SHOALHAVEN CITY COUNCIL

Swan Lake Entrance Management Policy

Draft for Exhibition

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Synopsis

This report provides an update of the existing Swan Lake Entrance Management Policy.

Disclaimer

Shoalhaven City Council has prepared this document with financial assistance from the NSW Government through its Coastal and Estuary Grants Program. This document does not necessarily represent the opinions of the NSW Government or the Department of Climate Change, Energy, the Environment and Water.

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Related Legislation:	
Associated Policies/Documents:	
Directorate:	City Development
Responsible Owner:	
Record Number:	[To be Advised – Draft Only]

Acknowledgement *of Country*

Walawaani (welcome),

Shoalhaven City Council recognises the First Peoples of the Shoalhaven and their ongoing connection to culture and country. We acknowledge Aboriginal people as the Traditional Owners, Custodians and Lore Keepers of the world's oldest living culture and pay respects to their Elders past, present and emerging.

Walawaani njindiwan (safe journey to you all)

This acknowledgment includes Dhurga language. We recognise and understand that there are many diverse languages spoken within the Shoalhaven.

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Appendices

1. Policy Overview

The purpose of this Entrance Management Policy (EMP) for Swan Lake is to prevent the flooding of low-lying assets through the long-term modification of some existing infrastructure, while reducing the need for planned entrance openings.

When water levels are high within Swan Lake it can result in nuisance inundation to some infrastructure and amenities including, roads, pathways and properties that surround the lake. As part of a series of studies undertaken within Stage 2 of the preparation of the Swan Lake and Berrara Creek Coastal Management Program (CMP), the Swan Lake Entrance Management Policy was reviewed and documented in a report by Advisian (2022a). The review found that the lake closely resembles a natural system and is in good health at present. However, it was identified that the need for planned entrance openings can be reduced, and some infrastructure modified, to improve the estuary's health, and to improve the resilience of the lake and its infrastructure to inundation events.

Current trigger levels do not allow for complete inundation of the mapped coastal wetlands at the northern end of the lake.

This EMP has been informed by additional studies undertaken as part of the Swan Lake Coastal Management Program (CMP) and documented in Advisian (2022a) including:

- fieldwork and ground survey of the fringing wetlands at the northern end of the lake, to understand the lake level at which the wetlands are adequately inundated
- coastal and tidal inundation and the impact to infrastructure through hydrodynamic modelling (Advisian 2022)
- assessing optimal opening duration, opening location, flushing time
- water quality assessment
- lake ecology assessment, and
- cultural heritage assessment.

This EMP document provides an update of the 2004 Swan Lake Entrance Management Policy (EMP) (last formally reviewed in 2008), as the issues affecting the lake have changed since adoption. The EMP provides a holistic framework for entrance management for short to longer term time frames that will aim to reduce entrance intervention and promote ecological benefits to surrounding ecosystems.

Additional considerations for the Entrance Management Policy include:

- how to deter unauthorised lake openings and gain broad community support for the Entrance Management Policy.
- the risk and implications of a lake opening occurring at an unplanned location.

- the assessment of inundation risk to assets at various lake levels and measures that can be taken to reduce this risk.

2. Policy Name

Swan Lake Entrance Management Policy.

3. Objectives

The EMP provides a framework that guides the management of the entrance to Swan Lake. The aim of the EMP is to provide Shoalhaven City Council (Council), State Government and the local community with a detailed procedure for the short- and long-term management of the Swan Lake Entrance. It describes:

- the procedures to be followed by Shoalhaven City Council for planned openings of Swan Lake entrance, should this course of action be necessary.
- the conditions that should be satisfied prior to a planned opening.
- the responses that may be requested of state agencies in response to artificial or natural opening events.
- a course of actions to approach totally natural entrance behaviour.

The EMP aims to:

- Minimise risk to life and risk to public and private property and assets due to catchment flooding.
- Establish clear triggers for initiating mechanical intervention in the natural processes of the entrance.
- Minimise interference with natural entrance behaviour and allow mechanical entrance openings to mimic a natural ICOLL opening regime as closely as possible.
- Accommodate future climate considerations, in particular sea level rise.
- Conserve or enhance the ecological diversity and flora and fauna communities of the lake system, including surrounding wetlands.
- Conserve or enhance the recreational activities within the lake and its foreshores.
- Determine key responsibilities for management of the entrance.
- Detail the procedures for monitoring the entrance.

Council is responsible for managing the Swan Lake entrance for the purpose of flood mitigation for low-lying properties and assets in accordance with authorisations from the NSW Government. The mechanical opening of the Swan Lake entrance will not prevent flooding of

properties within the entirety of the catchment. Accordingly, the EMP aims to reduce, not eliminate, the impacts of flooding.

4. Land to which the EMP Applies

The EMP applies to lands located at the entrance to Swan Lake. Swan Lake is located on the south coast of NSW and is a coastal lake that is intermittently connected to the ocean (Figure 4-1). Swan Lake is characterised by many environmental, social, commercial and recreational values that make it a popular place for a wide variety of activities. However, the pressures from these activities have sometimes resulted in competition for and degradation of the area's natural resources.

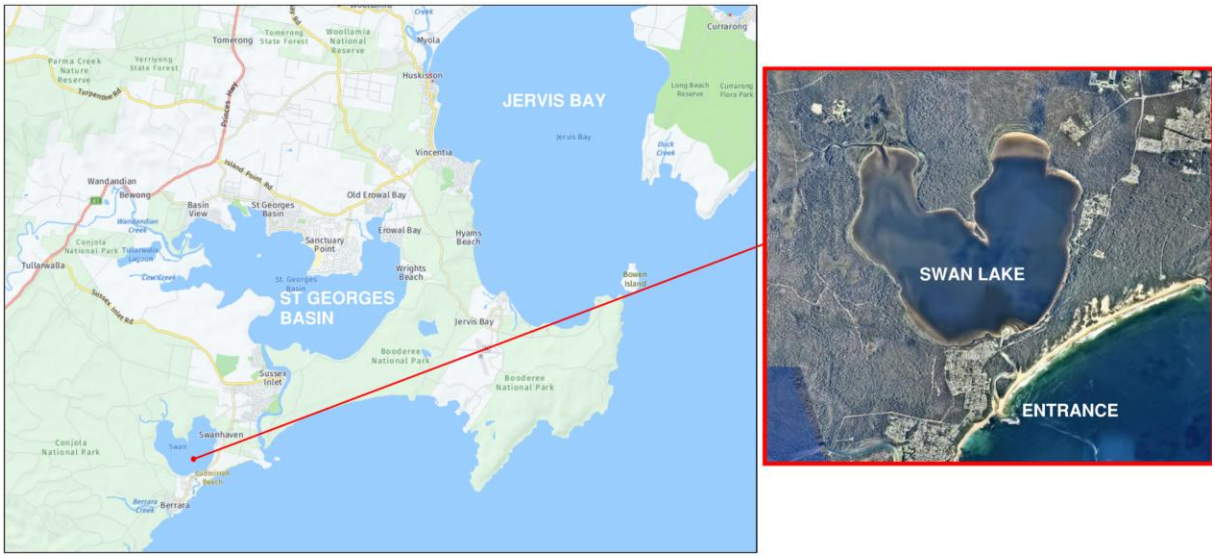

Figure 4-1 Location of Swan Lake and Entrance

The land to which the EMP applies is shown in Figure 4-2 and is wholly within Crown Land, being a mix of Minister-managed Crown land at the entrance and council-managed Crown reserve on either side. It includes the area locally known as "The Gap" as well as the entrance area on both sides of a rocky reef shown in Figure 4-2.

Figure 4-2 Land to which this EMP applies

5. Review of Environmental Factors

A supporting Review of Environmental Factors (REF) has been prepared to support the EMP and will be updated over time in line with any EMP changes and/or new information. The REF describes the activities involved in management of the entrance in accordance with the EMP, outlines the potential impacts of implementing the EMP on the coastal and estuary environments, and details the mitigation measures to be adopted to minimise potential impacts in accordance with the Environmental Planning and Assessment Act 1979, Part 5.

6. Climate Change

The current proposed trigger values for management of the entrance to Swan Lake (outlined in **Section 8**) will need to be revised over time in accordance with future sea level rise. These revisions should be considered at the proposed Review Periods of the EMP (refer **Section 12**) or at such other times determined by Council.

As of 2024, Council's adopted sea level rise projections are as below:

- 0.10 metres by 2030
- 0.23 metres by 2050
- 0.85 metres by 2100

In accordance with Council's Sea Level Rise Framework, Council will continue to monitor State and Federal Government advice and future Intergovernmental Panel on Climate Change (IPCC) reports to review existing sea level rise projections every seven (7) years.

7. Relevant Legislation, Policy and Approvals

The EMP broadly complies with various State Government initiatives for environmental management of coastal lakes, and will be applied with consideration of the following legislation and policies.

7.1 Planning Instruments

- *State Environmental Planning Policy (Transport and Infrastructure) 2021*
- *State Environmental Planning Policy (Resilience and Hazards) 2021*
- *Shoalhaven Local Environment Plan 2014*

7.2 NSW Legislation

- *NSW Environmental Planning and Assessment Act 1979*
- *NSW Environmental Planning and Assessment Regulation 2021*
- *NSW Biodiversity Conservation Act 2016*

- *NSW Fisheries Management Act 1994*
- *Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update)*
- *NSW Coastal Management Act 2016*
- *NSW Crown Land Management Act 2016*
- *NSW National Parks and Wildlife Act 1974*
- *NSW Heritage Act 1977*
- *NSW Protection of the Environment Operations Act 1997*
- *NSW Work Health and Safety Act 2011*
- *NSW Flood Prone Land Policy and Manual 2023*
- *NSW State Environmental Planning Policy (Resilience and Hazards) 2021*
- *NSW State Environmental Planning Policy (Transport and Infrastructure) 2021*

7.3 Commonwealth Legislation

- *Environmental Protection and Biodiversity Conservation Act 1999*
- *Native Title Act 1993*

7.4 Approvals Required

The REF has undertaken an assessment of potential permits/approvals that may be required for the carrying out of mechanical interventions at the entrance. The assessment is summarised in Table 7-1.

Table 7-1 Potential Approvals Required and Assessment

Relevant Act	Relevant Approval	Approval Body	Assessment
NSW Biodiversity Conservation Act 2016	Species Impact Statement	NSW Department of Climate Change, Energy, the Environment and Water	Part 7 of the BC Act contains the biodiversity assessment and provisions for approvals against which proposed activities or developments are to be assessed. There are not expected to be any significant impacts on any threatened fauna or endangered ecological communities (EECs) listed under the BC Act. Therefore, preparation of a Species Impact Statement would not be necessary and entry into the Biodiversity Offsets Scheme under the BC Act would not be required. Refer Section 6.2.3 of REF. A Threatened Species Licence will be required as per the issue of a Crown Land Licence under the *Crown Land Management Act 2016*.
Fisheries Management Act 1994	Permit for dredging and reclamation Permit to harm marine vegetation	NSW Department of Primary Industries – Fisheries	The proposal involves dredging works. However, Section 200(2) of the FM Act provides that there are two circumstances where a permit is not required. A permit is not required where the works are authorised under the CLM Act. Accordingly, as the works would be the subject of a general licence under the CLM Act, it would

Relevant Act	Relevant Approval	Approval Body	Assessment
	Permit for activities temporarily or permanently obstructing fish passage		not be necessary for Council to also obtain a permit under Section 200 of the FM Act. The proposal does not involve direct impacts to marine vegetation (i.e. mangroves, saltmarsh, seagrass or macroalgae), therefore, no permit is required under Section 205 of the FM Act. The passage of fish along Swan Lake Inlet would not be blocked as a result of the proposed changes, therefore, no permit is required under Section 219 of the FM Act.
NSW Crown Land Management Act 2016	Licence from NSW Crown Lands under the CLM Act to carry out excavation across the beach at Swan Lake entrance	NSW Department of Planning, Housing and Infrastructure – Crown Lands	It is understood that Council does not hold an existing licence from NSW Crown Lands under the CLM Act to carry out excavation across the beach at Swan Lake entrance. A new licence would be required from NSW Crown Lands for council to implement a revised EMP
NSW National Parks and Wildlife Act 1974	Aboriginal Heritage Impact Permit	NSW Department of Climate Change, Energy, the Environment and Water	The proposal would not have a direct impact on known Aboriginal sites. Therefore, an Aboriginal Heritage Impact Permit would not be required. For further detail, refer to Section 7.5 of the REF.

8. Entrance Management Framework and Procedures

8.1 Entrance Management Framework

A description of the updated EMP is provided below which is based on the "Swan Lake and Berrara Creek Entrance Management Review" report (Advisian 2022a). Overall, the purpose of the revised management regime is to prevent the flooding of low-lying existing assets through the long-term modification of some infrastructure, while reducing the need for planned entrance openings to improve the resilience of the Lake and its infrastructure to inundation events. This will allow the Lake to more closely resemble a completely natural system to improve the estuary's health. Refer to Appendix AA Section A-1 for further information.

The overall strategy for future management of the Swan Lake entrance is outlined in Figure 8-1, with the long-term aim being to restore the lake to a completely natural opening regime.

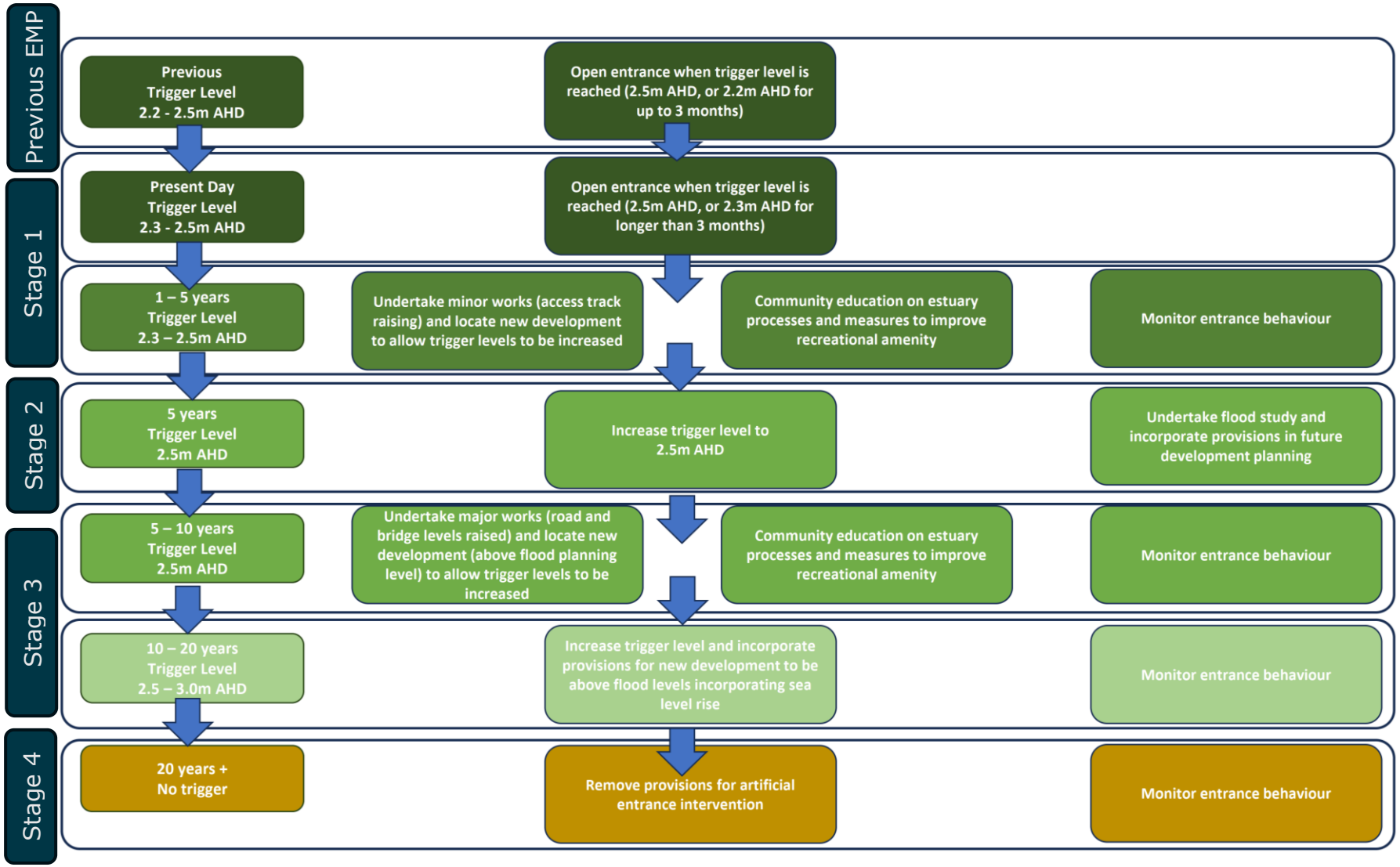

Figure 8-1 Entrance Management Framework

8.2 Intervention Levels – Present-day (Stage 1)

The EMP for the present-day, in accordance with Stage 1 of the framework presented in Figure 8-1, is to open the entrance once the trigger level is reached. This EMP establishes the use of a trigger level of 2.5 m AHD, with water levels allowed to stay between 2.3m AHD and 2.5m AHD for three months, to allow sufficient inundation of the coastal wetland area at the northern end of the lake to occur (refer to Figure A-1 in Appendix A).

The EMP and procedures for the present day are outlined in Figure 8-2. Key aspects of the EMP include:

- Monitor lake water levels weekly at **https://mhl.nsw.gov.au/Station-216425**, or daily if rainfall greater than 10 mm within 24 hours is occurring or forecast in the catchment area. It is noted that Council currently receives text and email alerts from MHL (Swan Lake gauge) when predetermined lake water level thresholds have been met. These alerts provide early warning of lake level rises and notify Council when key EMP water level thresholds have been met.
- Apply a 2.5 m AHD intervention level for opening the lake at the earliest opportunity but with consultation with NPWS and DCCEEW-BCS subject to consideration of ocean conditions and requirements regarding threatened migratory shorebirds
- If water levels are between 2.3 m AHD and 2.5 m AHD, undertake consultation with National Parks and Wildlife Service (NPWS) to determine the presence of nesting shorebirds prior to initiating an opening. Shorebird nesting season is from August to March. It is assumed that Green and Golden Bell Frogs could be present based on historical surveys in the Swan Lake area and *The Green and Golden Bell Frog Key Population at Sussex Inlet – Swan Lake Management Plan* (DECC, 2007). Lake levels should be allowed to remain at between 2.3 m and 2.5 m AHD for a minimum of three months prior to initiating an opening of the entrance to primarily allow inundation of the Coastal wetland at the northern end of the lake. This will also help to provide fresh or lightly brackish water which may also be of benefit to the endangered Green and Golden Bell Frog to allow for their successful breeding if present. If shorebirds are present, further consultation with NPWS and DCCEEW-BCS is required to determine the appropriateness of opening the entrance if the lake continues to rise.
- If a planned opening is required, follow the procedure below in Section 8.2.1 for opening the lake regarding location, entrance channel excavation width and opening times with respect to tidal levels and ocean conditions.

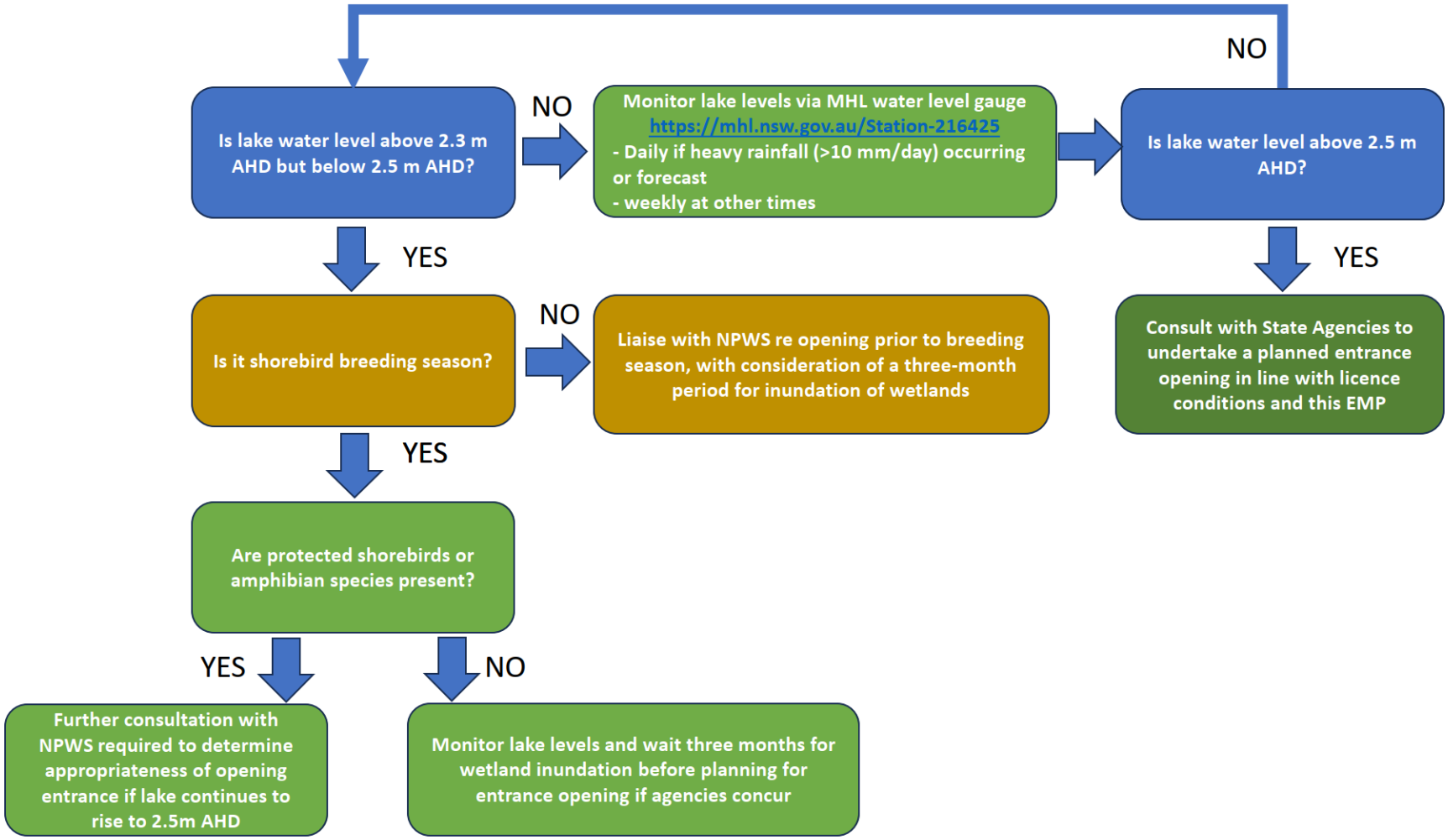

Figure 8-2 Present Day Entrance Management Protocol

8.2.1 Lake Opening Location

Locations where an entrance opening is permissible are illustrated in Figure 8-3, with these being:

- Location 1 – across sand spit immediately north of reef (preferred)
- Location 2 – south across reef (alternative)

The reasons for these locations being selected in the EMP include:

- the presence of the rocky reef limits the level of scour that can occur at the opening, which prevents the water level within the lake falling too low and too quickly. The slow rate of water level drop when the lake entrance opens is a natural feature of Swan Lake that an opening policy should strive to maintain (Peter Spurway & Associates 2002).
- the locations near the reef are areas where the Lake tends to open naturally, as the entrance berm levels are generally the lowest.
- the natural process for this estuary is for only limited tidal exchange to occur when the entrance is open, therefore, the opening location is selected to limit the tidal exchange and thus emulate the natural process.

If the water level falls too low too quickly, this can cause:

- water quality and odour issues with exposure of sand flats.
- water with low oxygen levels reaching the surface.
- scour and erosion of the banks of the channel due to high outflow velocities, leading to possible impacts on infrastructure; *e.g*. scour at the abutments of the Swan Lake Bridge.
- impacts on recreational amenity (*e.g*. the boat ramp at The Springs Road becoming unusable).

8.2.2 Lake Opening Procedure

The following procedures are to be applied to opening the lake under this EMP:

- The opening should take place within 10 metres of the reef at the entrance to the lake at Cudmirrah Beach, either across the sand spit to the north side of the reef (Location 1) or across the reef to the south (Location 2). The opening location is to be determined by the relative height of the beach berm at each location as determined on site prior to works commencing (i.e. using RTK survey methods to determine the relative berm elevation).
- Monitor ocean conditions including water levels and offshore wave conditions at the Port Kembla Waverider Buoy (https://mhl.nsw.gov.au/Station-PTKMOW) prior to opening, and only carry out the opening if it is safe to do so (i.e. significant wave height Hs <3 m at Port Kembla Waverider Buoy).
- The opening should be sufficient for scour flow to develop. The preferred size is 2m wide with the bed graded to the ocean. Either an excavator or a dozer will cut the channel, pushing the excavated sand as far as is feasible from the cut face. Normally a

sand plug will be left at the lake end of the entrance channel until the remainder of the channel is established.

- Access for construction vehicles is to be via the existing access track through the reserve at the corner of Second Avenue and Koolyn Drive, as per Figure 8-3. Alternative vehicle access is available if required via the beach access track at Sussex Inlet Surf Lifesaving Club and along the beach, approximately 3 km north of the lake entrance.
- The procedure is to be planned so that where possible the actual opening of the lake occurs shortly after the tide turns from high to low, for the lower tide of the day. Care must be taken to ensure construction vehicle access is maintained following the opening.
- The volume of sand to be excavated is expected to be small. This sand will be retained on the beach and may be washed into the channel as it expands laterally. Excavated sand is not to be removed from the beach area.
- Possible water quality impacts to adjacent surf beaches should be considered while the lake is emptying, for at least the first 7 days. Appropriate action should be taken to protect public health and safety at the site while excavation equipment is operating.

Figure 8-3 Locations where lake openings are possible. Locations 1 and 2 are specified as acceptable for planned openings by the Entrance Management Policy.

8.3 Monitoring

The following ongoing monitoring is to be undertaken under the EMP:

- Monitor lake water levels weekly, or daily if rainfall exceeds or is forecast to exceed 10 mm/24 hours. Realtime lake levels are available at **https://mhl.nsw.gov.au/Station-216425.** It is noted that Council currently receives text and email alerts from MHL (Swan Lake gauge) when predetermined lake water level thresholds have been met. These alerts provide early warning of lake level rises and notify Council when key EMP water level thresholds have been met.
- Monitor ocean conditions including water levels and offshore wave conditions at the Port Kembla Waverider Buoy (https://mhl.nsw.gov.au/Station-PTKMOW) on a regular basis (recommended fortnightly in conjunction with entrance berm monitoring).

- Monitor entrance berm levels on both sides of the reef on a regular basis. Where resources allow, fortnightly monitoring is recommended following an opening event for the first three months. Monthly entrance berm surveys should be undertaken during periods of Lake entrance closure. The purpose of this is to develop an understanding of how the berm level grows after a lake opening and the ultimate berm level that is likely to be reached. Council to undertake surveys using in-house personnel and RTK GPS survey equipment.
- Monitor berm levels at "The Gap" regularly to assess risk of lake breach here in line with monthly monitoring (refer to location in Figure 8-3 and survey transect in Figure 8-4). Beach scraping may be needed to prevent an opening from occurring here and prevent impacts such as major erosion of the surrounding dunes and a very rapid drawdown of the lake level leading to swift currents in the channel and risks including bridge abutment scour, loss of wetland vegetation and erosion of the channel banks. Surveys are recommended monthly when lake water levels are above 2.0 m AHD. This can be initiated by an MHL alert when this lake level threshold is met.
- If the regular survey shows that the berm level at "The Gap" falls below 2.5 m AHD, it is recommended that beach scraping be initiated to increase the level to at least 3.0 m AHD. The recommended survey transect location and indicative location for beach scraping to achieve a berm level of 3.0 m AHD is shown in Figure 8-4.
- Maintain record keeping of openings using the recording sheet provided in Appendix B.

Figure 8-4 Recommended survey transect location through "The Gap" to assess berm levels and the potential for a breach. Beach scraping recommended to achieve berm level of 3.0m AHD or above within hatched area.

8.4 Raising of Intervention Levels (Stages 2, 3 and 4)

It is considered feasible to raise the intervention levels for the lake entrance progressively over time to 3.0 m AHD with the following key activities to be undertaken (in accordance with the timing indicated in the EMP framework in Figure 8-1). This could be done in activities as described in the following:

- **Activity 1 -** undertake minor works to raise the access track to The Springs Cabins by 0.5 m to 2.7 m AHD or higher. Once complete, this would remove the need for any entrance intervention measures when the lake is below 2.5 m AHD. The proposed intervention procedure when lake levels of 2.5 m AHD are reached is outlined in Figure 8-5.

- **Activity 2 –** investigate and provide measures to improve recreational amenity when lake levels are high e.g. education, signage and enforcement measures to deter unauthorised lake openings. Enhance community education on water quality e.g. interpretive signage, publicising water quality results that demonstrate that water quality is acceptable in the lake regardless of whether the lake is open or closed. Installation of a rain gauge in the Swan Lake catchment would inform a future flood study and potential flood warning system for Swan Lake, to assess in more detail the inundation risk as per Action WQ02 in the Swan Lake CMP. Collected data should form

part of Shoalhaven City Council's Environmental Monitoring Program (EMP) and link to the on-line environmental monitoring dashboard.

- **Activity 3 –** Investigate the feasibility of raising the Springs Road to 3.0m AHD and investigate raising of Collier Drive to 3.0m AHD as well as minor works to reduce inundation impacts on the cabins at Holiday Haven caravan park. The feasibility of raising of roads would be dependent on engineering assessments regarding tying in with the proposed Swan Lake bridge upgrade, and factors such as allowing for sufficient longitudinal and cross-drainage during flood events. Once enacted, raise the "three months" minimum intervention level to 2.5m AHD and raise the opening level to 3.0 m AHD as per Figure 8-6. Any road raising would need to be investigated in a Floodplain Risk Management Study and Plan or Flood Impact and Risk Assessment after a Flood Study has been completed. Ideally a Flood Study and Floodplain Risk Management Study and Plan would be undertaken at the same time.
- **Activity 4 –** Following ongoing monitoring of entrance behaviour, the long-term goal would be to remove the need for entrance intervention completely, with the lake reverting to a natural hydrologic regime. The ability to remove triggers for opening would be dependent on the outcome of a flood study for the Lake identifying infrastructure at risk from flooding, future sea level rise and ongoing monitoring of lake levels and entrance processes to assess the upper limit of lake levels that lead to natural openings. Management Action E03 in the Swan Lake CMP includes monitoring of the risk of breakout of Swan Lake at The Gap, assessing the implications should a break-out occur and undertaking of sand scraping and dune revegetation to build up the dune. An assessment of the implications of a breakout on the morphology of the lake entrance and hydrodynamics of the lake is recommended to assess whether the beach scraping at The Gap discussed in Section 8.3 should continue, or whether the lake should be allowed to break out naturally at this location.

Changes to the trigger level adopted for this EMP will result in the review and update of this EMP and associated REF (as required) in accordance with the applicable legislation and statutory guidance, and Council Policies. Any future works as part of Activities 2 and 3 above would be undertaken by Council under separate planning approval processes.

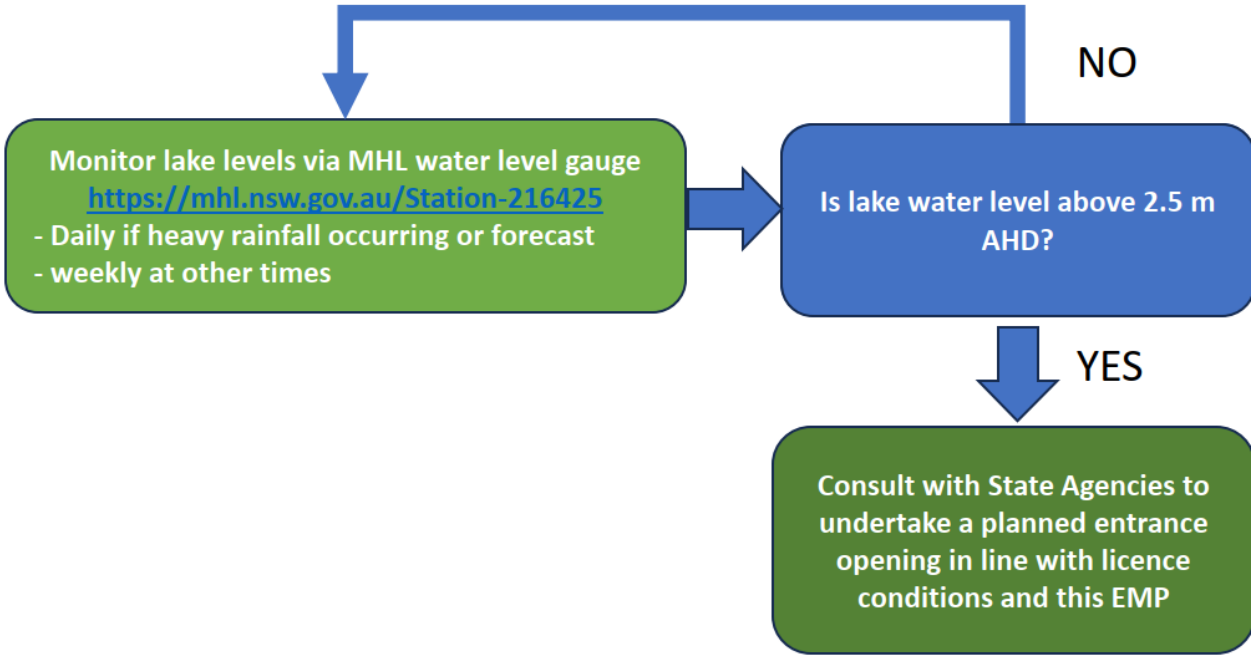

Figure 8-5 Proposed entrance management protocol for raising trigger level to 2.5m AHD

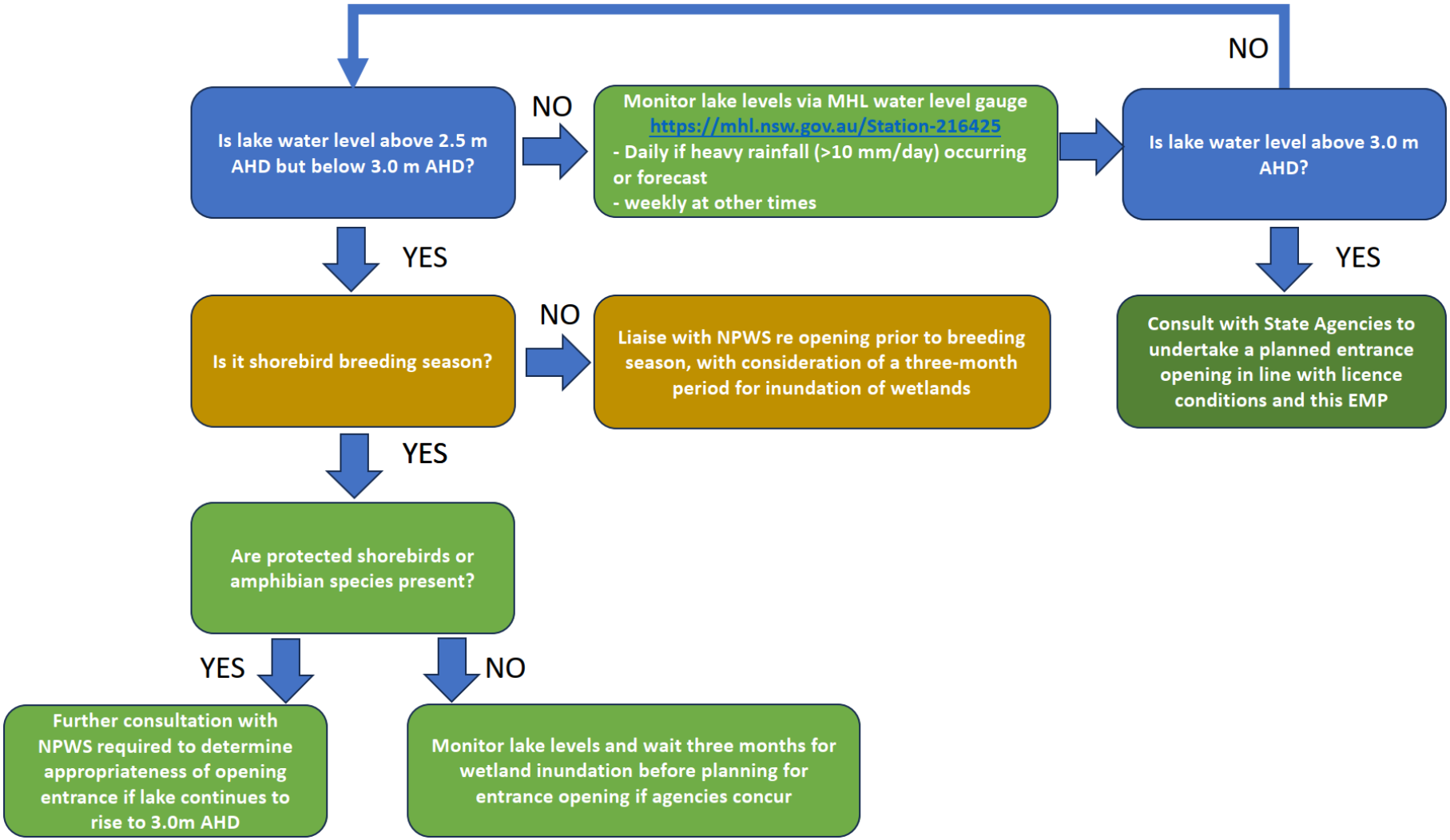

Figure 8-6 Proposed entrance management protocol for raising trigger level to 3.0m AHD

9. Penalties

Council has the authority to penalise persons opening the lake without appropriate authorisation under Section 632(1) of the *Local Government Act 1993*. It is also illegal under the *Fisheries Management Act 1994* to conduct non-authorised opening of the lake entrance.

10. Responsibility

Primary responsibility for implementing this EMP is with Shoalhaven City Council.

11. Contacts

The following organisations shall be contacted in the event of an entrance intervention being triggered under this EMP.

Organisation	Contact Details
Shoalhaven City Council	Lead Floodplain Management Number: 1300 293 111 Email: Floodplain.Management@shoalhaven.nsw.gov.au Lead Coastal Management Number: 1300 293 111 Email: coastal.management@shoalhaven.nsw.gov.au Manager Environmental Services Number: 1300 293 111 Email: Environmental.Services@shoalhaven.nsw.gov.au
Department of Climate Change, Energy, the Environment and Water (DCCEEW)	Senior Coast and Estuaries Officer (South East Regional Delivery - Shoalhaven LGA) Number: (02) 42216917 (Wollongong office) Email: admin-southeast@environment.nsw.gov.au
Department of Primary Industries (Fisheries)	Fisheries Manager – Coastal Systems Number: 1800 043 536 Email: information-advisory@dpi.nsw.gov.au and ahp.central@dpi.nsw.gov.au
National Parks & Wildlife Service	Number: (02) 4554 9500 (Ulladulla) or (02) 4428 6300 (Nowra office)

Organisation	Contact Details
	Email: npws.shoalhaven@environment.nsw.gov.au
National Parks & Wildlife Service	Shorebird Ranger Number: (02) 4428 6300 (Nowra office) Email: npws.shoalhaven@environment.nsw.gov.au
National Parks & Wildlife Service (24 hour Shorebird duty officer)	24 hour contact regarding shorebirds NPWS 24hr Duty Officer on Number: (02) 8275 1752
Environment Protection Authority	Regional Manager, South Coast Tel. (02) 4226 8100
Department of Planning, Housing and Infrastructure, Crown Lands	Area Manager Number: 1300 886 235 Email: cl.enquiries@crownland.nsw.gov.au Coastal Unit Email: coastal.unit@crownland.nsw.gov.au
Jerrinja Local Aboriginal Land Council	02 4447 5669 admin@jerrinja.org.au
Sussex Inlet Police Station	Number: (02) 4441 2665
St Georges Basin State Emergency Service	Number: 13 25 00

12. Review Period

This EMP is to be reviewed as necessary every five (5) to ten (10) years depending on the duration of the NSW Crown Land Licence. This will be determined following the receipt of a Crown Land Licence.

13. Amendments

[This section of the EMP should summarise the amendments to the EMP since its first adoption. The summary should include the date of the amendment, a brief description of the amendment, and the section within the EMP where the amendment can be found].

14. References

Advisian (2023) "St Georges Basin, Sussex Inlet, Swan Lake and Berrara Creek Coastal and Tidal Inundation Study", Report for Shoalhaven City Council, October

Advisian (2022a). Swan Lake and Berrara Creek Entrance Management Review, A report undertaken as part of the CMP for Shoalhaven City Council by Advisian.

Department of Environment and Climate Change NSW (2007) "The Green and Golden Bell Frog Key Population at Sussex Inlet – Swan Lake – Management Plan", July.

Peter Spurway & Associates (2002). Swan Lake Entrance Management Policy, report for Shoalhaven City Council.

Shoalhaven City Council (2008). Swan Lake Entrance Management Policy. Policy Number POL05/41.

Appendix A. Impacts of Inundation

Mapped Inundation Extents, Assets impacted by inundation

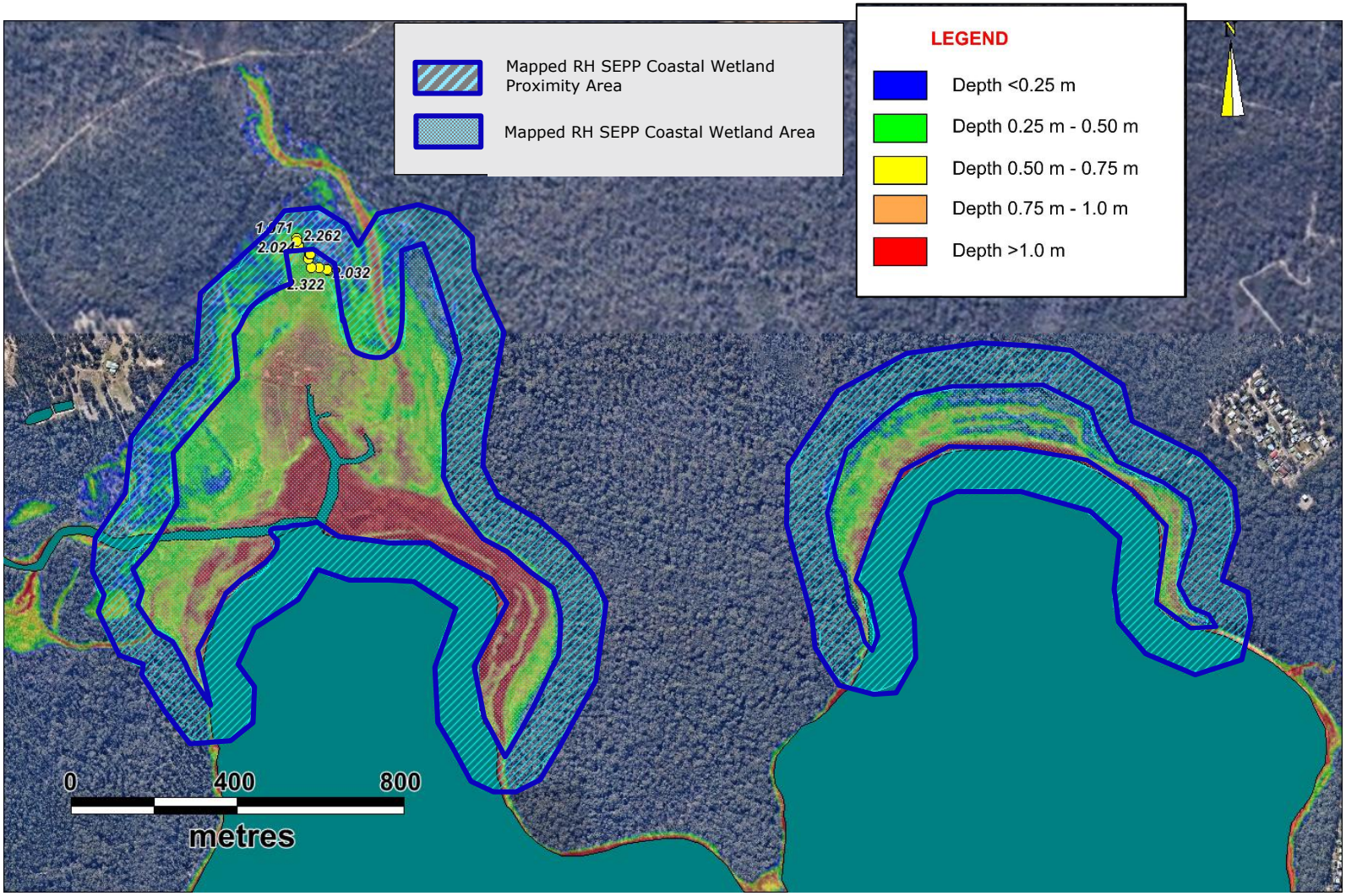

Figure A-1 Extent of inundation for lake level of 2.3m AHD, vs mapped Coastal wetland area extents (from RH SEPP)

A.1 Assets impacted by inundation

A list of assets that are low-lying and are at risk from inundation when lake levels are between 2 m AHD and 3 m AHD is provided in Table A.1 with suggested works that could be carried out to improve their resilience.

At the trigger level of 2.3m AHD for planning for a lake opening, the only infrastructure that would experience inundation is the access track at "The Springs" Lakeside Cabins. At the 2.5m AHD trigger for lake opening, the lowest point of Collier Drive south of the Swan Lake Bridge, and the lowest point within Swan Lake Tourist Park experiences inundation. At a level of 2.6m AHD, a 40m length of The Springs Road north of Collier Drive Bridge would experience inundation, and the sewage holding tank for "The Springs" cabins have a cover level at 2.7m AHD.

Table A-1 – Key asset inundation levels (Peter Spurway & Associates, 2002)

Asset	Asset Lake Level (m AHD)	Suggested works
A. Swan Haven		
'The Springs' Lakeside Cabins access track low point	2.03	Raise access track and culvert to 3.0 m AHD (minor works). Refer to Action I02 in Swan Lake CMP
'The Springs' sewage holding tank cover	2.70	Raise sewage tank to 3.0 m AHD (minor works)
Pumping Station 13 access track low point	2.93	Raise access track to 3.0 m AHD minimum (minor works)
'The Springs' lowest cabin (No 4) floor level	3.37	No works required
Public toilets floor level	3.46	No works required
Slab at Pumping Station No. 13 (Lake Drive Reserve)	3.62	No works required
B. Cudmirrah		
Shared path north of footbridge at Springs Road	2.28	Major Works - Consider raising to 3.0 m AHD minimum. Refer to Action I03 in Swan Lake CMP
Collier Drive – lowest point south of bridge	2.47	Major works – raise road to 3.0 m AHD minimum
Swan Lake Tourist Park lowest ground level	2.47	Minor works to raise main thoroughfares within park to above 2.5 m AHD
The Springs Road north of Collier Drive Bridge	2.60	Major works – raise road to 3.0 m AHD minimum
Underside of footbridge north of Collier Drive Bridge (from Works as Executed Drawings)	2.71	Consider raising bridge deck and adjoining shared path when bridge is due for replacement

Asset	Asset Lake Level (m AHD)	Suggested works
Footbridge deck level (from Works as Executed Drawings)	3.15	Consider raising bridge deck and adjoining shared path when bridge is due for replacement
Collier Drive at bridge deck	3.17	Consider raising bridge deck when bridge upgraded. Bridge soffit 3.0 m AHD minimum.
Swan Lake Tourist Park office floor level	3.25	No works required
Switchgear building Pumping Station No. 1 Goonawarra Drive	3.41	No works required
Public toilets floor level	3.60	No works required

Another asset that has been recently constructed is the footbridge at Errol Bond Reserve, where the soffit of the bridge is noted on the Works as Executed Drawings to be 2.71 m AHD.

Predicted inundation extents and depths for a lake level of 2.4 m AHD are provided in Figure A-2, and at 2.7 m AHD in Figure A-3. From these figures, it can be seen that (Advisian 2022a):

- At a lake level of 2.4 m AHD, the access road to The Springs cabins is cut, minor inundation occurs at Errol Bond Reserve but that other impacts accord with observations from site photographs taken in July 2022 (when lake levels were 2.28m AHD).
- At a lake level of 2.7 m AHD, the access road to Berrara at Collier Drive is cut and there is minor inundation of The Holiday Haven caravan park, and minor inundation at The Springs Road north of the Swan Lake Bridge.

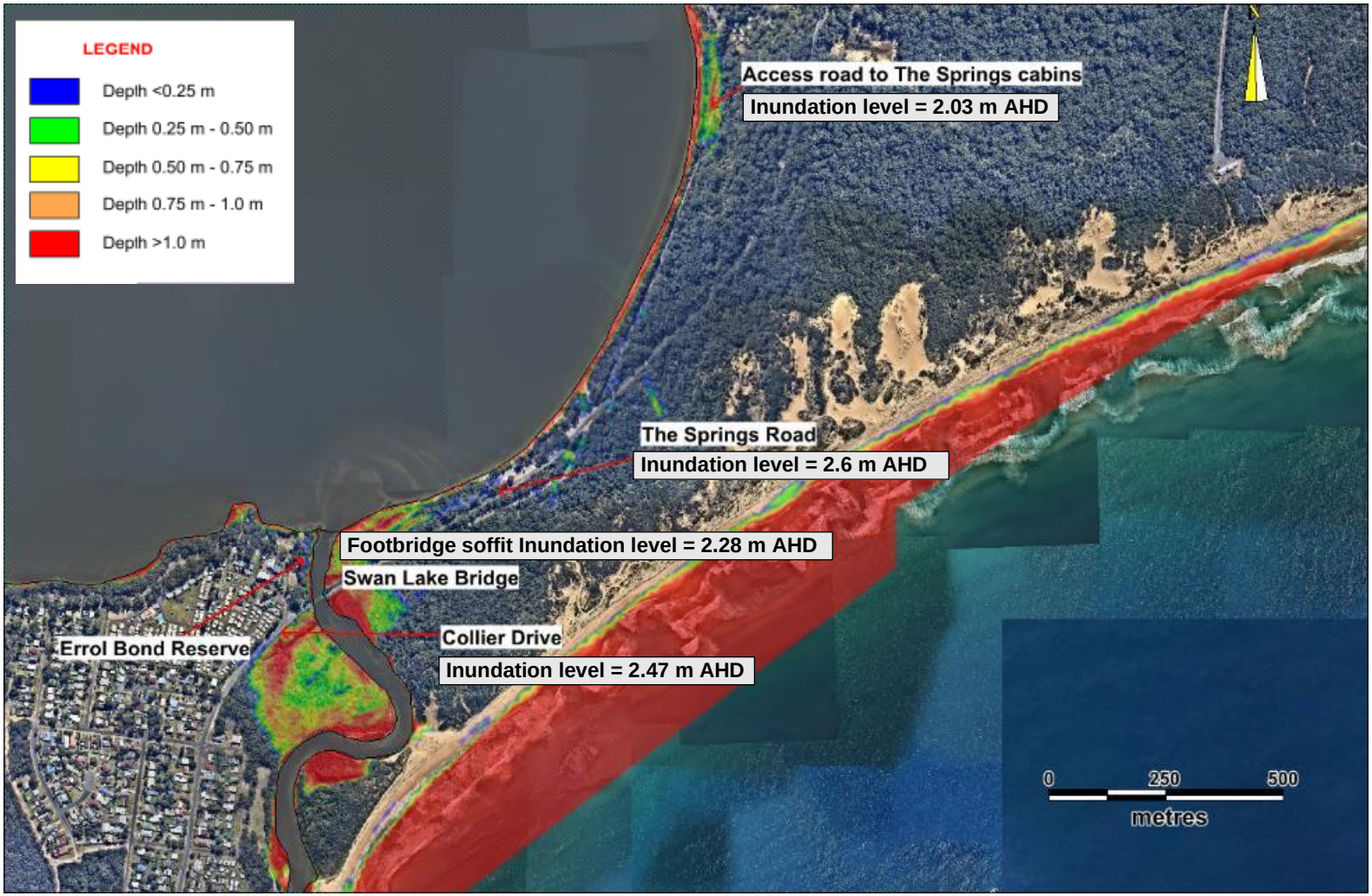

Figure A-2 Predicted inundation depth of key assets at lake level = 2.4 m AHD (Advisian 2022a)

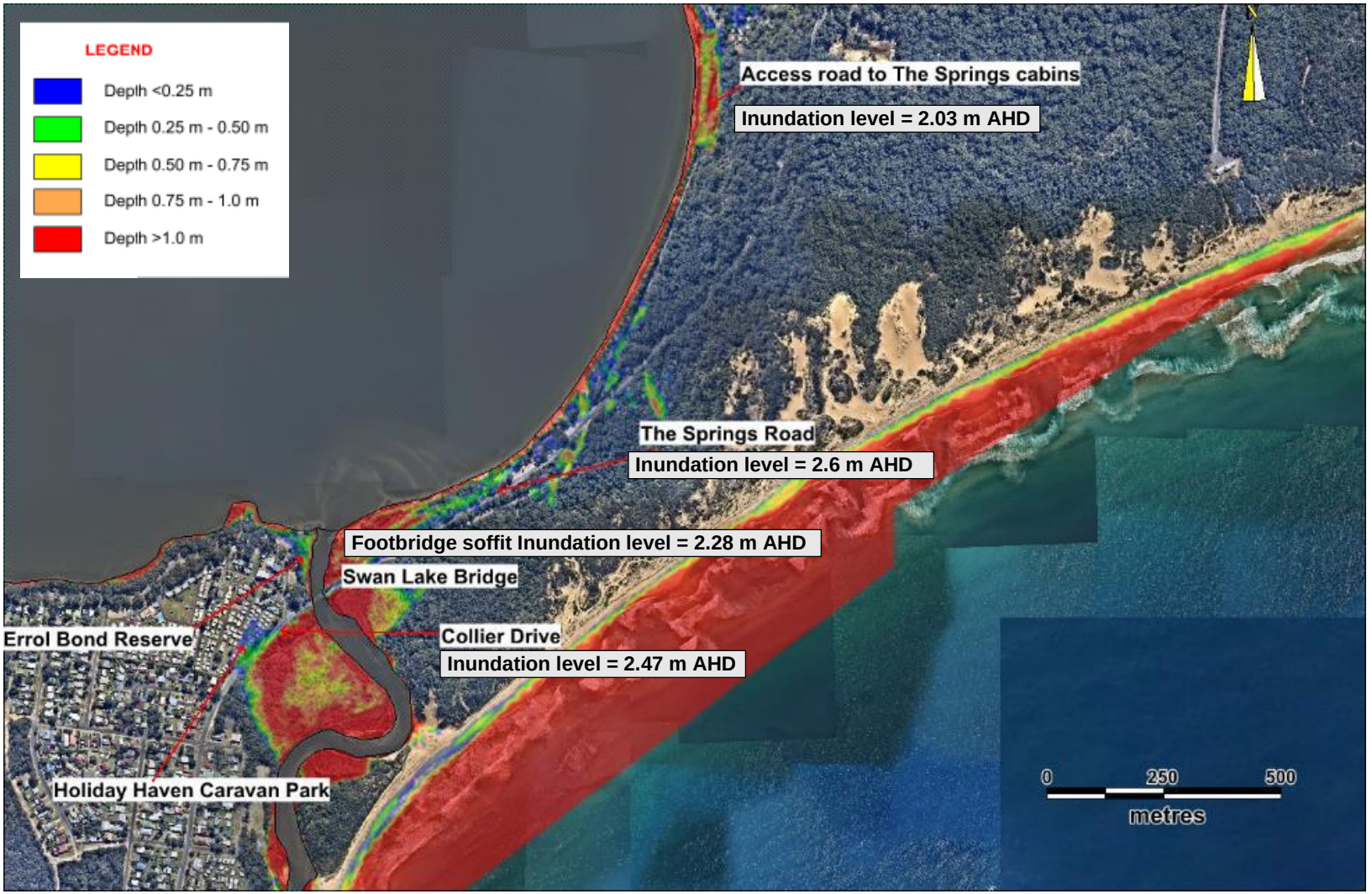

Figure A-3 Predicted inundation depth of key assets at lake level = 2.7 m AHD (Advisian 2022a)

Appendix B. Entrance monitoring

Example Record sheets

Swan Lake Entrance Openings - Monitoring

Date:	
Time:	
Recorder: (name and signature)	
Lake entrance opening level (m AHD) (refer to https://mhl.nsw.gov.au/Station-216425)	
Planned/unplanned opening?	
Location of opening (north or south of reef)	
Length and width of excavation channel	**Length (m):** **Width (m):**
Ocean swell conditions (offshore significant wave height Hs, period Tp, direction °TN). Refer to https://mhl.nsw.gov.au/Station-PTKMOW	
Tidal level	
Preceding rainfall (mm) Refer to http://www.bom.gov.au/nsw/flood/southcoast.shtml	
Comments/Observations	

Swan Lake Ongoing Entrance Monitoring

Date of opening:	
Date of berm closure:	

	Berm elevation (m AHD)	Date	Lake level (m AHD)	Berm level at "The Gap" (m AHD)	Comments/observations	Recorder (name & signature)
Week 2 (following closure)						
Week 4						
Week 6						
Week 8						
Week 10						
Week 12						
Month 3						
Month 4						
Month 5						
Month 6						
Month 7						
Month 8						
Month 9						
Month 10						
Month 11						
Month 12						