to the Bay occurring later, and the name varied over time). Refer to Figure 5 and Figure 6.

The *Report on the Department of Ports and Harbours to Parliament for the Year 1890-91* [003] is also available and includes advice regarding the impacts of storms on dredged cuttings, with silting of the Brisbane River of up to 18 inches, but that dredges were soon able to restore navigational access. The report notes that "considerable changes had taken place in the formation of the banks at the northern entrance to Moreton Bay", necessitating the relocation of the Tangaluma Light (established only in 1885). It also established the importance of the North West Channel as follows: "The floating beacon which marked the northern entrance to the port had been ashore on Bribie Island for some time, but, during the first interval of settled westerly weather, she was floated and brought to Brisbane to be repaired and supplied with new moorings". Further advice about the northern banks is provided as follows: "The banks at the northern entrance to Moreton Bay are constantly shifting, and the maintenance of the necessary lights and buoys to enable vessels to enter and clear the port in safety is a source of continual anxiety." The report also supports a view that the channel depths shown on the 1897 navigational chart include dredging prior to 1890: "No. 1 cutting, Hamilton Reach, has now a depth of 17 feet at low water, spring tides; and the entrance to the bar cutting is being dredged to a similar depth."

Regarding the chart, this advice is provided: "The survey discloses changes of a prejudicial character at the entrance to the North or Howe Channel, which has been contracted by the extension of the east bank in a northerly direction about four cables, and the south-east extreme of the north bank to the eastward, about three and a half cables, while to the north-north-east of the north bank a small patch has formed, having only three fathoms upon it at low water. This patch is only one cable to the westward of the line of lights, and a continuance of similar growths will render the entrance at night exceedingly difficult, and probably destroy the utility of the present leading lights. The channel, however, at present maintains a depth in its shallowest part of 21 feet at low water, spring tides. The attached plan shows the position of the line of lights in relation to the three fathom patch and north-west extreme of the east bank. The three and five fathom contours as existing in 1886 are shown in red, while their present positions are indicated in black. Numerous other changes are shown on the new chart, but the banks to the westward, in the vicinity of the north-west channel, have changed so very little during the last twenty-five years that the channel may be regarded as practically a permanent one. It is the widest, deepest, and only permanent approach to Moreton Bay, and vessels of heavy draught, whose visits are rapidly increasing—including some of H.M. ships—have now to wait for daylight to enter the port by this channel. It is buoyed for use in the daytime, and can—when considered necessary—be easily and cheaply lighted for use at night." A copy of that chart, with red markings, accompanies the report, but we have not included it here as it only shows a portion of the chart that we have provided below, the southern portion of the outer banks, and excludes Bribie Island. *(Note: 1 cable = 608 ft = 0.185 km.)*

3.3 Suggested messages

The suggested messages from this very brief overview of settlement impacts are that:

- **The ways in which we use natural resources contributes to natural dynamics.**
- **Dredging for navigational access, including most likely parts of the North West channel based on its early identification as the "only permanent approach" to Moreton Bay, commenced prior to the earliest detailed chart we were able to source (1865 with updates to 1897).**
- **Adverse environmental impacts from resource use ('abuse') resulted in early legislative action (late 1800s) to regulate activities and protect resource values.**
- **In the case of our predecessors, those impacts were significant, particularly during the last ~250 years, and are likely to have exacerbated and accelerated Neil's observed trend of 'natural degradation' occurring over the preceding ~5,000 years.**

Figure 5: **Moreton Bay, 1865 with updates to 1897, depths in Fathoms (~1.83m) available at https://nla.gov.au/nla.obj-230057663/**

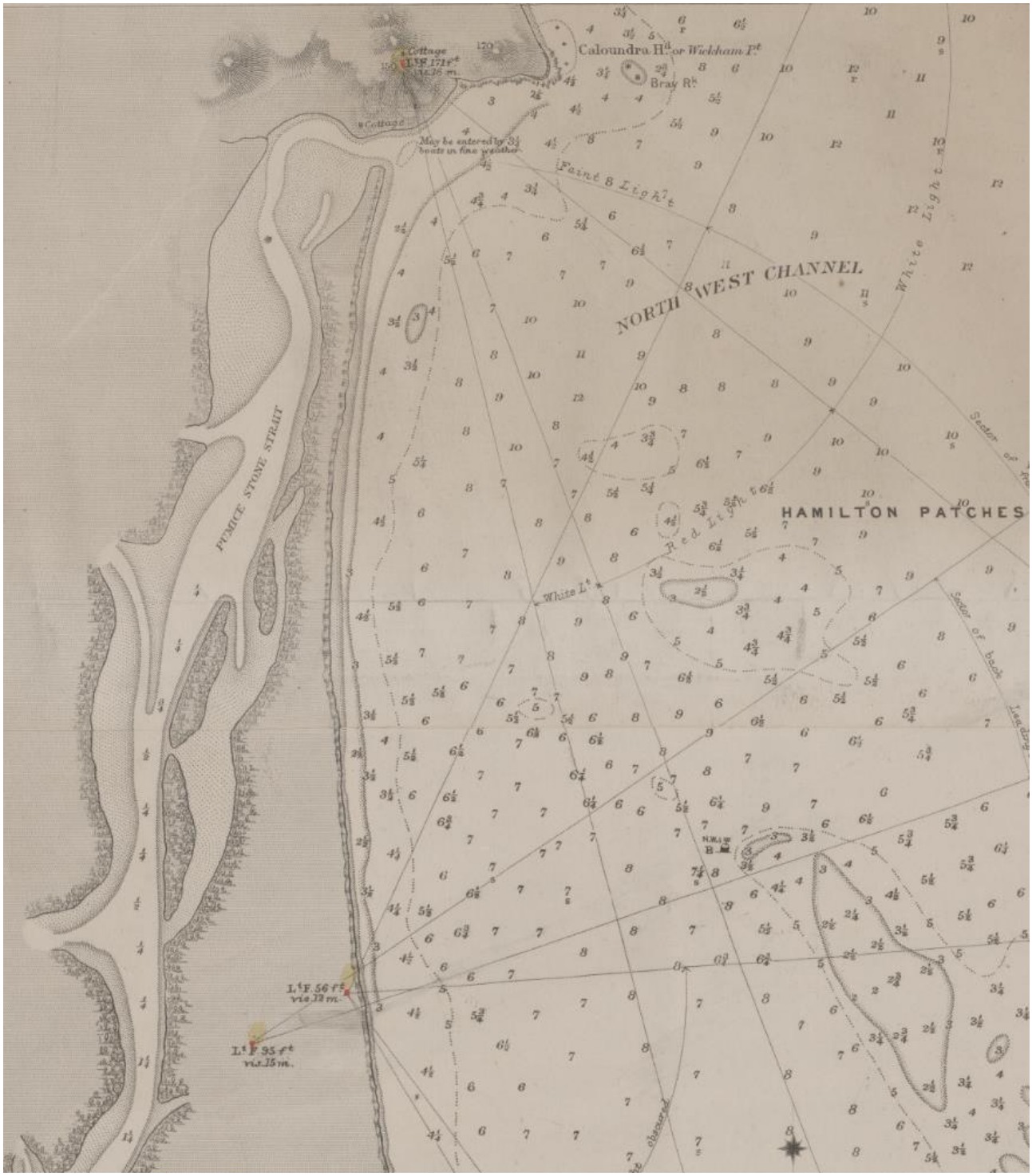


Figure 6: Close up detail from chart presented in Fig.4 above

4 EXPLORATION

The preceding sections are derived from secondary, tertiary, or even more removed sources. The papers by Neil and Lang, as well as others no doubt in the 1998 conference proceedings [104], are well written, both in terms of narrative/presentation, but also academic rigour, including thorough referencing, discussion of potentially conflicting source material, and peer review. There is little point in replicating that fine work here, other than to present what we consider to be key points, meaning those that are relevant to discussions and decisions about how we could and should move forward.

For the rest of this report, the discussion will mostly be about primary source material we identified, so the presentation will be more or less chronological, with the section headings meant to suggest themes that emerge from looking at the source material longitudinally. This is a casual, rather than rigorous classification, and reality would no doubt include a range of overlapping activities occurring across time. Nor is our source list necessarily complete. Notwithstanding these limitations, we hope this approach adds value by promoting a collective perspective that is broad and reasonably informed ('forest and trees').

4.1 Prospecting

Prior to 1957, the source material we collected is limited to imagery. The earliest written primary sources are two reports regarding investigations, including on Bribie Island, related to an Exploration Permit - Minerals (EPM 65, dated1957 and 1963). These are a little unusual in that they were released from QG files but appear to primarily be correspondence between the Consulting Geologist and the client that held the permit (in Vancouver, B.C.).

The first [015] has geological descriptions that advise: "It is evident that Bribie Island was part of the mainland, it's base being Mesozoic as indicated by coal measures, on top of which is built up with qarternery *(sic)* and tertiary sand dunes.". The geologist notes that there appear to be two separate periods of heavy mineral deposition, which include in approximate decreasing composition, Ilmenite, Zircon, Rutile, and other minerals. He concludes that it is likely that that the original shoreline was from Caloundra to the Northeastern peak and then shoreline of Moreton Island, continuing to Stradbroke Island. As an explanatory note, these are relatively dense minerals, which tend to be sorted by wave action into pockets or ribbons of black sand. These depositions may effectively illustrate the shoreline as it existed during periods of extended stable sea levels. A sketch map included in the report is provided below, refer to Figure 7.

The second document, *Project Feasibility Report* [022], advises that the reserves should support 5-years of extraction (10k t/yr of Rutile) with potential to pay back the $800k cost of the "Bribie Extraction Plant" in two years, on which basis they had no hesitancy recommending implementation so that production could commence by September 1964. As far as we know from the records, no extraction was ever progressed.

Queensland Globe provides footprints for current as well as historical EPMs. This particular permit area was south of the breakthrough, and there are no current EPMs shown on the Island. The Queensland Globe historical layer for 'Prior to 1961' shows that most of the Island was covered by permits. For the subsequent 1961-70 layer, the area of the Island with active EPMs is greatly decreased; after that, none are shown.

4.2 More prospecting

This review included a visit to the State Archives to view documents identified during searches that were not available digitally. Discoveries included correspondence concerning the issuance of exploration permits in 1987 to Denison Resources to prospect for mineral sands over a 230 km2 area of the sand banks between Moreton and Caloundra. The DHM file, *Plans to Sand Mine Moreton Bay and Dredging of Channel - Denison Resources* [074], includes various applications and approvals, as well as newspaper clippings that indicate strong opposition, notably from local commercial fishermen. One of the clippings provides quotes from a Denison representative, including that the exploration concerns "sterile sand banks" which have a tendency to slip southward and present a hazard to Port of Brisbane shipping traffic, refer to Figure 8.

Correspondence from DHM to the Minister included in the file advises that DHM's concerns (to be addressed in an EIS if mining, versus prospecting, is allowed) include commercial fishing interests, and the impact on foreshores from the removal of sand from offshore banks as they are believed to supply sand to nearby north coast beaches, refer to Figure 9.

This presentation of this matter here disrupts the general intention for a chronological approach in the report, however, as it concerns 'exploration', it seemed appropriate to include it here. As will be discussed later, the timing of the Denison issue falls within the final planning stages for current protected areas.

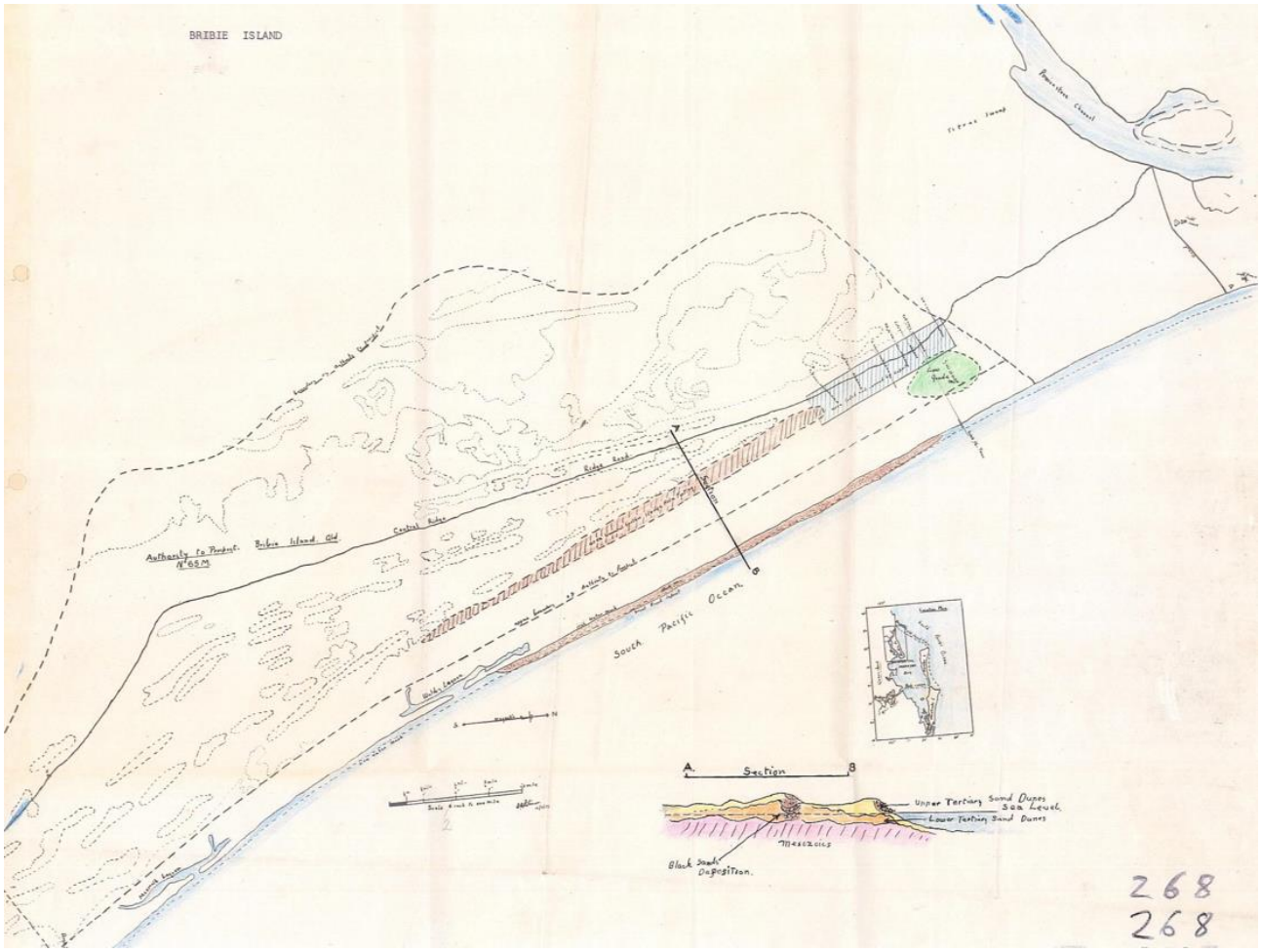
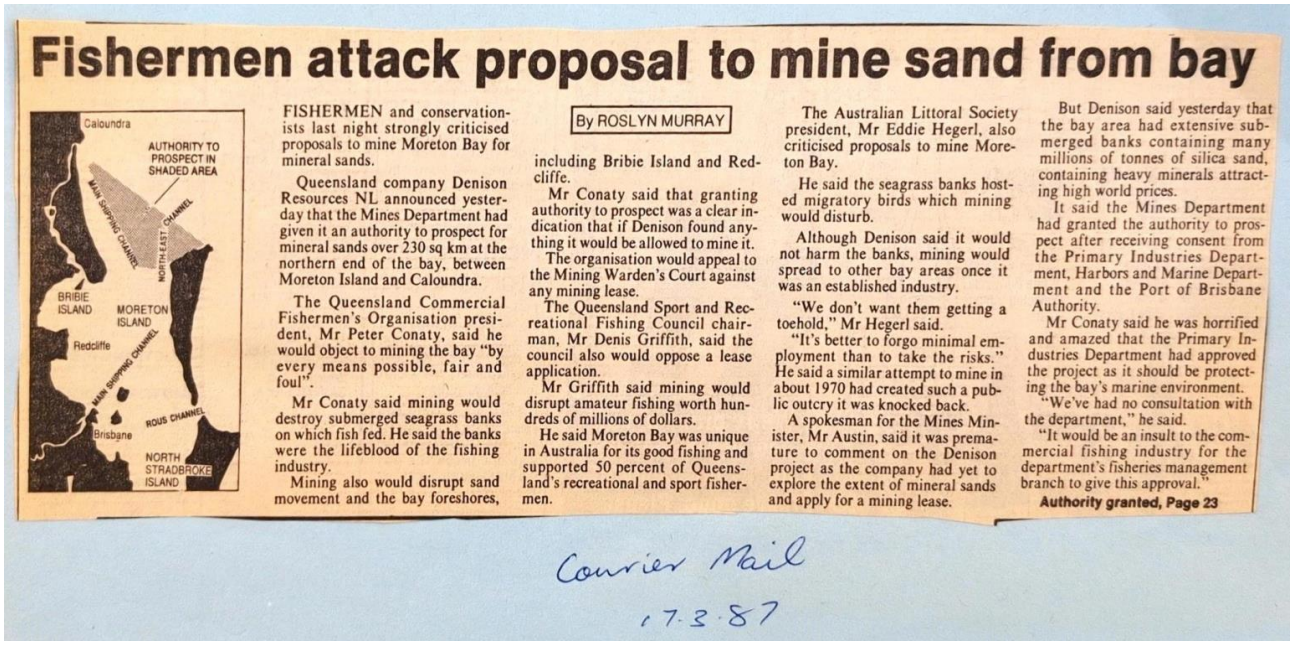


Figure 7: Map included with the *Bribie Island Preliminary Report* for EPM65 [015]



Fishermen attack proposal to mine sand from bay

FISHERMEN and conservationists last night strongly criticised proposals to mine Moreton Bay for mineral sands.

Queensland company Denison Resources NL announced yesterday that the Mines Department had given it an authority to prospect for mineral sands over 230 sq km at the northern end of the bay, between Moreton Island and Caloundra.

The Queensland Commercial Fishermen's Organisation president, Mr Peter Conaty, said he would object to mining the bay "by every means possible, fair and foul".

Mr Conaty said mining would destroy submerged seagrass banks on which fish fed. He said the banks were the lifeblood of the fishing industry.

Mining also would disrupt sand movement and the bay foreshores, including Bribie Island and Redcliffe.

By ROSLYN MURRAY

Mr Conaty said that granting authority to prospect was a clear indication that if Denison found anything it would be allowed to mine it.

The organisation would appeal to the Mining Warden's Court against any mining lease.

The Queensland Sport and Recreational Fishing Council chairman, Mr Denis Griffith, said the council also would oppose a lease application.

Mr Griffith said mining would disrupt amateur fishing worth hundreds of millions of dollars.

He said Moreton Bay was unique in Australia for its good fishing and supported 50 percent of Queensland's recreational and sport fishermen.

The Australian Littoral Society president, Mr Eddie Hegerl, also criticised proposals to mine Moreton Bay.

He said the seagrass banks hosted migratory birds which mining would disturb.

Although Denison said it would not harm the banks, mining would spread to other bay areas once it was an established industry.

"We don't want them getting a toehold," Mr Hegerl said.

"It's better to forgo minimal employment than to take the risks."

He said a similar attempt to mine in about 1970 had created such a public outcry it was knocked back.

A spokesman for the Mines Minister, Mr Austin, said it was premature to comment on the Denison project as the company had yet to explore the extent of mineral sands and apply for a mining lease.

But Denison said yesterday that the bay area had extensive submerged banks containing many millions of tonnes of silica sand, containing heavy minerals attracting high world prices.

It said the Mines Department had granted the authority to prospect after receiving consent from the Primary Industries Department, Harbors and Marine Department and the Port of Brisbane Authority.

Mr Conaty said he was horrified and amazed that the Primary Industries Department had approved the project as it should be protecting the bay's marine environment.

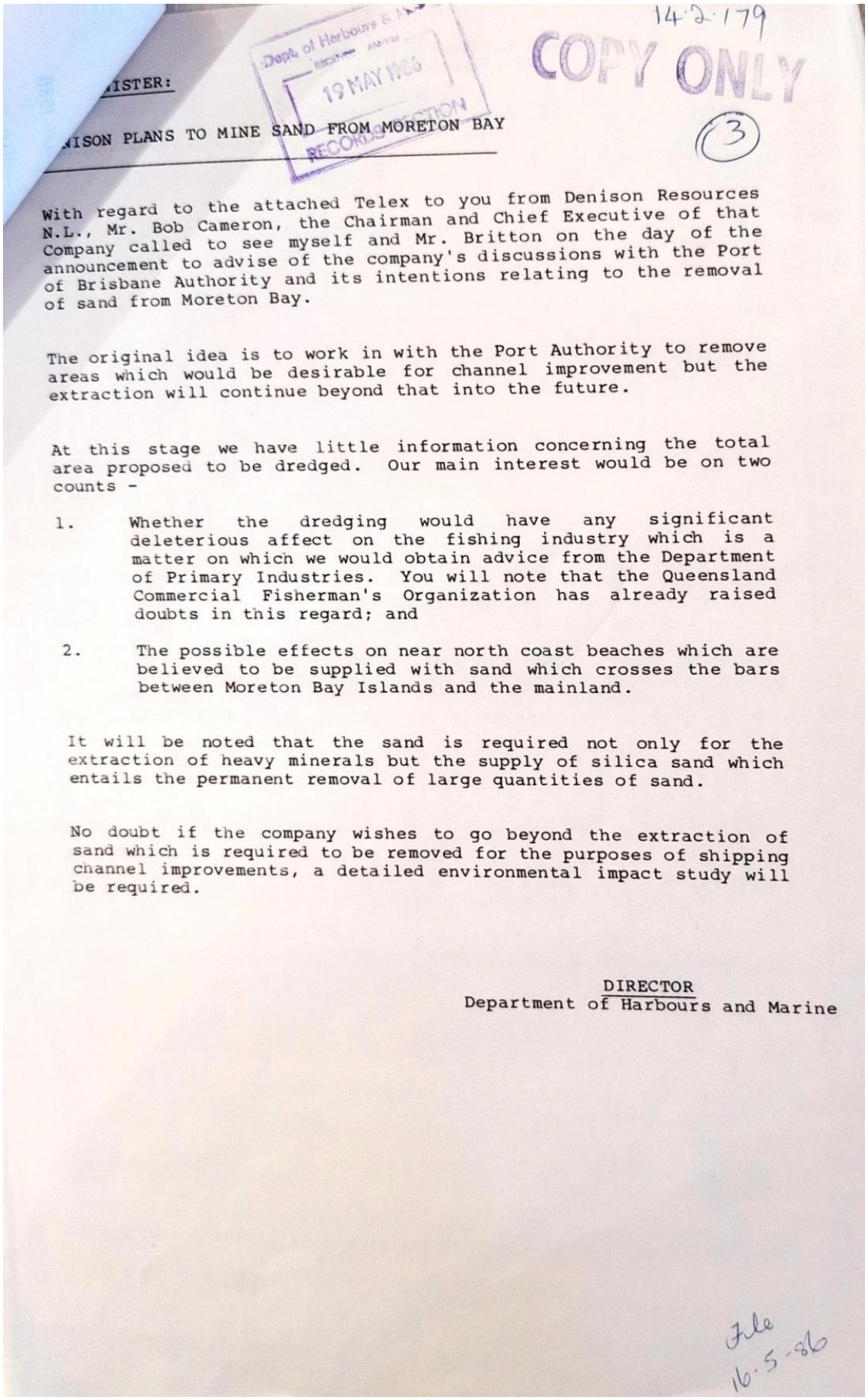
"We've had no consultation with the department," he said.

"It would be an insult to the commercial fishing industry for the department's fisheries management branch to give this approval."

Authority granted, Page 23

Courier Mail
17.3.87

Figure 8: Clipping included in DHM files at State Archives [074]



14.2.179

COPY ONLY

(3)

Dept of Harbours & Marine
19 MAY 1986
RECORDS SECTION

...ISTER:

...NISON PLANS TO MINE SAND FROM MORETON BAY

With regard to the attached Telex to you from Denison Resources N.L., Mr. Bob Cameron, the Chairman and Chief Executive of that Company called to see myself and Mr. Britton on the day of the announcement to advise of the company's discussions with the Port of Brisbane Authority and its intentions relating to the removal of sand from Moreton Bay.

The original idea is to work in with the Port Authority to remove areas which would be desirable for channel improvement but the extraction will continue beyond that into the future.

At this stage we have little information concerning the total area proposed to be dredged. Our main interest would be on two counts -

1. Whether the dredging would have any significant deleterious affect on the fishing industry which is a matter on which we would obtain advice from the Department of Primary Industries. You will note that the Queensland Commercial Fisherman's Organization has already raised doubts in this regard; and

2. The possible effects on near north coast beaches which are believed to be supplied with sand which crosses the bars between Moreton Bay Islands and the mainland.

It will be noted that the sand is required not only for the extraction of heavy minerals but the supply of silica sand which entails the permanent removal of large quantities of sand.

No doubt if the company wishes to go beyond the extraction of sand which is required to be removed for the purposes of shipping channel improvements, a detailed environmental impact study will be required.

DIRECTOR
Department of Harbours and Marine

File
16.5.86

Figure 9: Correspondence included in DHM files at State Archives [074]

4.3 Entrance stabilisation

Discoveries from the visit to the State Archives also included correspondence between 1964 and 1968 regarding foreshore erosion of the northern Bribie spit. The correspondence below is all included in the file *Co-ordinator General of Public Works - Co-ordinator General Works Section - Cooperation With Harbours and Marine - Departments - Bribie Passage - Caloundra* [025]. Whilst the matters discussed below are dated, we found that the file provided insights that was generally not available in the more contemporary sources on our list, so a reasonable level of detail is provided below (nevertheless summarising an extensive record). We suggest it provides an important component of this narrative, particularly with respect to the solutions focused ToR.

The "Caloundra Passage & Boating Development Association", Chair Peter Nelson Gracie, wrote to Sir James Holt, Co-Ordinator General (**DCG**) on 14/05/1964 and again on 16/07/1964. The first letter includes the aims of the newly formed association that arose from "the deep concern felt about the future of our main surfing beach and the rapid deterioration of fishing and boating facilities generally." It included an enclosed plan, refer to Figure 10. The included aims are:

1) To curb the erosion on Kings Beach and restore its surfing potential.
2) To establish a permanent entrance to Pumicestone passage with retaining walls.
3) To stop erosion on Bribie and reclaim lost beach.
4) To create a boat basin by directing the tidal flow.
5) By removing sandbanks, to develop over 100 acres of waterway ideal for Fishing, Sailing, Boating and Skiing.

The second letter provided a "Record of Caloundra Passage" that they had compiled (with chronological data regarding events, as well as weather observations, etc.), and a map of shoreline positions interpreted from aerial photos (1942, 58 and 61). They advise that action is required, refer to previous proposals that had been submitted, and suggest that the inevitable alternative is "that a new breakthrough will occur half a mile down Bribie, where the Island is already only 100 yds wide and eroding at an alarming rate from the inside." Their record concludes with the following suggested "Sequence of events":

> *"Starting from the assumption that the whole area remained in a reasonable state of equilibrium from 1845 until the early 1930's; with a good tidal prism balanced by a self-scouring entrance, which in tum controlled the erosion of King's Beach; then the following might be postulated as the sequence of deterioration.*
>
> *The sand blow-hole, tidal wave and heavy rains of 1931 permitted a temporary break through to occur from the ocean which initiated a silting trend of the Passage Basin.*
>
> *This continued into the early 1940's by which time the tidal prism had been so reduced that Kings Beach then began then began to control the entrance instead of vice versa as heretofore.*
>
> *During dry spells, erosion of sand from Kings Beach would tend to choke the entrance which was then unable to cope with run offs, thus resulting in new break throughs; each time further south.*
>
> *This cycle was repeated many times throughout the 1940's and into the 1950's. Indeed, if sufficiently accurate and detailed information could be obtained it would probably be found that these cycles were in phase with the flood runoffs of the period.*
>
> *The cyclones and very high rainfall of 1954 breached a completely new entrance well to the south through part of Bribie and although it took nearly two years to become established, it set a new pattern to events.*
>
> *By 1958 the remaining sandbanks had become breached from Bribie and the main channel from then on followed the island shoreline, inducing strong erosion all around its tip.*
>
> *By 1961 this erosion was proceeding faster than the growth of the sandspit from the north; with the result that the Entrance successively widened and shoaled, thus further destabilising the balance and reducing its self-scouring characteristics.*
>
> *Additional silting from both the ocean and creeks continued at the same time to reduce the tidal prism, so that the basin approached stagnation point.*
>
> *The pattern of the past can now be projected into the future.*
>
> *It is only a matter of time before all flow stops along the north shoreline; then erosion of the neck of Bribie will increase until a cyclone combined with a flood run off will breach it, forming a new entrance ½ mile down the Island. This will convert the basin into a permanent embracing sandbank as useful as Like Eyre."*

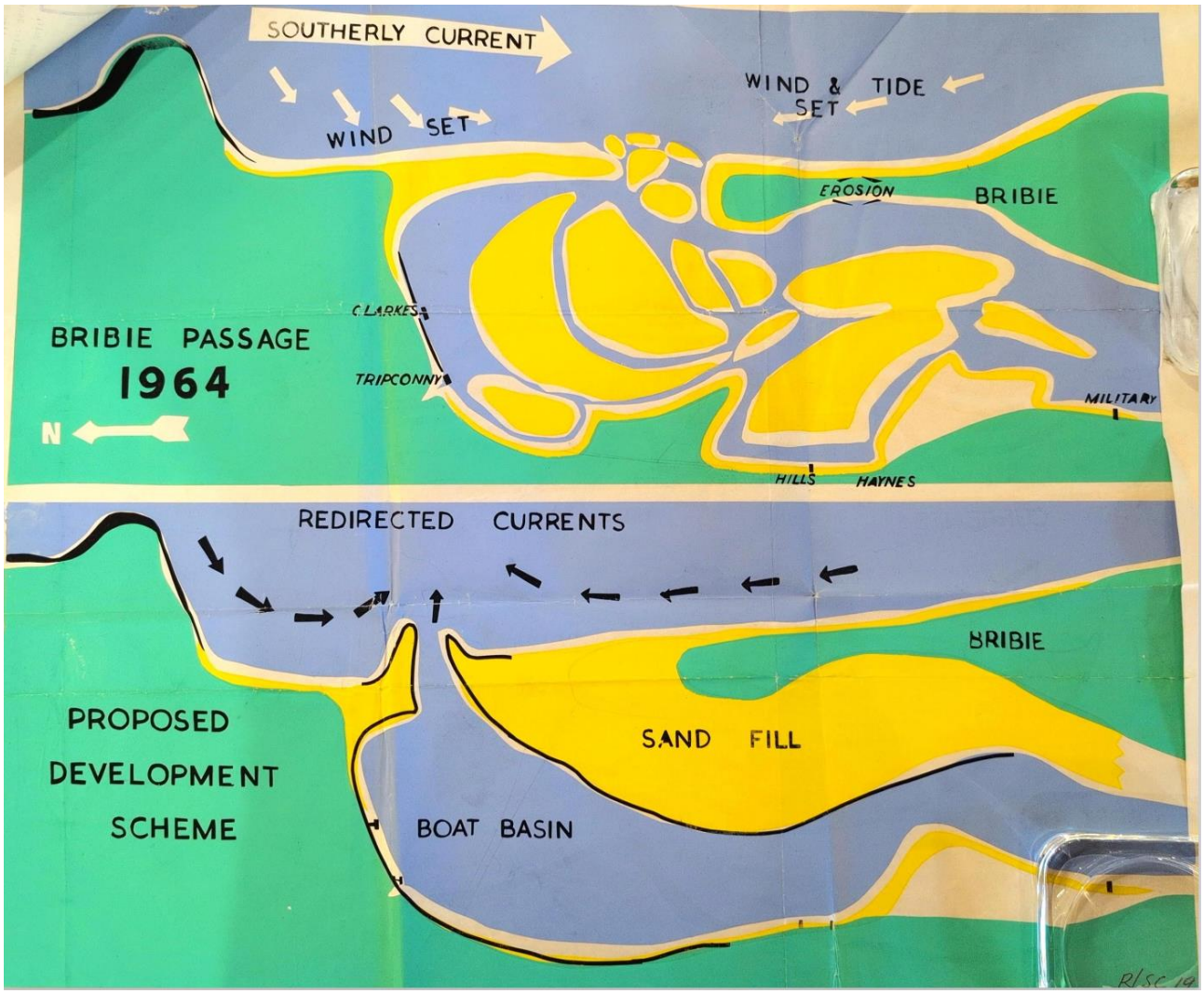


Figure 10: 1964 plan enclosed with correspondence from the 'Association' to DCG

An aerial photo, with the Association's proposed conceptual sand relocation in mark-up, is included in the file, with correspondence indicating it was taken on 10/06/1964, an hour prior to low tide, refer to Figure 11.

They highlight that a key impediment to a solution appears not be financing – finding the money – but timing, with the State better positioned to provide initial capital, and the community (Council) able to repay debt over time. They further advise that they considered the 'short-term' option of continuous dredging to maintain a channel, and note that the long-term expenditure would be likely to exceed capital costs of a stabilised entrance, and provide less benefits, including the potential to avoid an inevitable breakthrough, with the possible consequences including shoaling of the shipping channel. Their proposal, which they advise constitutes in their opinion the "minimum scheme required" includes "Breakwaters, Training Walls with Wave' Trap, and Dredging." The proposal is quite detailed, providing quantity estimates and costs with extrapolation from recent projects, with a total estimate of 200,000 pounds. They also provide a suggested 3-year programme of works, and financing details, which include revenues from rates, a commercial fishing levy, harbour dues and land development. This letter concludes as follows: "The issue is simple – Is the Caloundra Passage worth saving? If so, how do we do it?".

The records also include further correspondence between Peter Nelson Gracie and DCG regarding a separate, but potentially related proposal to establish a "Coast Protection Authority". The letter presents as personal correspondence from Mr Gracie, rather than in his capacity as the Association Chair. The DCG response acknowledges the proposal as worthy, but rejects Commonwealth involvement as proposed, as advice to date has been that these matters are State responibities, and that the DCG is: "hopeful that some type of State Authority with the responsibility for research, investigation and determination of ocean beach protection measures and with the authority to have them carried out will be approved in the foreseeable future." In closing, the DCG letter also provides this comment: "It anticipated that the report of the Dutch engineer Dr. Diephuis will give a lead in this direction."

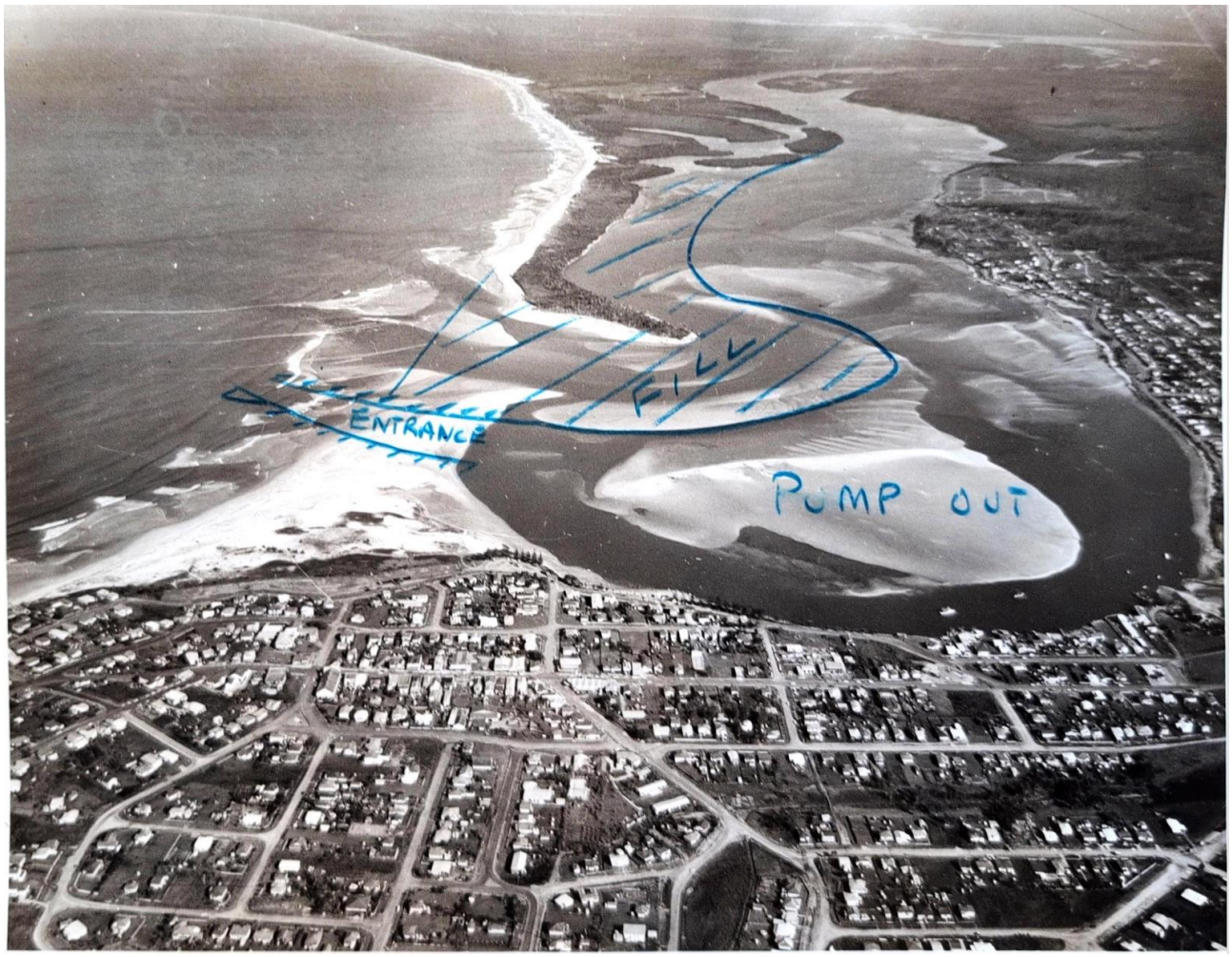


Figure 11: Aerial photo, with markup indicating sand relocation, as included in the file

A report of a meeting of the fifth public meeting of the Association on 18/09/1964 advises that 200 members were in attendance and that the membership now stood at 1,200, indicating strong local feelings in hearing the committee's report, and that member were invited to inspect the groyne on Kings Beach, which had just been raised an additional four feet on the Association's recommendation. It provides advice about studies, including hydrography and geological investigation of potential quarry material, and that the objections raised by the DHM to their proposal had been effectively refuted by showing that a "number of factors applied to our scheme were neither representative nor the accepted criteria used in other similar designs." An internal DHM memorandum included in the files provides what appear to be rationale that the Association considered to be "effectively refuted", which introduces an element that is addressed in other documents in this record, notably 'competing' proposals for boat harbors at Moffat Beach and Mooloolaba, with those two options being considered economically favourable, refer to Figure 12.

Further correspondence from the Association to the DCG on 09/11/1964 transmits a proposal with advice that this has been submitted to Landsborough Shire Council (**LSC**) for consideration on 16/11. The proposal discusses the fact that entrance stabilisation must precede any foreshore works inside the Passage, citing the Army Corps of Engineers as a source of advice regarding this necessary sequence, arising from the general nature of migrating entrances. They advocate for cost sharing, noting that LSC has both jurisdictional and financing limitations, and suggest that this approach could result in many more small boat harbours being realised. (*Note: the former LSC is now part of SCC.*)

Memorandums in the file from DCG (The Hon. G.F.R Nicklin at this stage) on 15/07/1965 and 21/02/1966 provide further insights regarding advice from Mr Diephuis. The first includes the following: "The stability of the tidal inlet at Caloundra was referred to in the report "Queensland Coastal Erosion" submitted by Mr. J. G. Diephuis. An extract from this Report headed "*Caloundra-Noosa area. Bribie Island.*" is attached. It will be noted that the opinion held that the inlet (and therefore the sandspit) is not stable and can only be made so by permanent training. This Department supports that view and questions the wisdom of any expenditure on the sandspit prior to the construction of such permanent training. In recent months there has been some retreat northwards of the southern point of the sandspit." The extract was included in the file and is provided below in full, refer to Figure 13.

RECEIVED 23 JUL 1964 C.O. of P.W.

...ANDUM:

From Senior Design Engineer

To Chief Engineer 16th July, 1964.

<u>Boat Harbour - Inside Pumicestone Passage</u>

Preliminary investigations into the feasibility and economics of establishing a boat harbour inside Pumicestone Passage, Caloundra, have now been completed. Though these surveys, etc., are not of sufficient detail to design the necessary breakwaters and boat harbour, enough information has been obtained to assess the overall economics of the proposal and provide an "order of cost" estimate.

Such a scheme involves the construction of breakwaters and wave traps out into the open sea a sufficient distance to prevent waves breaking at the entrance - breakwaters 40 chains long are considered necessary. Associated with this work extensive dredging would be required to remove sand bars and establish a boat haven.

The initial cost of the proposal would approximate £2,000,000 which is very much greater than the cost of a boat harbour and pilot station at Moffat Beach or Mooloolabah.

Another consideration that should be appreciated is the effect on sand movement along the neighbouring beaches. Beaches depend for their stability on constant replenishment, and without interference, a regime is established whereby dunes provide the source of sand which is eroded in heavy seas and deposited on the beaches in calmer weather. The protruding breakwaters would act as groynes interfering with the natural carriage and deposition of sand along the beaches. It is possible the sand may be taken from the dunes and carried out into deeper waters thus denuding the beaches.

To firmly establish the effects of this scheme and measures necessary to provide an acceptable boat harbour without upsetting the natural forces that govern and control the formation of beaches, an hydraulic model would be required. But as the cost of the scheme is in the vicinity of £2,000,000 (and it is certain no significant reduction is possible), it is considered unnecessary to carry out such detailed and prolonged investigations.

The firm conclusion is reached, therefore, that this scheme is uneconomical and inadvisable compared to the Moffat Beach and Mooloolabah proposals.

(Sgd.) F.M. WILSON
<u>SENIOR DESIGN ENGINEER</u>

DIRECTOR/

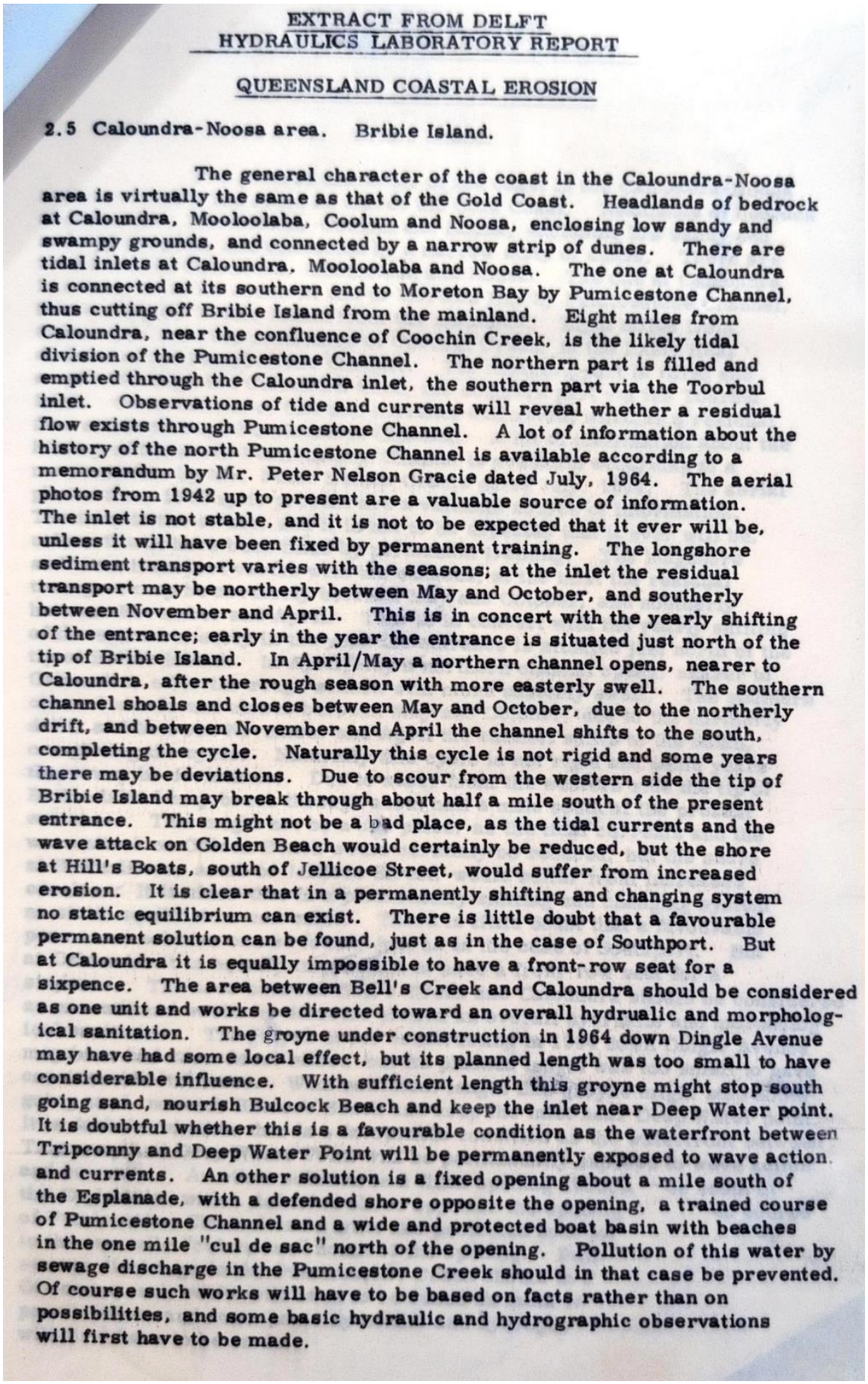
Endorsed and submitted. No detailed work has been carried out but it is clear that a satisfactory haven would be more costly than Moffatt Beach and the risk of adverse affects on the Caloundra Beach is real.

(Sgd.) E.L. JAMES
17.7.1964

21/7/64 C/E

Mr. McGrath. To note

Figure 12: Internal DHM memorandum providing advice re the Association's proposal



EXTRACT FROM DELFT
HYDRAULICS LABORATORY REPORT

QUEENSLAND COASTAL EROSION

2.5 Caloundra-Noosa area. Bribie Island.

The general character of the coast in the Caloundra-Noosa area is virtually the same as that of the Gold Coast. Headlands of bedrock at Caloundra, Mooloolaba, Coolum and Noosa, enclosing low sandy and swampy grounds, and connected by a narrow strip of dunes. There are tidal inlets at Caloundra, Mooloolaba and Noosa. The one at Caloundra is connected at its southern end to Moreton Bay by Pumicestone Channel, thus cutting off Bribie Island from the mainland. Eight miles from Caloundra, near the confluence of Coochin Creek, is the likely tidal division of the Pumicestone Channel. The northern part is filled and emptied through the Caloundra inlet, the southern part via the Toorbul inlet. Observations of tide and currents will reveal whether a residual flow exists through Pumicestone Channel. A lot of information about the history of the north Pumicestone Channel is available according to a memorandum by Mr. Peter Nelson Gracie dated July, 1964. The aerial photos from 1942 up to present are a valuable source of information. The inlet is not stable, and it is not to be expected that it ever will be, unless it will have been fixed by permanent training. The longshore sediment transport varies with the seasons; at the inlet the residual transport may be northerly between May and October, and southerly between November and April. This is in concert with the yearly shifting of the entrance; early in the year the entrance is situated just north of the tip of Bribie Island. In April/May a northern channel opens, nearer to Caloundra, after the rough season with more easterly swell. The southern channel shoals and closes between May and October, due to the northerly drift, and between November and April the channel shifts to the south, completing the cycle. Naturally this cycle is not rigid and some years there may be deviations. Due to scour from the western side the tip of Bribie Island may break through about half a mile south of the present entrance. This might not be a bad place, as the tidal currents and the wave attack on Golden Beach would certainly be reduced, but the shore at Hill's Boats, south of Jellicoe Street, would suffer from increased erosion. It is clear that in a permanently shifting and changing system no static equilibrium can exist. There is little doubt that a favourable permanent solution can be found, just as in the case of Southport. But at Caloundra it is equally impossible to have a front-row seat for a sixpence. The area between Bell's Creek and Caloundra should be considered as one unit and works be directed toward an overall hydrualic and morphological sanitation. The groyne under construction in 1964 down Dingle Avenue may have had some local effect, but its planned length was too small to have considerable influence. With sufficient length this groyne might stop south going sand, nourish Bulcock Beach and keep the inlet near Deep Water point. It is doubtful whether this is a favourable condition as the waterfront between Tripconny and Deep Water Point will be permanently exposed to wave action and currents. An other solution is a fixed opening about a mile south of the Esplanade, with a defended shore opposite the opening, a trained course of Pumicestone Channel and a wide and protected boat basin with beaches in the one mile "cul de sac" north of the opening. Pollution of this water by sewage discharge in the Pumicestone Creek should in that case be prevented. Of course such works will have to be based on facts rather than on possibilities, and some basic hydraulic and hydrographic observations will first have to be made.

Figure 13: Extract from Delft Hydraulics Laboratory report as included in correspondence

The second memorandum includes the following advice: “After consideration of the report by the Delft Laboratories following visit of Mr. Diephuis Cabinet decided (Decision No. 8093 of 23rd August, 1965) that a Beach Erosion Section be established within the Department to carry through such portions of the research programme recommended in the report as might be directed from time to time. As a first priority beach and oceanographic investigations are being undertaken to obtain Information needed for design and installation of Gold Coast ocean outfalls. When staff and equipment are not engaged on these investigations the Section will commence the long term beach investigations recommended in the in the Area between Noosa and the Gold Coast.” The memo provides further details on the Cabinet decision including that advice regarding a) the design of ocean outfalls for the Gold Coast, and b) remedial actions in response to beach erosion should be possible after two, and three years, respectively. It concludes with advice that the type of legislation, and functions of the any authority established to control beach erosion would be determined from the outcomes of the research programme.

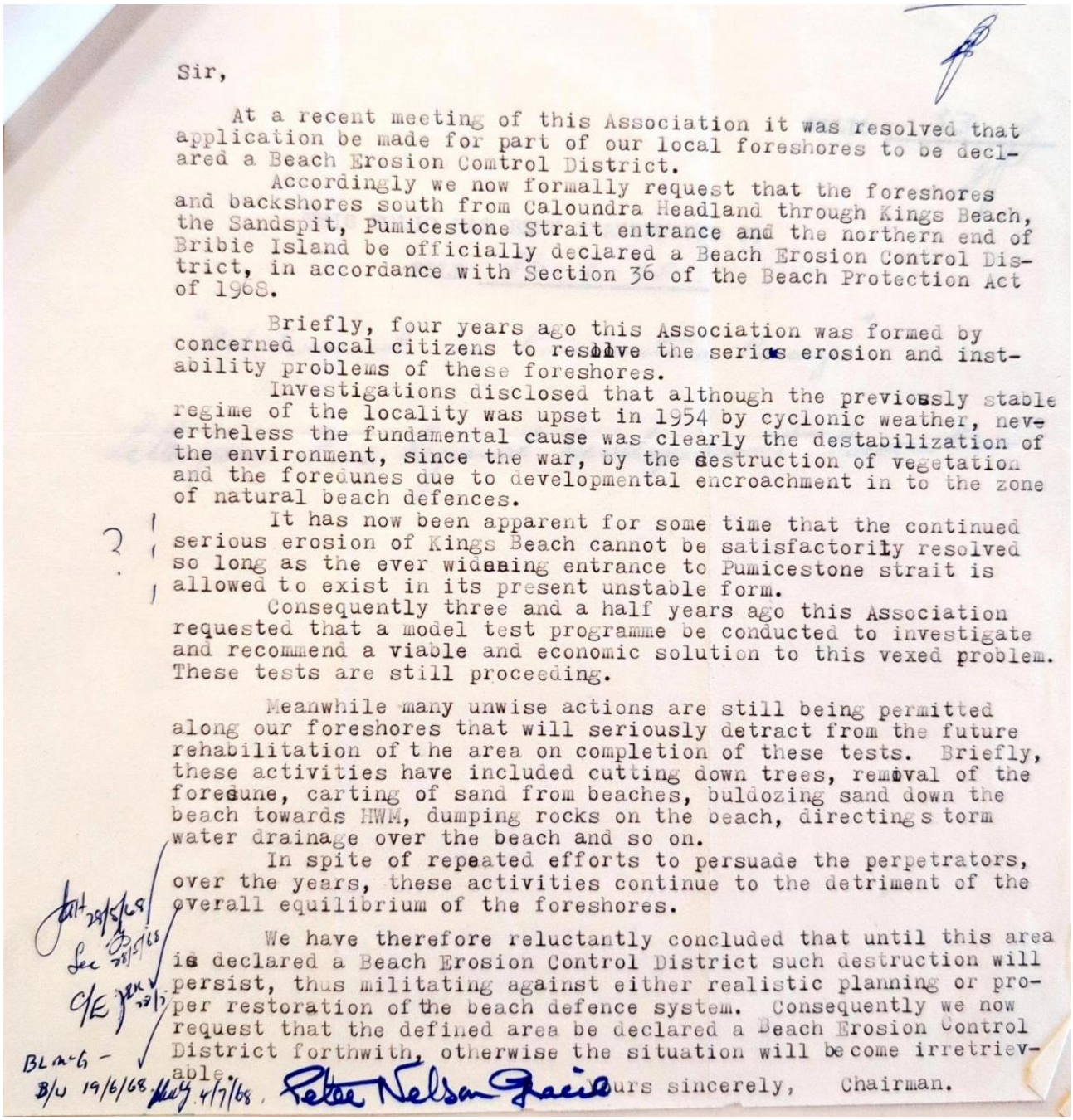
Further correspondence dated 17/05/1967 from LSC advises the DCG of “an economic solution” for Pumicestone Passage as proposed by the “Caloundra Passage Development Association” (*different name, but same Chair as reported above*), with investigation including model test by “University”. The file also includes correspondence from the Association dated 19/06/1968 expressing concerns regarding ongoing erosion, “unwise actions” along the foreshore, and requesting establishment of a Beach Erosion Control District (**BECD**).

LSC on 03/07/1968 advised the DCG that it “emphatically denies any suggestions contained in the Association’s letter that it has taken any action likely to create or aggravate erosion on beaches within the Shire.” LSC adds that “all erosion prevention work… has been undertaken on the advice of” DCG and DHM, and that LSC sees no need at this stage for a BECD. Further correspondence includes the Lands Department, with a response from DCG on 03/09/1968 advising that reservation of “Deepwater Point – The Spit” for Park and Recreation purposes is consistent with the purposes of the Beach Protection Authority (**BPA**), Refer to Figure 14.

4.4 Suggested messages

The suggested messages from this glimpse into the State Archives are that:

- **Erosion issues of the northern Bribie spit and Kings Beach, as well as shoaling of Pumicestone Passage were a community concern from at least the early 1960’s.**
- **The community took actions that included forming an association, developing a relatively thorough proposal to stabilise the entrance, including engineering and financing considerations, with expert advice from technical professionals.**
- **These erosion and shoaling concerns were part of the record at the time government was considering and took action to form the BPA (in 1968) and advice from the local community may have actually been foundational to the BPA’s creation and/or formulation.**
- **The Delft Hydraulics Institute provided advice in relation to the northern end of the Moreton Bay estuary at the time when the Delft report of 1970, which provides the foundation for the Gold Coast Seaway and Sand Bypass System, as well as the overall City of Gold Coast beach management strategy, including nourishment, was being formulated.**
- **A BECD had yet to be established for this area by mid-1968 and there was disagreement between LSC and members of the community regarding foreshore management.**
- **The community proposal to stabilise the entrance was considered by the State government with DHM concerns including cost-effectiveness relative to other proposals being considered at the time (including Moffats Beach and Mooloolaba).**



Sir,

At a recent meeting of this Association it was resolved that application be made for part of our local foreshores to be declared a Beach Erosion Comtrol District.

Accordingly we now formally request that the foreshores and backshores south from Caloundra Headland through Kings Beach, the Sandspit, Pumicestone Strait entrance and the northern end of Bribie Island be officially declared a Beach Erosion Control District, in accordance with Section 36 of the Beach Protection Act of 1968.

Briefly, four years ago this Association was formed by concerned local citizens to resolve the serious erosion and instability problems of these foreshores.

Investigations disclosed that although the previously stable regime of the locality was upset in 1954 by cyclonic weather, nevertheless the fundamental cause was clearly the destabilization of the environment, since the war, by the destruction of vegetation and the foredunes due to developmental encroachment in to the zone of natural beach defences.

It has now been apparent for some time that the continued serious erosion of Kings Beach cannot be satisfactorily resolved so long as the ever widening entrance to Pumicestone strait is allowed to exist in its present unstable form.

Consequently three and a half years ago this Association requested that a model test programme be conducted to investigate and recommend a viable and economic solution to this vexed problem. These tests are still proceeding.

Meanwhile many unwise actions are still being permitted along our foreshores that will seriously detract from the future rehabilitation of the area on completion of these tests. Briefly, these activities have included cutting down trees, removal of the foredune, carting of sand from beaches, buldozing sand down the beach towards HWM, dumping rocks on the beach, directing storm water drainage over the beach and so on.

In spite of repeated efforts to persuade the perpetrators, over the years, these activities continue to the detriment of the overall equilibrium of the foreshores.

We have therefore reluctantly concluded that until this area is declared a Beach Erosion Control District such destruction will persist, thus militating against either realistic planning or proper restoration of the beach defence system. Consequently we now request that the defined area be declared a Beach Erosion Control District forthwith, otherwise the situation will become irretrievable.

Yours sincerely,

Peter Nelson Gracie

Chairman.

Figure 14: Correspondence included in DHM files at State Archives

5 INVESTIGATIONS

This section concerns the decade from ~1974-84, and sources 039-068, including several ‘investigations’.

5.1 Coastal Management Investigation – NSW border to Noosa

The earliest is the 1974 report *Coastal Management Investigation, Queensland - New South Wales border to northern boundary of Noosa Shire* prepared by Gutteridge Haskins & Davey for the Co-Ordinator General's Department. This report is comprised of four volumes:

1. Summary and recommendations [040]
2. Wetlands and aquatic investigation [041]
3. Land use investigations [042]
4. Engineering investigation of canals [043]

These are available on the Geological Survey of Queensland Open data portal (links provided in the bibliography) as a series of TIFF images, which we converted to single volume PDF files for convenience. This copy of the report is marked as “Draft Report” and a handwritten note “Confidential” is present on the cover of the first volume.

Collectively, the full report is ~1,000 pages and appears as if it may have been produced on a typewriter, although it may be the result of early versions of word processing and printers. Regardless, it is noteworthy for its breadth as well as depth and we suggest it is an important source for understanding the origins of coastal management provisions for a large part of Queensland, including information specific to Bribie Island, Pumicestone Passage and the surrounding waters and lands.

The Volume 1 table of contents is worth listing here in part to succinctly illustrate the scope of consideration:

- **PRINCIPAL FACTORS OF CONCERN**
  - 3.1 Loss of Mangroves, Seagrass Beds and Wetlands
  - 3.2 Changes in Estuaries
  - 3.3 Loss of Open Space
  - 3.4 Alienation of Waterfronts
  - 3.5 Beach Erosion and Foredunes
  - 3.6 Mining and Extractive Industries
  - 3.7 Pollution
  - 3.8 Canal Estates
  - 3.9 Inadequacies in Environmental Impact Statements
- **EXISTING CONSTRAINTS**
  - 4.1 Local Authority Controls and Policies
  - 4.2 Canals Act
  - 4.3 Beach Protection Authority
  - 4.4 Public Attitudes
  - 4.5 Mining Leases and Authorities to Prospect
  - 4.6 Freehold and Leasehold Land
- **MANAGEMENT OF NATURAL RESOURCES**
  - 6.1 Management Philosophy
  - 6.2 Water
  - 6.3 Shorelines
  - 6.4Mangroves
  - 6.5 Wetlands
  - 6.6 Seagrass
  - 6.7 Terrestrial Vegetation
  - 6.8 Terrestrial Fauna
  - 6.9 Fisheries

The investigation also considers population and projections for land, aquatic recreation, and recreation in natural “bushland” settings; proposals for use of various land and resources; proposes land acquisitions and restrictive zonings; legislation and planning; and recommended future investigations. Pumicestone Channel and Bribie Island collectively comprise one of the eight nominated “Areas of Critical Concern to the Region”, with five more being connected to the greater Moreton Bay system (the outliers are the Noosa River and Lakes to the north, and Tallebudgera Creek to the south).

The introduction credits the Department of Harbours and Marine (**DHM**) with the initial suggestions that led to the investigation, prompted by the agency’s concern over problems arising from the rapid spread of coastal canal estates. The introduction advises that the “Basic Philosophy” for the investigation is as follows:

> *“The Brief for this Investigation included as an objective "the use of resources for the maximum long term benefit of the people".*
>
> *“The approach has been to try to retain in the coastal zone the qualities that make it attractive to the community, while making the best provision for its resources to be used and enjoyed.*
>
> *“Stress has been laid on the interests of the community in general with consideration given, and to be given in future by the relevant authorities in their detailed planning, to the interests of the various sections.*
>
> *“The principle of the "problem of the commons" is applicable. The total effect of small actions of individuals often proves to be detrimental to all even though each small action brought apparent benefit to the individual.*
>
> *“The "community" is considered essentially as the regional community, including visitors, with local geographical interests being subject to the overall regional interest.“*

The balance of the Basic Philosophy (s.1.2) is equally inspiring and would be worth including in full, as we consider it suitably aspirational for the context of this present review. Hopefully this brief overview illustrates why we suggest this is a seminal resource, despite its age. It provides the earliest/best insight we identified into the origins of the thinking and planning, both objective and subjective, that shaped our current governance context. In closing, it is worth noting that this section emphasised the prominence of local interests (set in consideration of the broader context), including the role of local government.

The reported methodology is robust, including coordination of subject matter experts under an Advisory Panel, preparation of maps to standards and similar treatment of relevant data, as well as public consultation (60 submissions, with “many being comprehensive, well documented, and of value”).

Regarding “Beach Erosion and Foredunes” the summary report notes (s.3.5):

- Shoreline regression resulting from long term erosion is 0.3 to 0.8m per year.
- Erosion has been of concern for many years, particularly where development has encroached on the foredune.
- Remedial measures undertaken such as rock walls, have provided protection to properties, but also lowered beach levels, with some areas of beach now entirely covered by water at high tide.
- Recent restoration by pumping of beach sand has been undertaken, but both that operation and use of seawalls require considerable research to ascertain viability.
- Appropriate planning and control are necessary to restore original dune/beach systems and limit interference of unaffected areas.

Regarding Environmental Impact Statements (s.3.9) the report notes that these have been useful, but examination of several EISs for major coastal area projects indicates deficiencies, including “the tendency for the environmental effects of a project to be considered in isolation, unrelated to surrounding areas or the Region as a whole”. It notes that several current land use investigations, including theirs, may better inform future EISs.

Regarding the Beach Protection Authority (**BPA**) the report notes the considerable powers of the agency to declare a Beach Erosion Control District (**BECD**) and then direct land owners to take protective measures, impose development controls, and restrict access to Crown Land, with a number of uses and activities prohibited. They advise that since 1968 the BPA has carried out investigations and declared BECDs over 125km of the coastline. Implementation of resultant schemes has been frustrated by financing, with responsibility residing with local government. (s.4.3)

The report notes that” Public attitudes in regard to land use are diverse and changing. It is necessary that they be recognised and either accommodated or re-shaped if change is to be accepted.” (s.4.4). They note

changes in attitudes, with increasing recognition of environmental values (as well as differences of opinion) and posit that clear communication of accurate information is likely to improve public attitudes, with recommended further investigation arsing from the report likely to assist in that regard.

The report advises that 34% of the study area that is considered as coastal zone is Crown Land, with the majority of that located on Bribie, Moreton and North Stradbroke Islands. Due to the cost of acquiring freehold land, the investigation identified planning for the use of this Crown Land as "one of the most important aspects considered in this investigation." (s.4.6).

Regarding shorelines (s.6.3) the report proposes three principal forms of reserves and zones to control waterfront land:

- Erosion reserves and zones – varying between 100-300m in width based on erosion potential;
- Ecological reserves – including swamp, salt marsh, and mangrove areas, with destruction of mangroves in these areas prohibited and preservation maximised elsewhere (they note existing provisions in the *Fisheries Act*, but uncertainty regarding historical implementation); and
- Foreshore reserves and zones – targeting the 38% (460km) of the study area shoreline that is theoretically available for public access (deducting freehold and leasehold lands, and other constraints) with a minimum viable width of 100m required, including to address issues such as foreshore erosion.

Seagrass (s.6.6) is described as ecologically important, promoting both biomass and biodiversity, with loss/decline noted in the northern parts of Moreton bay, and the principal areas of remaining seagrass including Pumicestone Channel. The report advises that these areas should be included in Fisheries Habitat Reserves or marine National Parks (*sic*). Other protection/preservation measures proposed concern direct discharge from stormwater outfalls, construction of boating facilities, and bait digging.

A number of National Parks are proposed (s.7.4.1) including on part of Bribie Island (western side, Portion 37). The reported total area of proposed National Parks or Environmental Parks is reported as 21,600 ha, with an additional 17,800 ha recommend for investigation and possible declaration (they note various issues, such as mining leases, that require more detailed consideration). The proposed areas would roughly double the area of National Parks within 160km of Brisbane and increase the area in the coastal zone ten-fold. Whilst a marine National Park is proposed surrounding Peel Island, as well as two areas where seagrass reserves should be protected, Pumicestone Channel is not included.

Environmental Parks are discussed (s.7.4.2) as a relatively new category of land reservation under the Land Act, for areas that may not be fully suitable for declaration as National Parks. This designation is suggested as potentially suitable for areas such as Stradbroke and Moreton Islands, which include areas affected by mining. Proposed areas for this designation include Bribie Island ("extensive foreshore areas and near University Reserve").

Regarding Foreshore (s.7.4.4) and Erosion (s.7.4.6) areas, the report proposed Reserves for Crown Land areas and Zones for other areas as a means to embed consideration into planning instruments. These areas are identified on included maps, which are unfortunately noted as "missing" from the copy of the report we were able to obtain. However, the report notes that the reserves/zones do not include BECDs but a strip landward of those BECDs is in most cases included, and that National Parks and similar reserves are also excluded. The report also notes that the proposed widths are greater than those proposed by the BPA for the 50-year term, as erosion can be expected to continue beyond that period.

The need for Educational Reserves, including "Scientific areas" (s.7.4.6) is also discussed, with mention that various departments of the University of Queensland (**UQ**) currently conduct research in several areas, including at a property that UQ owns on Bribie Island.

Waterfront facility projections (s.4.4.8) are included, based on projected boat ownership and usage (~3.7 times present use assumed) and figures from the United States for maximum boat densities. For Pumicestone Channel, the projected future number of required boat ramps reported is 48. *(Note: Projections appear to be based on 2010 demand using subsequent advice at s.13.9.)*

The presentation of Areas of Critical Concern to the Region, includes the following notes regarding Pumicestone Channel and Bribie Island (s.9.3):

- The area is considered important due to the relatively unaltered state of Pumicestone Channel and dominance of Crown Land on the shoreline; fishing and recreational boating values; the striking and attractive natural landscape; and the Island's recreational values, including ~80km of shoreline, with easy access from metropolitan areas, and predominant tenure as Crown Land.

- The "retention of Pumicestone Channel in a condition as close as practicable to that now existing is proposed", with most of the shoreline proposed as Ecological Reserve or Environmental Park.
- The finding of the Survey of Major Moreton Bay Islands (1972) that Bribie Island should be treated as a recreational resource is endorsed (*note: the Survey is included on our source list [035] but we were unable to locate a copy*).
- Provision is made for a population of ~30k (Bongaree, Bellara and Woorim) with urban expansion preferred at Toorbul Point, as "land on the island is of higher value for recreational purposes".
- The Survey recommendation of a 200-400m wide strip of public land along all beaches is endorsed.
- A "National Park of moderate area and Environmental Parks are recommended".
- The Caboolture Shire Council view that areas leased for pine plantations should revert to public ownership on expiry is endorsed.
- The estuaries of Lamerough Creek and Dux Creek were noted as having been given particular consideration as there were proposals in each case for canal estates and each estuary, particularly at the mouth, is lined with mangroves. These two areas were identified later in the report as an area for further investigation, to determine future land use (s.12.16).
- Drainage solutions for upstream urban areas were noted, with further detailed investigations, and preservation of the mangroves areas of greatest value in a viable condition recommend.

Further information specific to acquisitions (s.10.2) regarding Bribie Island (#12) includes cancellation of a narrow strip along the boundaries of Special Lease No. 23620 with addition to adjacent vacant Crown Land and dedication as an Environmental Park. Regarding Ecological Reserves (s.10.3) a long narrow coastal reserve (#12) is shown on the included maps, in the northern area of the widest part of the island (south of the narrow peninsula where the present breakthroughs have occurred).

Dredging is discussed in various areas of the report, including s.13.18, which acknowledges and supports dredging of dead corals (necessary for cement production) and extraction of sand and gravel from streams. Live coral is noted as being of considerable scientific interest and those areas should be protected by reserves. Impacts to those areas and seagrass areas from silt caused by dredging should be avoided, and deposition of dredged materials excluded from those areas.

Volume 2 of the report, *Wetland and aquatic investigation* [041] includes the following information:

- Pumicestone Channel in total can be considered as an estuary, being tidally dominated. Tidal flow varies from a maximum of 2.5m in the Brisbane and Caboolture mouths to less than half of this amount in Pumicestone Channel. (p.7)
- "14% of the total mangroves in the Investigation Area are in the Caloundra--Pumicestone Channel area." (p.17)
- A muddy sand mixture (1-50% mud) is present on the western side of the Bay, with one source being "the open shelf through the gap between Bribie and Moreton Islands". (p.33)
- "The removal of mangrove on the Bribie Island shore has resulted in a serious erosion problem." (p.96)
- "This process of rise in the water table followed by death of mangroves has been observed at the south end of Bribie Island." (p.2-10)
- Considerable areas of rocky foreshore, which grade into inter tidal and underwater reef exist along the shore, including at the entrance to Pumicestone channel (p.57). *(Note: it is unclear whether this is the northern ocean bar entrance, versus the Bay entrance to the southern end of the Passage.)*
- "Areas in the Broadwater and in Pumicestone Passage receive attention from locally based professional fishermen." (p.61)
- The most important areas for sand crabs includes Pumicestone Channel. (p.62)
- "Mangrove areas in Pumicestone Channel should also be protected, not only for their potential in aquatic productivity, but also for aesthetic reasons and to prevent erosion of the banks of the channel." (p.96)

Volume 3 of the report, *Land use investigation* [042] includes the following information:

- "Bribie Island is wholly sand and formed from the longshore drift process carrying sand around Cape Moreton and then towards the mainland. This process probably commenced in earlier geological periods and appears to be continuing… Bribie Island itself appears to be in a state of general accretion… This

accretion is in the longer term and is quite apart from the present state of erosion which may be only short term and cyclic." (p.10)

- "Bribie Island illustrates the results of coastline accretion. The interior of the island contains several raised ridges representing old frontal dunes, these being of a particularly pure sand." (p.16)
- "Sediment transport north of Cape Moreton is a relatively slow process - in towards Bribie and Caloundra, and partly into Moreton Bay. Ebb or flood channels into the Bay may be picked from the shape of submarine shoals and the origin of the channel could be of significance in locating permanent shipping lanes. A channel eroded by both the ebb and the flood is liable to require less dredging than one which undergoes erosion on one tide and accretion on the other." (p.17)
- "Movement of sands also occurs down Pumicestone Channel from the Caloundra spit, as James, a member of the project team, has noted from aerial photographs taken in the mid-1940's. This feature, combined with discharge of sediments from streams feeding into the Channel, indicates an eventual filling of the channel - or, at least, in terms of human lifetimes - a possible limited life for the channel as a navigation way. No time estimates have been attempted." (p.17)
- "Approximate estimates of the rate of shoreline accretion could perhaps be made in certain areas (e.g. Toorbul and Bribie Island). Full research would, however, be necessary to provide rates with any certainty." (p.18)
- "A count in Pumicestone Channel during Christmas 1972 was reported to the Department of Harbours and Marine as a total of 880 boats, but details of count, or what it represented, are not known." (p.47)
- "Bribie Island: Some old leases are extant held by Mineral Deposits. These are narrow coastal strips on Crown Land and may be mined although no plans are known." (p.81)
- "Silica sands as mentioned in 4.4 above, are used principally for foundry purposes and for glass making. Bribie Island provides most of the dune sands won as extractive industry and most of this goes to Toowoomba Foundry as foundry sand." (p.86)
- "For the Gold Coast, the long term recession rate has been estimated, by BPA, to be between 0.3 and 0.8 m/year. It is reasonable to assume similar results for Sunshine Coast beaches which are of similar form." (p.99)
- "Comparison of maps drawn from 1967 photographs, and photographs taken in 1974, indicates significant shoreline fluctuations in Pumicestone Channel and the muddy islands of the southern part of Moreton Bay." (p.100)
- "The northern entrance to Pumicestone Channel at Caloundra is very unstable. The vegetated tip of Bribie has eroded 660 m. since 1940. Before 1940 this channel was close to Caloundra but moved southward, and in 1971 breached close to the Bribie shore. Since then a sand spit has extended northward and in February 1974, the Bulcock Beach channel was flushed again close to the Caloundra side." (p.101)
- Pumicestone Channel surface area is 5,115 ha. This represents 0.03% of the total water surface in the study area, including the areas reported for the rivers in Landsborough and Caboolture shires. (p.123)
- This waterway is for the most part a maze of mud and sandbanks and mangrove islands, The navigable channel is tortuous and varies in depth between 0.6m and 6.0m at low water. The area is a small craft playground, with fishing being the principal recreation activity. The channel off the northern end of Bribie is recognised as one of the two most prolific bream fishing spots in the Investigation Area. Bait is obtainable from the banks exposed at low water, in the form of yabbies and soldier crabs. About one-third of the channel is a Fisheries Habitat Reserve. (p.128)
- The channel is not ideal for sailing except at the southern end; despite the restricted waterway off Golden and Bulcock Beaches, regular races are held. Five areas are currently reserved for water skiing. At Golden Beach, this use does compete with other activities. (p.129)
- It is apparent that some of the more popular areas are becoming overcrowded, including Pumicestone Channel foreshore on Bribie Island. (p.133)
- "Already some areas experience saturation fishing at certain peak periods. Pumicestone Channel near the northern tip of Bribie Island is one such spot, where sinkers cast into adjacent boats are not uncommon." (p.137)

- “An activity closely associated with fishing and involving, in the majority of instances, the use of small boats, is bait collecting… It may be necessary to establish and protect additional areas, and to protect them specifically from the competing activities of dredging and reclamation. The major existing bait banks” include Pumicestone Channel (particularly Bells Creek area). (p.137)
- “Bribie Island: Declaration of Portion 37 as National Park, and other areas shown on the Proposed Land Use Maps, generally adjacent to the Island shores, as Environmental Parks. Area of proposed National Park 1571 ha, and area of proposed Environmental Parks 3282 ha.” (p.173)
- “It is recommended that no bridge be built across Pumicestone Channel from the northern end of Bribie Island. Such a bridge would have adverse environmental effects on Bribie Island, and would detract from its future recreational value.” (p.197)
- “Future Development Lease: The Lands Department is considering the granting of a new development lease on Bribie Island south of the Caboolture-Bribie Island Road. This would involve some canal construction to drain the low lying area.” (p.202)
- “The southern end of the Island is subject to erosion and may be lost.” (p.3-9, referring to Bribie)

5.2 Coastal processes

The report Quaternary Geology of the Sunshine Coast [050] by the Geological Survey of Queensland (**GSQ**) was produced in response to a BPA request for assistance to support beach erosion investigations. It presents a synthesis of available data and a preliminary interpretation of geological influences that may assist with predicting future erosion. Findings include:

- “The Sunshine Coast beaches seem to represent a closed sand system. Losses into the foredune system and tidal deltas, and by longshore transport, have to be met by erosion into Pleistocene sand deposits. Replenishment of beach sand by net northerly longshore transport, a factor important on the Gold Coast, appears to be minimal on the Sunshine Coast.” (p.1)
- The South Passage tidal delta between North Stradbroke and Moreton Islands and the North Entrance tidal delta between Moreton and Bribie Islands… act as sand traps. Thus little sand bypasses the northern entrance of Moreton Bay. Underwater bedrock outcrops around Caloundra reach into fairly deep water, and these no doubt restrict the northward littoral drift of sand. Bribie Island acted as an effective sand trap during the Pleistocene. Net sand movement seems to have been southwards from Caloundra. Reserves of' sand suitable for beach replenishment occur onshore, in tidal deltas, and on inner parts of' the continental shelf.” (p.2)
- “Present sand movement was studied on the Brisbane CAB 365 and Gympie CAB 7043 aerial photographs at 1~84 000 scale, The lee fronts of the underwater dune systems (“hydro-barchans”) are directed northwards in the Hamilton Patches area, and in a limited area of the northwest channel between channel markers NW2 and NW4. Most other dune front show a southward direction, that is towards Moreton Bay. The order of magnitude of sand movement above -12 m (-15 m M.S L.) may be estimated from maintenance dredging in Northwest and Spitfire Channels. Redredging was necessary 8 years after establishment dredging. In 1972-73, 550 000 m3 were dredged. Considering an overdredging factor of 30 per cent, sand movement into the channel of 50 000 m3 per year is indicated (Frowd, pers. comm.).” (p.8)
- “The Delft Report (1970) and similar studies indicate that the sediment interchange between the beach and the offshore area is active down to a zone of 20 to 30m depth. The sand reserves within this zone should not be dredged. The area between 30 and 60m depth could become feasible for suction dredging. This zone begins between 1 and 2 km offshore and extends for 2 to 4 km.” (p.19)

The *Delft Report* is not included on the source list, primarily because the northern boundary for that study is South Stradbroke Island. However, as detailed earlier in this report, the authors did also specifically advise on Pumicestone Passage and Bribie Island in 1964. We also note that the author of this QSQ report regarding the Sunshine Coast thought it relevant to include the above information the 1970 Delft Report. It is worth mentioning that this study was foundational for the present-day management of foreshores on the Gold Coast, as well as the development of the Seaway and Sand Bypass system, the southern complement to Pumicestone Bar, as outlets for the Moreton Bay.

The *Northern Entrance to the Moreton Bay* [054] by A.W. Stephens in 1978 attributes the bypass phenomenon discussed above as responsible for the formation of the complex banks, or submarine sand platform, which he describes as extending from Comboyuro Point (Moreton Island) to Caloundra Head; he labels the ‘outer or seaward tidal delta’. The included figure shows the North West Channel as the westward boundary of this imaginary line. Refer to Figure 15.

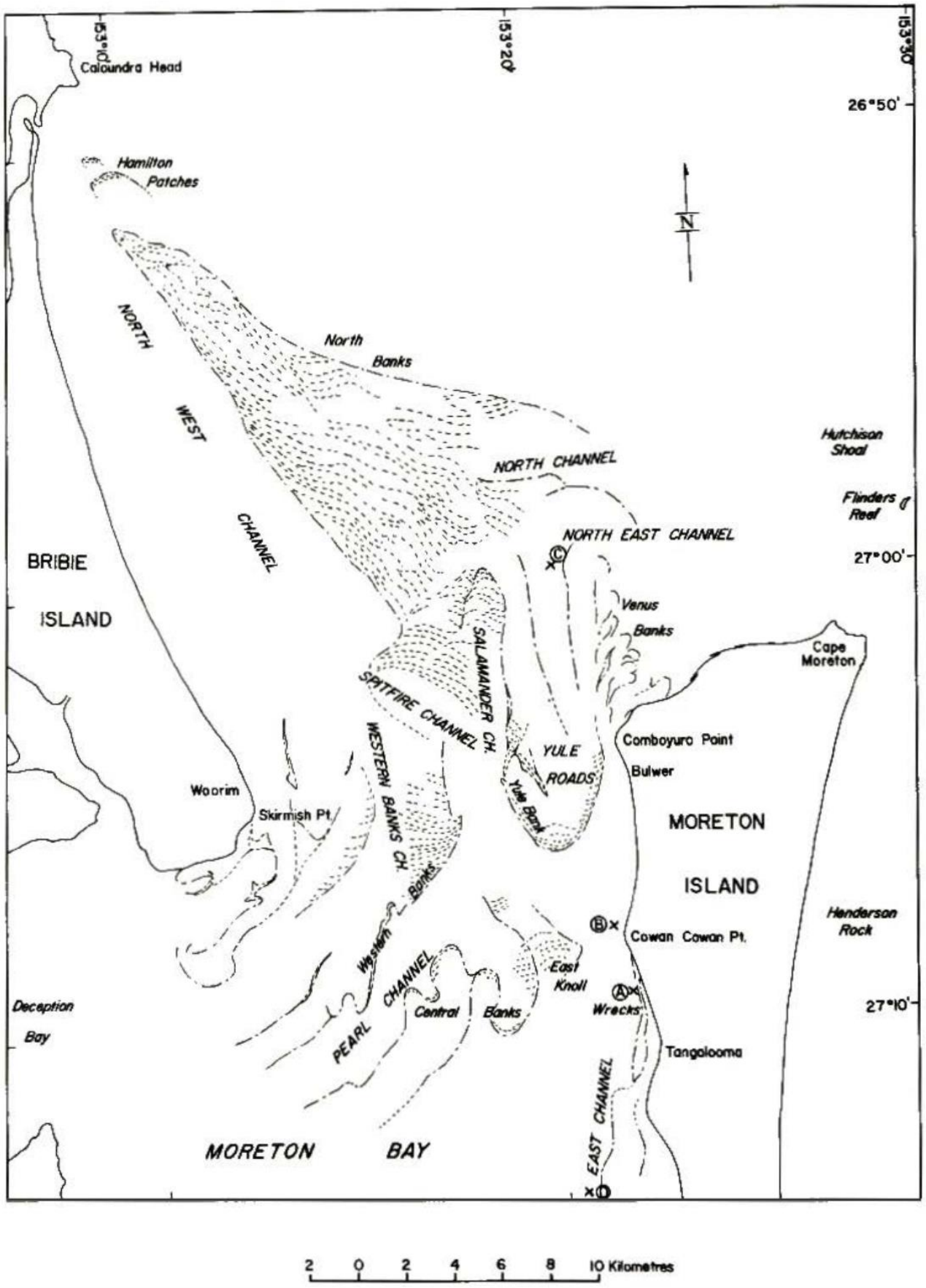


Figure 15: Map of the northern part of Moreton Bay showing 'outer or seaward banks' [054]

He notes that Moreton Island acts like typical south-facing rocky headland in an area with net northerly littoral drift, however, the expected pattern is disrupted at the outer end of the North Channel. He attributes offshore reef systems as contributing to the disruption and discusses three possible causes for the atypical sand curvature. He also discusses the Hamiton Patches and suggests that transport is to the north, but the actual mode of transport is not yet known.

Stephens discusses various components of the banks, generally noting complexities and uncertainties. He includes advice that the Spitfire Channel was dredged in 1965, with increased sand transport indicated following the dredging, but uncertainty regarding whether it was causal. In summary, he notes that preliminary measurements at this site contradict the overall hypothesis for ebb and flood channel transport (for 1966-1971). His overall summary at the end of the paper is that “Serial hydrographic surveys have shown that the accepted, generalised hypotheses (Robinson 1960) of ebb and flood channel dynamics are too simple (Langhorne 1973), especially with regard to predictions for short term movements.”

Regarding Lamerough Canal, the source material does include correspondence from the DHM in 1980 advising that the EIS is deficient in several respects [058]. That record also includes a response from Cardno & Davies in 1987 providing a revised EIS that addresses previous comments. So, that canal estate (Pelican Waters), was proposed by 1974 (mentioned in 040-043), with further studies scrutinised by DHM ~6-years later, and revised studies not provided for another ~6-years.

5.3 Pumicestone Passage Water Quality and Land Use Study

Another 4-volume report was produced in 1982, with a narrower focus, and by an inter-departmental committee, the *Pumicestone Passage Water Quality and Land Use Study* [060-063]. Concerns regarding water quality, notably impacts associated with potential catchment development, was the trigger for the study, with findings regarding water quality (vol.2) and conservation interests (v.3), then used to inform land use and planning options (vol.4).

Water quality investigations included approximately 2-years of background water quality monitoring; development of two pollutant models – a “Dynamic” model for transient effects (e.g. storms) and a “Steady State” model to simulate changes to land use; and a hydrodynamic model that could be used to predict changes arising from “changes engineered in the Passage”. The study found that stormwater drainage was the main direct influence on water quality and that changes to the geometry of the passage (e.g. dredging) was the most likely indirect influence. The Caloundra bar, as well as the Skids, were identified as having a throttling effect that significantly influenced water quality.

It advised that “The Passage is subject to a significant nett northerly tidal flow which, although small in comparison to daily tidal flow, is substantial when compared with fresh water inflows.” That nett flow was reported as being important to maintaining water quality, distinguishing the Passage from river estuaries. Overall, the Passage was reported as being well flushed, with “little variation during dry weather with marked short-term perturbations during and after storm-water inflows”.

The report includes a note about some dredging having occurred in the Passage at Caloundra, the southern end, and through the central reaches. It cautions about excessive dredging, as well as destruction of mangroves, with respect to habitat/resource quality impacts, rather than water quality per se. It notes that the northern shoals of the estuary are a major spawning area and that destruction of these shoals could have profound impacts both locally and more widely within the Moreton Bay and cautions against construction of a dredged entrance, bar stabilisation, or disturbance of the mobile shoals of the inner bar zone. It identifies that “The greatest concern to fisheries' interests is any development which might result in a significant increase in tidal volume causing changes to the tidal regime and estuarine conformation.”

The study considered three development concepts with differing population levels by the year 2000 and found that all were acceptable from a water quality perspective. However, the scenario with the highest population growth capacity was identified as unacceptable from the perspective of conservation interests. Recommendations were included regarding further planning to protect resources and provide for public access and urban development. Dredging in the passage was recommended to be limited to maintaining navigational channel access. A map showing proposed parks and reserves was included, refer to Figure 16.

Volume 3 includes the following further information regarding dredging:

- “THE ISSUE IS SIMPLE. There can be a tourist and recreational fishery at Caloundra and related bream fisheries elsewhere as an ongoing renewable resource OR these fisheries can be put at risk by large-scale changes in tidal regime or estuarine conformation associated with extensive dredging of the shallow sand and mud banks. Construction of a dredged entrance and bar stabilization by sea walls

when combined with disturbance of the mobile shoals of the inner bar zone, would constitute a major threat to the bream fisheries." (p.12)

- "DREDGING OR DISTURBANCE OF SAND OR MUD BANKS SHOULD BE PERMITTED ONLY FOR MAINTENANCE DREDGING OF ACCESS CHANNELS. SAND BANKS WITHIN THE PASSAGE SHOULD NOT BE USED FOR EXTRACTIVE INDUSTRY OR AS A SOURCE OF MATERIAL FOR BEACH REPLENISHMENT." (p.17, Recommendation 1 – presented in All Caps, as quoted here)
- "In considering changes in nett tidal flow and velocity resulting from a dredged channel in the vicinity of Roy's, a design width of 30 m and channel depth of 2 m was incorporated in the hydrodynamic model. The channel designated on the basis of habitat disturbance was defined as a maximum width of 20 m and a depth not exceeding 1.5 m. The channel incorporated in the modelling was thus approximately twice the cross-sectional area of that deemed the maximum for habitat disturbance. The position was reviewed in terms of fisheries constraints and the conclusion is reiterated that a channel should be of not greater dimensions than 20 m x 1.5 m. It is considered that provision of a larger channel would be of danger to habitat maintenance and unduly interfere with the use-pattern of this section of the proposed marine reserve complex in the Passage." (p.18)

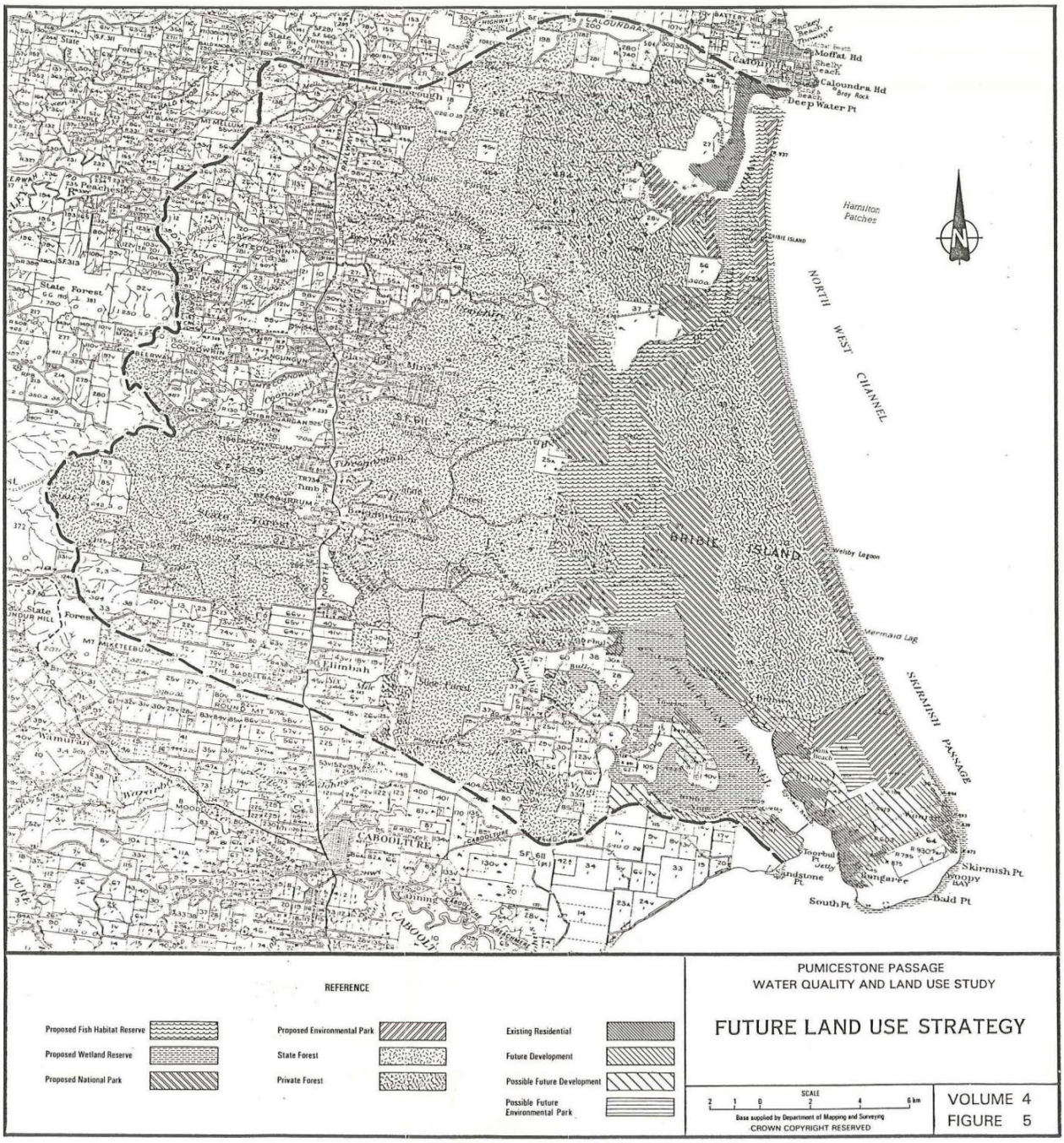


Figure 16: Proposed parks and reserves and existing land uses [060]

5.4 Coastal processes – Offshore banks

Dredgeability of the North East Channel, Moreton Bay [064] is an investigation for the Port of Brisbane (**PoB**), informed by core sampling at 9 sites, and 70km of continuous seismic reflection profiling that shows "a channel would have to be dredged to a depth of at least 20m (LWD)." It advises that an international trend towards bigger and deeper draft vessels challenges the viability of the PoB, and other ports around the world, with the large sandy delta a significant constraint to expansion. The main shipping channel for the PoB is identified as the North West Channel, where "Continual minor dredging in a few localities is needed to maintain a clearance depth of 12-13m below Low Water Datum (LWD)."

The Eastern Channel is reported as having a clearance depth of only 7m, with dredging along a distance of 2.6km required to provide the 12-13m clearance available in the North West Channel. To provide a future anticipated clearance depth of 20m, the North West Channel would require dredging along a 28km stretch, with the distance shorter for the North East Channel, 12km, and the dredged quantities estimated as less for the thicker but shorter cut.

The study notes that the ebb-delta includes two sectors. The northwestern sector is of simple form, with shoals of 3-7m depth that are exposed to ocean swells and partially protect the tidally dominated North West Channel. The northeastern sector, which includes the North East Channel, has a more complex morphology of ebb and flood channels, with significant wave energy present despite partially sheltering by Moreton Island and nearby reefs. The North East channel area is described as showing signs of both wave and tidal influence, suggesting that the area is highly dynamic.

The interpretation of the data includes three sediment units. All three units are identified as being unconsolidated and dredgeable. Two different models of deposition are presented, with advice that the most likely mode cannot be determined from the available data. One of the two modes suggests that a dredged channel would likely to be dynamic under present conditions, with the other mode suggesting limited changes and, accordingly, limited maintenance dredging requirements and more security of navigability. In summary, the study concludes that the North East Channel could be easily dredged to a depth of 20m, but further studies would be required to improve certainty regarding sustainability of the channel.

5.5 Entrance stabilisation (take 2, at least)

To wrap this section up, the source list includes correspondence regarding a *Caloundra Broadwater Proposal* [066] that notes erosion of Kings Beach and the inner side of Bribie Island opposite Nelson Street (several metres in the past three years) and advises: "It is known that these changes are mainly due to an oscillation of the position of the "bar" or outlet from Pumicestone Passage." A stable ocean outlet is proposed for construction at the eroding section of Bribie Island, and closure of the bar at the headland, refer to Figure 17. It is worth noting that construction of the Gold Coast Seaway was commencing around this time (~1984) and that Cardno & Davies, the author of this correspondence, was involved in the design of the Seaway and Sand Bypass.

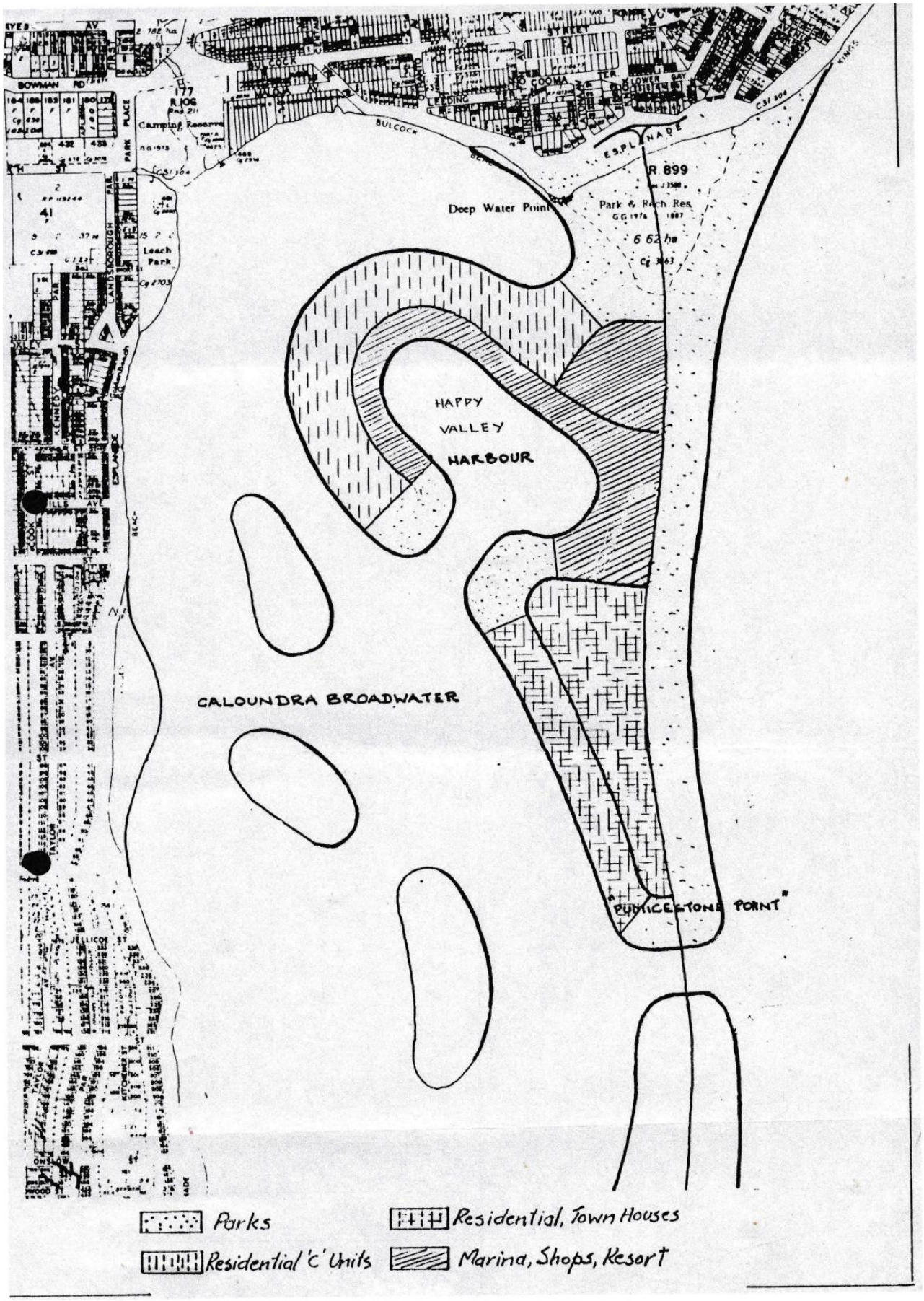


Figure 17: Caloundra Broadwater Proposal, 1984 [066]

5.6 Suggested messages

The suggested messages from this summary of several significant investigations are that:

- **Current coastal process, water quality and protected areas and land use policies and regulatory structures were preceded by investigations that were multi-disciplinary, with inter-agency collaboration, and stakeholder consultation.**
- **Those investigations appear to have been both robustly objective in methodology, within the limitations of available information at the time, provide transparent assumptions and uncertainties, and had both improvement and correction of historical practices as a fundamental goal.**
- **This focus was balanced, or perhaps governed, by a focus on stakeholder needs – providing high quality opportunities for recreation, notably in 'natural' outdoor settings – including an awareness of the need to ensure that demand was sustainable, and would not unacceptably degrade the quality of the environment.**
- **This segment also reports awareness of erosional processes in this location, and a second instance (at least) of a proposal to construct a trained entrance in an attempt to stabilise the issue, concurrent with construction of the Nerang River Seaway, but also amidst significant cautions about potential adverse effects on the environment in this area, notably fisheries resources.**

6 PROTECTION

This section covers the decade between ~1984-93, and sources 065-094. Many of the recommendations from the previous investigations were realised during this time, such as the declaration of protected areas. The intent for this section is to provide some brief insight regarding events surrounding that process, such as the sources we have collected indicate. However, it is not intended to be comprehensive or detailed regarding the history associated with the various regulatory provisions, as to an extent the current status of those measures generally reflects the outcomes, and is of greater relevance to progressing any solutions.

6.1 Cabinet papers

The collected sources include a number of Cabinet papers, which would have remained confidential until the statute of limitations for those matters recently expired. The earliest is from 1984 and is labelled as a Position Paper on Bribie Island and Pumicestone Passage [068]. This paper provides advice that the decision regarding a marine park was deferred whilst consideration of a coal port site was considered, "but in September 1983 (CD No. 41313) the Government decided that the concept of a major coal port at Bribie Island should no longer proceed." The paper also provides an update regarding negotiations for lands to be included in National and Environmental Parks, advice that LSC "favoured intention of a corridor through the proposed national park on Bribie Island to enable the construction of a future road on the island to link with a bridge over Pumicestone Passage just north of Coochin Creek", as well as a Cabinet decision to proceed with an Environmental Impact Study for a Dux Creek development.

The next four sources [069-071] are Cabinet papers dated 1985-1986, all related to BI+PP, including for a proposed National Park. Three are submissions from J. Bjelke-Petersen, Premier and Treasurer, including two written (06/12/1985 and 13/02/1986) and one verbal (20/10/1986), with the final one being from W.H. Glasson, Minister for Land Management (05/08/1988).

The first submission advises that on 12/09/1983, Cabinet accepted the proposals from the *Land use study* [060] and that the present position is that:

- Fish Habitat and Wetland Reserves – declared
- Little Goat Island – freehold donated to the National Trust
- Environmental Parks – Land Administration Commission has sought the views of trustees of a number of reserves
- National Parks, Bribie Island – the southern end of the proposed National Park (~200 ha) has been 'offered' as a 50-year Priority Special lease for residential and grazing purposes
- National Parks, other adjacent land – National Parks and Wildlife Service (**NPWS**) has approached owners with a view to negotiating purchase; response pending
- Marine Parks – proposal advertised; submissions received; consultant commissioned; financing for land acquisitions has "not been represented as a problem"

The Cabinet decision endorsed the recommendations, essentially for the Co-Ordinator General to expedite discussions and actions to finalise these matters. The subsequent submissions document that the Marine Park has been declared, but realisation of the other parks has become frustrated by tenure matters, with 'Stage 1', Crown Lands, progressing. The 1988 paper [075] details issues that have been progressed, including closure of the public promenade along the eastern and western foreshores of Bribie Island and discussion with the BPA and Caboolture Shire Council (**CSC**), both of whom made submission in response to advertisement of the proposed closure. The 1986 Pumicestone Passage Marine Park Zoning Plan [072] includes provisions for a single zone (General Use) with harbour works, beach protection works, or other works, subject to approval by the responsible statutory authority. (*Note: CSC is now part of SCC.*)

Further details are provided regarding NPWS refinements/recommendations in relation to various land parcels. The following advice is also included: "Ministers will recall that The Emanuel Group has previously submitted a proposal to Cabinet which incorporates residential, resort, canal estate and marina development extending over almost three quarters of Bribie Island and the entire area of Caloundra Downs. The development links the two areas by either a bridge or tunnel and it is also envisaged that access will be required on the eastern side to the sea."

The submission follows with advice that Cabinet decided on 17/03/1988 to reject that proposal, and that the Minister for Local Government and Racing be responsible for co-ordinating discussions with relevant

Ministers towards a proposal for use of the developer's land that is consistent with Government requirements for the area. This submission was only for 'noting', with the Cabinet decision endorsing urgent progression of Parks by the Minster for Environment, Conservation and Tourism.

6.2 Nourishment

The source list includes several more Executive Council Minutes from 1989 [077] and 1990 [078,079] that are available at the State Archives, but were not accessed. There is also a 1988 record of photographic negatives, "S*and pumping operation on Bribie Island*" [076]. The location is uncertain, but SCC has advised that they are aware of nourishment at Kings Beach in 1988, so these photos could be documenting nourishment of the northern spit of Bribie Island, but may be at the southern end with erosion issues at Woorim mentioned several time in the sources, with the northern end of the island generally drawing attention regarding migration of the entrance, combined with erosion of the northernmost tip of the Island.

Regardless, this record is incomplete, and it seem likely that our source list does not include records that would be expected to be there, such as BPA reports. There are some records of ETA line surveys (beach width) and aerial photo runs available on QImagery, and some library catalogue references to BECD maps/plans, but a noticeable gap in terms of reports that might shed light on studies, plans and actions to manage beach erosion. It would be interesting to understand the potential discussion/debate that may have taken place if nourishment was being undertaken at this time when protected areas had been declared (Marine Park) or were being progressed. The source list does include a 1992 report from the BPA that is potentially highly relevant, *Report on recent coastal changes near the northern end of Bribie Island and possible sedimentation in Pumicestone Passage* [082]. A copy was not available, but recession estimates from that report are provided below, from a secondary source that references the 1992 BPA report.

Figure 18: "Sand pumping operation on Bribie Island" [076]

6.3 Integrated Management Strategy

The source list includes several documents related to an Integrated Management Strategy (**IMS**) for Pumicestone Passage, its catchment and Bribie Island from 1992 [083, 085, 086] and 1993 [092-094]. These include a Cabinet submission [092] seeking permission to release the draft IMS for public consultation, with Cabinet consent for release and a 3-month consultation on 15/11/1993. The draft IMS is attached to that submission, which is the copy we obtained and reviewed. Our searches did not locate a copy of a final IMS or advice about consultation outcomes or adoption.

The submission, from the Minister for Environment and Heritage, advises that a consultant was engaged in 1992 to review the success of measures arising from the 1982 investigations, with the outcome being an indication that water quality had declined, and the consultant advising this was likely due to changes in land use and management practices – to increased pollutant loads in catchment runoff that reaches Pumicestone Passage waters – with the increased loading being sufficient to adversely affect Environmental Values.

It documents that various strategies were considered, with the recommended course being integrated in that it addresses various sources, including upgrading of sewage treatment plants (approximately one-half of the $50M long-term implementation cost) and various land uses, including through education and land use controls. It notes deficiencies in the 1982 strategy, including lack of legislative backing (e.g. vegetation clearing), funding, the sale of ~14% of the catchment to a land development company of private forest land, with the pine plantations now slated to be permanently cleared, and pressure for rezoning from various stakeholders to allow urban development.

It lists a number of component studies, including one on Coastal Processes, but we did not locate all of the component studies, including that one. Recalling the summary provided earlier of the 1992 study, there was a significant emphasis on circulation, including the status of the bar and a caution to not overdredge, as a critical element of water quality (as well as mangroves). The Draft IMS is almost exclusively focused on catchment management – inputs – although there is a mention of vessel-sourced pollution (sewage), but noticeably little discussion of water circulation, other than a brief mention that this was one of the two factors identified in the 1982 study. Regarding coastal processes, the IMS summary of related component studies includes this advice:

- “the review of coastal processes was conducted in two parts. The first part involved an assessment of existing data to gain a qualitative impression of the coastal processes and possible future movements of northern Bribie Island and the extent, if any, of sedimentation in the central part of the Passage. The second part was a quantitative assessment of a number of factors highlighted during the first part of the study.”

Under ‘Other reports and data’ (s.1.5.2) the following is included:

- “Two reports, prepared by WBM Oceanics on behalf of Queensland Commodity Exports Pty Ltd present water quality monitoring data for Pumicestone Passage before and after the logging of pine forests within the catchment. Monitoring was undertaken from June 1991 to February 1992.”

We did not locate those reports either. The coastal process information is of particular interest and it is possible that the 1993 publication by the BPA *Northern Bribie Island and Pumicestone Passage Photogrammetry 1940-1992* [091] is related. This publication is germane to this review, as is similar aerial photos available on QImagery, only a small portion of which are included in the source list. This material will not be discussed in depth here but will be integral to the discussion of solutions in subsequent reports.

Related publications include *Report on Holocene coastal evolution of southern Bribie Island* [080] in 1990 and a two volume 1992 report [084, 087] regarding the historical coastal evolution processes pertaining to south Bribie Island, and the Woorim to Point Cartwright coastline, which is discussed further below. In addition, the source list includes two sources regarding nourishment investigations pre-cyclone ‘Fran’, both of which are for Woorim, on the southern part of the Island [088, 089].

6.4 Evolution of the Woorim – Point Cartwright Coastline

The *Quaternary Evolution of the Woorim – Point Cartwright Coastline* is presented in two volumes and advises it was prepared by the Marine Geoscience Unit of the Department of Minerals & Energy for the BPA. This report, by M.R. Jones, provides the earliest insights we found in the record about a conceptual model for sand transport specific to the bar and open coastline, and is accordingly highly relevant to this review. Pending more thorough discussion in subsequent reports, we include the following notes:

- “During periods of falling sea level, the main areas of deposition migrated eastwards with the coastline on to the continental shelf. Between Moreton Island and Caloundra, the natural curve of the coastline during low sea level periods was conducive to the trapping of sediments moving northwards along the coast. The sediments formed large deposits which are now extensive offshore banks - North Banks and Hamilton Patches. Presently submerged, these old coastal deposits are being remoulded by today's tides and waves.” (p.1)
- “Caloundra Head is a critical location in the study area. It lies at a littoral drift divide, with alongshore transport directed away from the headland to both the south and the north. Caloundra Head also separates the coast to the south dominated by tides with some wave influence, from that to the north dominated by waves with little tidal influence. Off the headland, only a shallow cover of sand remains; extensive areas of bedrock occur at or near the seabed. The sediment budget for the beaches at Caloundra involves small volumes of sand, and there are minimal reserves in the nearshore zone to accommodate periodic erosion.“ (p.2)
- “The erosion problems being experienced along the coast stem largely from a lack of external sediment supplies. This is despite the existence of large volumes of sand in close proximity to the coastline off Bribie Island. These deposits are isolated from the processes directly influencing shoreline stability. The requirement for sand to balance the coastal sediment budget is met chiefly by erosion of preexisting coastal deposits. This has resulted in a re-arrangement of the sand deposits along the coast, with erosion in some areas occurring simultaneously with accretion in others.” (p.3)
- “For the study area as a whole, it is possible that there is a net loss of sand at Point Cartwright due to transport of sand around the headland to the north. Whether this deficit can be matched by a slow onshore transport of sand from the inner shelf is uncertain. The overall trend for the region appears to be continuing slow erosion at uneven rates along the coast. This problem may be addressed by supplementing the sediment budget in areas of localised erosion. The banks off Bribie Island are the best potential source of beach nourishment sand for the southern Sunshine Coast.” (p.2)
- “South of Caloundra, much of the wave energy is dissipated on the offshore banks before reaching the Bribie shore (Figure 2). Even on the eastern side of the banks (North East Channel data), shoaling has a major effect in reducing significant wave heights (Table 1).“ (p.5)
- “South of Caloundra Head, the coast comprises the eastern shore of Bribie Island. The shoreline is gently embayed, and oriented roughly NNW-SSE. Offshore are the North Banks (Figure 2), a triangular sand mass, with apex in the north, and extending southeastwards for more than 20km. A well defined channel along the western side of the banks separates them from Bribie Island. Further south towards Skirmish Point on Bribie Island, the alternating channels and banks of a large tidal delta occupy the entire entrance between Bribie and Moreton Islands. Here, tidal currents produce a dynamic environment for the evolution of ebb and flood dominated channels (Stephens, 1978; Harris and Jones, 1988). Along the Bribie shoreline, both wave and tidal currents are active, with tides becoming more dominant to the south (Stephens, Searle, and Holmes, 1983).” (p.5)
- “the northern part of Hamilton Patches is undergoing tidal and wave transport, resulting in a northwestward displacement of about 13m per year; despite the transport activity on Hamilton Patches, the deposits appear to be independent of the sediment budget of the beaches on the mainland and Bribie Island; a large sand bank is present in the 'nearshore zone south of Caloundra Head (Figure 26a,b); however its transport rate appears to be low, and the direction of transport northeastwards rather than onshore to supply Kings Beach.” (p.12)
- “Caloundra marks a transition in coastline types in the study area. In the south, the Bribie shore receives substantial sheltering from waves due to the North Banks and Hamilton Patches. At Caloundra Head and to the north, no such sheltering occurs. Tidal transport is important in the Caloundra tidal delta at the entrance to Pumicestone Passage. Tides are also important along the channel separating Bribie Island and Hamilton Patches. North of Hamilton Patches, wave activity is likely to dominate sediment transport.” (p.12)
- “Erosion in the 1960's led to the construction of a groyne at the southern end of Kings Beach. Prior to this, the stability of the beach was closely connected to the evolution of the Caloundra tidal delta immediately to the south. In the tidal delta, the main outflow channel migrated northwards and southwards over a distance of about 750m between Caloundra Head and Bribie Island. Historical data (Stephens, personal communication) shows that the outflow channel was hard against the Caloundra shore in 1865 and 1940; in the intervening periods the entrance moved southwards, at times eroding the tip of Bribie Island before returning northwards.“ (p.12)

- “When the outflow channel was in the north, there was an increased demand for sand from Kings Beach for the tidal delta. There was another factor also influencing Kings Beach, namely the effect of the waves. Even when the entrance moved southwards, variations in the angle of the wave crests arriving at the coastline created southward littoral drift. This also removed sand from Kings Beach, adding to its instability.” (p.13)
- “The Kings Beach groyne restricts the losses from Kings Beach itself, but transfers the demand for sand to the coast immediately to the south. This is seen as erosion and instability of the beach between the groyne and the Caloundra inlet.“ (p.13)
- “In the timeframe of the Quaternary Period, the Caloundra headland represents an un-erodible promontory likely to influence coastal alignment to the north and south. Only if there was a sufficient supply of sand for the coast to prograde seawards of the headland would its influence be negated. This has not occurred, and the headland is a rocky promontory with only minimal sand accumulations in pocket beaches such as Kings and Shelly Beaches.“ (p.19)
- “At the beginning of the sea level stillstand period in the mid Holocene, the ocean shoreline most likely lay at the rear of Golden Beach. The northern tip of Bribie Island developed later in the Holocene, and overlies a humic sandrock layer. The sandrock is exposed in the side of the channel on the mainland side of Bribie Island at the northern limit of vegetation.” (p.19)
- “Two sediment transport cells (Inman & Dolan, 1989) comprising sediment sources, transport pathways, and depositional areas influence the Woorim to Point Cartwright coastline. A division of the coastline occurs at Caloundra Head, with one cell to the north, and one to the south. The cell to the south encompasses the sediment budget for the Bribie shore, and this will be discussed first.” (p.22)
- “Prior to the sea reaching its present level Bribie Island lay to the west of a sandy plain that was later to become the North Banks. A shallow lagoon may have separated the two. In the vicinity of the present Caloundra Bar were Pleistocene foredune ridges. A possible scenario is that as the sea rose and began to submerge the deposits, some of the sand was swept westwards. Coastal progradation became possible between central Bribie Island and Golden Beach using this sand. The removal of a surface layer of sand from the North Banks deposit during the transgression may have been a "once only" event. By the time sea level had stabilised, the North Banks were too far offshore to provide any further contribution to the new coast to the west. As well, the development of the channel separating the North banks from the Bribie coast would have prevented any continuation of supply.“ (p.23)
- “On the offshore sand banks, a circulatory pattern of sand movement is observed, with one side being flood tide dominated, and the other ebb tide dominated (Kenyon & others, 1981; Harris & Jones, 1988). This allows a degree of conservation of sediment budget by recycling the bank sand. In contrast, when the migrating tidal channel impinges upon a large emergent bar, namely Bribie Island, only one side of the circulatory pattern can be established; no recycling can occur, and so a net loss of sand takes place along the channel margin. This produces an erosional scarp along the shoreline whereas an offshore bank merely shifts sideways while maintaining it overall shape. The lateral migration of the tidal channel at Woorim appears to be a major factor in the recent erosion of the area.” (p.24)
- “There is little evidence for present day onshore supply from the tidal delta at the southern end of Bribie Island; neither is there evidence for onshore transport in the northern area near Caloundra. However, air photo data show that northward directed bedforms with wavelengths of 100-200m and 500-700m occur in the shipping channel 12km south of Caloundra Head. Sequential sounding data suggests that Hamilton Patches is moving northwards. This information confirms that sediment transport can, and is taking place. However, since the areas where transport is occurring are outside the nearshore zone, there is probably little influence on the sediment budget of the beaches.” (p.24)
- “Littoral drift along Kings Beach is to the south (Figure 37), and sediments moving in the beach and nearshore zones are transported towards the Caloundra Inlet. Although some of these sediments are lost to the littoral transport system by being trapped in the Caloundra Inlet tidal delta, the remainder contributes to the southward movement along Bribie Island. The source of these deposits can only be the nearshore zone south of Caloundra Head. Yet the data indicate very limited sand resources in the nearshore zone, with the only significant bedform moving to the northeast rather than onshore to the northwest. Under these conditions, the prospects for coastal accretion at Kings Beach and along the northern part of Bribie Island are poor.” (pp.24-5)
- “It is uncertain how much sand is transported southwards across the Caloundra Bar. Although tidal currents are substantial in the inlet channel, the ebb tidal delta seawards of the shoreline is comparatively small. The size of the ebb delta is usually determined by a combination of factors such as

sediment transport rate, wave energy, and strength of tidal currents. Caloundra Bar has an added factor in that the estuary in which the flood delta lies - Pumicestone Passage - is a continuous waterway connecting through to Moreton Bay in the south. This may increase the asymmetry of the flood and ebb flows, and contribute to a large flood delta in the passage and a small ebb tidal delta in the nearshore zone. Nevertheless, alongshore transport rates to the south are likely to be small. This is supported by the bedrock and humic sandrock outcrops in the nearshore zone at Kings Beach and along the northern part of Bribie Island. With high transport rates, the outcrops would probably be buried." (p.25)

- "Comparison of air photo data from 1958 and 1972 shows significant modification and expansion of the tidal delta deposits inside the Caloundra Bar during this period. The main outflow channel in 1958 was directed towards the southeast, and was located against the northern vegetated tip of Bribie Island. The channel was approximately 100m wide. By 1972, the channel was positioned further north and had an eastward orientation; erosion had truncated the sand spit attached to the mainland on the northern side, and the channel had enlarged to a width of 400-500m. During this period, the vegetated tip of Bribie Island was also eroded. The erosion was principally on the landward side due to lateral movement of the main tidal channel. Within the tidal delta proper, the main changes were an increase in the size and extent of the shallow sand banks. The growth of the banks restricted the tidal flow, and the channels in 1972 were more numerous and complex than in 1958." (p.25)
- "Between 1958 and 1972, it is estimated that 3-400 000m3 of sand was released by erosion of the northern tip of Bribie Island. During the same period, a net gain of 125-130 000m3 was identified. This accretion occurred mainly as intertidal banks in the estuary. Approximately 220 000m3 was not accounted for. If this sand was supplied to the ebb tidal delta and subsequently removed by littoral drift, the volume may provide a minimum estimate of the littoral drift rate. Over the 14 year period, this provides an average of about 15 000m3 per year. The littoral drift direction indicated by the Kings Beach groyne is to the south, so the littoral drift in the vicinity of the Caloundra Bar may be of the order of 15 000m3 per year to the south." (p.26)
- "South of Caloundra Head, sand may be transferred shorewards from Hamilton Patches towards Kings Beach. This sand could supply the Caloundra Bar and tidal delta, as well as the Bribie shore. However there is no firm evidence to support this. Rather the differences in sediment type between the nearshore zone and Hamilton Patches suggests that the two zones are totally independent." (p.33)

6.5 Declarations

To round out this section on Protection, we note that the Moreton Bay Wetlands received Ramsar designation on 22/10/1993. The source list does include records for three different versions of the Information Sheet on Ramsar Wetlands ('**RIS**') with the first one, dated 1995 [099], providing this declaration date. This recognition and other regulatory protections will be discussed further in subsequent reports, in the context of solutions. Other protection milestones to note include:

- Declaration of the Moreton Bay Marine Park by 1986 [072]
- Bribie Island National Park (including the northern spit) by at least 1995
- The Fish Habitat Area was first declared in 1969

6.6 Suggested messages

The suggested messages from this summary of sources attributed as concerning 'protection' are:

- **Existing protected area designations took substantial time to enact following adoption of recommendations from preceding studies, including further concept refinement.**
- **Declining water quality in the Passage was identified as a concern, with integrated catchment management recommended (possibly adopted) but the record is unclear regarding whether circulation, e.g. due to changes to the bar, may have been a contributing factor.**
- **The conceptual sand transport model for this area is complex, with the Caloundra Headland forming a N/S divide, some potentially interaction between Kings Beach and the bar/entrance, and the North West Channel, as well as other factors, separating the large sand deposits west of the Channel from the Island foreshore, such that there is limited sand transport along the foreshore, potentially a net 15,000 m3/yr southwards from the bar/headland.**

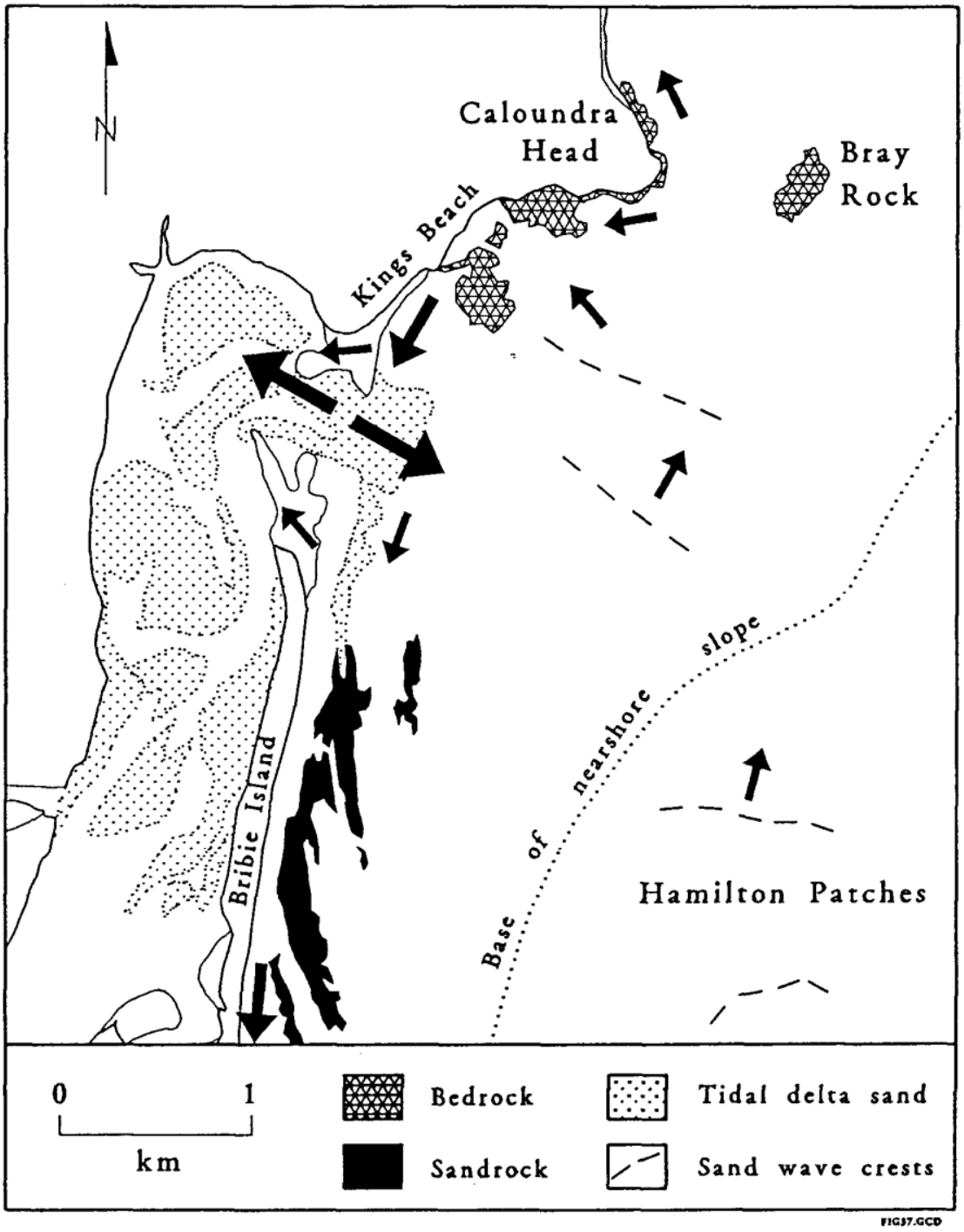


Figure 37: Sediment transport at Caloundra Head. Any sand moving onshore to Kings Beach is supplied wholely from within the nearshore zone. Hamilton Patches sand plays no significant role in the sediment budget of the beaches. Note the sediment transport divide at Caloundra Head with sediment moving away to both the north and south. Sand moving south from Kings Beach contributes to the tidal delta expansion in the inlet. Some also continues further southwards, mixing with the southward moving sand eroded from the Bribie coast. In the Caloundra inlet, recycling of sand enables short term expansion and contraction of the low emerged spits on either side of the entrance.

Figure 19: Figure as well as caption from [084] p.43

7 MANAGEMENT

This section covers the time period between ~1994-2021, and sources 095-162. The suggested theme 'management' reflects the fact that most of the present-day regulatory protections were in place. It does not attempt to fully document or analyse management actions. Rather, it is mostly an overview of activities that arose in relation to managing the protected areas, to the extent of the documents identified for the source list, which was neither exhaustive given time constraints, nor specifically intended to thoroughly document and analyse management activities.

Several sources including the few aerial photos on the source list suggest ongoing erosion of the foreshores in this area as a management concern during the early part of this period. The Moreton Bay and Catchment conference proceedings [104], excerpts of which were introduced early in this chapter (notably by Neil and Lang) are dated 1998.

7.1 An assessment of the stability of the Bribie Island Spit

In 2000 the thesis *An assessment of the stability of the Bribie Island Spit based on studies of geomorphology, sedimentology and shoreline processes* [106] was presented, and the author, Jared Lester, also presented a related paper at the '*PASSCON 2000*' conference, themed '*Science informing catchment management*' [107]. The thesis is a synthesis of previous studies, as well as original field work. We provide the following excerpts from the Abstract, and note that his prediction of the timing of the next breakthrough was relatively accurate:

- "Aerial photograph interpretation indicates erosion of the eastern shore of the spit over the last 60 years as the eastern shoreline has retreated landward by at least 75 m."
- "Sediment budget calculations for the spit system between 1978 and 1993 have indicated an increase in the rate of erosion of the eastern shore of the spit since 1972. Between 1978 and 1993 the eastern shore of the spit experienced erosion at a rate of approximately 144 000 m3/yr with approximately 80% of the eroded sand being deposited in the flood tidal delta of Caloundra inlet. The system experienced a loss of sand of approximately 30 000 m3/yr by littoral and offshore drift, which highlights the negative imbalance in the sediment system."
- "Severe storms constitute the main erosional events impacting on the spit. However, as the rate of erosion has increased since 1972 without a commensurate increase in storm activity, it is suggested a number of other factors are involved in the present erosional regime. They include a reduction in the rate of sediment supply from offshore, an increase in the rate of longshore drift, a rise in sea level, and anthropogenic impacts such as dredging in the inlet and North West Channel."
- "Human impacts on the stability of the spit are confined to localised activities, namely the dredging of sand resources in the flood tidal delta. Although minor volumes of sediment are removed from the system by dredging in comparison to the volumes of sediment moved by natural events, accommodation space is increased. As a consequence, more sand is moved into the passage from the spit."
- "Field observations and analysis of modern processes impacting on the spit shows the spit is presently accreting northward in association with a steady landward retreat of the southern section of the spit. If this trend continues it is likely that the spit will break through somewhere in the vicinity of Fort Bribie. Closure of the present inlet may occur following breakthrough of the spit. If erosion continues at the present rate, a breakthrough of the spit is likely in approximately 50 years. However, if the rate of erosion continues to increase as it has since 1972, breakthrough of the spit may occur in approximately 20 years."

Some additional points he makes are that tidal action is potentially more significant than wave energy to sediment transport in this system, so morphological changes can occur even during times of low storm activity, particularly on the inside of the passage, and that a well developed ebb tide delta (ocean bar) at this location has a substantial impact on the northern spit, refracting waves and promoting southwards transport of sand from the delta to potentially nourish the spit foreshores. However, he also notes other influences, including extension of the northern end westwards into the estuary and stabilisation by vegetation, as well as the build up of sand banks within the interior of the passage. He notes that this could result in a breakthrough to the south across narrow parts of the spit and possibly closure of the northern bar (p.71).

His field work included calculating sand budgets, which he compares to those provided by Jones [084] to conclude that erosion rates have increased (second dot point above). He reports an estimated system loss of 30,000 m3/yr during 1978-93 – that sand being transported into the North West Channel and Moreton Bay

– a doubling of the loss reported by Jones for the period 1958-72. However, the majority of the eroded material, 144,000 m3/yr, roughly 80% is suggested as having been imported into the Passage. He contrasts that with the estimate of 32% Jones provided for the earlier interval. He notes that storm activity for the two intervals was similar, so not likely to be a contributing factor.

He also advises that dredging of the flood tide delta, the sand banks inside the passage, occurred in 1991 (40k m3) and 1999 (25k m3) to provide foreshore nourishment. He acknowledges that these volumes are less than the theoretical deposition, but observes that the dredging potentially creates accommodation space – a 'void' that may encourage transport from the flood delta into the passage, thereby affecting nourishment of foreshores to the south of the bar. He does also note the potential influence of the oyster banks on circulation in the Passage and erosion of the interior foreshores (p.83). Consideration of these observations will be integrated into solution formulation in reports from subsequent parts of this review.

7.2 Sand extraction – Offshore banks

Sources 113-116 are excerpts from the EIS for the Brisbane Airport expansion that concern the extraction of sand from the offshore banks. The EIS advises that 15M m3 of sand from the Middle Banks was considered as a scenario with an expert panel endorsing supporting studies, and that the Queensland Government completed the *Moreton Bay Sand Extraction Study* in 2005, as well as a strategy to coordinate extraction to meet regional demand.

The EIS advises that on the basis of the study the government decided that of the estimated 3,770M m3 of sand available, it would support extraction of 60M m3 over the next 20-years, including 40M m3 for Australia TradeCoast projects (including expansion of the Brisbane Airport and the Port of Brisbane) and an additional 20M m3 to support the construction industry. Sources 142-144 are similarly related to dredging of 1.1M m3 to support extension of the Sunshine Coast Airport. Records related to dredging and sand extraction will be considered further in subsequent reports in the context of solutions.

7.3 Several more management activities

Another relevant thesis was submitted in 2007, *Modelling hydrodynamic processes within Pumicestone Passage, Northern Moreton Bay, Queensland* [117]. It advises the model worked well in the southern estuary, but was problematic in the northern area, with poor quality bathymetric data for that area a possible factor affecting performance. It confirms previous advice about a net northwards movement of water (as opposed to sand). It also advises that the extensive tidal areas inside the northern inlet significantly reduce tidal ranges. From that, we observe that it is reasonable to infer that the breakthrough has affected circulation as it has to some extent had the effect of effectively bypassing these restrictions.

Severe Storms on the East Coast of Australia 1770-2008 is a comprehensive catalogue of known activity [119]. We have not attempted to dissect that data to summarise storm activity relevant to this area; there are no doubt suitable summaries, but with the exception of design considerations related to solutions, we don't see this analysis as critical to the review, noting that the erosional processes are well documented and not limited to severe storm activity. Similarly, we merely reference the report *Effect of the March 2009 Oil Spill on the Moreton Bay Ramsar Site* [120], as well as Climate Proofing Bribie – A Climate Adaptation Action Plan [123] as the shoreline management actions largely concern development of a Shoreline Erosion Management Plan (**SEMP**), which has been developed and is discussed below.

7.4 SCC coastal processes studies, strategies and plans

SCC produced reports in 2009 related to the risk of a breakthrough that we were not able to locate prior to drafting this section of the review [121, 122] but studies they commissioned in 2013 [129, 130, 136] and 2015 [145] related to coastal processes, shoreline management options to address erosion, and a possible breakthrough, such has occurred, including advice on design options and approvals, were reviewed.

Interestingly, the coastal processes report [129] advises that periods of erosion are complemented by periods of accretion, and that the historical data does not provide strong evidence of a trend of ongoing shoreline erosion (p.i). This seemingly conflicts with the presentation above of previous studies. The text in this summary includes further information, so it may be inappropriate to interpret this statement out of context. The report does include some further advice that highlights areas of uncertainty that may merit further exploration:

- "In addition to the low littoral drift rates, onshore sediment supply from the inner shelf may also reduce the magnitude of the shoreline erosion driven by the littoral drift gradients. Recent studies completed by Patterson (2009) for the Gold Coast, approximately 150km south of the Sunshine Coast, indicate that the supply of sediment to the nearshore active profile from the inner shelf may occur in locations where the offshore profile is milder than the equivalent deepwater equilibrium slope. This process is discussed further in Section 2.5." (p.1-10)
- "As mentioned in Section 1.3.1, it is possible that a sediment source from the inner continental shelf may be acting to supply small volumes of sediment to Sunshine Coast beaches. This process has been hypothesised by Roy (2001), Cowell et al. (2001) and Goodwin et al. (2005) and is assumed to occur in areas where the offshore profile slope is flatter than the deepwater "equilibrium" slope, commonly observed to be approximately 1 in 55m (e.g. Patterson, 2009). Figure 2-4 shows relatively flat offshore profiles throughout the study area compared to the deep water equilibrium slope. It is expected that a small supply of sediment from the inner shelf to the active beach system (shallower than approximately -15mAHD) will occur at these locations." (s.2.5)

The report also includes an analysis of aerial photography for the coastline inside the Passage from Bells Creek to Caloundra Bar (s.2.6.2). We won't quote the full set of dot point observations of changes here, although these will be considered in relation to solutions in later reports from this review. In summary, the report advises that changes to the mainland shoreline have been relatively small, but they catalogue actions including clearing, dredging and shoreline protection works at isolated locations. They also include observations from Riedel & Byrne 1979 (a source we have not located yet, but we note that this report was prepared to support an application for a canal development, presumably Pelican Waters) regarding changes to the configuration of the channel. An accompanying illustration is provided, but not included here as the quality of the scan that we have is poor. However, the textual narrative is presented in the report as follows:

a) "In 1940 the coastline consisted of three crenulated bays. Each bay was aligned parallel to an historic channel path. It did not appear in 1940 that any of the channels was actively moving or was carrying a significant part of the tidal current.

b) "By 1958 the middle channel was an active ebb channel and another ebb channel had formed to the south. All traces of the northern channel had been obliterated by the slow movement south of a large sandbank under the influence of the flood current. This caused the southern most point (south of Jellicoe Street) to erode, and the beaches opposite Earnshaw Street to advance.

c) "Between 1958 and 1961 the flood channel had migrated to the left and was still scouring the southern point. The flood tide was moving the sand bar south and straightening the beach between Earnshaw Street and Beattie Street. The large sand bar is being moved south by the flood tide. As the sand spills over into the ebb channel it is swept back out towards the passage entrance.

d) "By 1972 the main ebb channel had moved north and had rotated further to the left. The secondary flood channel still existed but was less well defined because of the southerly movement of a large sandbank under the influence of the flood tide.

e) "In 1974 the ebb channel was continuing to move to the left and was causing a general straightening of the beach. It had eaten into most of what was left on the northern sand bar. The secondary channel still existed, but the sand bars were making it less well defined. Natural movements of the beach are now restricted because of rock placed at the eroding parts of the beach.

f) "By 1977 the main channel had started to veer to the right and sand was building up opposite McLean Street. The apparent reason for this is that as the main entrance bar has moved north, Bulcock Channel has taken more of the flood tide, and there has been a resurgence of the sand bar opposite McLean Street, fed by the flood tide from Bulcock Channel. The increased sand had deflected the ebb channel to the right. This has allowed the beaches to grow between Beattie Street and Earnshaw Street."

The 2015 report advises that tidal effects following a breakthrough would depend on the location of the breakthrough, with locations further south along the spit, such as opposite Lamerough Canal, expected to cause more severe tidal impacts on foreshore residents and assets. Accordingly, the plan identifies a range of escalating actions and triggers to guide an investment plan. Primarily, we note that these studies, as well as others discussed below, demonstrate that SCC has been concerned and taken action well in advance of this breakthrough to identify advance mitigation options and be able to provide an informed response when necessary. Whilst the time period and suggested sources for this section do include other detailed plans progressed by SCC, we will defer discussion of those to the subsequent reportss as they provide important considerations regarding the design of solutions.

This document is one of the few sources we located which provides an estimate of historical coastal foreshore recession rates. The body of the document provides an estimate of 2m/yr for 1970-84, citing a 1992 BPA report that we were unable to locate [082]. Note that this rate is approximately double the rate referenced above for the Gold Coast, with that previously discussed report suggesting that the Sunshine Coast should be similar [040]. The 2015 report also includes some fact sheets, as appendices, from the Pumicestone Passage Advisory Task force, which advise an erosion rate of 1m/yr, as well as possible loss in a single year of up to 10m. These various estimates are potentially based on different time periods (the fact sheet does not cite the source of the estimate, nor the time period to which the estimate applies).

7.5 Coastal processes – Further considerations

The date for *Indurated sand horizon influences present day coastal geomorphology of nearshore Northern Moreton Bay, South-East Queensland, Australia* [155] is uncertain, as it is labelled as a presentation for 2020 event, but mentions 'the site of the southern breakthrough' which would suggest a post-2022 date, however, it also discusses two breakthrough sites (south and north) and the photos do not show a breakthrough, so these may simply be erosion areas that could lead to breakthroughs. The presentation concerns the collection of data (sub-bottom acoustics) to identify the location of indurated sands ('coffee rock') in the offshore area. Reports reviewed earlier included advice that the visible presence of these features suggests that the nearshore area is deprived of sand (otherwise they would likely be covered). In conclusion, the observation is made that the coffee rock is not continuous in the offshore environment and that greater erosion could be expected in areas where it is absent as the exposed coffee rock has the potential to attenuate wave energy and runup.

As a final contribution to this section, we discuss the relatively complex technical paper *Shelf sand supply determined by glacial-age sea-level modes, submerged coastlines and wave climate* [157]. The authors determined the configuration of the shoreline when the sea level was 40m and 60m below present day levels, and identify the wave climate variations contributing to sediment transport during the respective periods. They suggest that: "The paleoshoreline and shelf evolution is key to understanding the distribution of present-day shelf sand deposits and the contemporary sand budget response to future wave climate changes." Perhaps controversially, they conclude that: "Our results indicate that wave climate variability in the subtropical to mid-latitudes is far more variable than previously thought... The assumption that the modal wave climate for the past half century is the best baseline for predicting future coastal change is flawed." We did attempt to contact the corresponding author to discuss their findings but were unable to speak with them. We note that this is simply additional evidence of the complexities and uncertainties associated with this issue.

7.6 Suggested messages

The suggested messages from this summary of management matters are that:

- **Despite a number of investigations, uncertainties remain regarding sand transport processes in this area, as well as debate, an inherent element of the scientific process, regarding the most appropriate models for predicting likely future changes arising from climate change.**
- **SCC has progressed planning in relation to coastal hazards in accordance with Queensland Government coastal policies, as well as specific investigations related to a potential breakthrough since at least 2013.**

8 RESPONSE

This final section of the first report from this review briefly summarises actions that have been progressed since the first breakthrough, from 2022 to the present, considering sources 163-200. These sources include actions by SCC that were already in progress prior to the breakthrough with the documents released afterwards, as well as investigations that they brought forward in response to the breakthrough. These are briefly noted below and will be more thoroughly addressed in this review by integrating them with proposed solutions in subsequent reports.

8.1 SCC recent activities

SCC's suite of related 'documents' includes the *Environmental and Liveability Strategy* (**ELS**) which was 'refreshed' in 2023 [181], under which sits the *Coastal Hazard Adaptation Strategy* (**CHAS**), the 2024 draft *Healthy Coast Management Plan* (**HCMP**) [192-194] and the *Shoreline Erosion Management Plan* (**SEMP**) [187]. Our source list includes the ELS *Project engagement summary* [182] and the 2025 *Draft Healthy Coast Management Plan and Shoreline Erosion Management Plan Community Engagement Summary* [199].

8.1.1 SCC CHAS

The SCC CHAS is dated 2021 [162], prior to the breakthrough (a washover did occur in 2021, but the CHAS had no doubt been under development for some time when that occurred). It introduces the QCoast minimum standards and guidelines which include an eight-phase process for preparing a plan to effectively respond to predicted climate change impacts in the coastal environment. It includes discussion at the locality level, with the Passage foreshore comprised of seven localities between the northern entrance (Locality 21: Kings Beach) and Bells Creek (Locality 27: Lamerough Canal to Bells Creek).

It is worth noting that Glass Mountain Creek, approximately 16km south of Bell's Creek (straight line measure) marks the southern boundary of SCC at this location, with Bribie Island divided roughly east/west between SCC and Moreton Bay Regional Council (**MBRC**). The road/bridge to the Island, canal estate and urban development on the Island, as well as the previously discussed erosion issues at the southern end of the Island, which is exposed to Deception Bay and directly connected to the Moreton Bay, are within the MBRC Local Government Area (**LGA**). The northern portion of Bribie Island that resides within the SCC LGA consists of protected areas that are largely controlled by the State. The narrowest part of the Passage, the 'skids', which is a 'null point' tidally, is within the SCC LGA.

The CHAS recognises the potential for foreshore erosion and tidal changes, and adaptation pathway options are identified for each locality, categorised into four themes:

1. Enhancing adaptive capacity
2. Planning
3. Modifying infrastructure
4. Coastal management and engineering

Examples of adaptation options from these themes that are listed for those seven localities include:

- maintenance and upgrade of groynes and foreshore protection works
- reviewing planning controls
- resilient homes
- drainage upgrades
- beach nourishment
- additional protection for the access road
- risk mitigation at Fraser Park
- mangrove protection and enhancement
- investigation of flood solutions for Pelican Waters

8.1.2 SCC SEMP and CHAPPi

The SCC *draft* SEMP 2025-35 is dated 2024, being an update of the 2014 SEMP [141]. The SEMP, as well as the 2025 *Golden Beach and Caloundra (Bulcock Beach) CHAPP Investigations - Community engagement summary* [198] provide the most current, detailed planning by SCC that is publicly available regarding management of the foreshore that is now exposed to changes arising from the breakthrough. They collectively provide fundamental considerations for any solutions we propose, as these documents arise from detailed consideration (spanning a longer interval than allocated for this review), consultation, and intricate knowledge regarding SCC foreshore infrastructure assets, as well as considerations such as management of flooding.

Accordingly, any solutions we develop will seek to integrate with that planning, including adopting those actions on the foreshore as a baseline, identifying any recommendations we may be able to make to facilitate appropriate, including timely, implementation, as well as ensuring that any components of our solutions that are based in the adjoining waters of the Passage work in synergy with shoreline management. As appropriate, we may also collaborate with SCC to modify those actions if the 'offshore' solutions we develop provide opportunities that SCC may not have included in their assumptions due to lack of jurisdiction, or may have slated for a future date due to the time required to engage the QG or other stakeholders, with this review offering the potential to promote more comprehensive solutions sooner.

8.2 Review of Causes of Northern Bribie Island Erosion

The *Review of Causes of Northern Bribie Island Erosion* [172] responded to a brief from the Department of Environment and Science (**DES**). It reports that natural processes were the most significant contributor, both within the Passage (channel migration due to sand shoal growth) and on the open coast (wave action with inadequate replenishment supply). Dredging of the nearshore and offshore areas was dismissed as a contributing factor due to a lack of supporting evidence. Vessel wash and propeller turbulence were found to contribute, but at an insignificant level, with waves from vessels breaking on the foreshore having relatively low energy compared to total wave energy received on that shore. Finally, Lamerough Canal was investigated through modelling with no contribution detected.

8.3 Coasts & Ports conference papers

Two papers for the Australasian Coasts & Ports 2023 Conference, held on the Sunshine Coast, relate to the breakthrough. *Bribie Island Breakthrough – A dynamic coastal system* [184] includes a discussion of work commissioned by Maritime Safety Queensland (**MSQ**) to investigate options for improving navigational access. It also provides advice about Queensland Government work that anticipated a breakthrough between 2012 and 2017 (Sultman 1997, not identified in our source searches). MSQ obtained satellite-derived bathymetry and combined it with other data sets to derive Digital Elevation Models (**DEM**s) for three dates, one being 8-months prior to the breakthrough, and the other two 7 and 10-months post breakthrough. These were used in a hydrodynamic model, followed by a sediment transport model. Ongoing evolution of the breakthrough restored navigational access such that no actions were necessary. However, the modelling indicated that a dredged channel would likely be unsustainable (subject to shoaling).

The second paper *Change in bathymetry and tidal dynamics after the Bribie Island breakthrough* [174] documents tidal changes, including increased flows through the northern entrance, increased range and altered form. The tidal range was found to have increased by 0.46m in the northern section near the breakthrough, inclusive of a decrease in mean-low-water of -0.21m and an increase in mean high-water of 0.23m. South of the breakthrough, the tidal range changed across a gradient from 0.57 to 0.06m compared to the historic tidal range. The tidal form is reported as being more semidiurnal in nature within the passage, changing from strong diurnal to weak diurnal in the northern section.

8.4 DES coastal processes and water quality assessment

As a final note, the *Bribie Island Breakthrough – Coastal Processes and Water Quality Assessment* [175] advises long-term monitoring by DES indicates a coastal shoreline erosion rate of 1-2m/yr, which brackets the above discussion of differences between the two estimates included in the 2015 report [145]. As discussed above, Lester [106] suggested that erosion rates resulting from his work indicated an increased rate (double) of erosion for the period he considered, compared to previous estimates for a prior period of time (Lester provides loss in volumetric terms – m3/yr – not as recession rates – m/yr).

8.5 Suggested messages

The suggested messages from this summary of 'response' activities are that:

- **SCC has progressed plans, in partnership with the community, relevant to concerns that this review is intended to address, and the success of any solutions we propose is dependent on their support in both development of appropriate solutions, as well as, no doubt, contributing to the coordinated implementation of any actions that the QG may choose to adopt.**
- **Accordingly, this review will progress collaboratively, with SCC officers and QG officers asked to contribute as appropriate throughout the review process.**
- **The previous review to this one had ToR that were limited to causes of the erosion and is therefore complementary, as is other work by QG departments to understand changes to tidal dynamics and options for ensuring navigational access. We will seek to integrate those contributions as we fulfill the broader scope of our ToR, which specifically includes solutions, as well as community consultation.**

Appendix A – Terms of Reference

Bribie Island Erosion and Breakthrough Review

Terms of reference – April 2025

Background

Ongoing erosion, has severely narrowed the width of the northern tip of Bribie Island, creating several weak points. In 2022, large waves cut a new channel through the weakest part of the northern tip of Bribie Island opposite Nelson Street, Golden Beach. This channel rapidly widened and became a new opening to the ocean. Soon after, the original Caloundra Bar closed over. This body of water has constrained the Caloundra Coast Guard, preventing access to the southern passage and open ocean.

Further severe weather caused by Tropical Cyclone Alfred in 2025 has further widened the 2022 breakthrough and caused more damage, including extensive erosion to the foredune at Lions Park. This event also created a second breakthrough south of Lions Park. These events have heightened residents' and businesses' concerns about future risk and impacts, given the Northern tip of Bribie Island has traditionally shielded Caloundra from effects of severe weather.

The Queensland Government committed to conducting an expert, independent review to investigate ongoing erosion, previous break through events and the impacts these have had on Bribie Island. Immediate and long-term recommendations will be developed and consultation with the Local Government, community organisations and local community will occur to assure that their concerns have been heard and are being actioned.

Scope

Issues and areas expected to be included in the review include, but are not limited to:

- Developing urgent recommendations to stabilise the situation for consideration by Government
- Undertaking a desktop review of previous reports and studies relating to the cause and impacts of the long-term erosion of the island and the breakthroughs in 2022 and 2025
- Identifying causes for the ongoing erosion of the island and subsequent wash overs and breakthroughs
- Identifying impacts of the breakthroughs on the natural protection of Caloundra including residents, business, recreational boating, and the Coast Guard.
- Assessing the impact of dredging and shipping channel operations in Moreton Bay that affect Bribie Island including on sand migration.
- Considering natural and anthropogenic changes contributing to island erosion across mainland catchment areas and Moreton Bay that affect Bribie Island.
- Developing long term recommendations to reduce risk of further damage, including to mainland foreshore, infrastructure, and waterways, preserve Bribie Island and maintain navigation through Pumicestone Passage
- Undertaking consultation with Local Government, Federal Government and the local community on short- and longer-term solutions.
- Any other relevant matters the independent reviewer considers appropriate to the review

Report

The output from the review is the final report. The report will include review of existing analysis, outcomes of consultation and short- and long-term recommendations. The review report will be compiled for submission to the Deputy Premier, Minister for State Development, Infrastructure and Planning and Minister for Industrial Relations. A critical element of the scope is that recommendations for immediate action can be made prior to the completion of the final report. Following approval, the final summary report may be published.

Public engagement

Community consultation will ensure transparency and that community views are representative of the local population. This will include a project webpage for written submissions and locally led community forums.

Appendix B – Authors and Contributors

Authors

An audience deserves to know something about the author. This review is the product of a team ('we') represented by two companies, RPS and ICM. RPS was founded in 1970 by a passionate team of academics in Oxfordshire, United Kingdom, and has been operating in the Australia Asia Pacific region since 2003. RPS is part of Tetra Tech Inc, which was founded in 1966 to provide engineering services for waterways, harbours, and coastal areas in the United States. Tetra Tech operations are global and include ~30k employees, however, this review is largely the independent voice of one RPS employee, Brian McRae.

Brian's relevant experience to contribute to this review includes three decades managing coastal and environmental matters in California (Los Angeles, including initiatives related to the L.A. River and the Santa Monica Bay), New South Wales (Sydney's Northern Beaches) and Queensland (including managing the Gold Coast Seaway, Sand bypass system, and navigational channel network), as well as involvement throughout his career in disaster management. His perspective includes training as a naturalist, biologist, environmental planner, and public sector manager. He attributes key achievements in his career to a passion for improving 'systems', including the complex dynamics between ecosystems, governance, economy and, importantly, relationships.

RPS supported Brian with his contributions to this review in a number of ways. Notable support was provided by Brad Williams, Practice Leader - Place (Sunshine Coast), who contributed insight regarding local community dynamics and context. He brings more than 28 years' experience as an urban planner and development consultant, and a deep appreciation of the Sunshine Coast community and environs. His key experience and abilities stem from his direction of large master planned communities, complex urban development projects, emerging regional communities and the drafting of statutory planning instruments.

ICM originated on the Gold Coast and earned global recognition for leading approaches to coastal resilience that rely on nature-based engineering solutions. As a Gold Coast City Council engineer in the 1980s, ICM founder Angus Jackson contributed to the pioneering of this approach, which is founded on Queensland Government investigations in the 1970s ('Delft report') pursuant to coastal storm damages. The Gold Coast Seaway, the GC and Tweed sand bypass systems, and the management of the Gold Coast shoreline originate from this early initiative. ICM has a strong history of innovation in coastal and waterfront design and delivery of cost-effective solutions globally.

Aaron Salyer, Director and Coastal Engineer, partnered with Brian to direct this project, and led the efforts of the team from International Coastal Management (ICM). Aaron's focus is on leading efforts to protect and restore coastal ecosystems, and in particular enhancing community resilience to ocean hazards. Through innovative engineering, he aims to implement nature-based solutions that promote multifaceted benefits. His goal is to foster a profound shift in how society values and interacts with coastal environments, promoting sustainable development and marine conservation worldwide. Aaron is also an expert panellist for the United Nations Ocean Decade.

Contributors

The Department of State Development, Infrastructure and Planning provided invaluable assistance to facilitate the delivery of this review, including supporting RPS/ICM throughout to successfully apply an agile delivery methodology, including organising a Queensland Government Technical Working Group (**TWG**). A separate working group of Sunshine Coast Council officers with relevant subject matter expertise was formed and operated in parallel with the QG TWG. Both groups assisted with the identification of relevant sources, and through reviewing and commenting on draft outputs. Agencies represented include:

- Department of State Development Infrastructure and Planning
- Department of Premier and Cabinet
- Queensland Treasury
- Department of Environment, Tourism, Science and Industry
- Department of Primary Industries
- Department of Resources, Mining, Manufacturing and Regional Development
- Department of Transport and Main Roads, Maritime Safety Queensland
- Queensland Reconstruction Authority
- Sunshine Coast Council

Appendix C – Source list

[001] 1825, Chart of coastline from Byron to Bribie Island, Moreton Bay District, surveyed by Lieut. Sterling. No scale given. ca 3 nautical miles to the inch, CTH, Queensland State Archives Item ID 620617, https://www.archivessearch.qld.gov.au/items/ITM620617

[002] 1885, General plan Pumice Stone Passage: to accompany my report dated 31st Jan. 1885, Williams, C, QG-Parliament, https://catalogue.nla.gov.au/catalog/2932257

[003] 1891, Report on the Department of Ports and Harbours to Parliament for the Year 1890-91, QG [DPH], Department of Ports and Harbours, State of Queensland, sourced from Project Gutenberg eBook, https://www.gutenberg.org/cache/epub/24442/pg24442-images.html

[004] 1897, Australia-East coast Queensland, Moreton Bay-Northern portion, Great Britain Hydrographic Department, Northern entrances by E. A. Cullen, Nautical Surveyor, 1891, https://nla.gov.au/nla.obj-230057663/view

[005] 1897, Pumicestone Channel from Bribie Island Jetty to Caloundra, QG, Date uncertain, listed as 1890-2003, Queensland State Archives, Item ID 887106, https://www.archivessearch.qld.gov.au/items/ITM887106

[006] 1900, Caloundra Panorama, QG, Brisbane John Oxley Library, State Library of Queensland, https://collections.slq.qld.gov.au/viewer/IE4184580

[007] 1901, View of Bribie Island from the Caloundra Lighthouse, Queensland, ca. 1901, QG, Brisbane John Oxley Library, State Library of Queensland, https://collections.slq.qld.gov.au/viewer/IE258358

[008] 1925, Moreton district 2 mile map. Sheet 3, QG [QSO], Queensland Survey Office, State of Queensland, https://collection.sl.nsw.gov.au/record/74VKD7oELqE3#viewer

[009] 1935, Bribie Passage, QG, Postcard in: Queensland Places, https://www.queenslandplaces.com.au/exhibit/postcard-folder/pc0069

[010] 1940, Aerial photo (Annotated by PPCMB), QG [BPA], Beach Protection Authority, State of Queensland

[011] 1942, Bribie 40 chains to an inch Mine map Provisional, QG [GSQ], Geological Survey of Queensland, State of Queensland, https://geoscience.data.qld.gov.au/data/map-collection/mr007081

[012] 1945, Beacon chart. Moreton Bay south. Pumicestone Channel, Australian Army, Survey Corps, Compiled and drawn by Sgt. E.R. Hooper from aerial photographs, https://catalogue.nla.gov.au/catalog/2164147

[013] 1949, Oyster stick culture, QG, Brisbane John Oxley Library, State Library of Queensland, https://collections.slq.qld.gov.au/viewer/IE154770

[014] 1950, Bribie Island [cartographic material] Military bases [flown 1940-1950], CTH, National Library of Australia, https://catalogue.nla.gov.au/catalog/4602106

[015] 1957, Bribie Island preliminary report - EPM65, Pitman, D, D.Pitman, consulting geologist, including sample analysis advice from Geological Survey of Queensland

[016] 1958, SAND REMOVALS - BRIBIE ISLAND - TRANSFER BATCH 1, QG [BPA], Beach Protection Authority, State of Queensland, Queensland State Archives, Item ID 843031, https://www.archivessearch.qld.gov.au/items/ITM843031

[017] 1958, Aerial photo - Caloundra - Coast-Key, QG [DERM], Q743-8, QImagery, State of Queensland

[018] 1958, Aerial photo - Caloundra - Run 4, QG [DERM], Q745-122, QImagery, State of Queensland

[019] 1958, Aerial photo - Caloundra - Run 3, QG [DERM], Q770-38, QImagery, State of Queensland

[020] 1961, Town of Caloundra on the Sunshine Coast, QASCO, Brisbane John Oxley Library, State Library of Queensland, https://collections.slq.qld.gov.au/viewer/IE1398270

[021] 1961, Aerial photo - Contour Plan in Bribie Island - Pumicestone Passage Investigation (Annotations by PPCMB), QG [BPA], Beach Protection Authority, State of Queensland

[022] 1963, Project Feasibility Report - Rutile, Zircon extraction from Bribie Island Sands, McMynn, J, N.D. Lea & Associates Ltd Consulting Engineers to Kootenay Base Metals, Vancouver, B.C.

[023] 1963, QTS (Queensland Topographic Survey) - Bribie Island; 1:100,000 map 9543, QG [QTS], Queensland State Archives, Item ID 3009032, https://www.archivessearch.qld.gov.au/items/ITM3009032

[024] 1967, CALOUNDRA - NORTH BRIBIE ISLAND - SEA BREAKTHROUGH, QG, Queensland State Archives, Item ID 887161, https://www.archivessearch.qld.gov.au/items/ITM887161

[025] 1968, Co-ordinator General of Public Works - Co-ordinator General Works Section - Cooperation With Harbours and Marine - Departments - Bribie Passage - Caloundra, QG [DCG], Department of the Co-Ordinator General, State of Queensland, Queensland State Archives Item ID 2286023, https://www.archivessearch.qld.gov.au/items/ITM2286023

[026] 1969, EPM 605 Exploration and Proposed Development of Offshore Beach Sands Along the East Coast of Australia, Planet Management, Sourced from Geological Survey of Queensland Open Data site, State of Queensland, https://geoscience.data.qld.gov.au/data/report/cr004436

[027] 1969, Airphoto Mosaic of Bribie and North Moreton Bay Sandbars, QG, Queensland State Archives, Item ID 1380702, https://www.archivessearch.qld.gov.au/items/ITM1380702

[028] 1969, Map of Bribie Island Showing Geological, QG, Queensland State Archives, Item ID 1380986, https://www.archivessearch.qld.gov.au/items/ITM1380986

[029] 1969, Beach Erosion, North Coast, Bribie Is Northern End, Eta 468 to 479 Beach Profiles - Survey, QG [BPA], Beach Protection Authority, State of Queensland, Queensland State Archives, Item ID 1378839, https://www.archivessearch.qld.gov.au/items/ITM1378839

[030] 1970, Aerial view of Caloundra and Pumicestone Passage, QG, Postcard in: Queensland Places (date uncertain), https://www.queenslandplaces.com.au/node/13578

[031] 1970, Overlooking Caloundra, showing Pumicestone Passage and the northern tip of Bribie Island, QG, Postcard in: Queensland Places (date uncertain), https://www.queenslandplaces.com.au/node/13641

[032] 1970, MORETON BAY - BRIBIE ISLAND TO WELLINGTON POINT, QG, Queensland State Archives, Item ID 887293, https://www.archivessearch.qld.gov.au/items/ITM887293

[033] 1970, Beach Erosion North Coast - Locality Plan of Sub A of Por 13a Parish - Bribie Beach Replenishment, QG [BPA], Beach Protection Authority, State of Queensland, Queensland State Archives Item ID 1378979, https://www.archivessearch.qld.gov.au/items/ITM1378979

[034] 1971, Parish of Bribie, QG, Brisbane Land Agent's District, State of Queensland, National Library of Australia - 1999387922

[035] 1972, Survey of the Major Islands of Moreton Bay, QG [CG], Department of the Coordinator General, State of Queensland

[036] 1973, Aerial photo - Pt. Danger-Inskp Pt - Beach storm damage, QG [DNRM], QImagery, Q2649-104, State of Queensland

[037] 1973, Aerial photo - Pt. Danger-Inskp Pt - Beach storm damage, QG [DNRM], QImagery, Q2649-110, State of Queensland

[038] 1973, Aerial photo - Pt. Danger-Inskp Pt - Beach storm damage, QG [DNRM], QImagery, Q2649-111, State of Queensland

[039] 1974, Beach Erosion Control District Schemes, Landsborough Shire, QG [BPA], DC Patterson for the Beach Protection Authority, State of Queensland, https://qldgov.softlinkhosting.com.au/liberty/opac/search.do?mode=BASIC&openDetail=true&action=search&queryTerm=uuid%3D%225b0d5d4cc0a81410003576ec1cb77ec6%22&editionUuid=5b0d5d4cc0a81410003576ec1cb77ec6&operator=OR&_open=1

[040] 1974, Coastal Management Investigation, Queensland - New South Wales border to northern boundary of Noosa Shire - v.1 Summary and recommendations, QG [CG], Gutteridge Haskins & Davey for Co-Ordinator General's Department, State of Queensland, https://geoscience.data.qld.gov.au/data/report/cr006769

[041] 1974, Coastal Management Investigation, Queensland - New South Wales border to northern boundary of Noosa Shire - v.2 Wetlands and aquatic investigation, QG [CG], Gutteridge Haskins & Davey for Co-Ordinator General's Department, State of Queensland, https://geoscience.data.qld.gov.au/data/report/cr006769

[042] 1974, Coastal management Investigation, Queensland - New South Wales border to northern boundary of Noosa Shire - v.3 Land use investigation, QG [CG], Gutteridge Haskins & Davey for Co-Ordinator General's Department, State of Queensland, https://geoscience.data.qld.gov.au/data/report/cr006769

[043] 1974, Coastal management Investigation, Queensland - New South Wales border to northern boundary of Noosa Shire - v.4 Engineering investigation of canals, QG [CG], Gutteridge Haskins & Davey for

Co-Ordinator General's Department, State of Queensland, https://geoscience.data.qld.gov.au/data/report/cr006769

[044] 1975, The northern tip of Bribie Island and Pumicestone Channel, Kuskopf, B (Publisher), Postcard in: Queensland Places, https://www.queenslandplaces.com.au/exhibit/postcard-folder/pc0229

[045] 1975, Northern tip of Bribie Island and Pumicestone Channel, Kuskopf, B (Publisher), Postcard in: Queensland Places, https://www.queenslandplaces.com.au/exhibit/postcard-folder/pc0229

[046] 1975, Sunshine Coast, Bribie Island - Current Measurement Eta Lines 440 3 Sept 1975 Survey, QG [BPA], Beach Protection Authority, State of Queensland, Queensland State Archives, Item ID 1380465, https://www.archivessearch.qld.gov.au/items/ITM1380465

[047] 1975, Sunshine Coast, Bribie Island - Current Measurement Eta Lines 476 4 Sept 1975 Survey, QG [BPA], Beach Protection Authority, State of Queensland, Queensland State Archives, Item ID 1380466, https://www.archivessearch.qld.gov.au/items/ITM1380466

[048] 1975, Sunshine Coast, Bribie Island - Current Measurement Eta Lines 476 16 Sept 1975 Survey, QG [BPA], Beach Protection Authority, State of Queensland, Queensland State Archives, Item ID 1380467, https://www.archivessearch.qld.gov.au/items/ITM1380467

[049] 1975, Coastal management investigation, South-east Queensland , Traves, N, et al, Paper for Second Australian Conference on Coastal and Ocean Engineering, 1975: The Engineer, the Coast and the Ocean, Institution of Engineers, Australia, https://search.informit.org/doi/epdf/10.3316/informit.913493769461883

[050] 1976, Quaternary Geology of the Sunshine Coast, South-East QLD, QG [GSQ], Geological Survey of Queensland, State of Queensland, https://geoscience.data.qld.gov.au/data/report/cr041985

[051] 1977, Moreton Bay - North West Channel - Post dredging to 13m clearance (sheet 1), QG [DHM], Department of Harbours and Marine, State of Queensland, Queensland State Archives Item ID 887428, https://www.archivessearch.qld.gov.au/items/ITM887428

[052] 1977, Moreton Bay - North West Channel - Post dredging to 13m clearance (sheet 2), QG [DHM], Department of Harbours and Marine, State of Queensland, Queensland State Archives Item ID 887429, https://www.archivessearch.qld.gov.au/items/ITM887429

[053] 1978, Pumicestone Passage: A living waterway, McArthur, Kathleen, Caloundra, Qld, https://ehive.com/collections/203532/objects/1667338/pumicestone-passage-a-living-waterway

[054] 1978, The Northern Entrance to Moreton Bay, Stephens, A.W., Papers of the Department of Geology, University of Queensland, Vol. 8(2): 25–43, https://espace.library.uq.edu.au/view/UQ:10889

[055] 1979, Pumicestone Passage - Water Quality and Land Use Study - Newsletter, QG [DPC], Department of Premier and Cabinet, State of Queensland, Queensland State Archives Item ID 2560123, https://www.archivessearch.qld.gov.au/items/ITM2560123

[056] 1979, Pumicestone Passage : Water Quality and Land Use Study Interim Report, QG [DPC], Queensland State Archives, Item ID 2560118, https://www.archivessearch.qld.gov.au/items/ITM2560118

[057] 1979, Estuarine and tidal study proposed canal development Caloundra, Queensland , Riedel and Byrne, Prepared for Cardno and Davies Pty Ltd

[058] 1980, EIS for Golden Beach Estate, Caloundra, QG [DHM], Letters - 1980 and 1987 - Department of Harbours and Marine and Cardno & Davies

[059] 1981, Sunshine Coast - Vegetation Study - Bribie Island - Mermaid Lagoon to Caloundra, QG [BPA], Beach Protection Authority, State of Queensland, Queensland State Archives Item ID 380554, https://www.archivessearch.qld.gov.au/items/ITM1380554

[060] 1982, Pumicestone Passage water quality and land use study - v.1 Summary report of the inter-departmental committee advising on the question of further urban development adjacent to Pumicestone Passage, QG [CG], Report of the inter-departmental Committee, Co-Ordinator General, , State of Queensland, Queensland State Archives, Item ID 2560114, https://www.archivessearch.qld.gov.au/items/ITM2560114

[061] 1982, Pumicestone Passage water quality and land use study - v.2 Water quality and circulation in the passage, QG [CG], Report of the inter-departmental Committee, Co-Ordinator General, , State of Queensland, Queensland State Archives, Item ID 2560115, https://www.archivessearch.qld.gov.au/items/ITM2560115

[062] 1982, Pumicestone Passage water quality and land use study - v.3 Conservation interests: marine and terrestrial, QG [CG], Report of the inter-departmental Committee, Co-Ordinator General, , State of Queensland, Queensland State Archives, Item ID 2560116, https://www.archivessearch.qld.gov.au/items/ITM2560116

[063] 1982, Pumicestone Passage water quality and land use study - v.4 Land use and planning options, QG [CG], Report of the inter-departmental Committee, Co-Ordinator General, , State of Queensland, Queensland State Archives, Item ID 2560117, https://www.archivessearch.qld.gov.au/items/ITM2560117

[064] 1983, Dredgeability of the North East Channel, Stephens, A, et al, Record 1983/69, Geological Survey of Queensland, State of Queensland, https://geoscience.data.qld.gov.au/data/dataset/cr041944/resource/geo-doc1177960-cr041944

[065] 1984, Memo To- Members of the Bar Stabilisation Committee, Caloundra Chamber of Commerce & Industry

[066] 1984, Caloundra Broadwater proposal, Cardno & Davies, Possibly an internal memo (unclear) which includes a sketch showing an entrance approximating the recent breakthrough, with the former bar closed (beach)

[067] 1984, Pumicestone Passage Marine Park Proposal, QG [CG], The Coordinator General, State of Queensland, Queensland State Archives Item ID 2560149, https://www.archivessearch.qld.gov.au/items/ITM2560149

[068] 1984, Bribie Island and Pumicestone Passage Position Paper to March 1984, QG [DPC], Department of Premier and Cabinet, State of Queensland, Queensland State Archives, Item ID 2560148, https://www.archivessearch.qld.gov.au/items/ITM2560148

[069] 1985, Bribie Island / Pumicestone Passage. - Sir Joh Bjelke-Petersen, QG [Cabinet], Queensland State Archives, Item ID 2447354, https://www.archivessearch.qld.gov.au/items/ITM2447354

[070] 1986, Bribie Island, Pumicestone Passage. - Sir Joh. Bjelke-Petersen, QG [Cabinet], Queensland State Archives, Item ID 2625705, https://www.archivessearch.qld.gov.au/items/ITM2625705

[071] 1986, Proposed National and Environmental Parks, Bribie Island. - Sir Joh. Bjelke-Petersen, QG [Cabinet], Queensland State Archives, Item ID 2627661, https://www.archivessearch.qld.gov.au/items/ITM2627661

[072] 1986, Pumicestone Passage Marine Park Zoning Plan, QG [CG], The Coordinator General, State of Queensland, Queensland State Archives Item ID 2560147, https://www.archivessearch.qld.gov.au/items/ITM2560147

[073] 1986, Harbours & marine : port & harbour development in Queensland from 1824 to 1985, QG [DHM], Department of Harbours and Marine, State of Queensland, https://catalogue.nla.gov.au/catalog/892839

[074] 1987, Plans to Sand Mine Moreton Bay and Dredging of Channel - Denison Resources, QG [DHM], Department of Harbours and Marine, State of Queensland, Queensland State Archives Item ID 3339651, https://www.archivessearch.qld.gov.au/items/ITM3339651

[075] 1988, Proposed National Park and Environmental Park, Parish of Woorim - Bribie Island. - Mr W.H. Glasson, QG [Cabinet], Queensland State Archives, Item ID 3000804, https://www.archivessearch.qld.gov.au/items/ITM3000804

[076] 1988, Sand pumping operation on Bribie Island 9.9.88, QG [DPC], Queensland State Archives, Item ID 3368323, https://www.archivessearch.qld.gov.au/items/ITM3368323

[077] 1989, Executive Council Minutes 4707 - Reservation of Land in the Parish of Bribie for Environmental Park Purposes, QG [EC], Queensland State Archives, Item ID 2700120, https://www.archivessearch.qld.gov.au/items/ITM2700120

[078] 1990, Executive Council Minutes 1780 - Acquisition of Special Lease on Bribie Island, QG [EC], Queensland State Archives, Item ID 2700167, https://www.archivessearch.qld.gov.au/items/ITM2700167

[079] 1990, Executive Council Minutes 2022 - Acquisition of Special Lease on Bribie Island, QG [EC], Queensland State Archives, Item ID 2700169, https://www.archivessearch.qld.gov.au/items/ITM2700169

[080] 1990, Report on Holocene coastal evolution of southern Bribie Island, QG [GSQ], Geological Survey of Queensland, State of Queensland

[081] 1992, Moreton Bay in the balance, Crimp, O, The Australian Littoral Socient Inc., https://ourstory.recollect.net.au/nodes/view/15623

[082] 1992, Report on recent coastal changes near the northern end of Bribie Island and possible sedimentation in Pumicestone Passage, QG [BPA], Coastal Management Branch, Beach Protection Authority, State of Queensland, https://qldgov.softlinkhosting.com.au:443/liberty/OpacLogin?mode=BASIC&openDetail=true&corporation=DERM&action=search&queryTerm=uuid%3D%225b41cb7ac0a81410018310b9357e7954%22&editionUuid=5b41cb7ac0a81410018310b9357e7954&operator=OR&url=%2Fopac%2Fsearch.do

[083] 1992, Pumicestone Passage, its catchment and Bribie Island : draft integrated management strategy - issues paper, QG [DEH], Department of Environment and Heritage, State of Queensland, https://catalogue.nla.gov.au/catalog/1455159

[084] 1992, Quaternary Evolution of the Woorim - Point Cartwright Coastline, Volume 1, QG [DME], Jones, M.R., Report for the Beach Protection Authority, Department of Minerals & Energy, State of Queensland, https://geoscience.data.qld.gov.au/data/report/cr070746

[085] 1992, Pumicestone Passage Catchment Area Comparative Land Use Study 1974-1991, QG [DPI], Department of Environment and Resource Management, State of Queensland,

[086] 1992, Pumicestone Passage and its catchment and Bribie Island - Integrated Management Strategy - Component study - Aquaculture, QG [DPI], Department of Primary Industries, State of Queensland, http://qldgov.softlinkhosting.com.au/liberty/libraryHome.do

[087] 1992, Quaternary Evolution of the Woorim - Point Cartwright Coastline, Volume 2, QG [GSQ], Geological Survey of Queensland, State of Queensland

[088] 1992, Bribie Island - Woorim Beach Nourishment Investigation - Pre Cyclone 'FRAN' - Hydro survey & levels - Feb-Mar 1992, QG [QT], Queensland Transport, Marine and Ports Division, State of Queensland, Queensland State Archives, Item ID 891331, https://www.archivessearch.qld.gov.au/items/ITM891331

[089] 1992, Bribie Island - Woorim Beach Nourishment Investigation - Post Cyclone 'FRAN' - Hydro survey & levels - May 1992, QG [QT], Queensland Transport, Marine and Ports Division, State of Queensland, Queensland State Archives, Item ID 891332, https://www.archivessearch.qld.gov.au/items/ITM891332

[090] 1993, Draft Integrated Management Strategy - Main Report for the Pumicestone Passage, its Catchment and Bribie Island, QG, Queensland State Archives, Item ID 416480, https://www.archivessearch.qld.gov.au/items/ITM416480

[091] 1993, Northern Bribie Island and Pumicestone Passage Photogrammetry 1940-1992, QG [BPA], Beach Protection Authority, State of Queensland

[092] 1993, Cabinet minute - Pumicestone Passage, its Catchment and Bribie Island: Review of Environmental and Conservation Protection Measures, QG [Cabinet], Queensland State Archives, Item ID 410334, https://www.archivessearch.qld.gov.au/items/ITM410334

[093] 1993, Pumicestone Passage, its catchment and Bribie Island : draft integrated management strategy - summary report, QG [DEH], Queensland Dept. of Environment and Heritage, State of Queensland, https://www.parliament.qld.gov.au/Work-of-the-Assembly/Tabled-Papers/docs/4793t3631/4793t3631.pdf

[094] 1993, Pumicestone Passage, its catchment and Bribie Island : draft integrated management strategy - main report, QG [DEH], Willing and Partners for the Department of Environment and Heritage, State of Queensland, https://catalogue.nla.gov.au/catalog/78155

[095] 1994, Aerial photo - Tweed Heads - Urangan, QG [DNRM], QImagery, 5239-07, State of Queensland

[096] 1994, Aerial photo - Tweed Heads - Urangan, QG [DNRM], QImagery, 5239-08, State of Queensland

[097] 1994, Aerial photo - Tweed Heads - Urangan, QG [DNRM], QImagery, 5239-09, State of Queensland

[098] 1994, Boating Safety Chart, Moreton Bay Series, Chart 4, QG [QT], Queensland Transport, State of Queensland, https://catalogue.nla.gov.au/catalog/369978

[099] 1995, Information Sheet on Ramsar Wetlands - 5AU041 - 26 September 1995, QG [DEH], Queensland National Parks and Wildlife Service, Department of Environment and Heritage, State of Queensland

[100] 1995, Fisheries (Pumicestone Strait Closed Waters) Regulation, QG [DPI], Made by the Chief Executive, Department of Primary Industries, State of Queensland

[101] 1995, Bribie Island - Narrowest Point - High water mark survey, QG [QT], Queensland Transport, Maritime Division, State of Queensland, Queensland State Archives, Item ID 891337, https://www.archivessearch.qld.gov.au/items/ITM891337

[102] 1997, Northern Bribie Island - Dune Management Plan, QG [BPA], Beach Protection Authority, State of Queensland, Queensland State Archives, Item ID 1381625, https://www.archivessearch.qld.gov.au/items/ITM1381625

[103] 1997, QTS (Queensland Topographic Survey) - SEQ1 Caloundra Maroochy 1:5,000 Mapping and Bribie Island DEM (Caboolture region), QG [DNR], Department of Natural Resources, State of Queensland, Queensland State Archives, Item ID 3009395, https://www.archivessearch.qld.gov.au/items/ITM3009395

[104] 1998, Moreton Bay and Catchment (proceedings of the Moreton Bay and Catchment conference), Tibbetts IR, Narelle JH and Dennison WC (Editors), School of Marine Science, The University of Queensland, https://ian.umces.edu/publications/moreton-bay-and-catchment/

[105] 1999, Information Sheet on Ramsar Wetlands - 5AU041 - June 1999, QG [EPA], Division of Environmental Planning, Environmental Protection Agency, State of Queensland

[106] 2000, Geomorphology, Sedimentology, and Shoreline Processes Impacting on the Stability of the Bribie Island Spit, Lester, J, Thesis (BSc), QUT ePrints, https://eprints.qut.edu.au/107123/#:~:text=This%20study%20represents%20a%20synthesis%20of%20previous%20research,that%20the%20spit%20formed%20prior%20to%203330%20yBP

[107] 2000, An assessment of the stability of the Bribie Island Spit based on studies of geomorphology, sedimentology and shoreline processes, Lester, J, et al, Paper for Pumicestone Passage and Deception Bay Catchment Conference, QUT

[108] 2000, Science informing catchment management : PASSCON 2000, QUT, Pumicestone Passage and Deception Bay Catchment Conference, Queensland University of Technology, https://library.moretonbay.qld.gov.au/cgi-bin/spydus.exe/FULL/WPAC/BIBENQ/163898415/29090862,11

[109] 2002, Survey and classification of oyster growing areas. Report 5 : Pumicestone Passage, North Stradbroke Island and Pimpama River , QG [QFS], Queensland Fisheries Service, State of Queensland, https://library.moretonbay.qld.gov.au/cgi-bin/spydus.exe/ENQ/WPAC/BIBENQ?SETLVL=&BRN=462861

[110] 2003, Moreton Bay - North West Channel - Dredging - Possible extension, QG [DHM], Department of Harbours and Marine, State of Queensland, Queensland State Archives Item ID 887447, https://www.archivessearch.qld.gov.au/items/ITM887447

[111] 2004, Aerial photo - Tweed Heads - Urangan, QG [DNRM], QImagery, 6078-163, State of Queensland

[112] 2005, Aerial photo - Caloundra - Road No 132, QG [DNRM], QImagery, 6163-072, State of Queensland

[113] 2007, Volume C1: Middle Banks, Moreton Bay - Context and project description, BAC, Brisbane Airport Corporation, https://www.bne.com.au/corporate/projects/completed-projects/brisbanes-new-runway/planning-and-approvals

[114] 2007, Volume C2: Middle Banks, Moreton Bay - Geology and Soils, BAC, Brisbane Airport Corporation, https://www.bne.com.au/corporate/projects/completed-projects/brisbanes-new-runway/planning-and-approvals

[115] 2007, Volume C3: Middle Banks, Moreton Bay - Coastal processes and natural features, BAC, Brisbane Airport Corporation, https://www.bne.com.au/corporate/projects/completed-projects/brisbanes-new-runway/planning-and-approvals

[116] 2007, Volume C9: Middle Banks, Moreton Bay - Dredge management plan, BAC, Brisbane Airport Corporation, https://www.bne.com.au/corporate/projects/completed-projects/brisbanes-new-runway/planning-and-approvals

[117] 2007, Modelling hydrodynamic processes within Pumicestone Passage, Northern Moreton Bay, Queensland, Larsen, Genevieve, Masters Thesis Research, QUT ePrints, https://eprints.qut.edu.au/16634/

[118] 2007, PUMICESTONE PASSAGE (SOUTH POINT TO CALOUNDRA BAR) PUMICESTONE PASSAGE BRIBIE ISLAND- SYLVAN BEACH POST DREDGE HYDROGRAPHIC SURVEY, QG [TMR], Queensland State Archives, Item ID 1453866, https://www.archivessearch.qld.gov.au/items/ITM1453866

[119] 2008, Severe Storms on the East Coast of Australia 1770-2008, Callaghan, J. & Helman, P., Griffith Centre for Coastal Management, Griffith University, Gold Coast, Queensland

[120] 2009, Effect of the March 2009 Oil Spill on the Moreton Bay Ramsar Site, QG [DERM], Department of Environment and Resource Management, State of Queensland

[121] 2009, Bribie Island Tidal Breakthrough Risk Assessment, SCC, Aurecon for Sunshine Coast Regional Council

[122] 2010, Bribie Island Breakthrough Risk Analysis, Colleter, G, et al, Paper for 5th Civil Engineering Conference in the Asian Region and Australasian Structural Engineering Conference, https://search.informit.org/doi/epdf/10.3316/informit.848490593333013

[123] 2010, Climate Proofing Bribie – A Climate Adaptation Action Plan, SEQ Catchments, SEQ Catchments in collaboration with the University of the Sunshine Coast and local working group

[124] 2011, Climate Proofing Bribie Island and the Noosa Biosphere, South East Qld: Moving beyond the 'case study', Chapman, S; English, K, University of the Sunshine Coast

[125] 2011, Managing Storm tide inundation risk in a changing climate, Charteris, A, et al, Paper for Queensland Coastal Conference, 19-20 October 2011

[126] 2011, Pumicestone Channel Fish Habitat Area (FHA-011), QG [DEEDI], Department of Employment, Economic Developement and Innovation, State of Queensland

[127] 2011, Draft Bribie Island Area Management Plan, QG [DERM], Department of Environment and Resource Management, State of Queensland

[128] 2012, Local Adaptation Responses in Climate Change Planning in Coastal Queensland, Zeppel, H, Australasian Journal of Regional Studies, Vol. 18, No. 3, 2012, pp. 342–363

[129] 2013, Coastal Processes Study for the Sunshine Coast, BMT WBM Pty Ltd, BMT WBM Pty Ltd for Sunshine Coast Regional Council

[130] 2013, Legislative Framework and Generic Shoreline Management Options, BMT WBM Pty Ltd, BMT WBM Pty Ltd for Sunshine Coast Regional Council

[131] 2013, Historical epidemiology indicates water quality decline drives loss of oyster(Saccostrea glomerata) reefs in Moreton Bay, Australia, Diggles, BK, New Zealand Journal of Marine and Freshwater Research, v47n4, https://www.tandfonline.com/doi/full/10.1080/00288330.2013.781511#d1e134

[132] 2013, Coastal Hazard Technical Guide - Determining coastal hazard areas, QG [DEHP], Department of Environment and Heritage Protection, State of Queensland

[133] 2013, Moreton Bay Ramsar Wetlands, QG [DES], Queensland Wetlands Program, Department of Environment and Science, State of Queensland

[134] 2013, Queensland's Ramsar Sites, QG [DES], Queensland Wetlands Program, Department of Environment and Science, State of Queensland

[135] 2013, Bribie Island National Park and Bribie Island Recreation Area Management Statement 2013, QG [DNPRSR], Department of National Parks, Recreation, Sport and Racing, State of Queensland

[136] 2013, BI tidal breakthrough investigation and management options, SCC, Fact sheets, badged Pumicestone Passage Advisory Taskforce, as part of the 14/11/2013 Ordinary meeting agenda (pp.335-338), Sunshine Coast Regional Council

[137] 2013, Pumicestone Passage and Catchment Action Plan 2013-2016, SCC, Sunshine Coast Regional Council, https://resilientrivers.com.au/wp-content/uploads/2024/03/Pumicestone-Passage-and-Catchment-Action-Plan-2013.pdf

[138] 2014, Moreton Bay and Its Estuaries: A Sub-tropical System Under Pressure from Rapid Population Growth, Gibbes, et al, Published in Estuaries of Australia in 2050 and Beyond, E. Wolanski (ed.), Springer Science, https://link.springer.com/chapter/10.1007/978-94-007-7019-5_12

[140] 2014, Coastal Management Policy (Public Lands), SCC, Sunshine Coast Regional Council

[141] 2014, Shoreline Erosion Management Plan, SCC, Sunshine Coast Regional Council

[142] 2014, Sunshine Coast Airport Expansion Project EIS, C1 - Dredging introduction, SCC, Sunshine Coast Regional Council, https://www.statedevelopment.qld.gov.au/coordinator-general/assessments-and-approvals/coordinated-projects/completed-projects/sunshine-coast-airport-expansion/eis-documents

[143] 2014, Sunshine Coast Airport Expansion Project EIS, C2 - Marine Geology, SCC, Sunshine Coast Regional Council, https://www.statedevelopment.qld.gov.au/coordinator-general/assessments-and-approvals/coordinated-projects/completed-projects/sunshine-coast-airport-expansion/eis-documents

[144] 2014, Sunshine Coast Airport Expansion Project EIS, C3 - Coastal Processes and Water Quality, SCC, Sunshine Coast Regional Council, https://www.statedevelopment.qld.gov.au/coordinator-general/assessments-and-approvals/coordinated-projects/completed-projects/sunshine-coast-airport-expansion/eis-documents

[145] 2015, Golden Beach and Bribie Island Breakthrough – Options, Design, Approvals and Investment Plan, BMT WBM Pty Ltd, BMT WBM Pty Ltd for Sunshine Coast Regional Council

[146] 2015, Moreton Bay seagrass survey, Unknown, GIS dataset (no accompanying report), coverage for southern Bribie Island and Moreton Bay to the south, but not northern Bribie Island

[147] 2017, QSat aerial imagery, QG, QImagery? (Jul-Sep)

[148] 2018, Moreton Bay Marine Park (zoning map), QG [DES], Department of Environment and Science, State of Queensland

[149] 2018, Information Sheet on Ramsar Wetlands - 5AU041 - December 2018, QG [DES], Department of Environment and Science, State of Queensland

[150] 2018, Relative dispersion in a two inlet estuary: An experiment in Pumicestone Passage, Tyler, Callum D.A., Suara, Kabir, Sidle, Roy, McCallum, Adrian, Fairweather, Helen, & Brown, Richard J., In Ocean Sciences Meeting 2018, QUT ePrints, https://eprints.qut.edu.au/113977/

[151] 2019, Operational Policy - Management of declared Fish Habitat Areas, QG [DES], Department of Environment and Science, State of Queensland

[152] 2019, Chapter 3 – History and Change in Moreton Bay, Richards J., In: Tibbetts IR, Rothlisberg PC, Neil DT, Homburg TA, Brewer DT, & Arthington AH (Eds). Moreton Bay Quandamooka & Catchment: Past, present, and future. The Moreton Bay Foundation. Brisbane, Australia, https://moretonbayfoundation.org/wp-content/uploads/2019/08/Moreton-Bay-Quandamooka-and-Catchment-137.pdf

[153] 2019, Managing for the multiple uses and values of Moreton Bay and its catchments, Ross H, Rissik D, Jones N, Witt K, Pinner B, Shaw S., In: Tibbetts IR, Rothlisberg PC, Neil DT, Homburg TA, Brewer DT, & Arthington AH (Eds). Moreton Bay Quandamooka & Catchment: Past, present, and future. The Moreton Bay Foundation. Brisbane, Australia, https://moretonbayfoundation.org/wp-content/uploads/2019/08/Moreton-Bay-Quandamooka-and-Catchment-563.pdf

[154] 2019, Role of Waves and Tides on Depth of Closure and Potential for Headland Bypassing, Valiente, N, et al, Marine Geology, Vol. 407, 2019, pp. 60–75

[155] 2020, Indurated sand horizon influences present day coastal geomorphology of nearshore Northern Moreton Bay, South-East Queensland, Australia, Heatherington, et al, EGU2020 presentation, University of Queensland

[156] 2020, Valuation of disaster risk reduction ecosystem services of Australia's coastal wetlands: review and recommendations, IDEEA Group, Institute for the Development of Environmental-Economic Accounting (IDEEA Group) for Department of Agriculture, Water and the Environment (DAWE), Canberra

[157] 2020, Shelf sand supply determined by glacial-age sea-level modes, submerged coastlines and wave climate, Ribo, M, et al, Sci Rep 10, 462, https://www.nature.com/articles/s41598-019-57049-8

[158] 2020, History of Bribie : from the beginning to 2000, Yetland, Doug, , https://library.moretonbay.qld.gov.au/cgi-bin/spydus.exe/ENQ/WPAC/BIBENQ?SETLVL=&BRN=807747

[159] 2021, Seagrass cover map for the optically complex waters of Moreton Bay, Queensland, Australia (2015), Kovacs, Eva M; Roelfsema, Christiaan M; Phinn, Stuart R; Lyons, Mitchell; Udy, James; Baltais, Simon, Dataset, PANGAEA, https://doi.pangaea.de/10.1594/PANGAEA.937501

[160] 2021, The Australian Guide to Nature-Based Methods for Reducing Risk from Coastal Hazards, Morris, RL, et al, Earth Systems and Climate Change Hub Report No. 26. NESP Earth Systems and Climate Change Hub, Australia

[161] 2021, Re: Follow-up meeting, PPCMB, QG [DES], Email and replies, with questions (PPCMB) and responses (QG-DES) regarding several matters related to northern Bribie Island and Pumicestone passage coastal processes

[162] 2021, Sunshine Coast Coastal Hazard Adaptation Strategy, SCC, Sunshine Coast Regional Council

[163] 2022, Bribie Island Breakthrough - Response to Criteria, BMT, Released under RTI Act 2009, Department of Environment and Science, State of Queensland

[164] 2022, Climate Change Toolkit for World Heritage Properties in Australia: Handbook for Property Managers, CSIRO, Department of Climate Change, Energy, the Environment and Water, Commonwealth of Australia

[165] 2022, Nature Positive Plan: better for the environment, better for business, DCCEEW, Department of Climate Change, Energy, the Environment and Water, Canberra

[166] 2022, Bribie Island Breakthrough, Keeshan, G, Engineering for Public Works, Issue 26, December 2022, IPWEAQ, https://issuu.com/ipweaqld/docs/4496_epw_journal_dec_06/s/17691942

[167] 2022, Bribie Island National Park and Recreation Area - Sustainable visitor capacity and management study, QG [DES], Bribie is one of three places that a "SVCM" study has been undertaken for - documents include Recommendation, Technical Appendices, and Government Response, Department of Environment and Science, State of Queensland, https://parks.desi.qld.gov.au/management/programs/sustainable-visitor-capacity-management-studies

[168] 2022, Pumicestone Passage Environmental Values and Water Quality Objectives – Part of Basin 141, QG [DES], Department of Environment and Science, State of Queensland

[169] 2022, Bribie Island Breakthrough - Terms of reference for independent technical review of causes and recommended further studies, QG [DES], Department of Environment and Science, State of Queensland

[170] 2022, Schonrock, Coastal Breakthrough Flooding Considerations – A Bribie Island Breakthrough Case Study

[171] 2022, Coastal breakthrough flooding considerations, a Bribie Island Breakthrough Case Study, Schonrock, C, Engineers Australia Hydrology and Water Resources Symposium, https://microsites.arinex.com.au/HWRS/pdf/full-paper_4.pdf

[172] 2023, Review of Causes of Northern Bribie Island Erosion, BMT, BMT for the Department of Environment and Science, State of Queensland, first revision 08/2022, finalised following several revisions 02/2023

[173] 2023, Managing Ramsar wetlands under a changing climate, DCCEEW, Department of Climate Change, Energy, the Environment and Water, Canberra

[174] 2023, Change in bathymetry and tidal dynamics after the Bribie Island breakthrough, Metters, et al, Australasian Coasts and Ports Conference 2023, Sunshine Coast, QLD, 15-18 August 2023, https://search.informit.org/doi/reader/10.3316/informit.480067150713706

[175] 2023, Bribie Island Breakthrough – Coastal Processes and Water Quality Assessment, QG [DES], Department of Environment and Science, October 2023, State of Queensland

[176] 2023, Karren Hussey, DDG, responding to Ken Mewburn, QG [DES], Letter, with responses included to a number of questions submitted by Ken on behalf of Take Action Pumicestone Passage (TAPP)

[177] 2023, Management Statement - Southern Moreton Bay Islands National Park, QG [DES], Queensland Parks & Wildlife Service, Department of Environment and Science, State of Queensland

[178] 2023, Information Sheet on Ramsar Wetlands - Site 631 - December 2023, QG [EPA], Department of Environment and Science, State of Queensland / Department of Climate Change, Energy, the Environment and Water, Canberra

[179] 2023, Beacon to Beacon Guide - Pumicestone Passage, QG [TMR], Maritime Safety Queensland, Department of Transport and Main Roads, State of Queensland

[180] 2023, Beacon to Beacon Guide - Pumicestone Passage, QG [TMR], Maritime Safety Queensland, Department of Transport and Main Roads, State of Queensland, https://www.publications.qld.gov.au/dataset/beacon-to-beacon-guides/resource/61a8391f-21b1-4f15-8516-973291727263?inner_span=True

[181] 2023, Environment and Liveability Strategy - Refresh, SCC, Includes 4 parts - Overview, Main report, 5-yr plan, and Network plan, Sunshine Coast Regional Council, https://els.sunshinecoast.qld.gov.au/about-the-strategy

[182] 2023, Environment and Liveability Strategy - Refresh - Project Engagement summary, SCC, Sunshine Coast Regional Council, https://els.sunshinecoast.qld.gov.au/about-the-strategy

[183] 2023, Modelling of the Bribie Island Breakthrough, Waterhouse, A, Presentation of work undertaken by BMT post breakthrough; includes acknowledgement of Tuflow and Australian Water School

[184] 2023, Bribie Island Breakthrough - A dynamic coastal system, Wood, P, et al, Australasian Coasts and Ports Conference 2023, Sunshine Coast, QLD, 15-18 August 2023, https://search.informit.org/doi/reader/10.3316/informit.474943083617701

[185] 2024, Port of Brisbane Channel Enhancement Project - Initial Advice Statement, BMT, BMT for Port of Brisbane Pty Ltd, https://www.statedevelopment.qld.gov.au/__data/assets/pdf_file/0031/95926/port-of-brisbane-channel-enhancement-project-initial-advice-statement.pdf

[186] 2024, Sunshine Coast Storm Tide Study, JPB, Jeremy Benn Pacific (JBP) for Sunshine Coast Regional Council, https://www.sunshinecoast.qld.gov.au/development/development-tools-and-guidelines/flood-mapping-and-information/storm-tide-study-2024

[187] 2024, Shoreline Erosion Management Plan 2025-35 - Volume 1, JPB, Jeremy Benn Pacific (JBP) for Sunshine Coast Regional Council, https://www.sunshinecoast.qld.gov.au/council/planning-and-projects/council-plans/shoreline-erosion-management-plan

[188] 2024, Question on Notice No.620, QG [Parliament], Mr S O'Connor asking Hon L Linard regarding impacts and actions regarding Pumicestone Passage and the Bribie Island Breakthrough, State of Queensland

[189] 2024, Port Procedures Manual - Port of Brisbane, QG [TMR], Maritime Safety Queensland, Department of Transport and Main Roads, State of Queensland, https://www.publications.qld.gov.au/ckan-publications-attachments-prod/resources/629cecd7-4cde-4305-9be2-6f5010fa8989/brisbane_ppm_master_october_2024.pdf?ETag=2c8a274ac071f51e97971c09fdab600d

[190] 2024, Project News - Coastal Hazard Adaptation Precinct Planning - Investigations, SCC, Advice re community consultation from 28/10 - 25/11 2024, Sunshine Coast Regional Council

[191] 2024, Golden Beach and Caloundra (Bulcock Beach) - Information sheet 01, SCC, Coastal Hazard Adaptation Precinct Planning — Investigation, Sunshine Coast Regional Council

[192] 2024, Healthy Coast Management Plan - Part 1 - The healthy coast context (DRAFT), SCC, Sunshine Coast Regional Council, https://haveyoursay.sunshinecoast.qld.gov.au/hcmp-semp

[193] 2024, Healthy Coast Management Plan - Part 2 - Healthy coast management (DRAFT), SCC, Sunshine Coast Regional Council, https://haveyoursay.sunshinecoast.qld.gov.au/hcmp-semp

[194] 2024, Healthy Coast Management Plan - Part 3 - Road map (DRAFT), SCC, Sunshine Coast Regional Council, https://haveyoursay.sunshinecoast.qld.gov.au/hcmp-semp

[195] 2024, Golden Beach and Caloundra (Bulcock Beach) CHAPP Investigations - Information sheet, SCC, Sunshine Coast Regional Council, https://www.sunshinecoast.qld.gov.au/golden-beach-coastal-hazard-adaptation-precinct-planning-investigation

[196] 2025, Moreton Bay Northwest Channel Bathymetry, Johnson, R, Unpublished documents and presentation providing GIS elevations based on AusENC bathymetry

[197] 2025, Presentation - Planning update re SEMP, CHAS and ELS, SCC, Presentation to RPS/ICM by SCRC officers, Sunshine Coast Regional Council

[198] 2025, Golden Beach and Caloundra (Bulcock Beach) CHAPP Investigations - Community engagement summary, SCC, Sunshine Coast Regional Council, https://haveyoursay.sunshinecoast.qld.gov.au/chapps?utm_source=sunshine%2Bcoast%2Bcouncil&utm_medium=website

[199] 2025, Draft Healthy Coast Management Plan and Shoreline Erosion Management Plan Community Engagement Summary, SCC, Sunshine Coast Regional Council

[200] 2025, Sand Movement on the Sunshine Coast - Fact sheet, SCC, Sunshine Coast Regional Council