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URGENT REPAIRS TO SEAWALLS AT 40 CHILDE STREET, BELONGIL

Prepared By

**International
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Management**

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1. OVERVIEW

A DA for minor but necessary repair works to make safe the existing wall protecting 40 Childe Street (Lot 2 of DP862599) from erosion is being prepared (**Error! Reference source not found.**).

This technical report, with the attached technical drawings (Attachment A), has been prepared to support the DA.

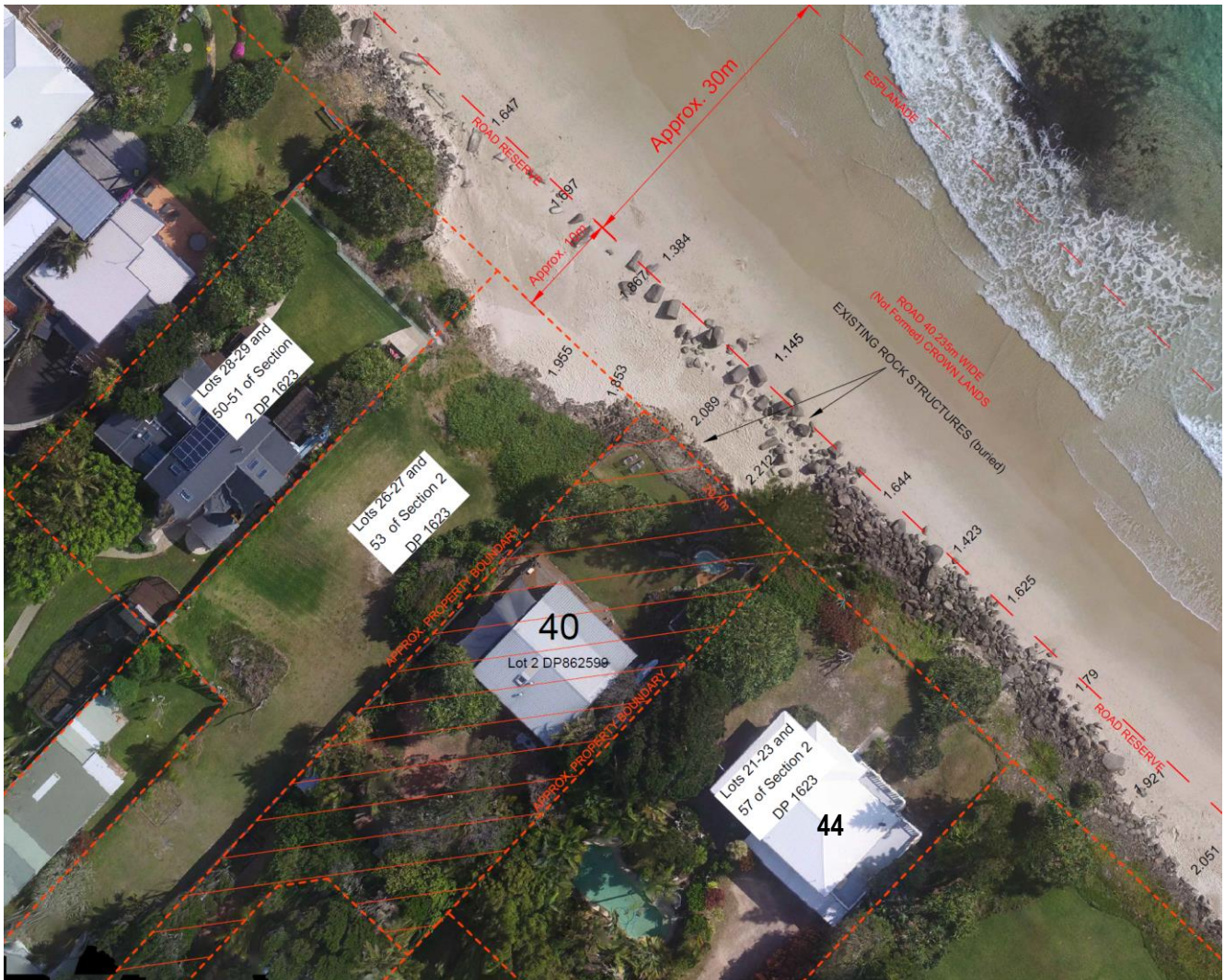


Figure 1 Site



2. BACKGROUND

The existing erosion protection works at, and adjacent to, 40 Childe Street consist of 2 seawalls (Figure 2 and Figure 3). The seaward wall, the primary wall, has been damaged and have been in a state of disrepair for some time.



Figure 2 Recent aerial (circa 2014) showing the 2 seawalls to seaward of No 40 Childe St

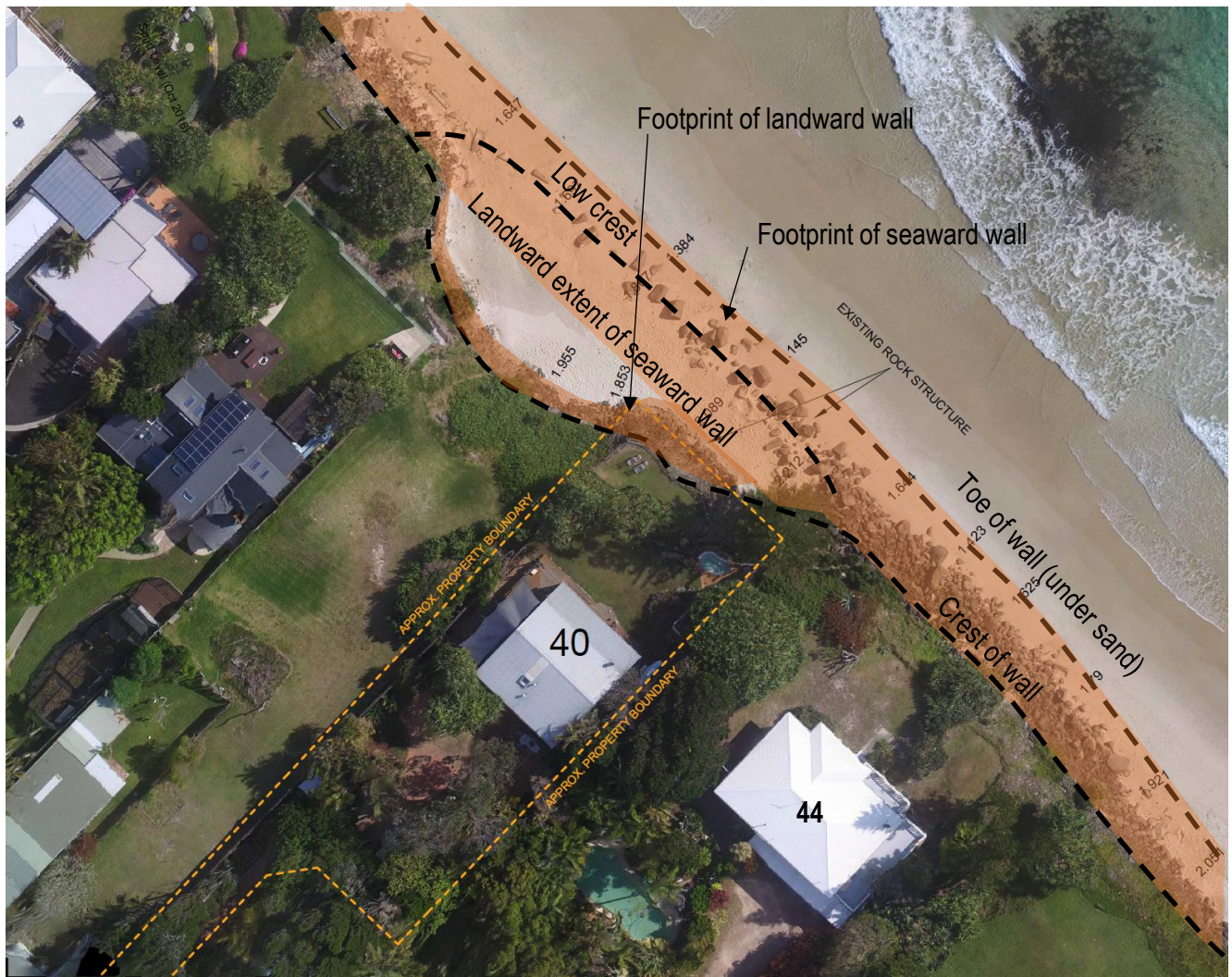


Figure 3 Recent aerial (2016) showing the 2 seawalls to seaward of No 40 Childe St (ICM photo Oct 2016)

The seaward wall consists of large boulders, generally in the range of 1.5-5t, (Figure 2) that effectively reduce the extent of toe scour and the wave energy reaching the second wall. From historical aerial photos, this wall was originally part of a continuous rock wall between the Old Jetty Site and Manfred Street (Figure 4) that is likely to date back to the erosion events and subsequent protection works in the late 1970's.



Figure 4 Aerial showing continuous rock seawall between Old Jetty Site and Manfred Street prior to damage of section at and adjacent to 40 Childe St (Circa 1980)

The seaward wall overtops in erosion events but still provides significant protection to the properties to landward. The wall currently has a broad base that is deeply founded to an estimated depth of at least -2m AHD.

The seaward structure at 40 Child Street is part of the rock seawall wall designed and constructed in about 1976 to protect the private properties to SE of Manfred Street between Manfred Street and the rock wall at the Old Jetty site from intermittent storm erosion events (Figure 5). The existing erosion



protection works at, and adjacent to, the subject properties have been damaged. These works have been in a state of disrepair for some time.

The 2015 BSC rock sea wall constructed to protect Manfred Street and the adjacent private wall to the NW connects into the 1976 wall. There is now a continuous rock seawall from the northern flank of the northern most private property on Belongil spit to the rock protection at the Old Jetty Site (State lands). With the natural sandstone outcrops at the southern end of the Old Jetty site and southward from Border Street with the BSC sandbag walls at Border Street and Don Street, there is now effectively a continuous protection structure (natural and artificial) between the SLSC to the south of Jonson Street and the northern most private property on Belongil Spit (WRL 2013) (Figure 5).

The landward rock wall along about the seaward property consists of grouted rocks (about 100-500kg) on the face and is founded on the back of the older wall. This wall has been constructed after the damage to the original seaward rock sea wall. It provides secondary protection and would be inadequate without the very substantial seaward wall.

The Belongil seawalls are generally landward of wave forces but the walls along Belongil, including the subject wall, have been subjected to wave impacts during a number of severe erosion events. Rock seawalls require maintenance and this is very much needed for this wall.

The subject wall has a well-documented history. Recently on 12/8/16, the Supreme Court of NSW issued orders made in proceedings brought by multiple plaintiffs. These orders were based on the long-documented impact of the Jonson Street structure constructed and maintained by Byron Shire Council on the down-drift beaches and seawalls at Belongil. These orders require that the subject wall, as part of the works protecting 44 Childe St, and the other walls protecting the multiple plaintiff's properties must remain in place and cannot be removed as per Schedule 1 of the Court Orders (Figure 6). BSC has consented to these orders. The walls to seaward of the subject property are included in the Court Order for 44-48 Childe St.

As there are safety issues, urgent repair works are needed and this report has been prepared to support the application for these urgent works.



Figure 5 Locality Plan



Figure 6 Schedule 1 from Court Orders (Subject properties circled in red by me)



3. CONDITION OF THE WALL

There is considerable data on the walls along the Byron Bay embayment. The urgent need for repairs was identified to Council in the 2013 report to BSC by Worley Parsons entitled “Byron Bay Erosion Protection Structures – Risk Assessment” (WP 2013). Without repairs the existing works could be further damaged, and become increasingly a threat to the public.

WP 2013 found that all of the structures along Belongil to be in a substandard condition as per Table 1 of WP 2013 (copied below as Table 1). Notes re Table 1:

- The Belongil walls are numbered 2.1 to 3.5.
- The walls along the subject property are part of Structure 3.1.
- Structures 3.2 and 3.3 have been upgraded by Byron Shire in 2015 from geotextile containers to an engineered rock wall.

WP 2013 provided a risk assessment only and no recommendations were made to repair and make safe any of the walls. Since the WP 2013 report:

- Structures 3.2 and 3.3 have been upgraded by BSC to a rock wall and, it is understood, a similar rock wall upgrading is being considered for 2.3.
- WP 2013 have prepared a report in 2014 for BSC investigating the options to upgrade at and adjacent to Jonson Street (Collectively referred to as Jonson Street Structure and structure numbers 1.1 – 1.7 in Table 1).
- Periods of beach erosion have occurred including erosion due to a major storm in early June 2016 that caused erosion along the NSW coastline and further damage to the walls.

Table 1 Summary of risk Assessment from WP2013, Table 1

Structure No.	Structure Description	Structure Resilience Rating	Coastal Processes Rating	Coastal Ecology Rating	Public Use and Amenity Rating
1.1	Interim coastal protection works at Byron SLSC	HIGH	LOW	LOW	LOW
1.2	Rock protection at Byron SLSC	MODERATE	MODERATE	MODERATE	LOW
1.3	Rock protection in front of the main reserve area adjacent to the surf club, separated from adjacent protection by concrete ramp	MODERATE	MODERATE	MODERATE	MODERATE
1.4	Rock protection in front of main reserve	EXTREME	MODERATE	MODERATE	MODERATE
1.5	Rock protection in front of Jonson Street carpark and east of groyne marking location of original jetty	MODERATE	MODERATE	MODERATE	MODERATE
1.6	Rock protection in front of Jonson Street carpark and west of groyne marking location of original jetty	HIGH	MODERATE	MODERATE	MODERATE
1.7	Rock toe protection in front of First Sun Caravan Park	HIGH	MODERATE	LOW	MODERATE
2.1	Border Street geotextile container interim protection works	LOW	LOW	LOW	MODERATE
2.2	Rock protection adjacent to Border Street works	MODERATE	MODERATE	EXTREME	EXTREME
2.3	Don Street geotextile container interim protection works	LOW	MODERATE	MODERATE	MODERATE
2.4	Concrete cube and rubble protection works adjacent to Don Street works	MODERATE	MODERATE	EXTREME	EXTREME
2.5	Geotextile container revetment adjacent to ad-hoc rubble works	MODERATE	MODERATE	MODERATE	MODERATE
3.1	Rock revetment north of old jetty site	EXTREME	HIGH	EXTREME	EXTREME
3.2	Manfred Street geotextile container interim protection works	MODERATE	MODERATE	MODERATE	MODERATE
3.3	Geotextile container revetment fronting private land adjacent to the Manfred protection works	MODERATE	HIGH	MODERATE	MODERATE
3.4	Rock protection north of the geotextile container revetment	EXTREME	HIGH	EXTREME	EXTREME
3.5	Geotextile container revetment works at northern flank of the rock protection at Belongil Spit.	MODERATE	MODERATE	MODERATE	MODERATE

WP 2013 provided a risk assessment only and no recommendations were made to repair and make safe any of the walls. Since the WP 2013 report:

- Structures 3.2 (Manfred Street) and 3.3 (adjacent to Manfred Street) have been upgraded by BSC to a rock wall and a similar rock wall upgrading is proposed for 2.1 (Border Street) and 2.3 (Don Street).

- WP 2013 have prepared a report in 2014 for BSC investigating the options to upgrade at and adjacent to Jonson Street (Collectively referred to as Jonson Street Structure and structure numbers 1.1 – 1.7 in Table 1).
- Periods of beach erosion have occurred including erosion due to a major storm in early June 2016 that caused erosion along the NSW coastline and further damage to the walls.

Looking at the detailed hydraulic stability evaluation for 40 Child St (part of structure 3.1) by WP 2013:

Structure No.	Structure Description	Design standard 30 – 40% damage (from Table 3); initial damage for geotextile revetments	Rating	Comments
3.1	Rock revetment north of old wharf site	<1yr ARI	Poor	Rock armour is too small to withstand estimated wave heights at this structure for events greater than the 1 year ARI

The public use and amenity rating by WP 2013 for the private structures along Belongil is between moderate and extreme. The public use and amenity rating for the subject property was extreme. These ratings were in 2013 and the public use and amenity rating may now be worse and the structure should be repaired and made safe. The repair works would improve the public use and amenity rating.

ICM engineers have made regular inspections of the walls along Belongil Spit since 1999 and a condition survey of the walls along Belongil, with particular attention to the walls covered under the consent orders (Figure 6), was carried out by ICM engineers on 13/10/16 using high precision aerial photogrammetry with RTK survey positioning to ascertain and record the condition the walls. This condition survey was more detailed than the 2013 inspections by Worley Parsons (WP 2013).

During the 2016 condition survey it was observed that:

- the sections of the walls lower than 2m were covered by sand and was landward of high tides and wave action (Figure 7).
- the seaward wall sloped down steeply from a crest height of about +6.5m on the SE end (No 44 – that is to be made safe under separate DA for 44-48 Childe St) to about +2m over a length of about 5m. (Figure 8)
- The repairs needed are restacking and replacement of displaced rocks on the SE section (Figure 8) face so that the wall face between 40 and 44 is at a stable slope of 1:1.5 with stable rocks.



Figure 7 Buried existing wall

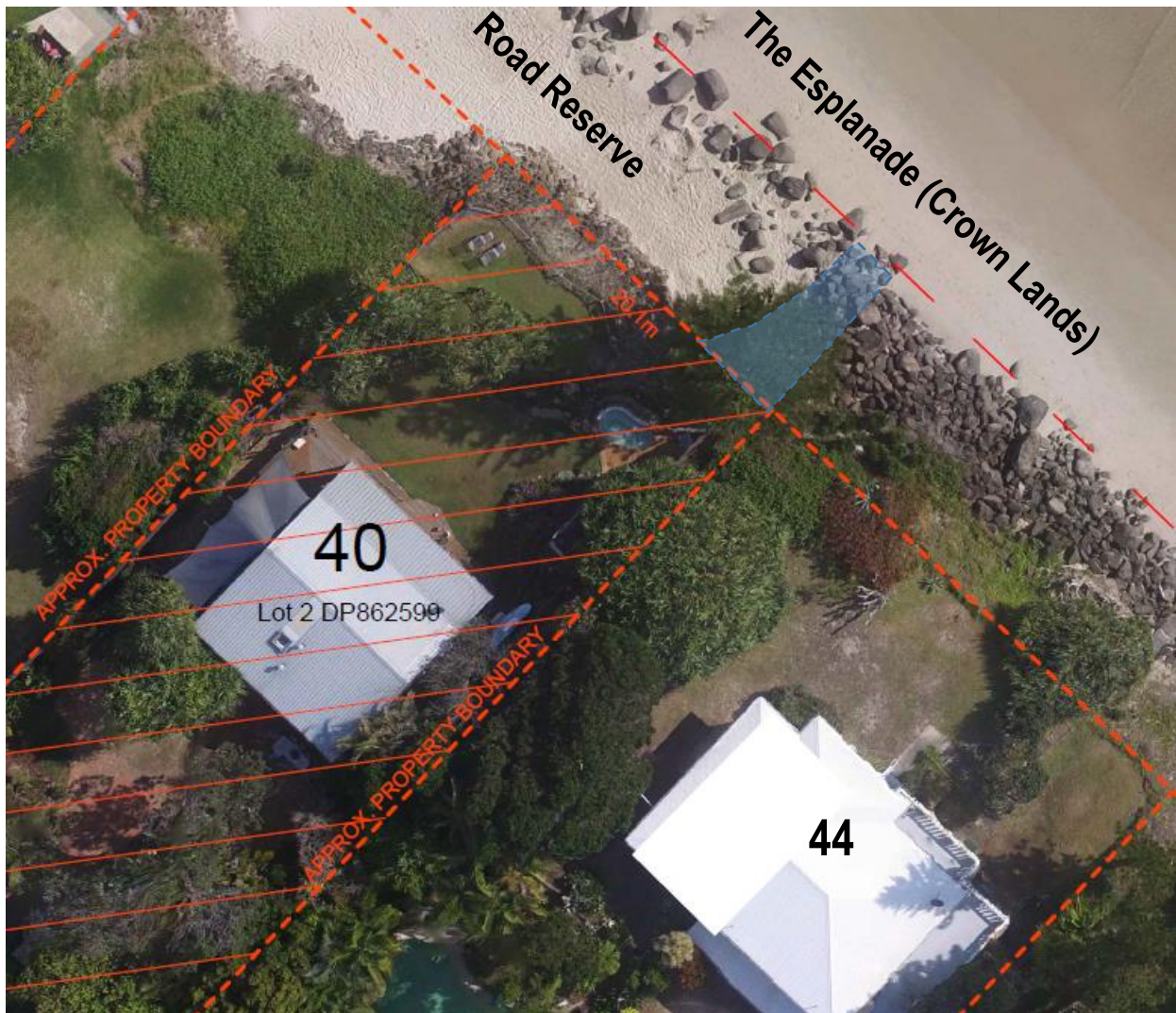


Figure 8 Section of wall to be made safe

The WP 2013 findings re risk and hydraulic stability reflected:

- the small rocks and steep slope on the seaward face of the southernmost 5m of the wall
- wall.
- The low crest for the remaining 15m of the wall

The proposed repair works will improve the public use, amenity, risk and hydraulic stability ratings.

Many of the inspections by ICM engineers since 1999 were during erosion events when the lower section of the wall was uncovered. The historical ICM photos along with publicly available aerial

photos from Google Earth and Nearmap provide good details of the condition of the wall below present sand level.

From the data available, the Belongil walls have generally been constructed with primary armour rocks with a grading of 1.5-5t with a smaller secondary armour layer and clay filter layers under the primary armour. The walls were located along the seaward face of the historical storm erosion scarps that are landward of normal high water. The continuous wall acts as a terminal seawall that not only protects public and private beachfront properties and infrastructure during major erosion events but also provides environmental benefits as it mitigates the risk of a breakthrough of Belongil Spit that, if allowed to occur, would have large adverse impacts on Belongil Creek and the Belongil wetlands (Figure 5).

The existing structure has been damaged due to overtopping but the adjacent walls have proven to be structurally adequate over the life, to date, of about 40 years (Figure 9 and Figure 4).



Figure 9 Aerial photo during erosion 2009 (Google Earth August 2009)

The wall is still providing protection and the proposed works are repair of the existing structure, not redesign and rebuild of a new structure

The present typical x-section of the wall is shown in drawing 003 of Attachment A.

The need for maintenance is to be expected after this time as rock seawalls are flexible structures that can accommodate some rock movements (“damage”) and should be maintained after major storm impacts. Present engineering rock seawall design formulas and guidelines incorporates the notion that a level of damage is acceptable and maintenance is required to limit the extent of damage.

The existing works have been damaged to an extent that they are now in need of repair to restore them to their original condition and safety.

Works to repair the existing seawall structures protecting these properties are to be carried out as contemplated with recent Supreme Court of NSW consent orders made 12/8/16.

4. REPAIR DESIGN

The most urgent works are to restack any unstable rocks on the exposed (above beach level) seaward face of the wall in a stable configuration in the SE section as marked. To achieve this, some additional rocks may be required. This will not change any characteristics, such as void ratio and energy dissipation.

For the initial urgent repairs and subsequent full repairs of the existing wall structure, all appropriate engineering principles, codes and standards will be applied. These include:

- Coastal Engineering Guidelines (Institution of Engineers, Australia, 2012)
- Guidelines for the design of maritime structures (Australian Standard AS 4997-2005)
- The Rock Manual (CIRIA, 2007)
- Actions from Waves and Currents on Coastal Structures (International Standard ISO 21650:2007)
- Eurotop (2016)

The works proposed in the August 2017 DA are for minor repairs to make safe the exposed sections of the seaward face of the existing wall above beach level. These works can be carried out without the need for any works, or equipment access, on the Esplanade.

The seaward wall will be partially repaired with the crest of the seaward wall topped up to +4m AHD using selected large rocks placed in areas subject to the highest wave forces. The beach amenity will not be reduced.



These investigations confirmed that the works are in need of repair. Drawings of the extent of repair works have been prepared and the proposed alignment and footprint of the repaired wall is as per

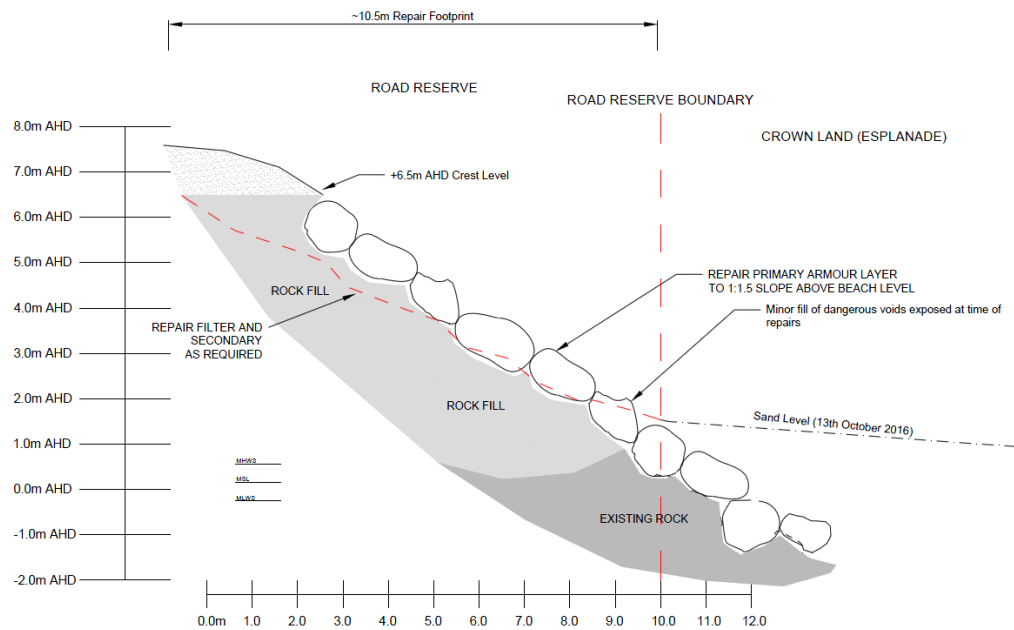


Figure 10 and
Figure 11.

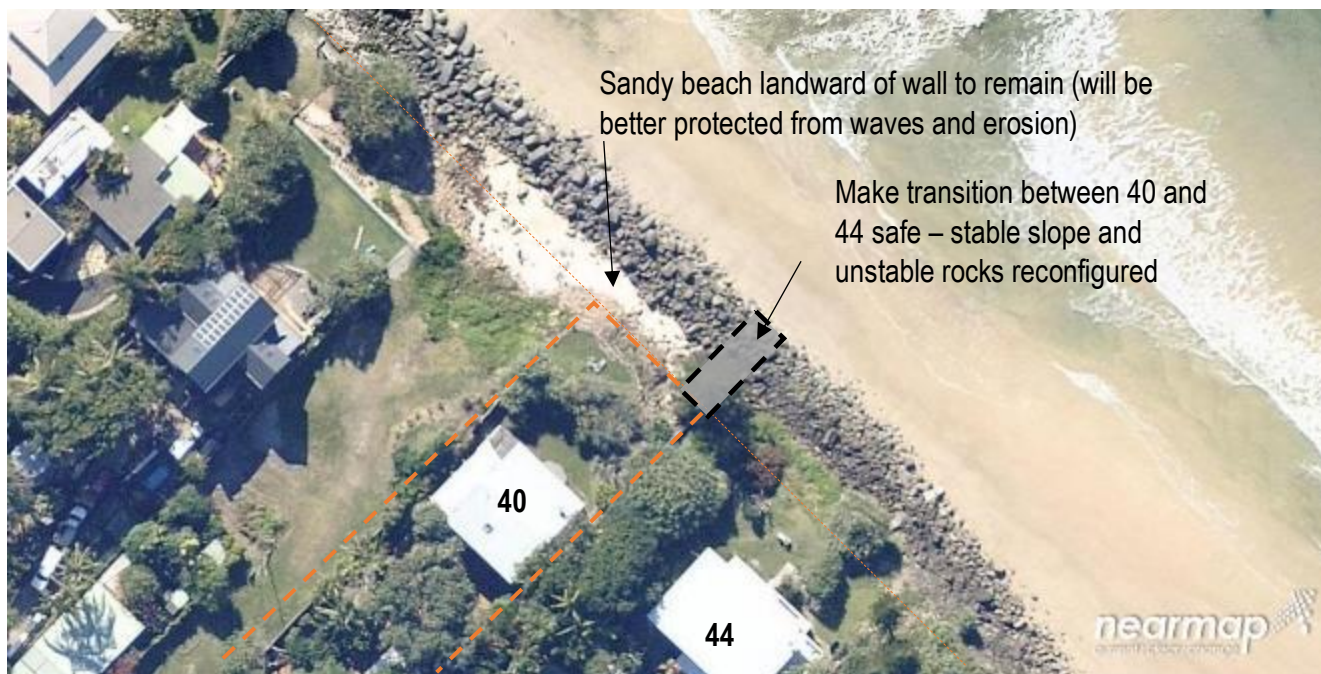


Figure 10 Proposed repairs superimposed on eroded beach aerial photo (Nearmap July 2012)

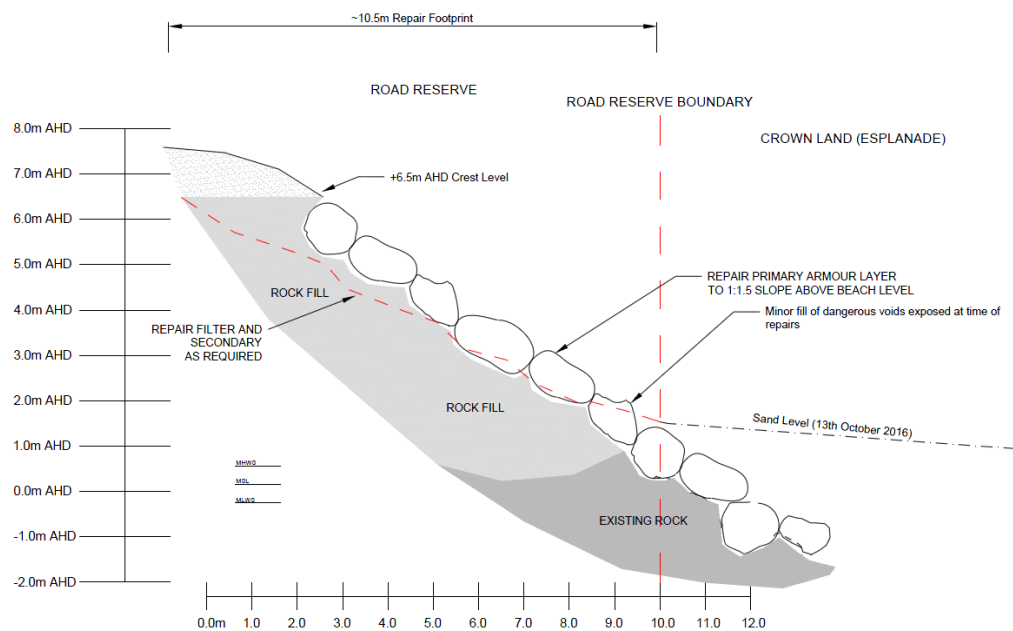
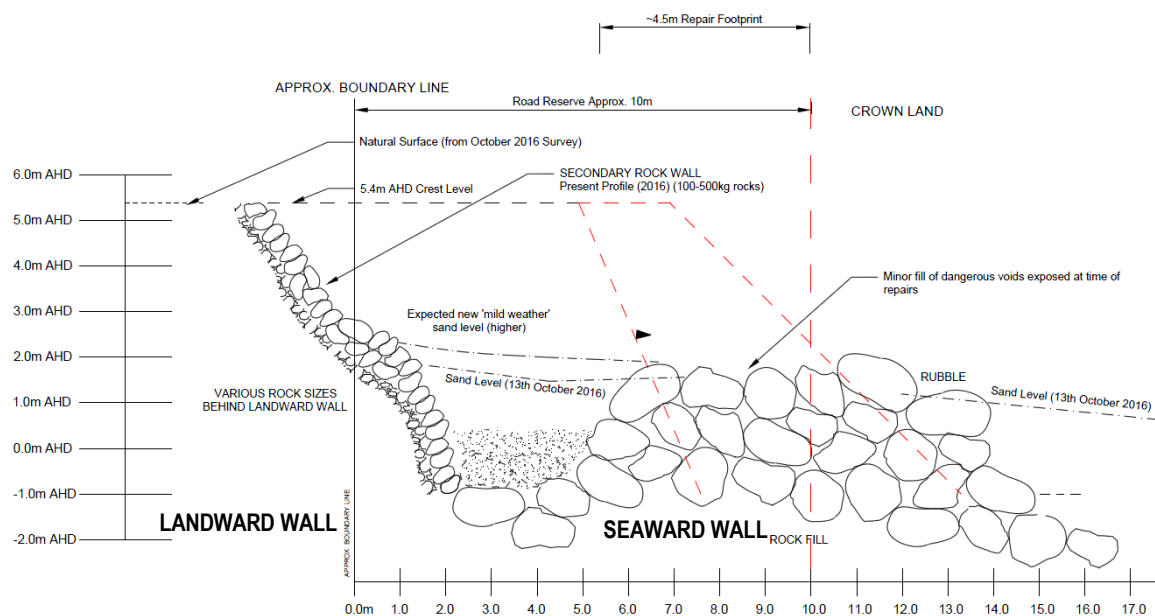


Figure 11 Proposed repair – typical x-section

5. REPAIR CONSTRUCTION METHODOLOGY

The proposed methodology is similar to the methodology used to investigate and repair sub-standard private and public seawalls along the Gold Coast.

Works to repair the existing seawall structures protecting these properties are to be carried out as anticipated by recent Supreme Court of NSW consent orders made 12/6/16. The proposed method of carrying out the works is as follows:

- Pre-Construction
 - All consents from adjacent landowners impacted by the works are to be formalised.
 - All statutory approvals to be obtained and notifications made.
 - A programme of works to be prepared that coordinates all of the private repair works such that the individual works proceed in an orderly manner, one property at a time, with the repair for each property completed and that section of beach opened before commencing on the next repair.
 - Safety fencing and signage is to be erected as per the construction drawing (Attachment A) to restrict public access to the work area. This fencing will be erected on the subject property and within the road reserve under Council control. The fence and construction works and activities will not intrude on the Esplanade. Access will be through the subject private properties as per the traffic plan. (Attachment A).
 - The traffic management plan which includes pedestrian access to and along the beach to be approved by BSC (attached in Attachment A). Truck traffic will be limited to a low loader to deliver and remove the excavator and no more than two 12t truck movements to deliver rocks over the repair time (estimated at 2-5 days).
- Construction (Estimated repair time 2 -5 days on weekdays, 7am to 6pm.)
 - Access for equipment and materials to be through the adjacent property (44 Childe Street).



- Work areas as per the construction plan (Attachment A) will be kept as small as practical and fenced with safety signage and barricades to restrict public access to work and stockpile areas. Safe public accesses to and along the beach will be maintained.
- The works will be carried out with a long reach excavator using a rock bucket and rock grab to position face rocks above beach level in a stable and safe configuration.
- The works shall be carried out working from private property and Council road reserve at the SE end.
- Rocks, temporarily removed or new, are to be stockpiled within the fenced work areas.
- Noise will be kept to acceptable limits as per similar projects
- Post-Construction
 - The beach is to be groomed and left in a clean condition free from rock or rubble from the repair works.
 - The access track is to be removed and the area impacted by the track revegetated and restored to the original condition.
 - The safety fencing is to be removed.
 - Maintenance by owners as required after major storms – estimated every 10 years.

6. NO IMPACTS

The proposed repair works to make safe the existing wall above beach level are minor and limited. Due to the nature and scope, the proposed repair works will not change the size, location or key physical characteristics (such as reflection coefficient) of the existing wall. As a result, there will be no change to the present interactions between the wall, when intermittently exposed to waves, and the coastal processes. In particular, there will be no adverse impacts on adjacent properties or down-drift impacts caused by the repair works.

The proposed repairs will improve the stability of the wall and will have positive impacts on safety and the protection of adjacent private and public properties.

Furthermore, the repairs are to a wall that is generally inactive with respect to coastal processes. The alignment of the walls along Belong Spit, including the subject wall, is landward of normal high water (Figure 5) and these walls act as a terminal seawall that not only protects public and private beachfront properties and infrastructure during major erosion events but also provides environmental benefits as it mitigates the risk of a breakthrough of Belongil Spit that, if allowed to occur, would have large adverse impacts on Council and Crown Lands.

The potential effect of specific coastal hazards and processes on the proposed repair works can be summarized as follows:



Processes and Hazards [from NSW Coastal Protection Act 1979]		Impact on repaired wall
a)	beach erosion	The works are repair of an existing structure.
b)	shoreline recession	
c)	coastal lake or watercourse entrance instability	The coastal hazards and processes on the repair works will be the same as the status quo.
d)	coastal inundation	
e)	coastal cliff or slope instability	However, the repaired wall will be better able to resist the present and future coastal processes and hazards.
f)	tidal inundation	
g)	erosion caused by tidal waters, including the interaction of those waters with catchment floodwaters	
h)	Sea level rise and associated climate change impacts	

The impacts of the proposed repair works on the coastal processes and hazards will be the same as the status quo as the works are repair of an existing structure.

The impacts of the repair of the existing coastal protection works on coastal processes and hazards can be summarized as follows:



Processes and Hazards [from NSW Coastal Protection Act 1979]		Impact by repaired wall
a)	beach erosion	<p>The works are repair of an existing structure.</p> <p>The impact of the repair works on the coastal hazards and processes will be the same as the status quo - no change</p>
b)	shoreline recession	
c)	coastal lake or watercourse entrance instability	
d)	coastal inundation	
e)	coastal cliff or slope instability	
f)	tidal inundation	
g)	erosion caused by tidal waters, including the interaction of those waters with catchment floodwaters	
h)	Sea level rise and associated climate change impacts	

In the design of the repair works, Section 55M of the Coastal Protection Act has been considered. Section 55M requires that:

- (a) *the works will not over the life of the works:*
 - (i) *unreasonably limit or be likely to unreasonably limit public access to or the use of a beach or headland, or*
 - (ii) *pose or be likely to pose a threat to public safety, and*
- (b) *satisfactory arrangements have been made (by conditions imposed on the consent) for the following for the life of the works:*
 - (i) *the restoration of a beach, or land adjacent to the beach, if any increased erosion of the beach or adjacent land is caused by the presence of the works,*
 - (ii) *the maintenance of the works.*

With reference to the above Section 55M conditions:

Re (a) (i); *the works will not over the life of the works unreasonably limit or be likely to unreasonably limit public access to or the use of a beach or headland*

- The proposed works are to make safe existing works by restacking of the wall to restore a stable slope without loose rocks that could be dislodged during erosion events.
- The completed repair works will improve safety of public access along the beach.

Re(a) (ii); *the works will not over the life of the works pose or be likely to pose a threat to public safety*

- The proposed repair works will improve public safety by restacking loose rocks. Thus, the repair works will not “pose a threat to public safety”.

Re (b) (i); *satisfactory arrangements have been made (by conditions imposed on the consent) for the following for the life of the works: (i) the restoration of a beach, or land adjacent to the beach, if any increased erosion of the beach or adjacent land is caused by the presence of the works.*

- The proposed repair works will restore a stable slope above present sand level. Impacts on the beach and adjacent land will be unchanged from present. Thus, any repairs will not cause “any increased erosion of the beach or adjacent land”.
- The proposed repair works will also reduce the risk of erosion and a breakthrough of the Belongil Spit at this site. A breakthrough would result in:
 - Damage to Childe Street and the associated public infrastructure to westward of the subject property.
 - Inundation and erosion of the Belongil Creek, wetlands and littoral rainforest to westward of the subject property.

Re (b) (ii); *satisfactory arrangements have been made (by conditions imposed on the consent) for the following for the life of the works: (ii) the maintenance of the works.*

- The proposed repair works can and should be maintained by the landowners after each erosion event that impacts the wall. A cost estimate for these repairs work is about thirty thousand dollars.
- The wall should be inspected after each erosion event that exposes the seaward face of the wall to wave action. This inspection should compare the condition of the wall to the “as repaired” condition after the proposed repairs. Specifically, the inspection should:
 - Identify any loose, broken or displaced rocks.
 - Any loose rocks should be repositioned to be in a well interlocked and stable orientation.



- Any broken rocks shall be replaced by a sound unbroken rock of similar size as the broken rock and placed in a well interlocked and stable orientation.
- Any displaced rocks should be removed and replaced in a similar position to the original position in a well interlocked and stable orientation.
- Check the crest level and seaward slope angle. Any subsidence or slope adjustment should be repaired to the original “as repaired” condition.

Other potential impacts

End effects:

A common concern re seawalls, particularly those like the Jonson Street Structure that generally extend into the surf zone, is that they have long term end effects. As the proposed works are repair of an existing wall that is landward of the general influence of the waves and tides, this is not an issue.

The lack of down drift impact beyond the status quo is confirmed.

Previous studies for BSC of existing and proposed upgrading of existing walls along the Byron embayment found that the only structure that had significant end effects was the Jonson Street structures. Near to the subject site, a geobag wall has been upgraded to a much larger rock seawall recently by BSC. In the consideration of the potential for end effects of this rock seawall with a length of 100m, WRL (2013) considered the McDougal et al 1987 diagramme as well as more recent work by NSW researchers (see WRL 2013 Section 8.7.2). WRL 2013 concluded that there would be no incremental end effects beyond the status quo ie referring to the McDougal et al 1987 diagramme (Figure 12):

- L (length of hard / protective structures) = 1,727m
- r (increased end effect recession) = 0m
- S (extent of increased end effect recession) = 0m

This assessment by WRL 2013 was supported by Umwelt 2013 (see Section 5.2.1):

“They are a replacement for an existing protection structure, so they would have no incremental (additional) impact beyond the status quo.”

ICM concluded, similarly, that there will be no incremental end effects from repairing the existing wall with a length of 10m at the subject site. That is, $r = 0\text{m}$ and $S = 0\text{m}$ as per the McDougal et al 1987 diagramme overlaid on Belongil (Figure 12) with dimensions.

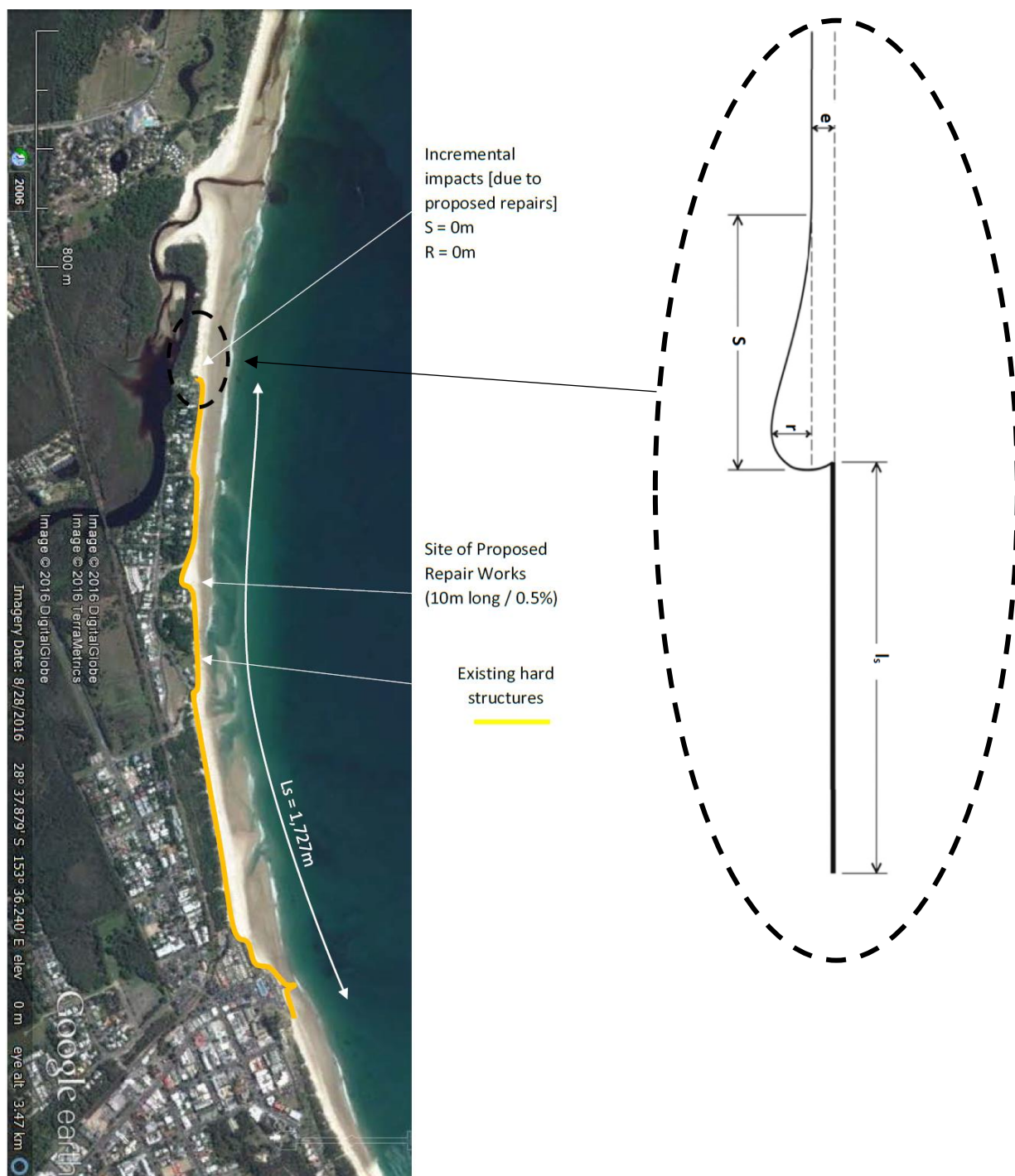


Figure 12 McDougal et al 1987 diagram applied to Belongil curved coastline

Summarising, there is now a continuous rock seawall from the northern flank of the northern most private property on Belongil spit to the existing rock protection at the NW section of the Old Jetty Site (State crown lands). With the natural sandstone outcrops at the southern end of the Old Jetty site and southward from Border Street with the BSC sandbag walls at Border Street and Don Street, there is now almost continuous protection (natural and artificial) of varying standards between the SLSC to the south of Jonson Street and the northern most private property on Belongil Spit. (WRL 2013). This repair is to a wall that is part of this continuous protection.

Habitat impacts:

A detailed environmental impact assessment was done for the new rock seawall recently constructed nearby to the subject site at Manfred St for BSC. This rock wall was found have minimal environmental impacts (Umwelt 2013 Table 2.1) The impacts of the proposed repairs will be much smaller and there will be no impacts on shore bird and turtle nesting.

Extreme weather events:

The repair time is only about 3 -5 days so works can be timed to avoid extreme weather events. Before commencement of the works the short and long-range weather forecasts will be checked and works will not be commenced unless weather is suitable. Should extreme weather events be predicted during the course of the works that could affect the works, then the works will be suspended and made sound for the predicted weather impacts

The cost estimate for the maintenance repairs is \$15,000 over a thirty year period.

7. SUMMARY

Urgent works are necessary to make safe the existing wall.

The present application is for minor urgent works above beach level. The additional rock to be imported will be limited to 24t. No excavation on the beach or works on crown lands will be required.

These repairs will:

- make safe the existing wall
- have positive benefits to the safety of beach users
- improve protection to private and public property and infrastructure

These repairs will not:

- increase the footprint of the existing wall
- move the existing wall seaward.
- change the characteristics of the existing wall with respect to to the status quo of impacts on or by coastal processes
- cause environmental impacts



8. REFERENCES

CIRCA (2007) The Rock Manual 2007

EurOtop (2016). Manual on wave overtopping of sea defences and related structures. An overtopping manual largely based on European research, but for worldwide application. Van der Meer, J.W., Allsop, N.W.H., Bruce, T., De Rouck, J., Kortenhaus, A., Pullen, T., Schüttrumpf, H., Troch, P. and Zanuttigh, B., www.overtopping-manual.com

ICM (2000), Proposed Interim Erosion Protection Works for Lots 32 to 36 Section 3 of DP 1623. International Coastal Management. 2000

(WRL 2013) - University of NSW Water Research Laboratory, 2013. "Design of Interim Beach Access Stabilisation Works – Belongil, Byron Bay" WRL Technical Report TR 2013/08. Report for BSC

(WP 2013) - Worley Parsons 2013. "Byron Bay Erosion Protection Structures – Risk Assessment" Report for BSC

(Umwelt 2013) – Umwelt (Australia) Pty Limited, 2013, "Review of Environmental Factors for Interim Beach Access Stabilisation Works at Belongil, Byron Bay", Report for Byron Shire Council.



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ATTACHMENT A

TECHNICAL DRAWINGS