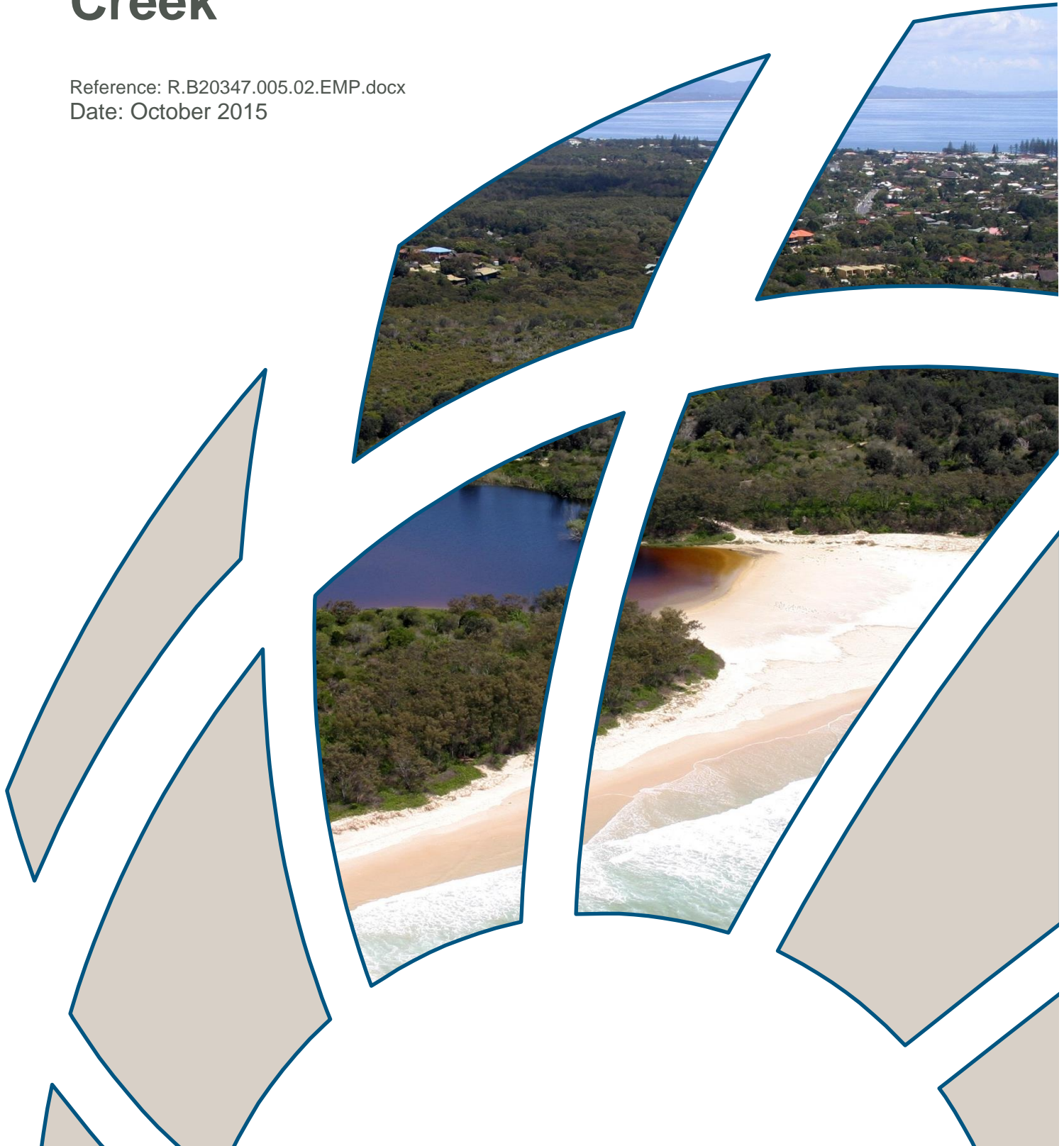




Environmental Management Plan and Opening Strategy for Tallow Creek

Reference: R.B20347.005.02.EMP.docx
Date: October 2015



Environmental Management Plan and Opening Strategy for Tallow Creek

Prepared for: Byron Shire Council

Prepared by: BMT WBM Pty Ltd (Member of the BMT group of companies)

Offices

*Brisbane
Denver
London
Mackay
Melbourne
Newcastle
Perth
Sydney
Vancouver*

Document Control Sheet

<p>BMT WBM Pty Ltd 6/20 Byron Street Bangalow NSW 2479 Australia</p> <p>Tel: +61 2 6687 0466 Fax: +61 2 6687 0422</p> <p>ABN 54 010 830 421</p> <p>www.bmtwbm.com.au</p>	Document:	R.B20347.005.02.EMP.docx
	Title:	Environmental Management Plan and Opening Strategy for Tallow Creek
	Project Manager:	Damion Cavanagh
	Author:	Damion Cavanagh
	Client:	Byron Shire Council
	Client Contact:	James Flockton
	Client Reference:	
<p>Synopsis: This EMP and Opening Strategy has been developed to provide environmental management guidance to Council staff in the conduct of an artificial opening or pre-emptive scraping event at the Tallow Creek mouth. It accords with and reflects key elements of the Review of Environmental Factors completed for this activity.</p>		

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by	Issued by
0	2 June 2015	J. Visser	D. Cavanagh
1	3 June 2015	J. Visser	D. Cavanagh
2	9 October 2015	J. Visser	D. Cavanagh

DISTRIBUTION

Destination	Revision										
	0	1	2	3	4	5	6	7	8	9	10
Byron Shire Council	PDF	PDF	PDF								
BMT WBM File	PDF	PDF	PDF								
BMT WBM Library	PDF	PDF	PDF								

Contents**Contents**

1	Introduction	1
1.1	Coverage and Audience	1
1.2	Need for the Activity	1
1.3	Location of the Activity	1
2	Entrance Management Processes	3
2.1	Description of the Activity	4
2.2	Approvals	11
2.3	Relevant Policies and Acts	11
3	Description of the Environment and Potential Effects	12
4	Communications	13
4.1	Communication Associated with Artificial Opening	13
4.2	Communication Associated with Beach Scraping	15
5	Management Plan Elements	16
Appendix A	Opening Strategy	A-1

List of Figures

Figure 1-1	Site Locality and Tenure	2
Figure 2-1	Indicative Channel Location (Artificial Opening and Pre-emptive Scraping)	7
Figure 2-2	Indicative Channel Cross-Section for Artificial Opening	8
Figure 2-3	Indicative Channel Cross-Section for Pre-emptive Scraping	9
Figure 2-4	Access Options for Machinery	10
Figure 5-1	Transect Locations	26

List of Tables

Table 1-1	Activity Location Description	1
Table 2-1	Triggers and Actions for Artificial Entrance Opening	3
Table 2-2	Triggers and Actions for Entrance Scraping	4
Table 4-1	Written Communications Table	14
Table 5-1	Construction Environmental Management Plan for Key Elements	17
Table 5-2	Operational Environmental Management Plan for Key Elements	21
Table 5-3	Water Quality Monitoring – Tallow Creek	24

Introduction

1 Introduction

This Environmental Management Plan (EMP) and Opening Strategy have been prepared to provide construction related environmental management guidance to Council staff in the conduct of an opening event (and also pre-emptive beach scraping) at the Tallow Creek mouth. It also provides operational environmental management guidance for ongoing or regular activities associated with entrance management.

It accords with and reflects key elements of the Review of Environmental Factors (and the National Parks and Wildlife Service permit application) completed for this activity.

1.1 Coverage and Audience

The EMP and Opening Strategy have been developed for internal Council use. It is to be used by managers and works staff alike. It is intended to describe aspects of the activity (need, location, outcomes, potential effects, management requirements) alongside communication protocols such that during the process of undertaking an opening or scraping, appropriate liaison and activities are implemented to open the creek.

1.2 Need for the Activity

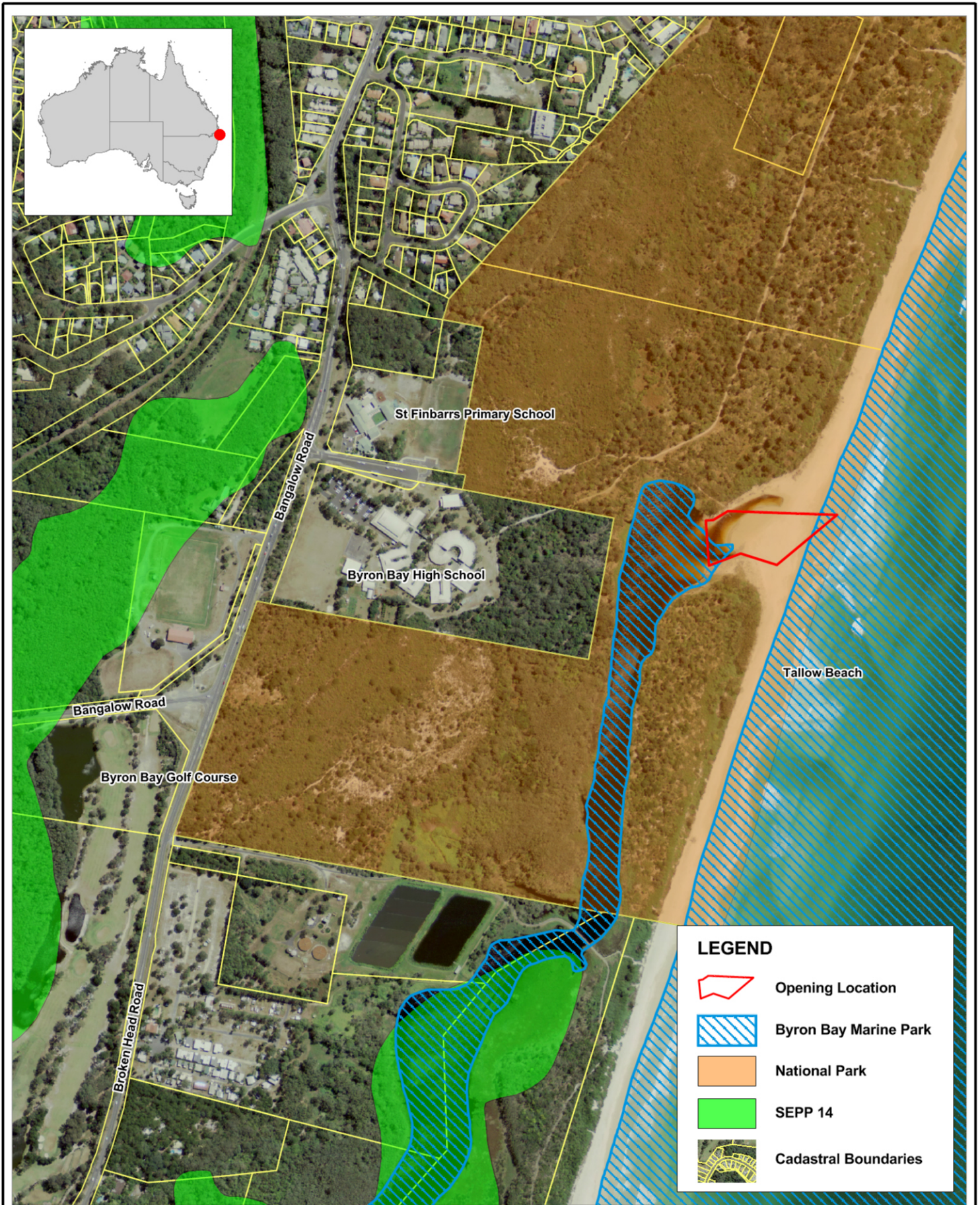
The proposed activity involves limited and infrequent sand relocation at the beach berm of Tallow Creek to allow waters within Tallow Creek to drain to the ocean to limit flood risks to properties within the catchment. Certain berm height triggers exist to maintain a balance between natural processes and requirements of flood mitigation in the catchment.

1.3 Location of the Activity

The activity will occur at the ocean entrance of Tallow Creek as it adjoins Tallow Beach as shown in Figure 1-1. It is approximately 700m east of the road entrance to St Finbarrs Primary School and Byron Bay High School (at intersection with Bangalow Road). The site is to the south of Byron Bay and to the north of Suffolk Park and is located within the Arakwal National Park.

Table 1-1 Activity Location Description

Suburb	Suffolk Park	
State	NSW	Postcode: 2481
Title reference	LOT 437 DP 729107	
Site reference	Easting: 560,691	Northing: 6,828,767
	MGA zone: 56	Reference system: GDA94
Local Government Area	Byron Shire	
National Park	Arakwal	

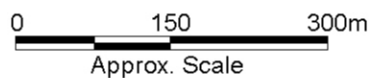


Title:
Site Locality and Tenure

Figure:
1-1

Rev:
C

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



2 Entrance Management Processes

Table 2-1 and Table 2-2 provide a condensed version of monitoring, communications and other actions which occur associated with an entrance opening or scraping event. As conditions on-site at the time of entrance management may be very different, an adaptive management approach is to be applied. Key parts of the adaptive management process discussed with stakeholders include:

- NPWS periodically monitoring the creek entrance for nesting bird activity, commencing when Council notifies NPWS that Tallow Creek water levels have reached 1.8 metres AHD;
- Council’s engagement of an ecological specialist to provide Council with further advice if NPWS observes threatened and/or migratory birds nesting adjacent the entrance. Council to liaise with NPWS regarding specialist management approaches for nesting species if identified to be subject to impact; and
- Liaison with NPWS regarding need for artificial opening based on poor water quality data. Water quality parameters and details of monitoring are included in Table 5-2.

The processes in Table 2-1 and Table 2-2 account for both low level (normal) activities and communications, as well higher order activities being initiated based on water or berm levels within Tallow Creek and at its entrance.

Table 2-1 Triggers and Actions for Artificial Entrance Opening

	Normal	Moderate Alert	High Alert	Initiate Opening
Water Level*	<1.8 m	1.8 to 2.0 m AHD	>2.0m	>2.2m
Monitoring	Periodic water level checks	<ul style="list-style-type: none"> • Weekly water level checks (Dec. to June), or monthly water level checks (July to Nov.) and periodic water quality checks • Level checks after rainfall events • Daily observation of rainfall predictions • Berm height check 	<ul style="list-style-type: none"> • Weekly water levels checks and daily observation of rainfall predictions • Additional water quality testing (as required) • Monitor complaints • Berm height check 	Opening required unless sandbar is likely to breach naturally (based on berm height)
Communications	None	Liaise with NPWS regarding need for NPWS observation of presence of nesting species at Tallow Creek entrance and to advise them of elevated water levels or depressed water quality conditions		<ul style="list-style-type: none"> • Liaise with NPWS regarding opening level and planned timing of opening • Advise Byron Bird Buddies of a planned opening event
Other Actions	None	Ecologist advising Council on mgt. options (if nesting species)	<ul style="list-style-type: none"> • Council Works Depot on standby • Ecologist advising 	<ul style="list-style-type: none"> • Complete pre-start surveys and activities (as required)

	Normal	Moderate Alert	High Alert	Initiate Opening
		present)	Council on mgt. options (if nesting species present) • Aboriginal cultural heritage spotter on standby	• Complete opening of system (at or within 2 hours of a daytime low tide), with required persons present.
Responsibility	Overseer Road Maintenance	Overseer Road Maintenance	Overseer Road Maintenance and Council Engineer	Overseer Road Maintenance and Council Engineer

* In the absence of an automated water level sensor manual monitoring of water levels is completed at the calibrated gauge attached to the public walkway bridge over Tallow Lake.

Table 2-2 Triggers and Actions for Entrance Scraping

	Observation	Entrance Scraping
Berm Level	<2.2m	>2.2m
Monitoring	<ul style="list-style-type: none"> Berm level observed at a minimum monthly frequency (this will typically occur associated with activities outlined in Table 2-1) 	<ul style="list-style-type: none"> Berm level observed at a minimum monthly frequency
Communications		<ul style="list-style-type: none"> Liaise with NPWS regarding: <ul style="list-style-type: none"> Need for NPWS observation of presence of nesting species at Tallow Creek entrance Actual presence of species at entrance and specialised management approaches Timing of pre-emptive scraping works Advise Byron Bird Buddies of a planned opening event
Actions		<ul style="list-style-type: none"> Ecologist advising Council on management strategies (if nesting species present) Complete entrance scraping with required personnel present applying agreed (with NPWS) management strategies for nesting species.
Responsibility	<ul style="list-style-type: none"> Overseer Road Maintenance 	<ul style="list-style-type: none"> Overseer Road Maintenance and Council Engineer

2.1 Description of the Activity

Artificial Opening

The proposed activity will comprise the mechanical opening of the mouth of Tallow Creek at the sandbar. The excavation will create a “pilot” channel that is both narrow and shallow and allows for

elevated waters in Tallow Creek to drain to the ocean. Once drainage commences, the escaping waters will erode the pilot channel to form a larger drainage channel.

A 5 tonne excavator will be used to construct the pilot channel. The excavator will operate from the shoreline toward Tallow Creek and then the last section of sand at the sandbar will be taken from the water in the estuary. The excavator will operate from either side of the channel, while operating to protect existing banks. All excavated material will be placed on the northern side of the work area to minimise erosion risks to existing dunes.

The proposed location of artificial opening works is shown in Figure 2-1. This location is preferred on the basis that it promotes drainage channel formation away from the northern and southern vegetated foreshores and may avoid erosion of dunes and loss of vegetation. There are other on-site environmental constraints which may exist including the presence of nesting fauna. The presence of these fauna will be advised prior to access being granted to construct the pilot channel. A consulting ecologist will be on-site to observe local site conditions and determine a suitable location for the pilot channel to be excavated. There may also be other restrictions imposed by the ecologist which would need to be observed, depending on site conditions at the time.

The channel will be excavated to between 0.5 and 1.0 m depth below the ground surface of the beach berm (depending on berm height and water level at the time). The channel is to be constructed nominally two (2) metres wide. The length of the channel will vary as it will depend on the configuration of entrance and beach profile at the time of opening. It is expected that the length could vary between 50 and 80m although it will be as long as it needs to be to affect an adequate entrance opening. Figure 2-2 provides a scale image of an indicative entrance channel.

Pre-emptive Beach Scraping

The proposed activity will comprise the mechanical scraping of the Tallow Creek ocean berm to facilitate a breakout in the event of future catchment rainfall events. Anecdotal information indicates that the beach berm at Tallow Creek can exceed 2.2m AHD. Such elevated beach berm levels can assist flood levels to elevate to high levels.

The scraping will form of a broad swale which has an invert (bottom) elevation at 2.2m AHD. Sands removed to form the swale will be dispersed on the northern side of the swale. The proposed location of scraping is shown in Figure 2-1 (although it is for a swale not a channel in this instance) and has been selected to minimise risks of impacts to vegetation and dunes.

The location of the swale is also subject to the outcomes of any pre-scraping ecological surveys (if required based on advice from NPWS). These surveys may identify the presence of certain species which may influence the location and approach to scraping activities. The intended outcome of the opening will be to avoid nesting species; this includes the sand scraping and dispersant activities.

In terms of dimensions, the swale is to be constructed nominally five (5) metres wide along the base with batter slopes of up to a couple of metres width. It is expected that the entire swale would around 10 to 15 metres in width. The length of the swale will vary depending on the configuration of entrance and beach profile at the time of opening. It is expected that the length could vary between 50 and 80m, although it will extend as far as required to provide a suitable escape path for

In summary, the location of the swale will aim to avoid locations near to the existing north and south dunes, as well as any nesting species identified from pre-works surveys.

Figure 2-3 provides a scale image of an indicative scraped beach swale and sand dispersal area.

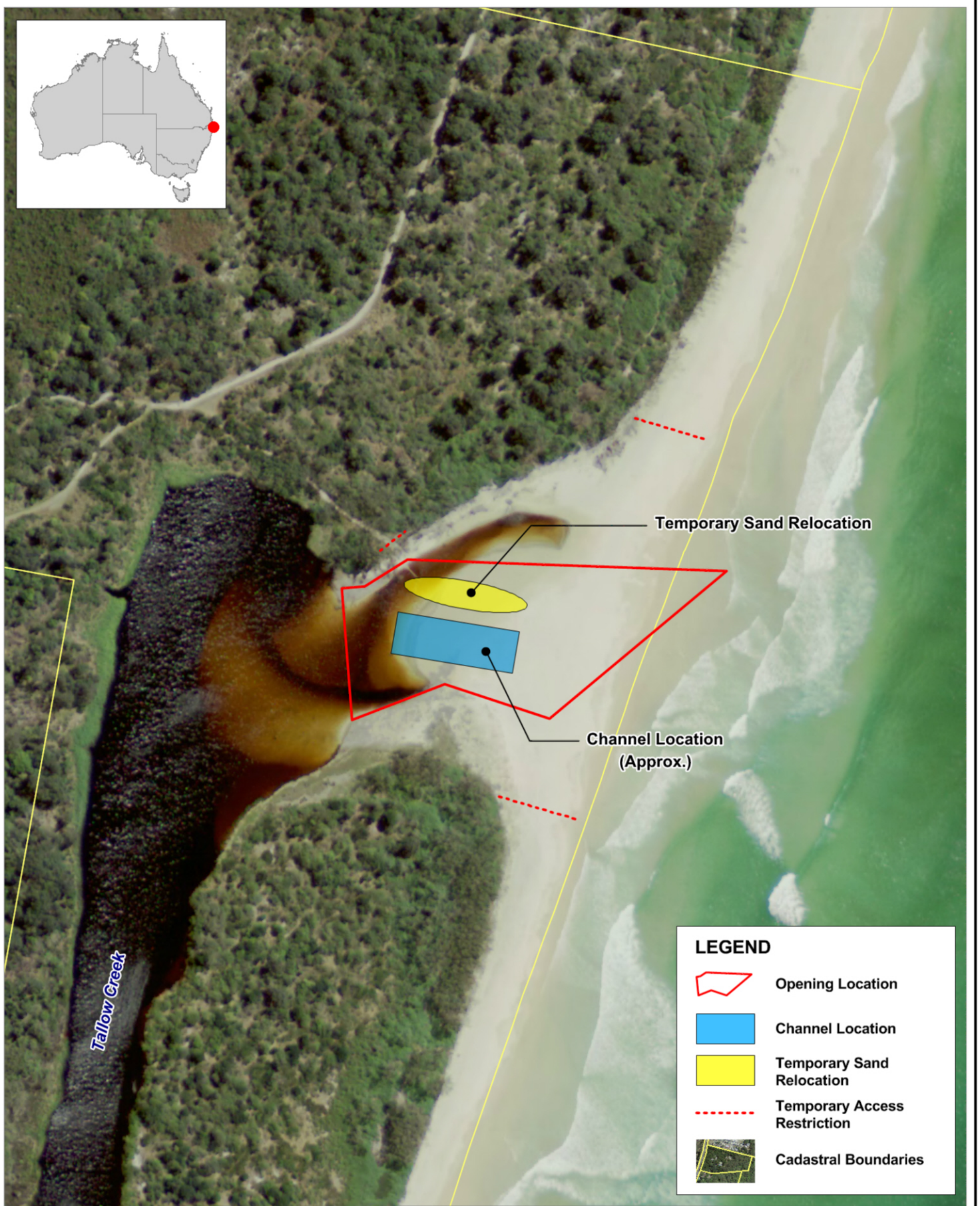
Access

The excavator will access the site via three potential access routes (refer Figure 2-4), in order of priority these are outlined below:






- (1) Clifford Street – Suffolk Park (travel distance – 3 km);
- (2) Beach Road/Broken Head Reserve Road – Broken Head (travel distance – 4.6km); and
- (3) Tallow Beach car park in Cape Byron State Conservation Area – Byron Bay (travel distance – 2.6 km).

An emergency access is also available via Ocean Street Byron Bay, however, this access has narrow clearances to vegetation and may have a sizeable beach dune to navigate to then access the beach.

The selection of a beach access point would depend on suitability at the time works are proposed.



LEGEND

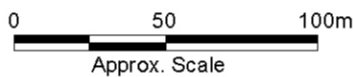
-  Opening Location
-  Channel Location
-  Temporary Sand Relocation
-  Temporary Access Restriction
-  Cadastral Boundaries

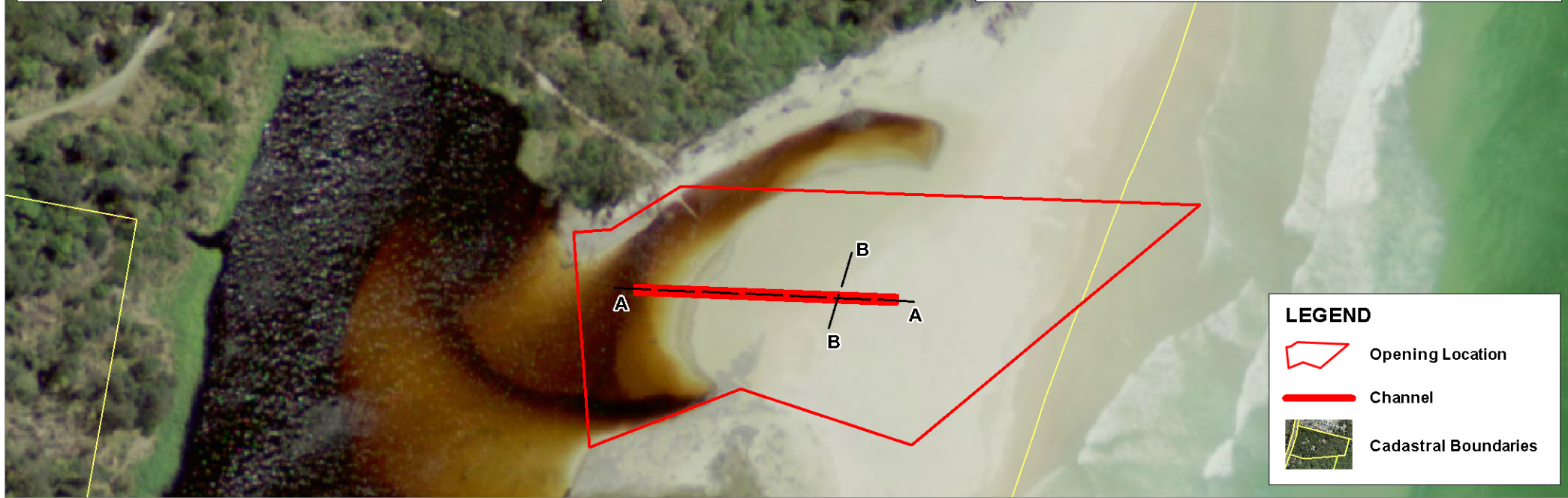
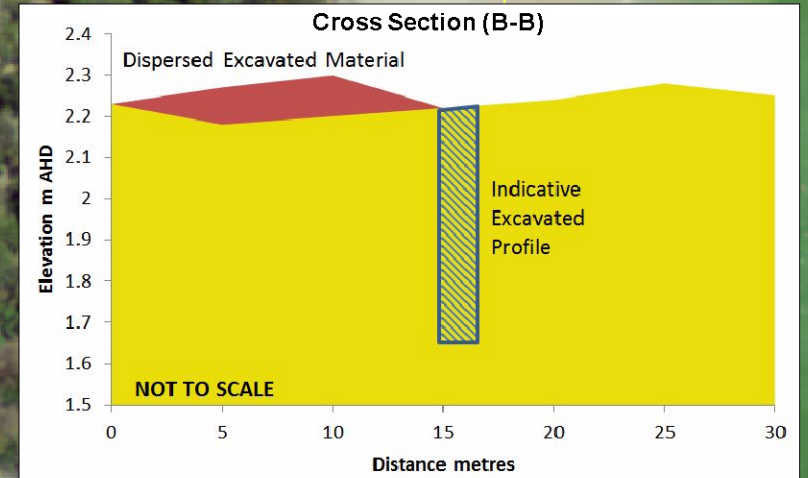
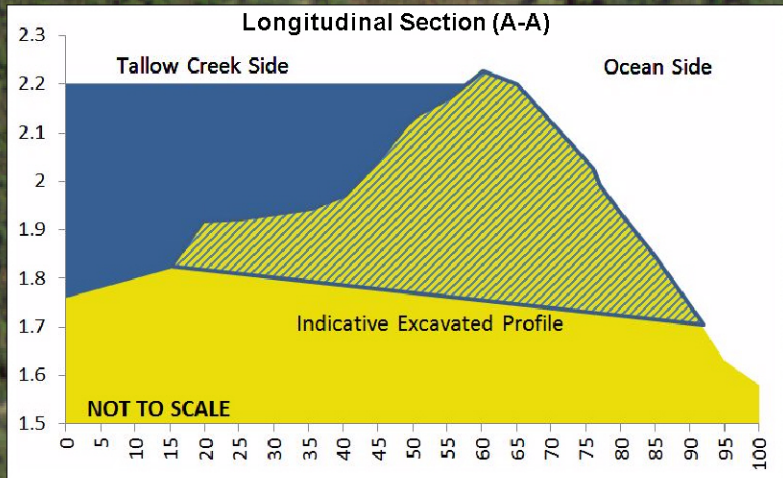
Title:
Indicative Channel Location

Figure:
2-1

Rev:
B

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



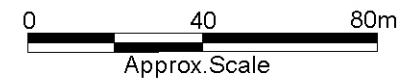


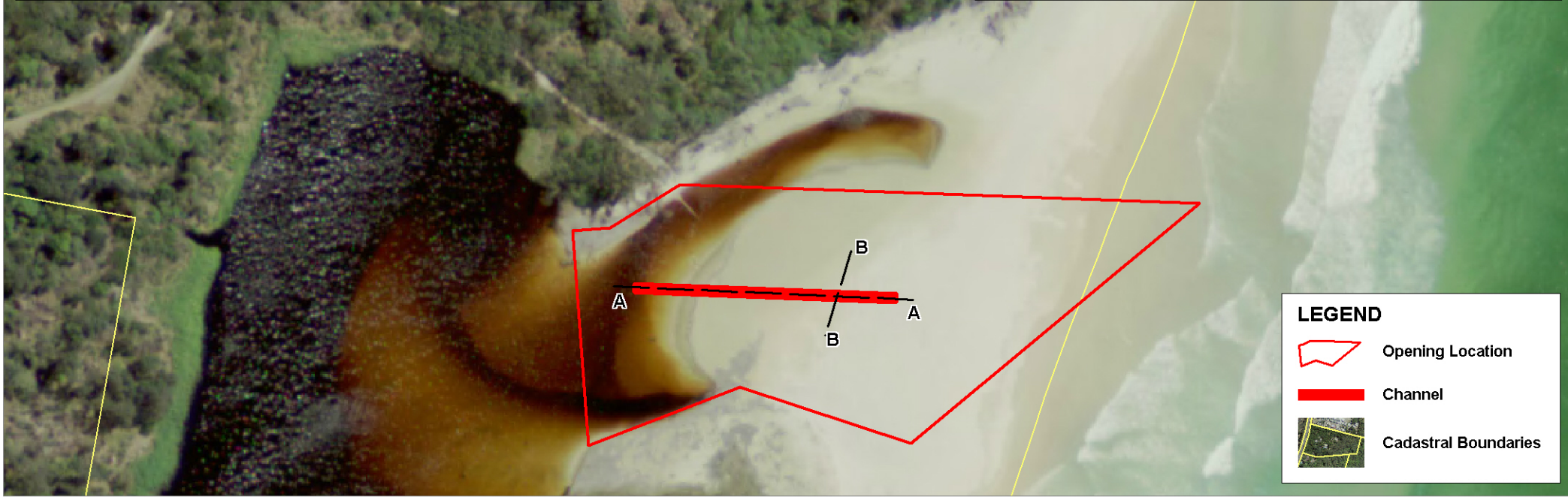
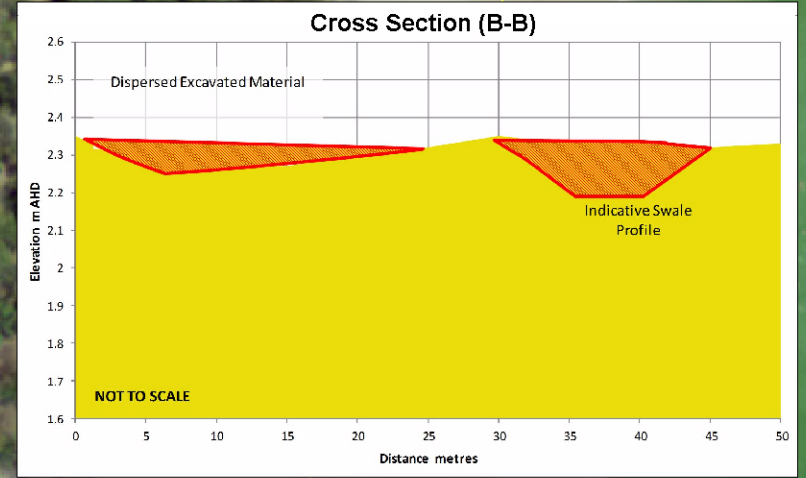
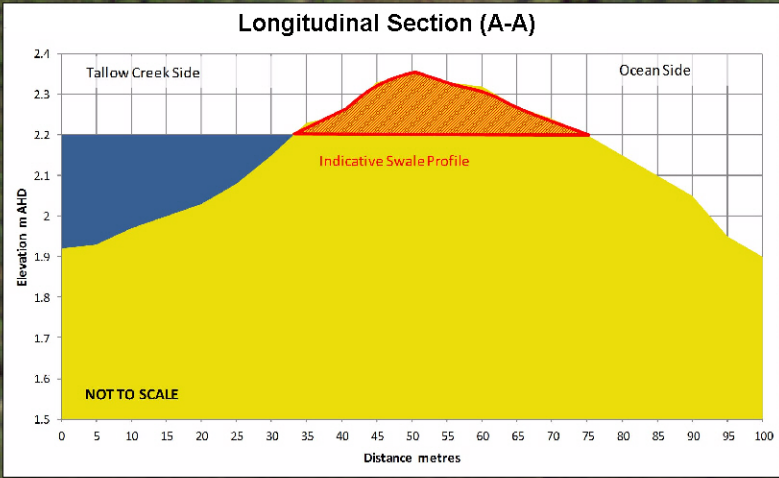
Title:
Indicative Channel Cross Section

Figure:
2-2

Rev:
B

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.





LEGEND

- Opening Location
- Channel
- Cadastral Boundaries

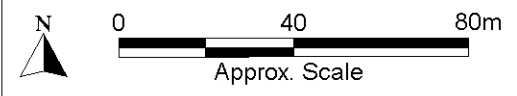


Title:
Indicative Scraping Cross Section

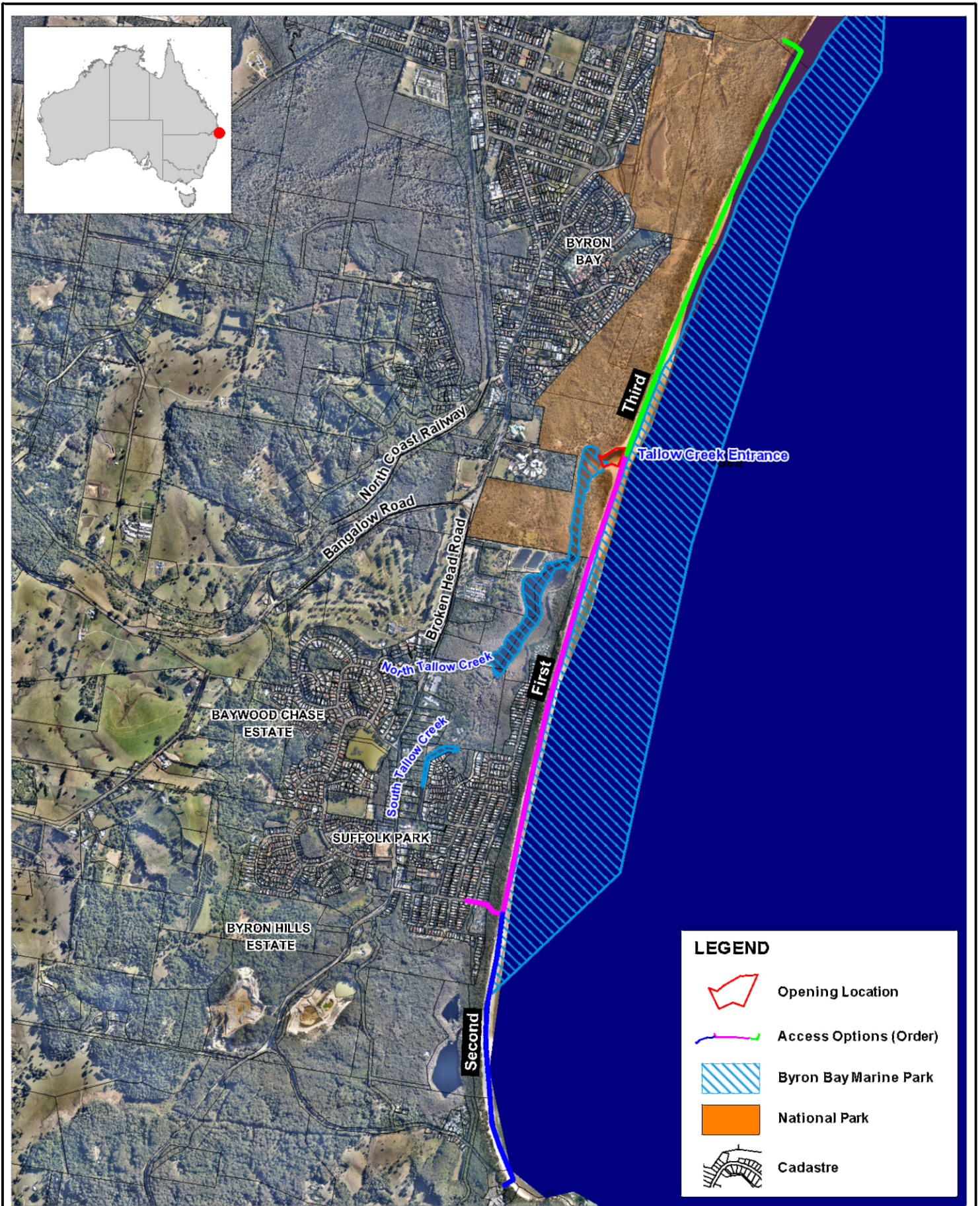
Figure:
2-3

Rev:
A

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



Filepath : I:\B20347_I_DCC_Tallows Creek\DRGWQU_007_151009 Indicative Scraping Cross Section.wor



Title:
Access Options for Machinery

Figure:
2-4

Rev:
A

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



0 450 900m
Approx. Scale



2.2 Approvals

No additional approvals will be required to undertake the entrance opening activity, as it is conducted under a Licence (under s151, NPW Act) granted by the NSW Office of Environment and Heritage (NPWS).

2.3 Relevant Policies and Acts

The Review of Environmental Factors has considered the permissibility of the activity against the following legalisation.

- *National Parks and Wildlife Act 1974* (NPW Act);
- *Marine Parks Act 1997* (MP Act);
- *Environmental Planning and Assessment Act 1979* (EP&A Act), including environmental planning instruments (EPIs);
- *Threatened Species Conservation Act 1995* (TSC Act);
- *Fisheries Management Act 1994*;
- *Water Management Act 2000*; and
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The activity is permissible under these relevant Acts, and a licence has been granted by OEH for the activity. The licence does not cover activities outside of the scope of the REF.

All work crews are to ensure they abide by Work Health and Safety Act and Regulations. All necessary paperwork for the tasks required of this EMP will be prepared prior to undertaking the activity and approved by the relevant manager for the activity.

3 Description of the Environment and Potential Effects

Without providing a detailed description of coastal and fluvial processes, it can simply be stated that the Tallow Creek entrance exists in a dynamic environment which is regularly modified by the actions of coastal sand movement (by winds and waves) and catchment processes (i.e. rainfall and runoff).

The entrance (beach berm) of Tallow Creek is typically closed, but does periodically open to allow water to drain to the ocean. Typically these openings occur naturally at heights below 2.2 m AHD. If the beach berm is allowed to increase above 2.2m AHD, it has the potential to worsen flood impacts in the catchment, particular for a number of low-lying properties.

The subsoil conditions of the Tallow Creek sand berm are likely to include a mixture of predominantly marine sands interspersed with terrestrially derived and reworked marine sands from the catchment and inside Tallow Creek. Acid Sulfate Soils are not expected to be encountered at the site.

The site has been assessed for its potential European and Aboriginal cultural heritage value and Tallow Creek (as well as its beach and dune systems) are an important Aboriginal cultural heritage landscape for the Arakwal people. However, the activity proposed is unlikely to unearth items of cultural heritage significance. An Aboriginal cultural spotter will be on-site to observe for the potential unearthing of significant artefacts.

In terms of human use, Tallow Beach is regularly used by beachgoers for swimming, fishing, walking and various forms of nature appreciation. The proposed activity will bring relatively heavy and uncommon machinery along the beach to the entrance to excavate a channel. This activity may cause temporary inconvenience to beach users. The activity may also pose small risk to beach users unfamiliar with an eroding channel, potentially with small shallow drop offs on the edge of the channel.

At the entrance of Tallow Creek (in the vicinity of the activity), the following species of conservation significance have been identified as potentially being affected, beach stone curlew, pied oyster catcher, little tern, loggerhead turtle and green turtle. Other species, particularly a range of migratory species, may also be potentially affected as well and impacts to these species should be minimised.

As indicated earlier, the presence of these species will be advised prior to issuing orders for entrance management activities. An ecologist will be on-site to assist in locating the pilot channel to manage potential impacts to nesting species.

Entrance opening activities have the ability to influence water quality in Tallow Creek after opening events and has been implicated in past fish kills. The exact mechanism leading to fish kills has not been investigated in detail, but is understood to relate to de-oxygenation of residual waters within Tallow Creek after the opening event. As a result, it is recommended to complete the system opening coincident with a daytime low tide or up to two hours after the low tide. This timing from experience serves to limit the extent of scouring and lake emptying and reduces the potential for impacts.

4 Communications

The key party with which Council will liaise with is NPWS. Council will liaise with NPWS regarding need for observation of the presence of nesting species at the Tallow Creek entrance when Council themselves become aware that water levels in Tallow Creek have exceeded 1.8m AHD. Similarly, Council will liaise with NPWS if beach berm levels at the entrance exceed 2.2 m AHD and beach scraping may be a future requirement.

NPWS will then communicate back to Council regarding the presence of nesting species in the entrance area that may be affected. Council will be required to initiate further monitoring to ascertain if identified species are actually nesting in the entrance area.

When an artificial opening or pre-emptive scraping event is imminent, Council will advise and liaise with NPWS about the timing and procedures for the artificial opening, along with advising other relevant parties.

Council will liaise with support staff as required to assist in entrance management at Tallows Creek. It is anticipated that this will include an ecologist to advise regarding potential adaptive measures to minimise impacts to species that may be present, and an Arakwal representative to spot for any potential Aboriginal cultural heritage items. An Aboriginal spotter is not required for pre-emptive scraping activities.

4.1 Communication Associated with Artificial Opening

Water Levels up to 2.0m AHD

Council's Overseer Road Maintenance will be responsible for monitoring lake water levels on a weekly basis. The location to measure the water level is at the footbridge of Tallow Lake. The water level that is recorded dictates the action that is carried out (refer Table 2-1).

The overseer is responsible for initiating processes once the 1.8m AHD trigger level has been reached.

The Overseer Road Maintenance will consult and update NPWS on a weekly basis, once the 1.8m trigger level has been reached. The Overseer Road Maintenance is responsible for all communication internally, and with NPWS between the water levels 1.8 to 2.0 m AHD.

Water Levels above 2.0m AHD

When the 2.0m water level is imminent or reached the Overseer Road Maintenance is to consult with Council's Flood and Drainage Engineer regarding ongoing management and any approval to initiate an opening event. In the absence of the Flood and Drainage Engineer Council's Team Leader Infrastructure Planning will stand in. The Overseer Road Maintenance will arrange for suitable site operators and equipment to be made available to complete the opening. Typically the opening will occur within one to three days of the upper trigger level being reach (or likely to be being reached).

Councils Engineer will advise and liaise with NPWS (and Byron Bird Buddies) about the timing and procedures for the artificial opening. Council's engineers will also advise other persons to attend the opening, including a cultural heritage spotter who will be invited to attend and

observe the opening activities, and ecologist who may be required to guide entrance opening locations and activities to manage impact to nesting species that may be present.

During the opening event, the Site operators will be required to communicate with Council’s Engineer and others nominated by the Engineer, such as the cultural spotter and ecologist. Site activities may need to be modified on-site prior to or during the opening based on conditions and events at the time. Site operators will also be required to inform beach users of the activities being performed (if asked).

For all written (email) correspondence, the following are to be copied into all communication regarding management of Tallow Creeks Entrance (see Table 4-1).

Table 4-1 Written Communications Table

Name	Responsibility	Agency	Number	Email
Patrick Dwyer	Conservation Manager	NSW Fisheries	6626 1397 0407 264 391	Patrick.dwyer@dpi.nsw.gov.au
Sue Walker	Area Manager	National Parks and Wildlife	6620 9300 0401 832 843	Sue.walker@environment.nsw.gov.au
Andrew Page	Manager	Marine Parks Authority	6639 6200 0439 485 266	Andrew.page@environment.nsw.gov.au
Ben Fitzgibbon	Coastal Officer	Office of Environment and Heritage	6620 9310 0428 303 733	Ben.fitzgibbon@environment.com.au
James Flockton	Council Flood and Drainage Engineer	Byron Shire Council	6626 7158 0408 187 375	James.flockton@byron.nsw.gov.au
TBC (Tony Nash in absence)	Team Leader – Infrastructure Planning	Byron Shire Council	TBC 6685 9303	TBC Tony.nash@byron.nsw.gov.au
Rob King	Overseer Road Maintenance	Byron Shire Council	6685 9313 0418 484 359	Rob.king@byron.nsw.gov.au
Sandy Pimm	Consulting Ecologist	Private	6626 7104	Sandra.pimm@byron.nsw.gov.au
Jan Olly		Bird Buddies	0428 864 378	jeanatteolley@gmail.com

4.2 Communication Associated with Beach Scraping

Communications commence once berm levels exceed 2.2 m AHD. Berm levels typically change relatively slowly unlike water levels which can vary rapidly, hence there is likely to be ample time to respond to increasing berm heights.

Council's Overseer Road Maintenance will be responsible for monitoring berm levels on a regular basis and will consult with Council's Flood and Drainage Engineer regarding pre-emptive scraping once the trigger height has been reached. In the absence of the Flood and Drainage Engineer, Council's Team Leader Infrastructure Planning will stand in.

Council's Engineer (or stand in) will inform NPWS that the entrance berm has exceeded 2.2 m AHD and seek feedback on the presence of nesting species. The Engineer will arrange for further specific ecological monitoring work to be completed if required.

Council's Engineer will advise and liaise with NPWS (and Byron Bird Buddies) about the timing and procedures for the pre-emptive scraping. Council's Engineer will arrange for other necessary personnel to attend the opening. The Overseer Road Maintenance will arrange for suitable site operators and equipment to be made available to complete the scraping. Typically the scraping will occur within a month of the upper trigger level being reached.

During the scraping, the Site operators will be required to communicate with Council's Engineer and others nominated by the Engineer, such as ecologist. Site activities may need to be modified on-site prior to or during the opening based on conditions and events at the time. Site operators will also be required to inform beach users of the activities being performed (if asked).

For all written (email) correspondence, those listed in Table 4-1 are to be copied into all communication regarding management activities at the Tallow Creeks Entrance.

5 Management Plan Elements

Once an action has been chosen, Table 5-1 provides the relevant Construction Environmental Management Plan (CEMP) elements for the proposed activities. These should be used to guide the management of site works from an environmental perspective.

An Operational Environmental Management Plan (OEMP) is included in Table 5-2 to capture normal operational management activities and particular monitoring activities that are triggered or relate to entrance management activities.

Appendix A includes a 2-page Opening Strategy document which has been prepared as a Quick Read document for field staff to familiarise themselves with the activities that are required to be undertaken.

Management Plan Elements

Table 5-1 Construction Environmental Management Plan for Key Elements

Aspect	Potential Impacts	Management Objectives	Management Actions	Monitoring and Reporting	Corrective Actions
Flora and Fauna	Traversing to the site and excavation / scraping of the entrance channel has the potential to impact on species, including threatened species (birds and turtles).	Conduct work practices to avoid impacts to resident species through appropriate route selection for access to the site, excavation of the pilot channel, beach scraping and dispersal of removed materials.	<p>If species are known or thought to be present, an ecologist will be on-site for the entrance management works and will guide certain activities, particularly locating the pilot channel and sand dispersal areas. Ongoing liaison with NPWS will be required, particularly if any actively nesting species are present.</p> <p>Threatened (T) or migratory (M) species to observe for during pre-opening inspections include:</p> <ul style="list-style-type: none"> • Beach Stone Curlew (T) • Pied Oyster Catcher (T) • Little Tern (T) • Loggerhead Turtle (T) • Green Turtle (T) • Sand Spurge (T) • Cattle Egret (M) • Ruddy Turnstone (M) • Short-tailed Shearwater (M) • Wedge-tailed Shearwater (M) • Sharp-tailed Sandpiper (M) • Eastern Reef Egret (M) • Bar-tailed Godwit (M) 	<p>Photograph works at commencement, half way and at completion.</p> <p>Report any harm to species to the Council Engineer who will liaise immediately with the OEH (NPWS) Ranger.</p> <p>Report presence of any unknown bird nests/eggs and subsurface turtle egg nests immediately to the Council Engineer who will liaise immediately with the OEH (NPWS) Ranger</p> <p>Relevant information will be recorded in Council's REFLECT system in the field.</p>	Cease or modify works as advised by ecologist, and Council Engineer (after consulting with OEH (NPWS))

Management Plan Elements

Aspect	Potential Impacts	Management Objectives	Management Actions	Monitoring and Reporting	Corrective Actions
			<ul style="list-style-type: none"> • Pacific Golden Plover (M) • Common Tern (M) • Grey-tailed Tattler (M) • Common Greenshank (M) • March Sandpiper (M) • Rainbow Bee-eater (M) • Little Tern (T, M) <p><i>Access</i></p> <p>Inspect access route prior to traversing for presence of species and suitability.</p> <p>Access site via preferred access ways in order of priority, unless access route will lead to excessive impact.</p> <p>Traverse to the site on hard packed intertidal sands (if possible).</p> <p><i>Pilot Channel / Berm Lowering Swale</i></p> <p>Locate channel / swale to avoid nesting species (consult with ecologist if required). Move sand to the dispersal area and spread out (again the ecologist may advise on where this area is located to avoid impacts to species).</p>		

Management Plan Elements

Aspect	Potential Impacts	Management Objectives	Management Actions	Monitoring and Reporting	Corrective Actions
			<p>Use small machinery appropriate for task (i.e. 5 tonne excavator).</p> <p>Wash vehicles prior to entry to site.</p>		
Water Quality	<p>Over-draining of Tallow Creek estuary leading to a situation which might contribute to poor water quality and ultimately fish kills</p> <p>Chemical spill to the waters or substrate surrounding Tallow Creek</p>	<p>Remove final portion of pilot channel and commence draining of Tallow Creek at the correct time.</p> <p>Avoid contamination of waters with chemicals</p>	<p>Complete opening of system coincident with a daytime low tide or up to two hours after the low tide.</p> <p>In the event of a fluid spill from machinery, the spill will be managed to mitigate and reduce potential impacts to the environment and nearby humans. Equipment operators are trained to respond to fluid spills.</p> <p>An Artificial Opening event will trigger the completion of water quality monitoring. The necessary parameters are included in 'Physical' monitoring as outlined in Table 5-3, at the locations nominated.</p>	<p>Record time that the pilot channel has been connected fully to Tallow Creek and waters commence to drain.</p> <p>Record with GPS the location of the material spill to allow later identification.</p> <p>Relevant information will be recorded in Council's REFLECT system in the field.</p>	<p>It may be possible to block the initial drainage by blocking it with sand, but this likelihood will decrease with time as the outflow rate increases.</p>
Coastal and Dunal Processes	<p>Activities which remove sand from the coastal environment, affect coastal processes</p> <p>The pilot channel location will influence where the drainage channel forms, if it is</p>	<p>Ensure all materials excavated from the beach remain on the beach.</p> <p>Locate the pilot channel away from existing dunes to limit risk of them eroding as the drainage channel</p>	<p>All sand materials excavated for the purposes of constructing the pilot channel are to remain on the beach, typically dispersed on the northern side of the pilot channel</p> <p>Complete the pilot channel or scraping activities away from the existing northern and southern banks</p>	<p>Photograph works at commencement, half way and at completion.</p> <p>Record with GPS the location of the entrance channel.</p> <p>Relevant information will be recorded in Council's</p>	<p>None.</p>

Management Plan Elements

Aspect	Potential Impacts	Management Objectives	Management Actions	Monitoring and Reporting	Corrective Actions
	close to banks this may result in bank/dune erosion	forms.		REFLECT system in the field.	
Cultural Heritage	Exposure of items of Aboriginal or European Cultural Heritage significance	<p>Work activities will cease if potential artefacts in substrates are located during the progress of excavating the pilot channel</p> <p>A cultural spotter may be on-site at the time of the opening.</p>	<p>Adopt a 'Proceed with Caution' approach to the excavation activities as there may be items of cultural significance in the subsoils.</p> <p>Cease work activities if an item of potential cultural significance has been found (this may be advised by the cultural spotter if present), inform Council's Flooding and Drainage Engineer immediately. Await advice from the Council Engineer on what further activities <u>may</u> need to occur on-site prior to leaving, such recovering the items to limit vandalism.</p>	<p>Report a potential find immediately to Council's Engineer who will consult with relevant parties (OEH and/or Aboriginal groups) in respect of the potential find.</p> <p>Take photographs of the item(s) in-situ after advising the Engineer.</p> <p>Provide photographic evidence to the Council Engineer for broader distribution.</p> <p>Relevant information will be recorded in Council's REFLECT system in the field.</p>	<p>Cease works as advised by the cultural spotter.</p> <p>Await advice on further actions on site once the initial suspected find has been reported to Council's Engineer.</p>
Beach Amenity and Use	Disruption of typical beach usage patterns and beach access	Mark out construction site for duration of works using high visibility marker	Limit access to the site of planned works, including beach access (north and south) and pathway access on the north side of Tallow Creek. Note that it may be possible to provide	<p>Take photographs of barriers once installed.</p> <p>Relevant information will be recorded in Council's</p>	Modify or move barriers as required to ensure they remain

Management Plan Elements

Aspect	Potential Impacts	Management Objectives	Management Actions	Monitoring and Reporting	Corrective Actions
		materials	<p>safe beach access from the pedestrian pathway, this will need to be determined on site.</p> <p>Utilise a suitable barrier material which can be quickly erected with limited staff and equipment, and will be suitable for the duration of works in an exposed coastal location. Remove barriers at completion of works.</p>	REFLECT system in the field.	effective for the duration of works.

Table 5-2 Operational Environmental Management Plan for Key Elements

Aspect	Potential Impacts	Management Objectives	Management Actions	Monitoring and Reporting	Corrective Actions
Flora and Fauna	It is anticipated that vegetation communities at the upper extent of the floodzone will be most sensitive to a potential decrease in flooding extent and residency as a result of more frequent	Assess and document changes in the floristic composition, particularly threatened communities within the estuary in response to artificial entrance opening of Tallow	<p>Figure 5-1 indicates the location of two monitoring transects within the predicted impact zone. Thesetranssects sample ecotones between saltmarsh and freshwater wetlands for the purpose of detecting changes in vegetation composition and condition.</p> <p>Indicators of condition to be measured will include species composition and cover, occurrence of dieback, disease and other</p>	<p>Vegetation transects shall be monitored twice per year in Autumn and Spring.</p> <p>Permanent monitoring transects will be established across each ecotone to track vegetation composition and condition. The length of each transect will be determined based on site condition with both ends to be permanently marked with a wooden stake, star picket and/or PVC pipe and georeferenced.</p> <p>Photographs will be taken along and perpendicular to the transect line at the start, middle and end points to document landscape features within and adjacent to the monitoring sites.</p>	TBC

Management Plan Elements

Aspect	Potential Impacts	Management Objectives	Management Actions	Monitoring and Reporting	Corrective Actions
	opening of the estuary mouth.	Creek.	<p>stresses and observations of substrate and profile characteristics.</p> <p>Monitoring will be undertaken once a year following the wet season (April). Baseline monitoring will be undertaken a year before artificial opening commences. Monitoring will be carried out for a minimum of three years following artificial opening of the mouth.</p> <p>Data collected from the permanent transect and survey plots is primarily intended to track vegetation changes over time and will be used to analyse mean cover by species, change in community structure over time, water soil salinity and species richness.</p>	<p>Starting at the 0m point, 1m x 1m squares will be located every 5m along the transect line until the end point. Care must be taken during transect establishment not to remove or damage vegetation and substrate within the plots. The percentage cover of groundcover species will be assessed within each of the quadrats. Observations of vegetation condition including dieback and disease will be recorded and observations of substrate condition (such as cracking soils, siltation) will be noted. Spot photos will be taken of each quadrat to document groundcover condition over time.</p> <p>Walking along the transect line looking upwards, the start and finish distance of the woody canopy will be recorded to determine the percentage canopy cover over the transect line per height class. Multiple overlapping canopies will be identified as continuous unbroken cover. Shrub canopy cover will be measured using the same line intercept method and can be assessed from above the canopy if below eye level. Observations of woody vegetation condition such as dieback and disease will be recorded.</p> <p>Data collected shall be compiled by Byron Shire Council and provided to third parties as required.</p>	
Water Quality	Elevated water levels in Tallow Creek increase likelihood of human	Collect water quality data as part of operational monitoring of the estuary.	<p>Water levels > 1.8m</p> <p>Completion of a water quality test for 'Health' parameters outlined in Table 5-3. Testing may be repeated as required if water levels</p>	<p>Complete water quality testing as outlined in 'Management Actions' and by reference to Table 5-3.</p> <p>Data shall be collated by Council in a single secure location for ongoing records and reference.</p>	TBC

Management Plan Elements

Aspect	Potential Impacts	Management Objectives	Management Actions	Monitoring and Reporting	Corrective Actions
	<p>interaction with it. Providing increased health risks.</p> <p>Additionally the effects of entrance management and catchment inputs on water quality are not fully understood and further data is required to improve understanding.</p>	<p>Use data in special circumstances to justify an artificial opening when it is likely that the water in the estuary is presenting a sufficiently high health risk.</p> <p>Use data to better understand and manage catchment inputs to the estuary over time.</p>	<p>are sustained for extended periods above 1.8m AHD.</p> <p>Permanent Logger</p> <p>If a logger is installed, it should be telemetered to provide real-time data on-line as well as SMS alerts. The logger should as a minimum record water level and water salinity/conductivity.</p> <p>Artificial Opening Event</p> <p>Included in Table 5-1.</p> <p>No Opening Event</p> <p>If no artificial openings occurs, 'Physical' monitoring as outlined in Table 5-3 will be completed in Autumn and Spring of every year.</p> <p>'Nutrient' sampling to completed at the rate of twice per year if funded.</p>		

Management Plan Elements

Table 5-3 Water Quality Monitoring – Tallow Creek

Parameter	Unit	Site 1	Site 2	Site 3	Site 4	Site 5
Health*						
Enterococci (any one sample)	EC/100mL	N/A	N/A	>700	>700	>700
Enterococci (median across 4 out of 6 samples)	EC/100mL	N/A	N/A	>230	>230	>230
Faecal coliforms (median in 4 out of 6 samples)	FC/100mL	N/A	N/A	>1000	>1000	>1000
Cyanobacteria (toxic species)	cells / mL	N/A	N/A	>15000	>15000	>15000
Mosquito larvae	Lv/100mL	N/A	N/A	>100	>100	>100
Physical (Permanent Logger)**						
Water Level	Metres AHD	N/A	N/A	N/A	N/A	0-2.2
Conductivity (Salinity)	µS/cm	N/A	N/A	N/A	N/A	7-50,000
Physical (on mechanical opening or skimming)***						
Conductivity (Salinity)	µS/cm	125-2200	125-2200	0 – 10,000	0 – 10,000	0 - 10,000
Temperature	Degree C	8-25	8-25	8-25	8-25	8-25
Dissolved oxygen	% Saturation	85-110	85-110	80-110	80-110	80-110
pH (outside range)	no units	6.5 to 8.5	6.5 to 8.5	7 to 8.5	7 to 8.5	7 to 8.5
Turbidity	NTU	6-50	6-50	0.5-10	0.5-10	0.5-10
Physical (twice a year)****						
Conductivity (Salinity)	µS/cm	125-2200	125-2200	0 – 10,000	0 – 10,000	0 – 10,000
Temperature	Degree C	8-25	8-25	8-25	8-25	8-25
Dissolved oxygen	% Saturation	85-110	85-110	80-110	80-110	80-110
pH (outside range)	no units	6.5 to 8.5	6.5 to 8.5	7 to 8.5	7 to 8.5	7 to 8.5
Turbidity	NTU	6-50	6-50	0.5-10	0.5-10	0.5-10
Nutrient (desirable program and range)*****						
Total phosphorus	mg/L	<0.025	<0.025	<0.03	<0.03	<0.03
Chlorophyll a	µg/L	<5	<5	<4	<4	<4
Total nitrogen	mg/L	<0.35	<0.35	<0.3	<0.3	<0.3

Key:

- Site 1 Entry point from Byron Hills drainage system – Broken Head Road near BP station
- Site 2 Stormwater drain into Tallow Creek on boundary of Byron @Byron, near the weir
- Site 3 End of Marattia Place

Management Plan Elements

- Site 4 Behind 34-38 Acorn St
- Site 5 Footbridge over Tallow Lake

*Samples to be taken fortnightly when lake water level is above 1.8m AHD. If results above these figures are found, a discussion with NPWS will be held. Council will advise if they believe the results warrant an opening and request concurrence from NPWS, in accordance with licence conditions.

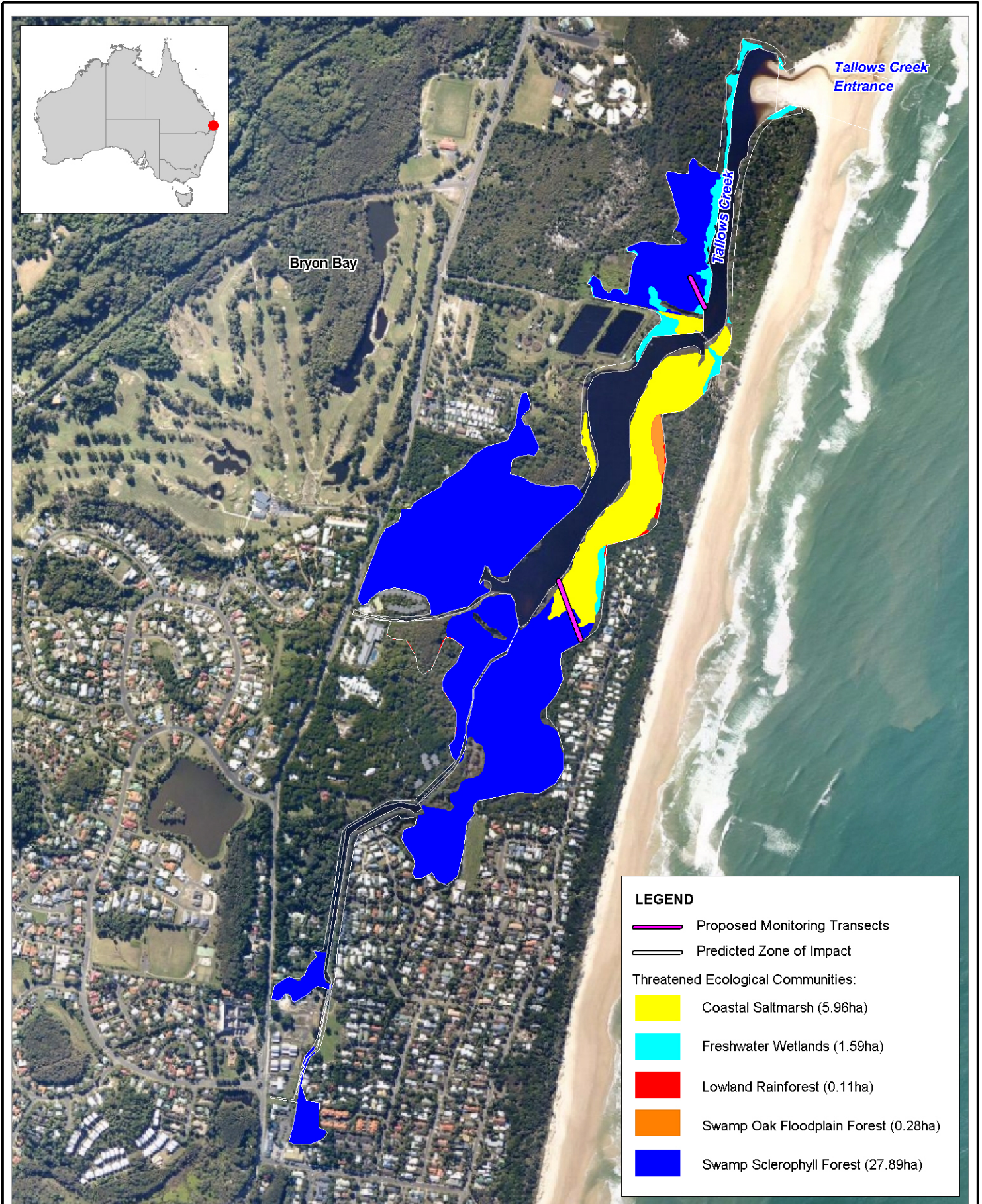
**A single logger constantly monitoring water level and salinity to provide long term data on the water quality, and the effects and timing of openings. The numbers provided indicate the range of values that need to be recorded by the logger.

***Sampling regime to occur 1 day before and 6 days post a mechanical opening or an opening due to mechanical skimming. Figures for Site 1 and 2 show desirable catchment runoff targets, Sites 3, 4 and 5 show the estimated ranges for Tallow Creek. ICOLLS such as Tallow Creek tend to display a wide range of water quality data and further data is required to derive typical "healthy" values for this estuary.

****Twice yearly sampling program. If a mechanical opening does not occur. Figures show the typical ranges for catchment runoff and estuaries.

*****A desirable sampling program should funding become available through Council, NPWS or grants. Values reflect WQO for Lowland Rivers as per ANZECC guidelines.

Note: Health parameters taken from ANZECC Guidelines, Paper 4, Vol 1, Section 5 for secondary contact. i.e boating, walking or riding through water, fishing, water in private back yards.



Title:
Transect Locations

Figure:
5-1

Rev:
A

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



Appendix A Opening Strategy

Introduction

This Opening Strategy applies to activities associated with entrance management at Tallow Creek, this includes artificial openings to release waters from Tallow Creek or pre-emptive scraping activities to reduce the height of the berm to alleviate potential flood effects.

When should Entrance Management Activities Occur?

An artificial opening will normally be undertaken once water levels in Tallow Creek (when measured at the permanent gauge on the walk bridge) exceed 2.2m AHD. An entrance scraping event will only occur when berm levels exceed 2.2 m AHD (with or without elevated water levels). In special circumstances associated with continued poor water quality in Tallow Creek (and water levels exceed 1.8m AHD) an artificial opening may also be affected.

Where

The location of artificial openings and pre-emptive scrapings can only occur within a polygon shown within the EMP (refer Figure 2-1). This location is preferred to promote drainage channel formation away from the northern and southern vegetated foreshores to avoid erosion of dunes and loss of vegetation.

Responsibilities for Entrance Management

There is a variety of monitoring, communication and decision making which occurs prior to a decision to manage the entrance at Tallow Creek.

The entrance management activities can only be undertaken with approval of Council's Flood and Drainage Engineer. In the absence of the Flood and Drainage Engineer, Council's Team Leader Infrastructure Planning will make these decisions. Council's 'Engineer' will advise and liaise with NPWS (and Byron Bird Buddies) about the timing and procedures for the artificial opening or scraping.

Council's Engineer will also advise other persons to attend the entrance management activities, including a cultural heritage spotter who will be invited to attend and observe artificial openings, and an ecologist who may be required to guide entrance management activities to minimise impacts to nesting species.

The Overseer Road Maintenance will arrange for suitable site operators and equipment to be made available to complete the opening. Typically the opening will occur within one to three days of the upper trigger level being reached (or likely to be being reached).

During the opening event, the Site operators will be required to communicate with Council's Engineer and others nominated by the Engineer, such as the cultural spotter and ecologist. Site activities may need to be modified on-site prior to or during the opening based on conditions and events at the time. Site operators will also be required to inform beach users of the activities being performed (if asked).

An Environmental Management Plan has been prepared for the entrance management activities to avoid and/or manage impacts to:

- Flora and Fauna
- Water
- Coastal and Dunal Processes

Opening Strategy

- Cultural Heritage
- Beach Amenity and Use

This plan needs to be applied during entrance management activities. Also, an Artificial Opening event will trigger the need for water quality monitoring for a period of time after the opening. This is done to build knowledge of estuarine response after openings occur.

Description of the Activity

Artificial openings involve the excavation of a “pilot” channel that is both narrow and shallow and allows for elevated waters in Tallow Creek to drain to the ocean. Once drainage commences, the escaping waters will erode the pilot channel to form a larger drainage channel.

A 5 tonne excavator will be used to construct the pilot channel. The excavator will operate from the shoreline toward Tallow Creek and then the last section of sand at the sandbar will be taken from the water in the estuary. The excavator will operate from either side of the channel, while operating to protect existing banks. All excavated material will be placed on the northern side of the work area to minimise erosion risks to existing dunes.

The proposed location of artificial opening works is discussed above, other on-site environmental constraints such as nesting fauna and these will be advised by Council's engineer or advised on site by a consulting ecologist.

The channel will be excavated to between 0.5 and 1.0 m depth below the ground surface of the beach berm (depending on berm height and water level at the time). The channel is to be constructed nominally two (2) metres wide. The length of the channel will vary as it will depend on the configuration of entrance and beach profile at the time of opening.

The main difference with pre-emptive scraping is that the excavator will be used to form of a broad swale which has an invert (bottom) elevation at 2.2m AHD. Sands removed to form the swale will be dispersed on the northern side of the swale.

In terms of dimensions, the swale is to be constructed nominally five (5) metres wide along the base with batter slopes of up to a couple of metres width. It is expected that the entire swale (top width) would be less than 10 metres.

The excavator will access the site via three potential access routes in order of priority:

- (1) Clifford Street – Suffolk Park (travel distance – 3 km);
- (2) Beach Road/Broken Head Reserve Road – Broken Head (travel distance – 4.6km); and
- (3) Tallow Beach car park in Cape Byron State Conservation Area – Byron Bay (travel distance – 2.6 km).

An emergency access is also available via Ocean Street Byron Bay, however, this access has narrow clearances to vegetation and may have a sizeable beach dune to navigate to then access the beach.

The selection of a beach access point would depend on suitability at the time works are proposed.



BMT WBM Bangalow	6/20 Byron Street, Bangalow 2479 Tel +61 2 6687 0466 Fax +61 2 66870422 Email bmtwbm@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Brisbane	Level 8, 200 Creek Street, Brisbane 4000 PO Box 203, Spring Hill QLD 4004 Tel +61 7 3831 6744 Fax +61 7 3832 3627 Email bmtwbm@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Denver	8200 S. Akron Street, #B120 Centennial, Denver Colorado 80112 USA Tel +1 303 792 9814 Fax +1 303 792 9742 Email denver@bmtwbm.com Web www.bmtwbm.com
BMT WBM London	International House, 1st Floor St Katharine's Way, London E1W 1AY Email london@bmtwbm.co.uk Web www.bmtwbm.com
BMT WBM Mackay	PO Box 4447, Mackay QLD 4740 Tel +61 7 4953 5144 Fax +61 7 4953 5132 Email mackay@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Melbourne	Level 5, 99 King Street, Melbourne 3000 PO Box 604, Collins Street West VIC 8007 Tel +61 3 8620 6100 Fax +61 3 8620 6105 Email melbourne@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Newcastle	126 Belford Street, Broadmeadow 2292 PO Box 266, Broadmeadow NSW 2292 Tel +61 2 4940 8882 Fax +61 2 4940 8887 Email newcastle@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Perth	Level 3, 20 Parkland Road, Osborne, WA 6017 PO Box 1027, Innaloo WA 6918 Tel +61 8 9328 2029 Fax +61 8 9486 7588 Email perth@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Sydney	Level 1, 256-258 Norton Street, Leichhardt 2040 PO Box 194, Leichhardt NSW 2040 Tel +61 2 8987 2900 Fax +61 2 8987 2999 Email sydney@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Vancouver	Suite 401, 611 Alexander Street Vancouver British Columbia V6A 1E1 Canada Tel +1 604 683 5777 Fax +1 604 608 3232 Email vancouver@bmtwbm.com Web www.bmtwbm.com