HIS DUMP SITE, OUR PLAYGROUND;
a call for the configuration placement of dredge sand

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1.0 Abstract:

Port Hacking estuary is dredged to maintain the safety of navigation channels for the benefit of boating enthusiasts. The dredge spoil is transported a short distance via barge, with random disposal of the sand in the nearshore to nourish Cronulla Beach. Dredging/disposal works in 2003 and 2007 created sand banks that influenced wave breaking patterns for up to six months. In 2010 another round of dredging was announced, approximately 45,000m3 of sub-aqueous sand will be relocated.

In 2008 Cronulla was recognised as a National Surfing Reserve, as an iconic surfing location that links past, present and future generations with the coast. In response to the announcement of the 2010 dredging/disposal works, a formal proposal was forwarded to Sutherland Council seeking additional benefits, with no estimated extra cost.

The proposal calls for the planned configuration placement of dredged sand, to temporarily create a wave focusing sand ridge, a submerged sand bar that is transverse to the shoreline, an elongated mound extending from 4m to 11m deep. The Placement Zone template is to be located just offshore the Prince Street seawall. The sand feature will act as a wave focusing sand ridge and is designed to temporarily provide;
1) improved surfing opportunities inshore of the sand feature, by inducing wave 'peaks' with longer length of surfing ride, rather than wave 'close outs', there will be no surfing directly over the sand feature, with waves head high and smaller,
2) a slightly wider beach in the lee of the sand feature, as the sub-aqueous sand slug experiences a natural shoreward direction dispersal, assisting in the protection of the Prince Street seawall.

Sutherland Council is open to the proposal, though seeks further study and community consultation. A local committee, the Bate Bay Sand Placement Committee was established to help steer the process and circulate information.

This paper will seek to answer the following. Should Cronulla be viewed as a dump site or an iconic location? How has the sand placement proposal been received by government, coastal scientists and the community? What is the feedback and critique? What of similar projects, including beach nourishment works in New Jersey USA designed to create temporary sand banks favourable to local board riders? What is the theory behind a wave focusing sand ridge?

The paper will expand on the proposal for configuration placement of dredge sand and discuss; site context, design influences, the concept plan, placement zone template, risks/benefits, feedback/critique, recommendations and conclusion.

2.1 Site Context, Cronulla National Surfing Reserve

Cronulla is one of Sydney's most popular and longest beaches. The 5km beach is embayed, with an almost easterly aspect at South Cronulla curving around to a northwest aspect at Boat Harbour. Cronulla is a well maintained beach, popular and adjacent to a vibrant commercial zone. Typical wave height is less than 2m high on approximately 80% of days and typical swell direction varies from east through to south south east on more than 70% of days (Patterson Britton 2006). The area has a long association with the ocean, with four surf clubs; Cronulla Surf Life Saving Club (SLSC), North Cronulla SLSC, Elouera SLSC and Wanda SLSC. There are also several board riding clubs including; Cronulla Sharks Boardriders, Elouera Boardriders, Cronulla Point Board-riders, Cronulla Christian Surfers, Cronulla Girls Boardriders and Cronulla Bodyboard Club.

In 2008 Cronulla was formally recognised as a National Surfing Reserve and as an iconic Australian surfing location, linking past, present and future generations with the oceans, waves and coastline. The NSW Department of Lands and Sutherland Shire Council were closely involved in the Cronulla Surfing Reserve declaration (www.surfingreserves.org).

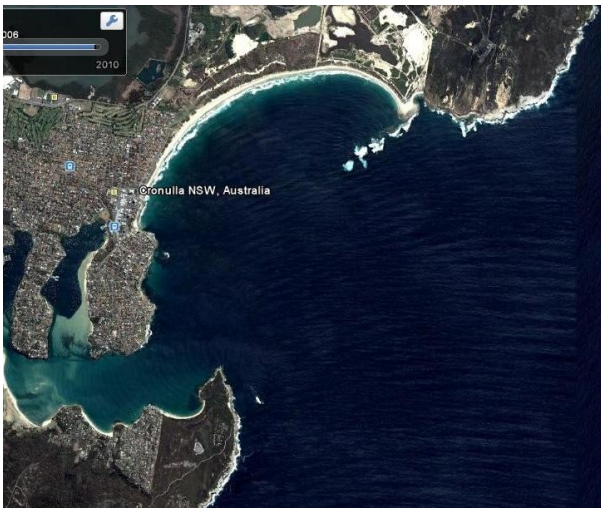

Image 1. Cronulla Beach, 30km south of Sydney CBD, image courtesy Google Earth

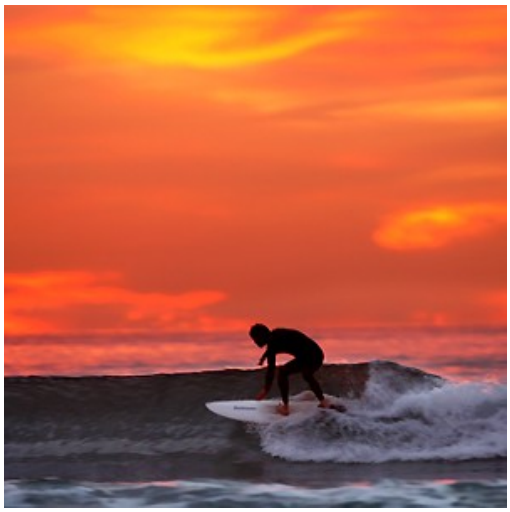

Image 2. Board rider on a peeling wave, early morning Cronulla, photo courtesy John Veage

The local surfing industry is a big employer in the Sutherland Shire, including surf/fashion retail outlets, board manufacturers, surf schools and a well managed surf event and competition calendar, which injects regular cash flow into the local retail economy. The Surfing Australia Annual Report (2009) estimates 2.5 million Australians will 'go for a surf' this summer. Many will wear surf clothing brands Billabong (BBG) or Globe (GLB) both companies listed on the Australian Stock Exchange, or surf brands from USA listed companies including Quiksilver(ZQK), Vulcom (VLCM) or Hurley, a Nike (NKE) brand.

2.2 Port Hacking dredging and Cronulla beach nourishment

To the south of Cronulla is Port Hacking estuary, a popular waterway for boating enthusiasts. A distinct sand body has been identified in the mouth of the estuary, this marine delta is slowly prograding into the estuary, the navigation channels are naturally infilling with sand (Patterson Britton 2010).

To improve the ongoing safety of navigation channels and for the management of dredging within Port Hacking, Sutherland Shire Council entered into a Memorandum of Understanding (MOU) with the NSW State Government. The MOU commits the NSW Government to fund regular dredging of the channels in order to maintain a navigable depth. Council is paid to administer the dredging contracts as a consultancy. The NSW Department of Environment, Climate Change and Water (DECCW) exercises a regulatory function and issues approvals. In early 2010 funding of $1,160,000 was allocated for a further round of maintenance dredging. Council is to be paid an additional $97,000 to administer the dredging contract on a fee for service basis (Sutherland Council 2010).

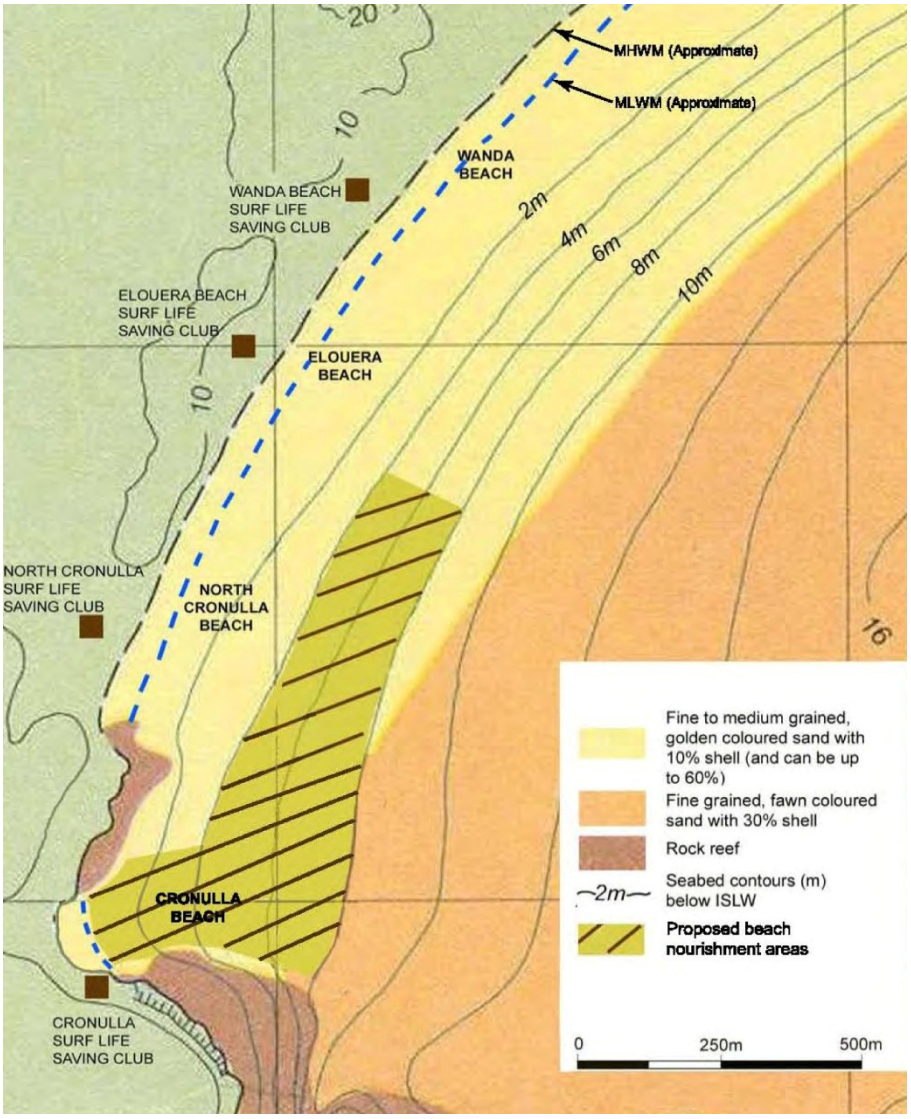

Image 3. Nourishment Zone template included in the REF 2010, hatched area (from Fig 3.1, Patterson Britton 2010, base map is the PWD Bate Bay Seabed Information 1989)

Prior to the 2007 dredging/disposal works, DECCW coordinated and published an exhaustive and high quality 302page REF, Review of Environmental Factors (Patterson Britton 2007). The 2010 REF (Patterson Britton 2010) is a 173 page condensed version of the 2007 REF. The 2010 project will involve the dredging of approximately 45,000m3 of marine sand. The dredged material, spoil, is randomly spread across a disposal/nourishment zone (see image 3), a dump site in 4m to 8m water off Cronulla Beach.

The sub-aqueous nourishment zone was identified in a coastline management plan (Patterson Britton 2006) as requiring ongoing maintenance to sustain beach levels to the current profile, compensating for the natural movement of beach material to the north east.

An unplanned variation to the nourishment zone occurred in 2003. A bathymetric study involved 5 surveys spread over 10 months in 2002/3. Comparing pre and post nourishment topography indicated a large proportion of dredge spoil was dumped in an unplanned mound on the southern edge of the disposal zone, though the sand slug was dispersed in a shoreward direction (DIPNR 2005). A contingency variation to the 2007 works placed a large proportion of spoil in the southern part of the zone again, to replace sand removed during a storm event (Patterson Britton 2010). There are precedents for work variations.

The 2010 REF provides quality information and is an exhaustive document. Yet the REF did not consult local boardriding clubs, nor did the REF acknowledge or mention the Cronulla National Surfing Reserve. The REF did not consider the impact on surfing.

2.3 Previous dredge spoil disposal works, impact on surfing

Horvath lives at Cronulla and reviews surfing conditions on a daily basis. Horvath considers the 2003 and 2007 disposal/nourishment works had a noticeable impact on local wave breaking patterns, though not necessarily improving wave breaking patterns. The 2007 works created an offshore sand mound/bank/slug at South Cronulla (see Image 4) that was noticeable for up to 6 months (Horvath 2010).

Image 4. Cronulla, an offshore sand bank, a sand slug, was created during the spring 2007 dredging/disposal works. This photo of a surfer riding a rare overhead plus wave was taken in January 2008. The life expectancy of a sand bank can be up to 6 months. Photo courtesy, Ben Horvath

Other local surfers have similar observations (Bate Bay Sand Placement Committee 2010). Given the impact of previous works, local surfers feel the scheduled 2010 dredging of Port Hacking and sand disposal off Cronulla Beach, has the potential to provide additional benefits of better surf and protection of the seawall, at no extra cost. In consultation with local surfers, Pitt (2010) prepared a formal proposal and forwarded it to Council and others.

3.1 Design influences

The objective of the planned configuration placement of dredge sand is to deposit a temporary feature, a sandy mound, on the seabed topography. The configuration of the Placement Zone template for a wave focusing sand ridge is inspired by the site environment and technical constraints.

The design of the wave-focusing-sand-ridge is also influenced by;

a) studies linked to artificial reef projects and surfing,
b) other sand placement projects, topography and surfing,
c) topography of naturally occurring bombora controlled beachbreaks.

A summary of these design influences will be discussed.

3.2 Surfing and artificial reef projects

Walker (1974) used a nomenclature in the study of topography at Hawaiian surfing reefs; submerged promontory, ridge configuration, mound, saddle and trench. He also popularised the surfing parameters of; wave peel velocity, length of peel and peel angle. He based his conceptual surf site, a triangle shaped reef, on Queen's Reef (Haw). Mead & Black (2001) identified surfing reef components of; ramp, focus, pinnacle, wedge, ledge and ridge.

Shoreline protection was the primary objective of the artificial reef constructed with sand filled geo-textile bags at Narrowneck (Qld) in 1999 (Black & Mead 2001). A long term monitoring program indicates the sandy beach is slightly wider in the lee of the reef (Blacka, Anderson & Lopez, 2008), with a semi-permanent salient, or 'elbow', on the shoreline. The secondary objective of the Narrowneck reef, a twin reef setup, was to improve surfing. Local surfers at Narrowneck report that wave breaking patterns are improved to the north of the reef (down-drift), though the reef is rarely surfed. All parties agree - Council, scientists, surfers – the reef has had no negative effect on beach width or surf quality. More recently, Mead (2010) reports other success with multi-purpose artificial reef projects that aim to both protect sandy shorelines and increase surfing opportunities.

A new concept for wave focussing surfing reefs was tested with computer modelling (West, Cowell et al. 2003). The reef structure would be installed seaward of the breaker zone, to act as a topographic lens, focusing waves to break as peaks further inshore. The primary purpose of the reef is to prevent waves from closing out (see Image 10) inshore; it is not designed to force wave breaking over it. Minimum dimensions for their wave focusing reef, with wave height 1m, period 8s is; 1.5m height x 10m width x 40m length = 600m3 volume.

3.3 Sand placement projects, topography and surfing

A shore based beach nourishment project at Long Branch Beach, New Jersey, tested a configuration placement with a 'trapezoidal template' (Mahon, Miller & Herrington 2009). Post project monitoring, bathymetric and Google Earth, indicated the broad sand feature acted as a feeder beach, with a longshore and shoreward dispersal of sediment. For surfers, the sand feature induced steeper, plunging breakers, preferred by body boarders. Board riders preferred the down drift beach areas.

Better for surfers was a protruding 'elbow' of sand created at St Augustine Beach, Florida in 2003 and 2005 to protect community assets at an erosion hot spot. With a shore based outlet, more than 5,500,000m3 of sand was relocated via pipeline and concentrated on one section of the shoreline. Post project monitoring (Albada, Goshow, Dompe 2007) indicated the sand point like feature acted as a feeder beach, with a longshore and shoreward dispersal of sediment. Remarkable surfing conditions were also enjoyed at the hot spot, now called 'The Dredge', with fast peeling point like waves popular with a range of surfers. Peel angles of +/-30° were recorded. Whereas pre-project seabed conditions typically consisted of straight contours parallel to approaching swell lines, with wave breaking peel angles of +/-6° which typically induced closeouts.

A submerged 'berm configuration' was created at Newport Beach, California in 1992 when just under 1,000,000m3 of sand was disposed off via barge in water depths ranging from 1.5m to 9m (Mesa 1996). A monitoring campaign, bathymetric and air photo, indicated sediment experienced shoreward direction dispersal and surfing was temporarily and significantly enhanced. A series of submerged mounds encouraged a more scattered wave field and a series of linked peaks throughout the nearshore zone, surfing conditions never experienced at that location (Mesa 1996). Pre-project seabed conditions typically consisted of straight and parallel contours with waves breaking close to shore, surfing short, fast spilling lefts or rights.

One of Australia's most popular surf spots was the Gold Coast 'Superbank' in Queensland. An initial by-product of the Tweed River Entrance Sand Bypass Project TRESBP, the Superbank was a continuous sand bar that stretched up to 1000m from a sand pipeline outlet located on the tip of a headland. Unplanned and short lived, the long shore sand bar dispersed and the bay in-filled after several years. At one time, the worlds best human made surf spot, the Superbank is yet to be duplicated at will. Alletson (1996) notes a shore based sand pipeline used at nearby Duranbah were less successful at improving local surfing conditions.

A scoping study to mine offshore sands to nourish NSW beaches looked at sand placement methods (Withycombe et al 2009); this concept has an opportunity to consider configuration placement zone templates to increase surfing opportunities.

3.4 Surfing at bombora controlled beachbreaks

The NSW coast has 721 beaches (Short 1993) and more than 205 recognised surfing reefs (Pitt 2009). Topographic features, including headlands, groynes and bomboras are often associated with popular surfing beaches. More than 26 of NSW's most popular surfing beachbreaks are located inshore of deep water reefs, known as bomboras, a word sourced from Aboriginal Eora language, describing the sound of waves breaking on an offshore reef, always submerged and separate from the shore.

Bombora controlled beachbreaks (Pitt 2009) in NSW include; North Narrabeen, Wairo, Old Bar, Booti Booti, Pelicans, Merewether, Woonona, North Narrawallee and Congo. Other locations include Woolamai (Vic) and 13th Beach (Vic). Gisborne Pipe (NZ) was studied by Beamsley and Black (2003) who looked at the impact of offshore reefs on inshore surfing conditions. At these locations surfing typically takes place over sand, yet in the lee of a bombora. The bomboras are rarely, if ever, surfed. Walker (1974) also identified offshore reefs (known as cloud breaks) at Pipeline, Sunset and Makaha (Haw).

Bathymetric studies (Pitt 2009) of North Narrabeen (33°S) and South Coast Peak (35°S) highlight natural examples of bombora shape and dimension that influence fantastic surf. The bombora off North Narrabeen (NSW) is diamond in plan shape, domed, 400m wide at the hip, commencing 200m offshore and extending more than 750m offshore. At the crest of the dome, the bombora is 4m higher than the surrounding sandy seabed.

The bombora at South Coast Peak (NSW) commences 150m off the sandy shoreline. In form, the bombora is like a dissected and flattened cone, extending more than 750m seaward, tip of the cone shoreward, 500m wide at the hip. The reef is only up to 2m higher than the sandy seabed. At both spots, a beach salient is often visible on the shoreline in the lee of the bombora and semi-permanent rips are reliably located adjacent the bombora. At both locations no reef is exposed on the sandy shoreline.

Image 5. A peeling wave in the lee of a submerged reef, because of wave refraction and amplification, approaching swells are focused to arrive to the beach as peaks, a breaking pattern that offers long length of surfing ride, at this south coast bombora controlled beachbreak

Both bomboras are subtle domed ridges that angle seawards, submerged topographic features that **focus** approaching waves (Mead & Black 2001) (West, Cowell et al. 2003). Before swell crests have crumbled and broken as waves, the bomboras influence wave breaking shape through wave amplification and swell refraction, in the wave pre-conditioning zone (Mead & Black 2001). At both Narrabeen and Peak, the bomboras are rarely surfed, only with wave height overhead and greater. Surfing typically occurs over sand, in the lee of the reef. Popular and typical wave breaking patterns include; peaks, peeling rights and/or lefts, long length of ride.

Bombora controlled beachbreaks are popular with surfers because of:

1) **certainty**, the bomboras focus advancing waves to a more certain location on the beach (West, Cowell et al. 2003) (Pitt 2009)
2) **swell magnets**, wave height is larger by an extra +25%, depending on wave period and wave amplification (Walker 1974) and (Beamsley & Black 2003) (Pitt 2009),
3) **length of ride**, waves are more likely to break as peeling peaks, rather than closeouts and offer a longer surfing ride (West, Cowell et al. 2003) (Pitt 2009),
4) **safety**, most surfing action takes place over sand, the deep outer reefs are rarely surfed, safer to wipeout on a sandy seabed than a reef.

4.1 Proposal for configuration placement of dredge sand

The following proposal presents a plan to create a temporary wave focusing sand ridge offshore Cronulla Beach. The sand bank will be created with marine delta sand dredged from Port Hacking to maintain safe navigation channels. However, rather than random disposal of spoil, a patchwork of small mounds spread across a broad zone, this proposal suggests a more planned approach and a concentrated placement of dredged sand within a more confined Placement Zone template. It is estimated there will be no additional cost for this variation in works. The objective of the wave focusing sand ridge is to temporarily;

a) enhance wave breaking patterns favourable to surfers,
b) increase beach width and assist protecting community assets, the Prince Street seawall,
c) assist with safer bathing within flagged areas.

4.2 Placement Zone location

The Placement Zone (see image 7) will be located directly offshore the Prince Street seawall. The site was selected because;

- the template of the Placement Zone (see Image 7) overlaps the Nourishment Zone (see image 3) outlined in the Review of Environmental Factors 2010,
- to assist in the protection of community assets, the Prince Street seawall (see Image 6) will benefit from the shoreward dispersal of sand and a slightly wider beach,
- the site enjoys a moderate to high energy wave climate, exposed to the dominant south-south-easterly swells, though far less exposed to summer north-east swells,
- the site is sub-aqueous, there is no sand added directly to the beach
- the site is typically a board rider's area, rarely used as flagged area for swimmers,
- a respect for the working constraints and safety of the dredge vessel and crew.

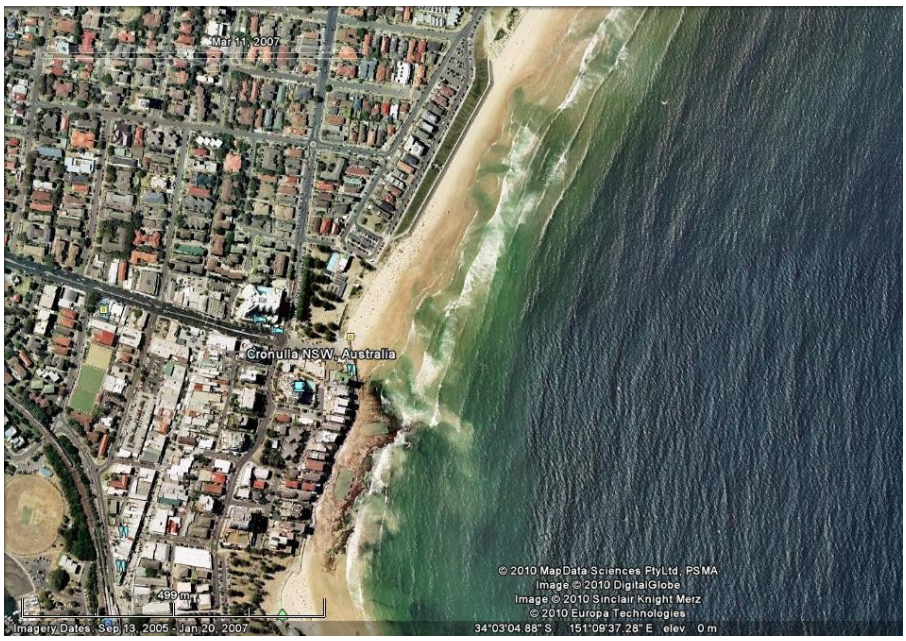

Image 6. North Cronulla Beach and Prince Street seawall at the top of image, showing small waves, short surfing rides and/or closeouts, image courtesy Google Earth.

4.3 Shape and form of the wave focusing sand ridge

The Prince Street Placement Zone (see Image 7) will act as a template for the deposit of a wave focusing sand ridge (see Image 8). The Placement Zone will extend from 200m off the shoreline to 600m offshore, water depth ranges from 4m to 11m deep (ISLW Indian Spring Low Water, the lowest low tide). The Placement Zone template is 400m long, with a shoreward base of 50m wide, tapering to 10m wide at the seaward tip. The template has an area of 12,000sqm. The Zone is aligned south south east.

A wave focusing sand ridge will result from the Placement Zone template. The anticipated shape and form of the sand feature is a long, low, narrow, mounded ridge. A submerged sandy ridge extending slightly off perpendicular to the shoreline, shore normal. The temporary wave focusing sand ridge will be an extra 2m higher than surrounding sandy seabed (see Image 8). At its shallowest, the sand feature will be 2m deep, though much deeper after natural shoreward sand dispersal. At its deepest the final crest level will be 9m deep.

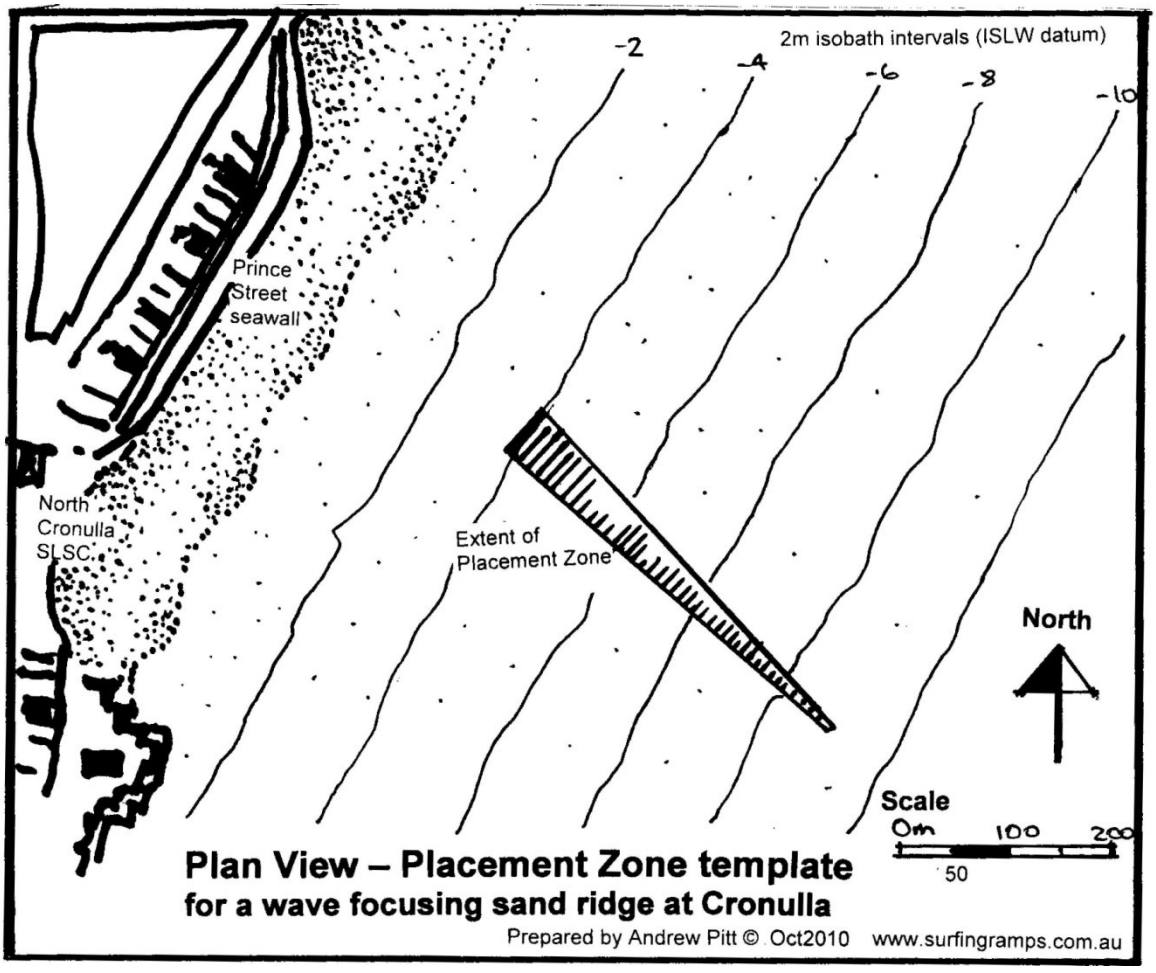

Image 7. The Placement Zone will act as a template for disposal of dredged sand, to shape a wave focusing sand ridge located beyond the typical breaker line. With typical wave height, waves pass over the sand ridge and break as peaks in the lee of the sand feature.

4.4 Construction methods, timing, scale, life expectancy

Trailing suction hopper dredgers were used during the 1999, 2003 and 2007 dredging. The 2010 works are likely to use same, pending tender negotiations (Patterson Britton 2010). This type of vessel is self propelled, ocean going, with on-board hopper for carrying sand. The vessel has equipment to extract subaqueous sand, store in hopper and transport. The vessel is capable of working in swells up to 1.5 m, with GPS locating and the hopper with bottom dumping capabilities. During this process, because the dredger actually rises out of the water as the load is dumped, navigable depth is maintained.

The Prince Street Placement Zone works to a minimum depth of 4m; this is consistent with the REF 2010 and respects the working constraints of the vessel to maintain a safe navigable depth. The Port Hacking dredging contractor will only be working in the Prince Street Placement Zone on days with low wave energy, consistent with the 2010 REF.

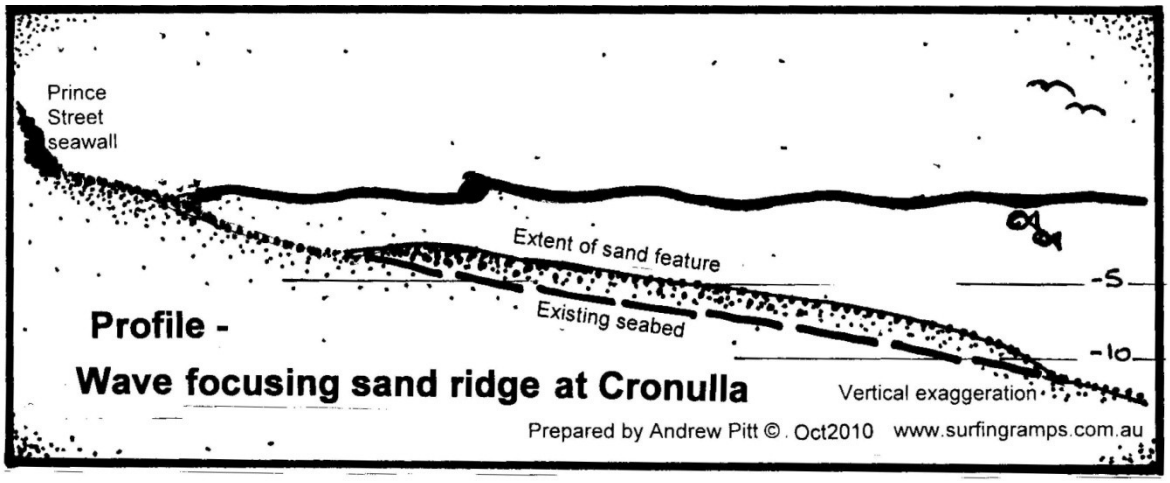

Image 8. Wave Focusing Sand Ridge profile, located beyond the typical breaker line, in the wave pre-conditioning zone. With typical wave height, waves pass over the sand ridge and break as peaks inshore the sand feature.

The scale of the works is flexible and dependent on the total quantity of dredging sand; approximately 45,000m3 of sand will be relocated. The wave focusing sand ridge design allows for 24,000m3, placed in layers, though is acceptable to a greater or lesser quantity of sand.

Timing the works is critical. Originally the 2010 works were scheduled for winter. Summer and autumn are inappropriate, as Cronulla is too busy with people. Spring should also be considered, as this season is typical of closeout sand bank conditions.

Previous bathymetric studies (DIPNR 2005) indicate sand slugs, like the wave focusing sand ridge, will experience a gradual dispersal in a shoreward direction. The sand feature acts a feeder beach to the shoreline. The life expectancy of the sand feature will depend on the variability of climatic conditions following the placement. Major storm events of long duration will rapidly redistribute sand on the seabed, reducing and dispersing the sand feature. Previous nourishment works at Cronulla had a noticeable impact on local wave breaking patterns up to 6 months (Horvath 2010). Overseas examples at Newport (Calf) and St Augustine (FL), suggest similar, from 3 to 12 months.

4.5 Benefits and advantages of creating a wave focusing sand ridge

The proposal can provide the following benefits (see Image 9) for board riders;

1) **certainty**, the wave focusing sand ridge will focus advancing waves to a more certain location on the beach (West, Cowell et al. 2003) (Pitt 2009),
2) **swell magnet**, wave height is likely to be slightly larger (Walker 1974) (Beamsley & Black 2003) (Pitt 2009),
3) **length of ride**, in the lee of the sand feature, waves are more likely to break as peeling peaks (rather than closeouts) and offer a longer length of surfing ride (West, Cowell et al. 2003) (Pitt 2009),
4) **safety**, regardless of wave height, all surfing action will take place over sand.

The sand feature can provide the following benefits for the community;

1.) the submerged sand slug feature will act as a feeder beach and experience a natural shoreward dispersal of sand (DIPNR 2005), this will assist a wider beach,
2.) a salient (beach elbow) will form in the lee of the sand feature, particularly as the feature is dispersed and sand tapped shoreward. The location, will increase beach width at the foundations of the Prince Street seawall and assist in shoreline protection,
3.) locating the sand feature equal distance from North Cronulla SLSC and Elouera SLSC, the sand ridge will draw board riders away from flagged swimming zones, making for clearer demarcation and a safer beach.

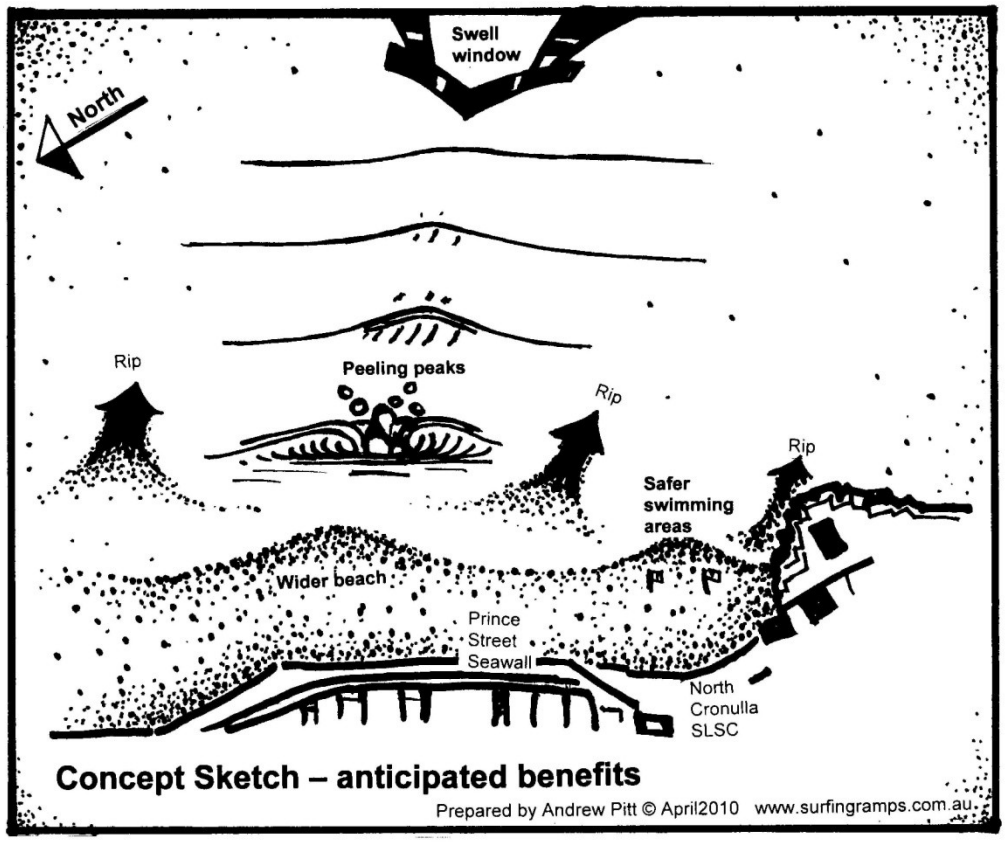

Image 9. Anticipated benefits from a wave focusing sand ridge include; peaks with peeling waves and a wider beach to assist in protecting seawall. More benefits, no extra cost.

4.6 Potential risks and disadvantages of the proposal

The wave focusing sand ridge has the following risks and disadvantages;

1.) short life, there is always a risk the sand feature will rapidly disperse if major storm events occur shortly after the works,
2.) community expectations, there is a risk the community will have high expectations, benefits beyond what a temporary sand bank can provide, this is not Grajagan,
3.) disruption of works, inclement weather may disrupt the placement of sand, leading to an un-finished sand bank, leading to community disappointment,
4.) subtle impact, the sand feature may only provide a small and subtle change to surfing conditions and beach width, discernable only by locals and close monitoring.

Image 10. A close-out, @ Prince Street seawall Cronulla, the length of ride is very short; hence close-outs are not popular with board riders.

5.0 Feedback and future recommendations

The April proposal (Pitt 2010) was well circulated, available as an online pdf, publicised with www.coastalwatch.com and the local paper. The proposal was formally emailled to DECCW, Sutherland Council and selected coastal experts seeking feedback and critique.

Sutherland Council responded, 'Council is open to consider (the) proposal… it that's what the community wants and there is no adverse environmental impacts', (Herring, via email April 2010). Though Paul Tyler, President Elouera Boardriders Club was more direct, '…you have the clubs support for this project… thank you for including locals in the process...' (via email April 2010).

Coastal scientists and coastal engineers contributed excellent recommendations, including;

1.) **Computer modelling**, to test the design and estimate the life of the sand feature, under a variety of wave heights, swell directions and storm scenarios. (Brandi Mortensen, personal email April 2010) and (Couriel, personal email April 2010).
2.) **Monitoring**, pre and post construction of the sand feature and evaluation is important. Dr Andy Short, 'I agree the (proposal) would be a win-win for sand disposal and surf….though you need to quantify your benefits…you should monitor/survey the site and quantify the surf, the best way to verify impact', (personal email April 2010). James Carley, a coastal engineer expanded on the complexities, '…monitoring is a big aspect to consider, both surf quality and beach response. This

> justifies future decisions; repeat, modify,or don't touch the concept again! Surf quality is hard to do objectively… before and after the case would be best, but natural variability may swamp any effects of the (sand feature). Coastal imaging cameras (with analysis) can detect breaking (waves) and rips…. and (may provide) objective measurement (with) a surfer head count', (personal email April 2010).

Bancroft (1999) used a head count method to determine surfable days at Perth's artificial surfing reef. The method was simple; a surfable day was defined as surfers in the water, yes or no, with a score of total days per month. This method could be adapted, expanded and modified for Cronulla. Comparing results from a 9am daily head count of surfers per section of the beach (The Alley, The Wall, Elouera, Wanda), pre and post construction, would be useful.

Other recommendations are contained within existing literature, including, '...the dredging and disposal campaigns...should be .... revised to obtain most benefit from the placed material', from the Bate Bay Coastline Management Plan and Beach Nourishment Strategy (Patterson Britton 2006). Of interest too is, '...Council has the prerogative to adjust the scope of works to suit the available budget' (Sutherland Council 2010).

The Bate Bay Sand Placement Commiittee was established in 2010 to help steer the process and circulate information and suggestions. Committee members are listed on the final page of this paper.

6.0 Conclusion

Sand is removed from Port Hacking navigation channels and relocated to Cronulla Beach for the benefit of boating enthusiasts and beach users. Sub-aqueous sand nourishment projects have an impact on wave breaking patterns. Similar projects in the USA have successfully provided temporary benefits for board riders.

Cronulla is a popular surfing beach. The call for configuration placement of dredge sand is well supported within the community. The Prince Street placement zone template is shaped and aligned to create a wave focusing sand ridge. Inshore of the sand feature, wave breaking patterns will include peeling peaks and longer length of surfing ride.

The submerged sand feature is temporary; it will experience a natural shoreward dispersal and nourish beach width in front of the Prince Street seawall. Computer modeling can fine tune the placement zone template, monitoring pre and post project will identify benefits and disadvantages of the wave focusing sand ridge. The dredging works are due to begin. Cronulla beach is not a dump site; it is a National Surfing Reserve.

7.0 References

Albada, E., Goshow C., Dompe, P., 2007. St Johns County Beach Nourishment: Surfing Aspects. Proceedings from National Conference of Beach Preservation Technology, Fort Lauderdale FL.

Alletson, T., 2006. Duranbah Beach management; preserving surf quality and beach amenity through an artificial sand nourishment program. 15th NSW Coastal Conference, Coffs Harbour.

Bancroft, S.,1999. Performance Monitoring of the Cable Station Artificial Surfing Reef. Honours Thesis, Department of Environmental Engineering, University of Western Australia.

Bate Bay Sand Placement Committee. August 2010, minutes from Committee Meeting

Beamsley, B. & Black, K.,2003. The effect of offshore reefs on inshore surfing conditions. Proceedings from 3rd International Surfing Reef Symposium, Raglan New Zealand.

Black, K., & Mead, S., 2001. Design of the Gold Coast reef for surfing, public amenity and coastal protection; surfing aspects. *Journal of Coastal Research*, issue no 29.
Blacka, Anderson & Lopez,2008. Analysis of shoreline variability, seasonality and erosion/accretion trends. UNSW WRL Technical Report 18. Manly.
Brandi Mortensen, S., 2010. Personal email, DHI Group Qld
Carley,J., 2010. Personal email , coastal engineer, UNSW, Water Research Laboratory
Couriel,E., 2010. Personal email, principal engineer, Manly Hydraulics Laboratory
DIPNR Coastal Unit, Department of Infrastructure Planning and Natural Resources, NSW, 2005. Cronulla Beach (Port Hacking Dredging) Hydrographic Monitoring Survey (Appendix, 2007 REF).
Herring, A., 2010. Via email, Sutherland Shire Council.
Horvath, B., 2010. Good news for southern Sydney surfers. www.coastalwatch.com
Mahon, A., Miller, J. & Herrington, T.. 2009. Assessment of Alternative Beachfill Placement on Surfing Resources. ASBPA National Coastal Conference Program. Florida USA.
Mead, S. & Black,K., 2001. Field studies leading to the bathymetric classification of world class surfing breaks. *Journal of Coastal Research*, issue no 29.
Mead, S., 2010.Science, Models and Reality – Where are we at with MPR's? The 7th International Surfing Reef Symposium, Sydney, NSW
Mesa, C., 1996. Nearshore berm performance at Newport Beach, California USA. Proceedings from International Conference on Coastal Engineering, Orlando FL
Patterson Britton & Partners, 2006. Bate Bay Coastline Management Plan, Beach Nourishment Strategy. Report prepared for Sutherland Shire Council.
Patterson Britton & Partners, 2007. Maintenance dredging of Port Hacking navigation channels including nearshore nourishment of North Cronulla Beach, Review of Environmental Factors. Report for NSW Department of Environment and Climate Change (DECC).
Patterson Britton & Partners, 2010. Maintenance dredging of Port Hacking navigation channels including disposal on the nearshore off the Cronulla Beaches and on the Lilli Pilli Dropover, Review of Environmental Factors. Report for DECC and Sutherland Shire Council.
Pitt, A., 2009. Surfing at Bombora Controlled Beaches. The 5th Western Australia Coastal Conference, Fremantle WA.
Pitt, A., 2010. Proposal for an ephemeral bombora at Cronulla. Report prepared for the Bate Bay Sand Placement Committee, Cronulla, NSW
Short, A.D.,1993. *Beaches of the New South Wales Coast*; a guide to their nature, characteristics, surf and safety. Australian Beach Safety and Management Program.
Short, A.D. 2010. Personal email. University of Sydney.
Surfing Australia, 2009. Annual Report. Coolangatta QLD.
Sutherland Shire Council minutes, 15th March 2010. SAF146-10, File Number: EM/09/908610, 2009/2010 Waterway Program Dredging of Port Hacking Navigation Channels.
www.surfingreserves.org 2010. Cronulla National Surfing Reserve.
Tyler, P., 2010. Personal email, President Elouera Boardriders Club
Walker, J.R.,1974. Recreational surf parameters. Look Laboratory Report TR-30, Department of Ocean Engineering, University of Hawaii, Honolulu.
West, A., Cowell, P., Battjes, J., Stive, M., Doorn, N., Roelvink, J., 2003. Wave-focusing surfing reefs; a new concept. Proceedings from the 3rd International Surfing Reef Symposium, Raglan NZ.
Withycombe, G., Walker, J., Nielsen, L., Pinzone, T. and Morrison, C., 2009. Scoping Study for Extraction of Offshore Sands for Beach Nourishment; Outcomes, Lessons Learnt and Ways Forward. 18th NSW Coastal Conference.

8.0 Bate Bay Sand Placement Committee

Chair – John Veage, Secretary – Andrew Pitt, Brad Whittaker - Cronulla Beach Manager, Ben Horvath – coastalwatch.com, Mark DePena – Cronulla.

9.0 Author Biography - Andrew Pitt

Andrew Pitt studied Landscape Architecture at the University of New South Wales (UNSW) and *Surfing Reefs: the role of bathymetry* postgraduate research supervised by Professor Short at Sydney University. Andrew served as president UNSW Surfriders Club and was event founder and director of the 1st International Surfing Reef Symposium 1997 and the 7th in 2010. Andrew is the principal of Surfing Ramps consultancy.