Lake Illawarra Entrance Options Study

Summary of the *Lake Illawarra Entrance Channel: management options assessment report* by the UNSW Water Research Laboratory

We acknowledge the Traditional Custodians of the land on which our city is built, the Aboriginal people of Dharawal Country. We recognise and appreciate their deep connection to this land, waters and the greater community.

13 November 2024

This project is supported by Wollongong City Council and Shellharbour City Council with technical and financial assistance provided by the NSW Government through its Coastal Management Program.

Through the Lake Illawarra Coastal Management Program, Wollongong City Council and Shellharbour City Council are working with the NSW Government to consider options to manage erosion in the Lake Illawarra Entrance Channel.

The Lake Illawarra Entrance Options Study (EOS) is being undertaken by the University of NSW Water Research Laboratory in collaboration with a team of coastal experts.

The study has tested a range of management options to see how they address the erosion and changes that have occurred since the lake was permanently opened and impacts they would have on the lake's usage and the surrounding environment.

We are now seeking community input to understand what is important to you about the lake. This information will assist us in understanding what values are most important to maintain into the future.

Wollongong City Council and Shellharbour City Council prepared the Lake Illawarra Coastal Management Program and the Lake Illawarra Entrance Options Study with technical and financial assistance from the NSW Government through its Coastal and Estuary Grants Program.

Background

Lake Illawarra is a large, shallow estuary system located on the south coast of New South Wales. For thousands of years, the lake and its surrounds have been home to the local tribes of the Dharawal people providing an important source of food, shelter and spirituality. Many sites around the lake are of great cultural significance to the local Aboriginal community, and these connections with the lake continue today.

Historically, the lake functioned as an “Intermittently Closed and Open Lake and Lagoon” (ICOLL) and naturally changed between being opened or closed to the ocean.

When closed, the lake was separated from the ocean by a sand barrier that formed when ocean waves and tides pushed sand into the entrance channel. In times of drought, the entrance channel could remain closed for long periods, resulting in no exchange of water with the ocean.

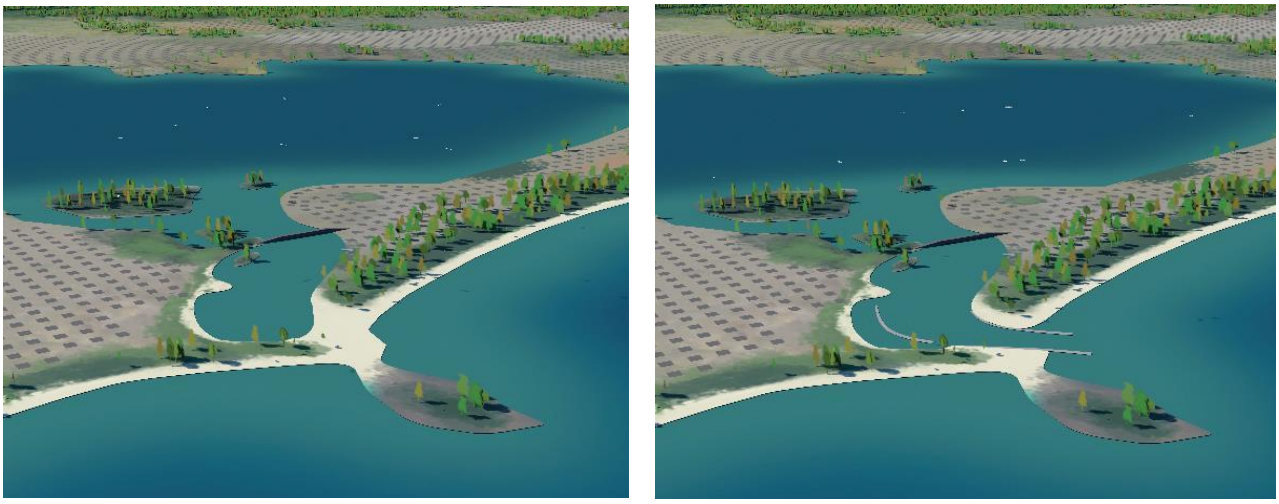


Image: Lake Illawarra entrance in its closed condition (left) and following construction of the permanent training walls in 2007 (right)

In 2000, during the Millenium Drought and following significant community concern around poor water quality and deteriorating estuary health, the former Lake Illawarra Authority made the decision to permanently open the lake by constructing training walls where the lake meets the ocean (the entrance).

Detailed information on the history, staging and construction of the entrance training walls is provided in the Lake Illawarra Synthesis Report (BMT, 2020a).

At that time (in 2007), permanently opening the entrance was the community’s preferred option to manage issues associated with low water levels, algae blooms and associated odours. It is now well understood that construction of permanent entrance training walls can have many costly and undesirable consequences for an estuary, many of which have occurred in Lake Illawarra.

Best practice management of estuary health involves taking action to reduce stormwater runoff and sources of pollution from the surrounding catchment. Using nature-based methods like restoration of foreshore vegetation can also help filter water to improve water quality and environmental health. Integrated management measures to address water quality are now being implemented more effectively (see Management of the Lake - Lake Illawarra Coastal Management Program 2020 - 2030 in section below).

The Problem

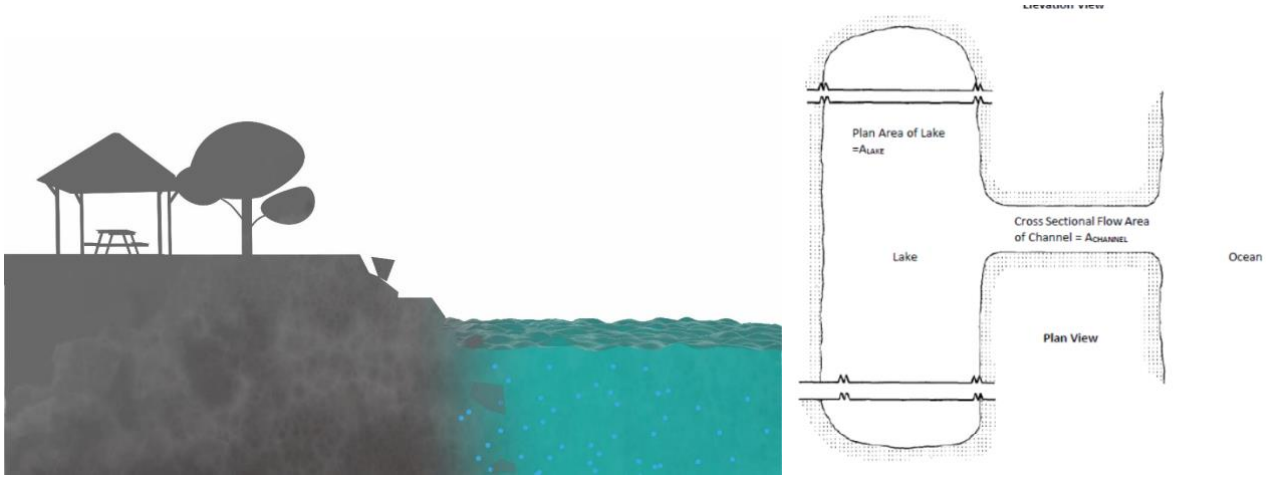
The permanent opening of the entrance channel has significantly altered tidal patterns in the lake, creating strong tidal currents in the channel and causing sand movement and erosion in the channel bed and foreshores. Erosion is undermining foreshore infrastructure and impacting boating and recreational activities in the entrance.

Image: The lake is highly valued for recreational activities. Erosion in the channel has undermined jetty structures (top right) and natural, built and cultural assets on Picnic Island (below right).

The amount of tidal water being exchanged with the ocean is continuing to increase. Changes in tidal patterns (also called the tidal regime) have impacted the ecology of the lake, altering the balance of salt and freshwater inputs and causing shifts in the animal and plant communities. New growing conditions have resulted in mangrove expansion around the foreshores and declines in seagrass and saltmarsh habitats around the lake fringes. This, in turn, has impacted recreational and commercial fish stocks and roosting areas for populations of migratory birds.

Above: The Lake Illawarra entrance channel showing foreshore areas subject to erosion

Understanding the erosion problem



Above: Fast moving tidal currents cause movement of sand and erosion of the foreshore as the tide moves in and out through the entrance channel (left).

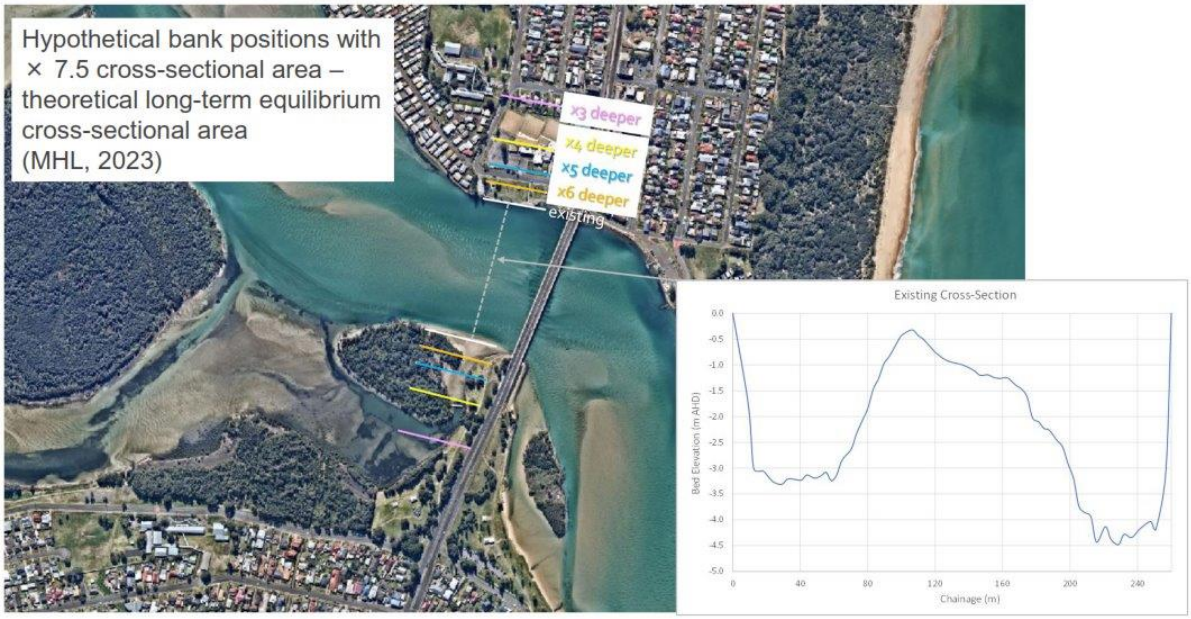
Difference in water levels between the ocean and the lake cause fast-flowing tidal currents to move through the channel, which acts like a valve controlling water movement between the ocean and the lake. The entrance training walls allow the daily tidal flows to move in and out of the entrance channel more efficiently, meaning the tidal flows have increased velocity and therefore have greater potential to transport sand.

On the changing of the tide, current movements cause sand to be scoured from the channel bed and foreshore, moving it further into the lake or to different parts of the channel where shoals develop, or offshore of the training walls. The erosion is causing the cross section of the channel to get bigger, which allows more tidal water in through the channel, which in turn causes tidal flows to be faster, leading to more scour and erosion. This process is known as a positive feedback loop.

Tidal changes and fast flowing current through the entrance has undermined Windang bridge piers. To ensure the bridge remains stable, rocks have been placed from the northern abutment up to pier 11 (or approximately one third the length of the bridge) to stabilise these piers and protect against further erosion. Further work is being progressed to place rocks along the full length of the bridge.

Above: Works undertaken by Transport for NSW to stabilise piers and ensure the bridge remains safe now and into the future

This process is projected to continue to accelerate the widening and deepening of the entrance channel for at least the next 100+ years, or until such time as the tidal range is the same between the ocean and the lake. When this happens, the entrance channel dimensions may be up to around 7 times greater they were in 2012.



Above: Hypothetical shoreline changes modelled in the Stage 1 data compilation report and the existing channel cross section (image UNSW Water Research Lab)

The same process is also occurring in other estuaries where entrance training structures have been installed, including in Wagonga Inlet at Narooma, Wallis Lake at Forster/Tuncurry and Lake Macquarie. Research has shown that changes in Lake Illawarra have occurred much faster than in these estuaries.

If we do nothing to manage accelerating tidal flows in the entrance channel, erosion and loss of land along the shoreline will continue. Natural, built and cultural assets will be progressively undermined, and the tidal range (difference in the maximum and minimum water level over a tidal cycle) will increase. This means:

- High tides will get higher, and low tides get lower within the lake
- Shorelines within the lake will be altered and flooding of foreshores and infrastructure from higher water levels will become more frequent
- Publicly used spaces and property will continue to erode
- Habitats like seagrass will no longer be able to grow in areas that become too shallow, and foreshore habitat like saltmarsh will be inundated too often for vegetation to survive
- Mudflats and mangrove communities will become more common around the lake fringes
- There will be more nuisance flooding of low-lying areas on high tides

In the *Lake Illawarra entrance channel: management options assessment report*, not doing anything at all is referred to as the ‘base case scenario”.

Management of the Lake

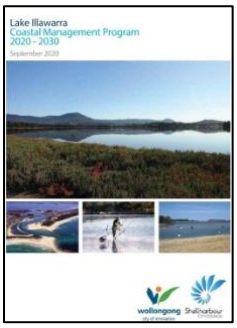
Lake Illawarra and its catchment extend over two separate Local Government Areas, Wollongong and Shellharbour. Both Councils along with various State Government agencies have role in managing the lake.

The Lake Illawarra Coastal Management Program (CMP) was created and certified as the long-term strategy to guide coordinated management of the lake. It contains a list of actions to manage threats and protect and improve the health of lake over the next 10 years. These actions were developed in consultation with the community and align closely with community values and uses of Lake Illawarra.

One of the actions in the CMP is: *Investigate and finalise options to manage erosion and accretion (buildup of sand) changes in the entrance channel*. This action, along with others in the CMP, all play a role in addressing long-term threats and changes from coastal hazards.

CMP agencies responsible for implementing actions include Wollongong City Council

- Shellharbour City Council
- Department of Housing, Planning and Infrastructure (Crown Lands)
- Department of Climate Change, Energy, the Environment and Water (DCCEEW)
- Transport for NSW
- Illawarra Local Aboriginal Land Council
- Department of Primary Industries and Regional Development (Fisheries)



Note: The CMP and other supporting documents are available on Wollongong City Council and Shellharbour City Council's websites.

The Entrance Options Study

Wollongong City Council and Shellharbour City Council are working with the NSW Government to progress the Lake Illawarra Entrance Options Study (EOS). The study is looking at options for managing the impacts of the entrance opening and protect parts of the foreshore that are actively eroding.

The University of NSW Water Research Laboratory have been engaged to conduct an independent assessment of the natural processes impacting the entrance channel and similar lake systems to identify all viable options. The consultants have worked in collaboration with a multi-agency team of coastal experts to assess these options.

Stage 1

A list of more than 50 possible management options were initially considered. Through the Stage 1 process, this was narrowed this down to a shortlist of 5 options for detailed assessment and modelling.

The 5 options shortlisted were:

Option 1: Rock weir near Windang Bridge (a rock barrier built across the channel)

Option 2: Rock weir near Windang Bridge with gate structures to manage flood impacts and increase tidal flushing when required (e.g. during extended dry periods)

Option 3: Rock weirs at the western end of the channel across all three channels

Option 4: Staggered groyne field with armoured bed (low lying rock barriers that extend into the channel, with rock protecting the bed beneath)

Option 5: Remove both training walls and undertake large-scale sand nourishment (return the lake to its natural ICOLL state)

Stage 2

The 5 options were tested against the base case scenario to see how well they perform in reducing tidal flows and erosion (these were the primary management objectives*). We also considered other impacts they would have to the lake and surrounding areas, how much they would cost, and whether they would cause further environmental harm elsewhere.

Here is the full list of management criteria that were used to assess each option:

	**Foreshore erosion and tidal range**	These two criteria are closely linked and refer to the slowing down of tidal currents to reduce removal of sand from the lakebed and foreshore. *The primary management objectives are to reduce foreshore erosion through constraining the tidal range to that of 2008 immediately following the entrance training works. This would slow tidal velocities and return the entrance channel to a more stable state
	**Water quality in the lake**	Water quality refers to how clean the water is. It is influenced by many things, but in this study, it was considered as the level of tidal flushing, or how often water in the lake is replaced with water from the ocean
	**Recreational safety for unpowered in-water activities**	This is a measure of how safe the channel would be for activities like swimming, kayaking and paddle boarding. It depends on the speed of tidal currents moving through the channel
	**Flooding from catchment/rainfall events**	Flooding or raised water levels from intense rainfall resulting in water flowing into the lake from the surrounding catchment
	**Flooding from coastal storms or oceanic flooding**	Flooding or high-water levels that result from a rise in water level in the absence of rainfall, that usually occurs when a storm surge coincides with high tide
	**Fish passage**	This refers to how well fish can move into and out of the channel, which is important for fish migration and movement between the ocean and the lake's tributaries. It is impacted by barriers and how fast-flowing and rough the water is
	**Flora and fauna**	Changes to estuarine plant communities (mangroves, saltmarsh and seagrass) and animal communities (including birds and fish)
	**Cultural values and heritage**	Changes to traditional uses and value of the lake systems, and risks to archaeological sites
	**Boating access**	This is how safely boats can move between the ocean and the lake through the entrance channel. It is impacted by structures in the water as well as current speed and water depth

The capital cost, which is an estimated range required to construct the option, as well as other risks associated with the option were also considered.

The base case is what would happen if we took no additional action to manage the entrance channel. Under this scenario, many of the problems we are experiencing in the entrance channel would continue to worsen over the next century.

The table below provides a summary of the ratings used to assess each criteria against the base case.

Colour	Description
Improvement	There is a strong consensus among the multi-agency group that implementing an option will result in an improvement in a criteria with significant certainty, often supported by modelling or observations.
Improvement*/ Improvement#	The multi-agency group agreed that implementing an option will likely result in an improvement in a criteria, however more information is required to confirm this direction of change.
Further study/ consultation required	A consensus was not reached by the multi-agency project team, and further information is required to determine whether implementing an option would improve or deteriorate a certain criteria.
Deterioration*/ Deterioration#	The multi-agency group agreed that implementing an option will likely result in a deterioration in a criteria, however more information is required to confirm this direction of change. Alternatively, implementing the option would cause a deterioration, however this could be readily managed through additional mitigation measures.
Deterioration	There is a strong consensus among the multi-agency group that implementing an option will result in a deterioration in a criteria with significant certainty, often supported by modelling or observations.

Table 1: Definitions and table colourings for criteria ratings

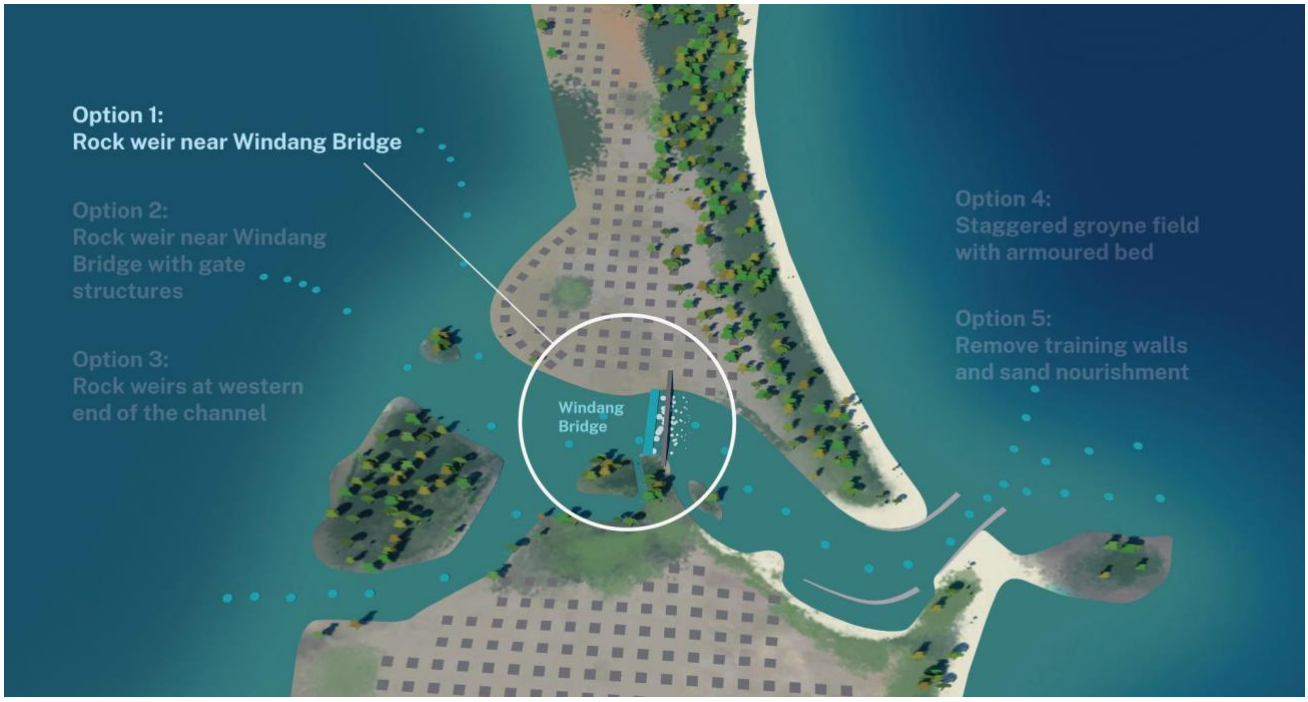
Option	Objectives and criteria									
	Lake tidal range	Foreshore erosion	Water quality in the lake	Recreational safety	Flooding from rainfall/ catchment	Flooding from coastal storms	Fish passage	Flora and fauna	First Nations heritage	Boating access
Base case	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change
Option 1: Rock weir near Windang Bridge	Improvement	Improvement	Deterioration*	Deterioration*	Deterioration#	Improvement#	Deterioration*	Further study required	Further consultation required	Deterioration
Option 2: Rock weir near Windang Bridge with gate structures to manage flood impacts	Improvement	Improvement	Deterioration*	Deterioration*	Deterioration#	Improvement#	Deterioration*	Further study required	Further consultation required	Deterioration
Option 3: Rock weirs at the western end of the channel across all three channels	Improvement	Improvement	Deterioration*	Deterioration*	Deterioration#	Improvement#	Deterioration*	Further study required	Further consultation required	Deterioration
Option 4: Staggered groyne field with armoured bed	Improvement	Improvement	Deterioration*	Deterioration	Deterioration#	Improvement#	Improvement*	Further study required	Further consultation required	Deterioration
Option 5: Remove both training walls and large scale sand nourishment (return to pre-2007 conditions)	Improvement	Improvement	Deterioration*	Improvement	Deterioration#	Improvement#	Further study required	Further study required	Further consultation required	Deterioration

* Assessed with a narrow criteria which may not reflect the direction of change, further studies are recommended and/or there are potential mitigation actions that could be implemented with this option

Presently being assessed (at the time of writing) as part of the *Review of the Lake Illawarra Floodplain Risk Management Study and Plan* (WCC, 2023b)

Table 2: Summary options assessment matrix relative to base case scenario

Option 1: Rock weir near Windang Bridge



A weir is a rock barrier built across a channel to slow tidal currents and raise the water level slightly on the upstream side. The top of the weir would be 0.1m above mean sea level (AHD), as this is the lowest height that would achieve the target tidal range. The weir would be underwater during high tides and have water flowing over it during low tides. An example from the Coquet River, Amble, UK, is shown in the image below.

The precise location of the weir structure would need to be determined but could be located upstream or downstream of Windang Bridge to reduce the risk of increasing stresses on the piers.

Overall assessment

Constructing a rock weir near Windang Bridge would meet the key objectives of the target lake tidal range and reducing foreshore and bed erosion. However, water quality in the lake, upstream flooding, fish passage and boating access would deteriorate overall compared to the base case.

Assessment Criteria

Lake tidal range

Constructing a weir would achieve the 2008 target tidal range in the lake. It would raise the mean water level in the lake by approximately 0.2 m which is about the same level it was just before the training walls were constructed. A weir would raise high tide levels and lower low tide levels between the structure and the ocean.

Rating: Improvement

Foreshore erosion

Constructing this option would significantly reduce the present rate of erosion of the channel bed and both foreshores. The rate of erosion would be reduced both downstream and upstream of the weir due to reduced tidal velocity on both sides.

Rating: Improvement

Water quality in the lake

Due to a reduction in tidal flushing, there would be an overall negative impact on water quality. Some parts of the lake would have no change in water quality while the greatest changes would be expected on the eastern side of the lake near the entrance channel. Water in the entrance channel upstream of the weir would change from being marine dominated to more brackish, particularly after rainfall.

Rating: Deterioration

Recreational safety

Although in-water recreational safety would be improved throughout most of the entrance channel (because tidal channel velocities upstream and downstream of Windang Bridge would be reduced), it would not be safe for non-powered watercraft or swimmers to cross (or wade along) the weir. These impacts would affect the entrance channel and the eastern sections of the lake but are unlikely to be problematic elsewhere.

Rating: Deterioration

Flooding from rainfall/catchment

A weir would have a negative impact on upstream flooding, with higher peak flood levels and increased time for water to drain away. The impacts would be influenced by the scale, duration, rate of rise of the event and if it coincides with a coastal event. Detailed modelling is essential to understand the flood risk implications and it will be undertaken prior to implementing any measure. To that effect, the Lake Illawarra Floodplain Management Study and Plan (FRMSP) is in progress in accordance with the NSW Government's flood poly under the NSW Flood Program.

Rating: Deterioration

Flooding from coastal storms

A weir is likely to reduce the impacts of flooding due to coastal storms surges.

Rating: Improvement

Fish passage

A weir across the channel would create an obstruction to the existing two-way movement of fish into and out of the lake, as the water depth over the weir is too shallow to allow fish (particularly large fish) to traverse the weir over most of the tidal cycle. This may also change the range of fish species and fish abundance from what presently exist in the estuary.

Rating: Deterioration

Flora and fauna

The option would change lake water levels and the balance of salt and freshwater. This will mean conditions will change to suit different species of animals and plants, and favour those that prefer more brackish water. There will be changes in the types and number of invertebrates, fish and birds that use the lake, but the exact impact on each of these requires further investigation. As it is presently unknown which other estuarine flora and fauna may decline and which will flourish with a smaller tidal range in Lake Illawarra, no rating has been provided.

Rating: Further study required

Cultural values and heritage

There may be both benefits and drawbacks on the impact a weir will have on archaeological sites and broader cultural values.

Rating: Further consultation with First Nations stakeholders is required.

Boating access within the lake

A weir would have an overall negative impact on boat access as it would be a physical barrier across the entrance channel. Vessels launched from boat ramps around the lake would not have access to the channel east of the bridge or the ocean.

Rating: Deterioration

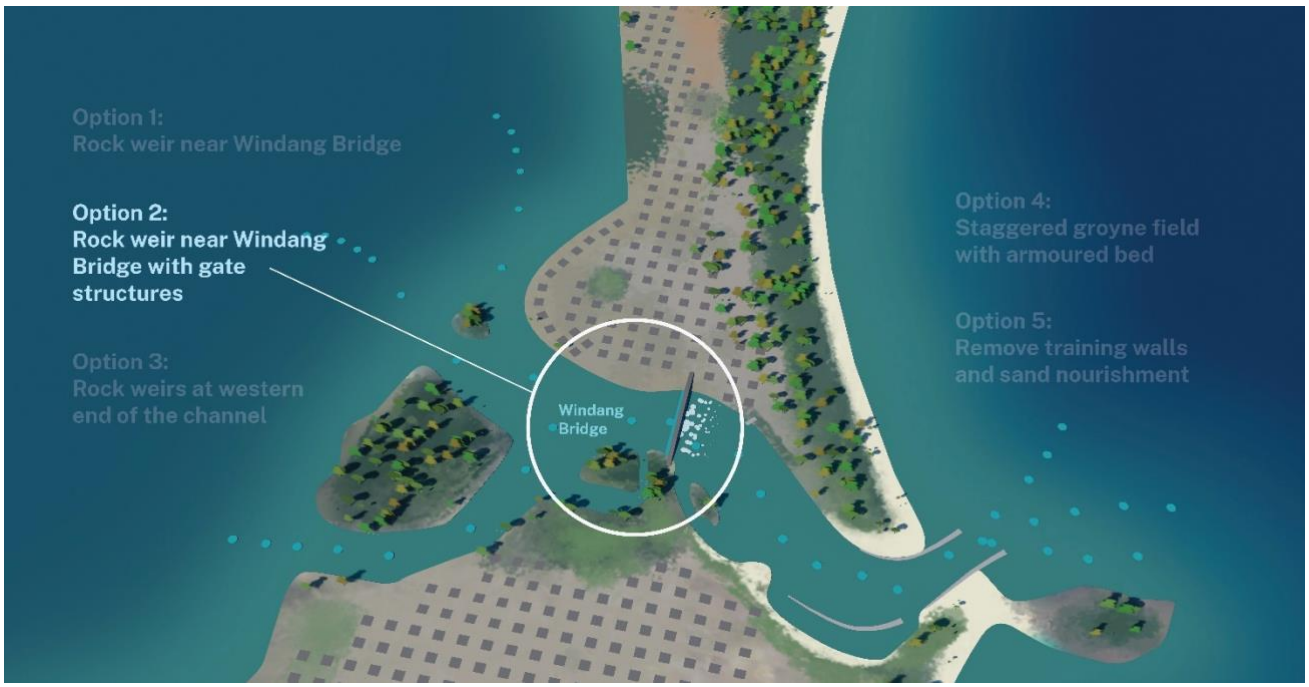
Cost

The capital cost for a weir beneath Windang Bridge is estimated to be between $20 - $45 million.

Other risks

The channel downstream and upstream of the weir may infill with sediment. Also isolated areas of erosion may occur immediately adjacent to the weir which would require further management. Increased tidal ranges downstream of the weir may have an impact on infrastructure and navigability in this area.

Option 2: Rock weir near Windang Bridge with gate structures to manage flood impacts



This option would combine a rock weir (like Option 1) with adjustable gate structures that open and close to allow water to move through to manage flood impacts. The precise location of the weir structure would need to be determined. The structure could involve a rock weir spanning two thirds of the channel and adjustable gate structures on the final third of the channel (approximately 85 m in length).

The gate structures could be operated to increase tidal flushing when required, this has not been considered at this stage of the assessment. An example of adjustable gate structures at Beavers Creek, Collingullie, NSW, is provided in the image below.

Overall assessment

This option is expected to meet the key objectives of the target lake tidal range and reducing foreshore and bed erosion. However, water quality in the lake, upstream flooding, fish passage and boating access would deteriorate overall compared to the base case.

Assessment Criteria

Option 2 was capable of achieving the same reduction in tidal range and erosion as Option 1. It also has the same issues and ratings associated with each of the criteria as presented for Option 1. However, Option 2 is considered to have different impacts on catchment flooding than Option 1.

Flooding from rainfall/catchment

The gate structures could be designed so that they can be opened prior to, or during, a flood event to provide faster drainage of flood waters. However, it is still likely that drainage time would be longer compared to the base case. The impacts would be influenced by the scale, duration, rate of rise of the event and if it coincides with a coastal event. Detailed modelling is essential to understand the flood risk implications and it will be undertaken prior to implementing any measure. To that effect, the Lake Illawarra Floodplain Management Study and Plan (FRMSP) is in progress in accordance with the NSW Government's flood policy under the NSW Flood Program.

Rating: Deterioration

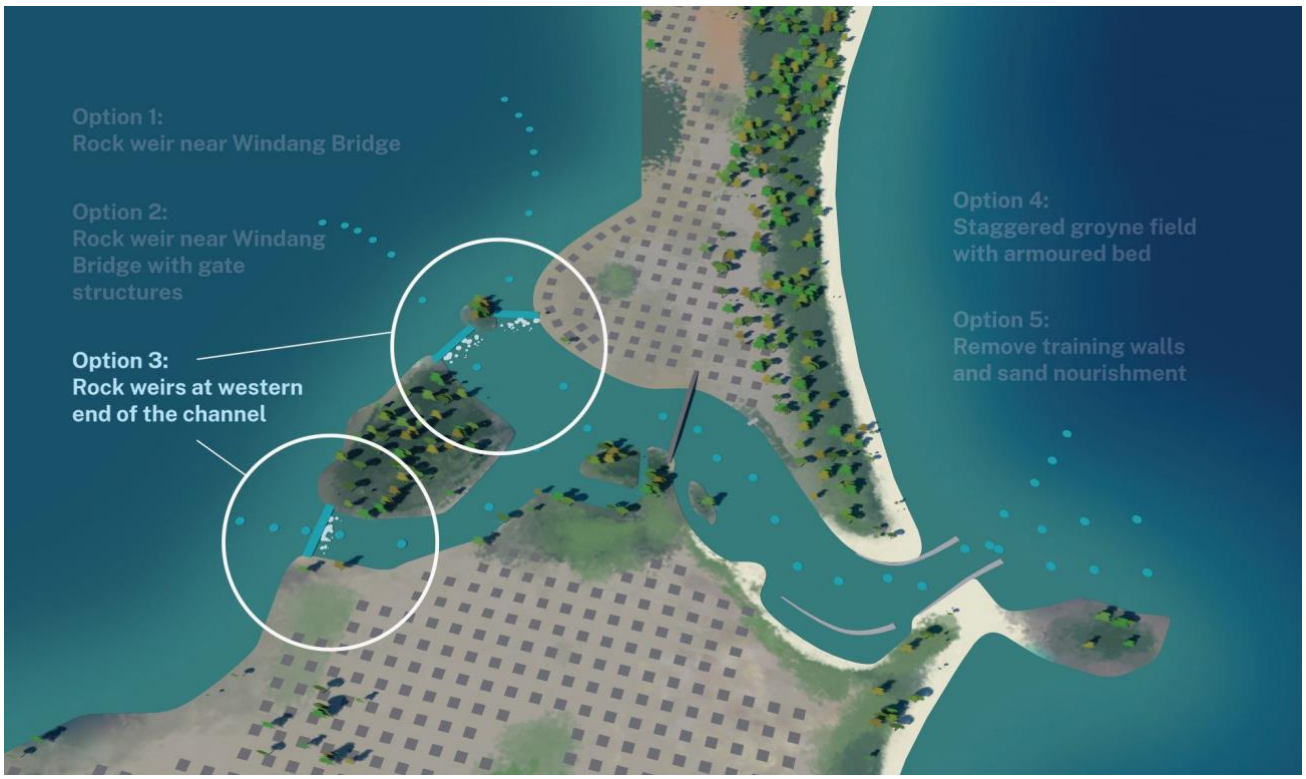
Cost

The capital cost for the combined weir and adjustable gate structures beneath Windang Bridge is estimated to be between $60-105M.

Other risks

The risks associated with this option are like those for Option 1. An additional risk is the operation of the adjustable gate structures. Relying on management of the gate structures during an emergency event (e.g. a flood) is a potential liability risk for the operator of the structure. It may also result in upstream communities becoming complacent to the risks of flooding if the structure fails to operate as expected.

Option 3: Rock weirs at western end of the entrance channel across all three channels



This option would involve constructing three rock weir structures at the western end of the entrance channel, between the Shellharbour foreshore and Bevans Island, between Bevans Island and Cudgeree Island and between Cudgeree Island and the Wollongong foreshore.

Overall assessment

Constructing three weirs at the western end of the entrance channel is expected to meet the key objectives of the target lake tidal range and reducing foreshore and bed erosion. However, water quality in the lake, upstream flooding, fish passage and boating access would deteriorate overall compared to the base case.

Assessment Criteria

Option 3 was capable of achieving the same reduction in tidal range and erosion as Options 1 and 2. It also has the same issues and ratings associated with each of the criteria as presented for Options 1 and 2. However, Option 3 may have impacts on First Nations heritage and cultural values.

Cultural values and heritage

Preliminary input suggests weirs abutting the islands may not be appropriate due to their cultural significance.

Rating: Further consultation is required with First Nations stakeholders

Cost

The capital cost for the three weirs at the western end of the entrance is between $15-30M.

Other risks

The channel downstream and upstream of the weirs may infill with sediment. Also isolated areas of erosion may occur immediately adjacent to the weirs which would require further management.

Option 4: Staggered groyne field with armoured bed

This option would involve constructing three groynes, or rock barriers, perpendicular to the foreshore on either side of the lower section of the entrance channel to slow tidal currents. These structures would not extend across the full length of the channel. Bed armouring or the placement of rock on the channel bed would also be required to prevent sand scour and erosion. The groynes would be exposed at all stages of the tide.

Overall assessment

A staggered groyne field is expected to meet the key objectives of the target lake tidal range and reducing foreshore and bed erosion, while also maintaining fish passage. Water quality in the lake, upstream flooding, boating access and recreational safety would deteriorate overall compared to the base case.

Assessment Criteria

Lake tidal range

Constructing a staggered groyne field at the downstream extent of the entrance would achieve the 2008 target tidal range in the lake.

Rating: Improvement

Foreshore erosion

Option 4 can achieve the similar reduction of foreshore erosion as described in Option 1. Localised bed armouring is required to ensure scour of the entrance channel bed at the location of the groynes does not occur.

Rating: Improvement

Water quality in the lake

Option 4 is assumed to have similar issues associated with water quality as discussed in Option 1. A reduction in tidal range will reduce tidal flushing and exchange, decreasing water quality.

Rating: Deterioration

Recreational safety

Option 4 is the most dangerous from a recreational safety perspective. Very high velocities (up to 3 m/s) have been modelled during normal tidal conditions. Drastic changes in water levels (gradients) through the groyne fields will further increase risks to unpowered in-water activities in this area.

Rating: Deterioration

Flooding from rainfall/catchment

Option 4 is assumed to have the similar issues associated with flooding from rainfall/catchment as discussed in Option 1, although there is currently no numerical modelling available to quantify the change.

Rating: Deterioration

Flooding from coastal storms

Option 4 is assumed to have the same improvements to flooding from coastal storms as discussed in Option 1 through decreased hydraulic efficiency. Additional study is required to confirm that it is an improvement under a wide range of environmental conditions.

Rating: Improvement

Fish passage

While high velocity and highly turbulent flow will be an issue at the groyne field, this is viewed as an overall improvement in fish passage. Compared to the base case velocities will not continue to increase into the future and access to the lake by fish is maintained across the whole tidal cycle. Additional study is required to confirm that it is a net improvement across a range of fish species.

Rating: Improvement

Flora and fauna

The net change in flora and fauna compared to the base case is difficult to assess for this option. The changes will be complex and interrelated. On this basis, no rating has been provided.

Rating: Further study required

Cultural values and heritage

Preliminary input indicated that the staggered groyne field may be viewed negatively due to the hard engineering structures abutting onto natural foreshores.

Rating: Further consultation required with Aboriginal stakeholders

Boating access

Modelling results suggest the high velocity turbulent flows (up to 3 m/s) through the structures would pose substantial safety risks to vessels. Extremely steep water level gradients through the groyne fields will increase risks to vessel activities. Due to these dangerous conditions, boating access through the channel between the ocean and the lake would no longer be allowable.

Rating: Deterioration

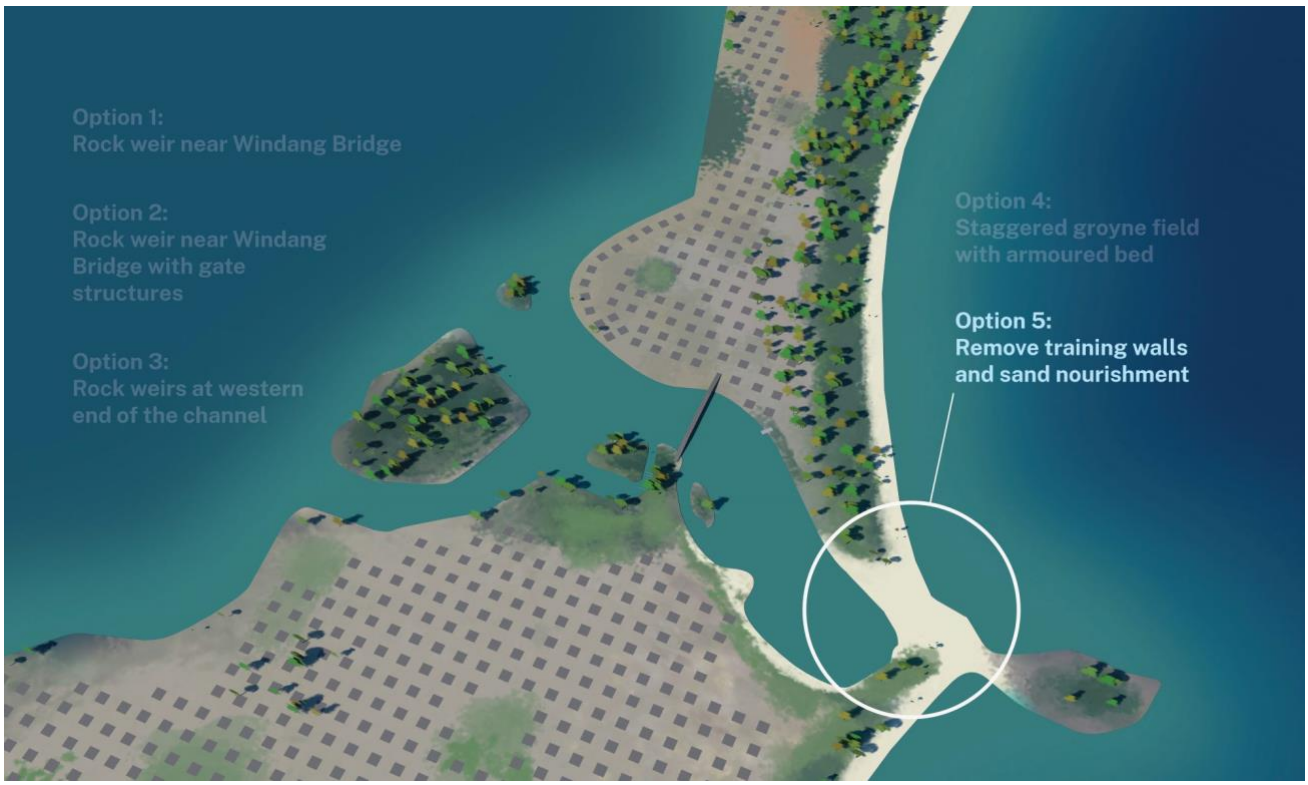
Cost

The capital cost for the staggered groyne field with the armoured bed is estimated to be between $145-240 million. Large amounts of rock would be needed, and construction would be difficult due to high tidal velocities.

Other risks

Sediment may accumulate upstream and downstream of the groyne field. The entrance channel may need to shut for a time to allow construction of the groynes. Risks to recreational and boat safety may pose a liability risk if an accident occurs.

Option 5: Remove both training walls and undertake large-scale sand nourishment



Removal of the training walls constructed in 2007 in conjunction with large scale sand nourishment, or sand replacement. Sand nourishment, which is the artificial placement of sand to replace what has been lost due to erosion, would be required to more efficiently return sandy shoals in the entrance area that naturally restrict tidal range. This would be required to return the system to its natural condition as a lake that is intermittently open and closed (ICOLL).

Above: Approximately 200 000m^3 of sand was dredged from the lake entrance to complete the permanent opening. 900 000 m^3 has been lost to erosion since 2007. Photo Neuman Dredging

While the Stage 2 assessment only considered the removal of both training walls, other variations of this option could be assessed including the removal of only one training wall or the shortening of one or both training walls to increase sand replenishment from the ocean.

Overall assessment

Removing both training walls and using large scale sand nourishment to return Lake Illawarra to an ICOLL would meet the key objectives of the target lake tidal range and reducing foreshore and bed erosion. However, water quality in the lake, upstream flooding and boating access would deteriorate overall compared to the base case. Preliminary input suggests that this option may be preferable from a First Nations perspective, although further consultation will be required.

Assessment criteria

Lake tidal range

Returning Lake Illawarra to an ICOLL would achieve the target tidal range.

Rating: Improvement

Foreshore erosion

The aim of this option would be to revert Lake Illawarra into an accretionary mode (i.e. a lake that is intermittently open) to effectively address foreshore erosion within the entrance channel. However, a risk of this option is that the beach (approximate length 150 m) between the southern training wall and the coastal structure extending to Windang Island (completed in 2001) would likely be realigned and reduced in width because of removal of the southern training wall.

Rating: Improvement

Water quality in the lake

This option will reduce tidal exchange, which would result in a negative impact on water quality based on the criteria established, however poor water quality could be further exacerbated by urban and agricultural development in the catchment. Management measures to improve the quality of water entering the lake from the catchment would need to be considered to manage issues associated with poor water quality, which were a major driver for the initial construction of the training walls. There may be negative impact on amenity as the water in the entrance channel would change from its existing high proportion of clear marine water to more brackish water.

Rating: Deterioration

Recreational safety

As there are no structural barriers in this option, it would result in improved recreational safety of unpowered in-water activities (e.g. swimming, canoeing/kayaking, stand-up paddle boarding) through reduction of the tidal velocities across the whole of the entrance channel.

Rating: Improvement

Flooding from rainfall/catchment

A negative impact on upstream flooding in the lake. It is likely that active management of the entrance channel would be required to facilitate rapid scour during a flood event, which is common in ICOLLs in NSW.

Rating: Deterioration

Flooding from coastal storms

It is expected this option would reduce the impacts of most oceanic flooding, including coastal storm surge into the lake.

Rating: Improvement

Fish passage

While returning Lake Illawarra to an ICOLL system will intermittently reduce connectivity between the ocean and the lake, the impact on fish passage is not well understood. ICOLL systems, particularly large ICOLLs, can be more productive in fish than permanently open estuaries, however a fish passage and fish migration study specific to the Lake Illawarra estuary would be required to understand the implications if this option was pursued.

Rating: Further study required

Flora and fauna

As with previous options, it is difficult to determine whether the changes to flora and fauna would result in net improvement or deterioration. It is assumed that eventually the flora and fauna would return to a similar condition that existed between 2001 and 2006 prior to the construction of the training walls, however this may take some time. Changes to animal and plant communities would be complex and interrelated. On this basis, no rating has been provided.

Rating: Further study required

Cultural values and heritage

Preliminary input suggests this option may be considered appropriate from a First Nations perspective, as it would preserve archaeological sites which are at risk from erosion and there is likely to be a preference to returning to a more natural ecological condition. Unlike the other options, there would be no new built infrastructure. However, it is acknowledged that this will worsen upstream flooding, which may impact areas of cultural significance along the lake foreshore. Similarly, the removal of the training walls may require consideration of impacts of heavy machinery if completed from the land.

Rating: Further consultation required with Aboriginal stakeholders

Boating access

This option restricts boating access between the lake and ocean. While the lake would remain accessible from the Windang boat ramp, the lake and channel would no longer be able to be accessed from the ocean.

Rating: Deterioration

Cost

The capital cost to remove the entrance training walls in conjunction with large scale sand nourishment is estimated to be between $35-70M. Approximately 900 000m^3 of sand has eroded from the channel since the permanent opening. However, all the lost sand may not need to be replaced to get the entrance to close. Further studies would find out how much may be required.

Other risks

The lake may tend towards a closed condition. An ICOLL Entrance Opening Policy would need to be developed to accompany this option. The entrance may meander, and openings may occur in new locations which may impact sand dunes, cultural sites, beach access and public amenity.

Outcome of the assessment and next steps

All long-term entrance management options investigated can improve tidal impacts and erosion within the entrance channel, but all options will have negative impacts on water quality (i.e. tidal flushing), recreational safety, boating access and cultural values and heritage. There is no single option that improves all ten of the management criteria for Lake Illawarra. **All** options will have trade-offs, and some of them may impact greatly on community values and lifestyle.

All long-term options will require monitoring and adaptive management over time to maintain the stability of the entrance as sea level rises. The cost of all options will be considerable and is not forecasted within the budget of the Lake Illawarra CMP. Councils will not have capacity to fund them without support, and responsibility for funding and ongoing maintenance of any works is yet to be determined.

A future management option will need to consider:

- The objectives of the Lake Illawarra Coastal Management Program and its relevant actions.
- The best compromise between management objectives, informed by feedback from the community on which Lake Illawarra values are important to them.
- The benefits or impacts on current and future generations of lake users and stakeholder groups.
- What is permissible under existing legislation.
- Feedback from NSW Government agencies who are partnered in managing Lake Illawarra.
- How the option could be adapted to continue to stabilise the entrance with sea level rise and under future climate conditions.
- Likely cost of option implementation and maintenance and where the funding would come from.
- Information from additional studies

Following on from community consultation, a community engagement report will be prepared. This will summarise feedback received from the community. *The Lake Illawarra entrance channel: management options assessment* report will then be finalised to provide additional information and clarify any items raised by the community and confirm the additional studies that will be required.

To get involved, take the time to understand the impacts of each option and provide your feedback by 20 December 2024. You can visit Council's websites to read the Stage 1 and 2 reports, summaries and supporting documents, and find answers to some frequently asked questions.

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