NSW Police Force

EXPERT CERTIFICATE COVER PAGE

Expert Personal Details	
Title:	Dr
Family Name:	BRANDER
Given Names:	Robert Williams
Date of Birth:	[redacted]
Place of Birth:	Ajax, Ontario
Country:	Canada
Gender:	Male
CNI Number:	

Expert Home Details	
Home Address:	[redacted]
Suburb/Town:	[redacted]
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State:	[redacted]
Post Code:	[redacted]
Country :	
Home Telephone:	
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E-mail Address:	[redacted]

Expert Work Details	
Occupation:	University lecturer
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Branch/Section:	
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City:	Sydney
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E-mail Address:	

Statement Details	
Time Statement Taken:	
Date Statement Taken:	31 January 2017
In the matter of:	Death of Ross Bradley WARREN- 1989
Place Statement Taken:	Helensburgh Police Station

NSW Police Force

EXPERT CERTIFICATE

Section 177, Evidence Act 1995 No. 25

In the matter of : Death of	Death of Ross Bradley WARREN- 1989
Place Statement Taken:	Helensburgh Police Station
Date:	31 January 2017

Name:	Dr Robert Williams BRANDER
Work Address:	School of Biological Earth and Environmental Sciences Kensington NSW 2052
Work Telephone	[redacted]
Occupation:	University lecturer

STATES:

1. This statement made by me accurately sets out the evidence that I would be prepared, if necessary, to give in court as a witness. The statement is true to the best of my knowledge and belief and I make it knowing that, if it is tendered in evidence, I will be liable to prosecution if I have wilfully stated in it anything that I know to be false, or do not believe to be true.

   I acknowledge that I:

   (i) have read the Expert Witness Code of Conduct in Schedule 7 of the NSW Uniform Civil Procedure Rules 2005, and,

   (ii) agree to be bound by the Code.

2. I am 51 years of age.

3. I hereby certify, I am a Coastal Scientist and Geomorphologist. I have a specialised knowledge based on the following training, study and experience as a Geomorphologist for the past 32 years. I hold the following qualifications:

Qualification :

Bachelor of Science (1989), Masters of Science (1991), Ph. D (1997). All these qualifications relate to the field of Coastal Geomorphology, with emphasis on waves, currents and sand movement.

Other Study/Experience: I have also written a significant number of peer-reviewed articles; and books including 'Dr. Rip's Essential Beach Book' (2010); in relation to Coastal Geomorphology.

Witness: [redacted] Signature: _____

Robert Williams BRANDER

4. I have made two previous statements to police in relation to this matter. The first was a four-page signed statement dated 01 August 2001. My further statement in relation to this matter was a two-page signed statement dated 11 April 2002, annexed to a further six-page document titled **'Summary of wave and current conditions for Bondi/Tamarama headlands for the period July 21 – August 20, 1989 and November 22 – 24, 1989'.** That document was dated 05 April 2002.

5. Based wholly or substantially on the above knowledge, I wish to clarify the following queries raised by Police in relation to my earlier statements and report, and I am of the opinion that:-

6. Why rip systems from Palm Beach to Eastern Suburbs are similar?

Rip currents are primarily a function of the offshore wave climate (wave characteristics) and the nearshore morphology of the beach system, including grain size of the sand sediments. The offshore wave climate of the greater Sydney region, and indeed, much of the NSW Coast is similar and well understood *(see Short and Trenaman, 1994).* The stretch of coast from Palm Beach to the Sydney Eastern suburbs is subjected to the same wave conditions (wave height, period, direction as well as storm events) although there are some modifications as the waves travel offshore to the nearshore, due to refraction processes caused by headlands.

Similarly, the sand grain size of these beach systems is similar and the beaches exhibit the same type of nearshore bar characteristics and behaviour as they are known as intermediate beaches (Short, 2007). As such, they behave in a similar fashion and often have well developed rip current systems. Most of the rips along the open sections of beaches are what are known as fixed rip currents as they are channelised and relatively persistent in location and there are also well established rip currents adjacent to many headlands that are known as topographic rip currents. These are often relatively permanent features. The flow behaviour of these rip current systems are similar between Palm Beach and the Eastern suburbs. A recent scientific review of rip current types and circulation patterns is provided by Castelle et al. (2016).

Castelle, B., Scott, T., Brander, R., McCarroll, R. (2016). Rip current types, circulation and hazard. Earth-Science Reviews, 163:1-21).
Short, A.D. (2007). Australian beach systems – nature and distribution. Journal of Coastal Research, 22(1):11-27.
Short, A.D. and Trenaman, N.L. (1994). Wave climate of the Sydney region, an energetic and highly variable ocean wave regime. Australian Journal of Marine and Freshwater Research, 43(4):765-791.

7. Comment on Rock shelf – specifically during the tide rise:

- ***Is it walkable?***

Witness: [redacted] Signature:

Robert Williams BRANDER

- ***Would access to the sea level rock shelf be submerged during a spring tide/high tide?***

Rock shelves, or rock platforms, typically have a relatively flat surface known as the 'level of saturation' that is equivalent to the approximate water level of mean sea level. At low tide, they are often completely emerged and absent of breaking wave activity (except during larger wave events). As the tide rises, the seaward edge, or rampart, of the rock shelf/platform is overtopped and the rock shelf becomes increasingly inundated by water as well as wave breaking that can result in surges of water landward across the shelf. There can also be instances of water draining, or being reflected back offshore across the rock platforms.

This process continues with water levels becoming deeper and inundation and wave action reaching further landward until culminating at high tide. At high tides, and particularly during spring high tides, these platforms can be completely inundated by water. Therefore, while these rock shelves are walkable at low tide, they become increasingly difficult to traverse during a rising tide and are generally not walkable at high tide without extreme risk due to inundation and wave action.

The rock shelves near sea level in the vicinity of the headland extending from Bondi around to McKenzie's Bay/Tamarama beach to the south are both narrow and discontinuous and do not offer many flat areas. As such they are not easily walkable as they are consistently exposed to wave action, particularly at high tide. Walking over these rock platforms would be hazardous due to slippery surfaces, wave exposure and would involve scrambling over boulders and uneven surfaces. The exception is the rock shelf between McKenzie's and Tamarama Beach which is wide, flat and easily accessible.

However, the region between McKenzies and the Marks Park Headland are characterized by some raised sandstone platforms. These are easily accessible to people from the main public walkway who can scramble down and continue walking along these narrow platforms (at some elevation) towards the north and end of the headland. It's not necessarily easy, and the width of the walking area can vary from 1-2 m's, but it can be done. There are overhangs and caves that (from my experience living in the area) are often used for fires and sometimes homeless people. These platforms would not be exposed to wave activity unless during extreme storm events (6 m + wave heights).

I have been shown on Feb 15 2017 a video of a police walkthrough of the area with a witness who claims to have found a set of keys in the vicinity of the rock ledges under the Marks Park public pathway. Without

commenting on the plausibility of the key discovery, it would be possible to access and walk in that area, particularly at low tide.

8. Are you able to provide a modern day (3D) example of the water movement to and from the shore

The following two videos from YouTube show a 3-D animation of waves shoaling and breaking as they approach a sandy shoreline. I was not able to find an animation of wave approaching a rock platform:

https://www.youtube.com/watch?v=erpBoRVFt8A (short)

https://www.youtube.com/watch?v=7dVoDpEO_u4 (long)

Idealised nearshore cell circulation and rip current flow is depicted in Figure 1 showing the formation of rip currents. What this image does not show is the presence of bed return flow, which is a relatively gentle offshore flow which exists close to the bottom bed and is ubiquitous across regions of breaking waves (shoreline, sandbars).

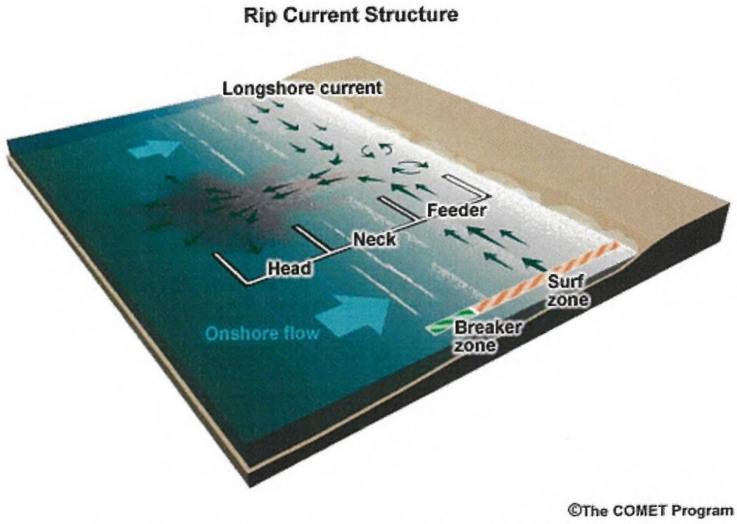

Figure 1. *Idealised schematic diagram of nearshore cell circulation including onshore flow due to breaking waves, alongshore flow in the form of feeder currents and offshore flow in the form of rip currents (source: The Comet Program).*

The following two YouTube videos provide real footage of waves breaking across rock platforms in relation to the rock fishing hazard along the NSW coast. It is a good illustration of the way that waves can inundate and travel across rocky shores:

Witness: [redacted] Signature: _____

Robert Williams BRANDER

https://www.youtube.com/watch?v=NKOOtlj6KBs

https://www.youtube.com/watch?v=8Z011UeRkUo

9. Would a submerged body become lodged on or beneath the rock shelf?

Sand levels immediately seaward of rock shelves constantly adjust to changing wave conditions. During large storms, sand is dominantly removed offshore and the sand level is lowered. During these conditions various irregular topography including subaqueous caves and notches can be exposed. During these times it would be possible for a submerged body to become lodged between exposed rocks and notches beneath the water surface.

It is also possible that wave action and associated processes of reflection and turbulence can lift a submerged body onto the surface of the rock shelf, particularly during a rising tide and energetic wave conditions. As the tide rises, water levels over the rock shelf become deeper and wave action increasingly extends landward across the platform. A body could be swept along the surface of the rock platform and become wedged or lodged in any cracks or crevasses or between boulders.

During extended periods of smaller waves, sand on the seabed tends to be transported landwards and the sand level rises, which can cover and fill in uneven rock topography below sea level. In the case of McKenzie's Bay, this can sometimes result in the formation of an ephemeral beach as the small embayment acts as a trap for sand (see Figure 2). However, it is difficult to determine historical time periods of the presence and absence of McKenzie's beach due to lack of documentation. Of note, the rock shelf from the southern side of the Marks Park headland around to the northern side is never completely covered in sand due to constant exposure to wave action and turbulence.

Figure 2. *McKenzie's Beach with sand (December 1997) and without sand (April 1998). Photos R. Brander*

10. Would a body become lodged on the shore platform and not be reflected out to sea?

It's difficult to comment on this as it would depend of course on the degree to which a body is wedged or lodged. Wave action and reflection is very effective at moving any object back out to sea, but again it depends on how well a body was caught/wedged. But it is certainly possible for a body to become wedged and not be reflected back out to sea.

11. Would this impact a body being swept out to sea?

In regards to the bottom topography around South Bondi Headland and McKenzie's Bay restricting a body being swept out to sea – the configuration of the topography, including isolated boulders would not restrict the offshore movement of water by wave action or currents. However it is possible that an object such as a body could get snagged in the topography (caves, notches etc.).

12. Can Dr BRANDER comment on other bodies located, one found submerged near Dover Heights on 23 July 1989 and the body of Kritchikorn RATTANAJURATHAPORN, found in the water off Mackenzies Point on 22 July 1990; why is it that these bodies were located and that of WARREN wasn't?

It is difficult to comment on this given the randomness of such events. Where a body in the water in these locations may travel and end up is dependent on considerable variability that may exist due to different wave direction, wave height, time of tide and the natural variability of the rock topography. These conditions can vary greatly over periods of even hours and can therefore affect drift directions over the same time frame. Conditions may vary spatially on the order of metres due to the rock topography variability. However, in my opinion it would be very unlikely for a body off of Marks Park to end up at the location at Dover Heights. This is due to the fact that wave energy is focused on the headland at Marks Park

and would tend to push water either into the Bondi embayment or the Mackenzies/Tamarama embayment.

13. Who supplied you with the Wave measurement Data, Synoptic charts, tidal data and synoptic observations?

It's difficult to remember, but I suspect it was from Sgt Graham Nicholas of the Rose Bay Area Command. I imagine he would have sourced wave measurements from the Manly Hydraulics Laboratory who maintain a network of offshore wave rider buoys along the NSW coast. The present contact name at MHL (who has been there a long time) is Mark Kulmar.

14. What is this based on? Does this consider the rock shelf and the possibility the body would be lodged? (Previous statement you indicated the rock shelf runs approximately 50 metres off shore)

My statement is in response to 'a body in the water off the shore platforms, or on the bed' moving landward over the time frames and climatic conditions during the period following the incident. This was based on several factors: i) the wind conditions at the time would promote an offshore drift of water for any object floating on the surface; ii) the general pattern of current direction at the bed would be in the offshore position; iii) the processes of turbulence and reflection just seaward of the edge of the rock platform (caused by the interaction of incoming waves and the rock platform) can make it difficult for any floating object to be transported onshore onto the rock shelf/platform.

None of these statements consider the width of the rock shelf – the main issue is how the body would get back onto the rock shelf. However, this was my opinion only and I cannot be 100% sure that a body would in fact end up on the rock shelf in these conditions. If this did occur, then it would be possible for the body to get lodged on the rock shelf, particularly near the landward end where rocks are more common.

<u>Response to Queries regarding 5/4/2002 Report – Summary of wave and current conditions for Bondi/Tamarama headlands</u>

15. Is Dr. BRANDER able to do a report on his own research – material he obtains not something Police have provided him with.

Subsequent to the reports and statements I made in 2002, I have done many releases of purple dye into the rip currents at Tamarama Beach as part of my community education talks. While these releases do not

apply to circulation patterns directly around Marks Park, they do provide information about circulation patterns at Tamarama Beach. However, based on past dye releases and my own experience living and recreating at Tamarama Beach, the rip current flow patterns are extremely variable and are largely a function of the nearshore sand bar patterns, which are also variable. Examples of different rip current dye releases at Tamarama showing different flow patterns are shown in Figure 3.

Figure 3. *Examples of purple dye releases in rip currents at Tamarama Beach showing variable circulation patterns.*

In 2012, I was involved in research at Bondi Beach using floating drifters with attached GPS to monitor the circulation patterns within the beach. We measured flow patterns across the entire beach and inner embayment for a period of a tidal cycle. Flow patterns for one experiment are shown in Figure 4. In general it was found the flow of water with the Bondi embayment was largely restricted to the surf zone (area of breaking waves) with some flows extending offshore towards the middle of the beach. None of our measurements show flow extending out to the Marks Park Headland.

It would be useful to obtain archival information about the presence/absence of a beach at McKenzie's as this would give clues as to whether there was an abundance, or lack, of sand in the area at the time. However, sourcing this information is difficult and would require a detailed search of newspaper articles at the time, Waverley Council archives and/or an appeal to people who lived in the area at the time to see if they have any pictures of McKenzie's/Tamarama during this time.

From August 2000 to June 2004, I conducted monthly surveys of Tamarama Beach to monitor how the shoreline responded over time. During this time, the shoreline position at Tamarama Beach varied by approximately 100 m, quite a significant amount. However, these fluctuations were not linked to the appearance/disappearance of sand at McKenzie's Bay.

Witness: [redacted] Signature: _____

Robert Williams BRANDER

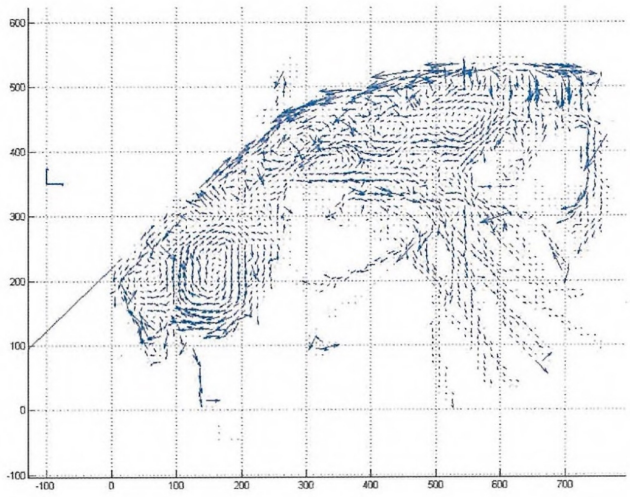

Figure 4. *Flow circulation patterns on Bondi Beach on 6/8/2012. This overhead view shows arrows relating to flow patterns. The beach runs from left to right along the boundary of the arrows and offshore is towards the bottom of the diagram.*

However, there is a general relationship that periods of extend El Nino conditions tend to be associated with a lack of storm waves and overall onshore sand transport resulting in wider beaches with more sand. During periods of La Nina, there are more storms and a tendency for offshore sand transport which would reduce beach volumes. Figure 5 shows the SOI index where +ve values (blue) indicate La Nina periods and –ve values (yellow) are El Nino periods. It is apparent that in the lead up to 1989, there as an extended period of predominantly El Nino conditions (almost 6 years), but that 1989 was a distinct El Nino event. It would therefore be expected that the sand volumes on Tamarama-McKenzie's-Bondi would be less than normal and it is unlikely that a beach would have been present at McKenzie's in July 1989. The La Nina phase presumably would result in lowering of the sand profile immediately offshore of the rock platforms and may have exposed underwater rock topography in the form of notches and caves (albeit still underwater).

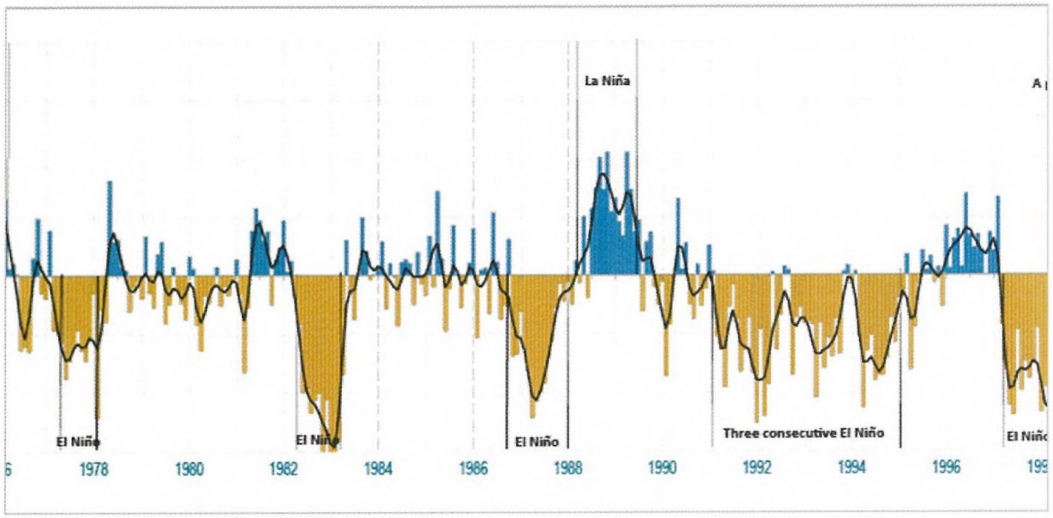

Figure 5. *El Nino (yellow shading) and La Nina (blue shading) periods between 1978 and 1996. July 1989 was in the middle of a La Nina period with more storms (Source: BOM).*

16. Waves - In his report he states he was unable to access the data provided, how was he able to comment on this area

Although the data provided to me was incomplete, I was able to make statements about wave conditions based on educated guesses from interpreting synoptic charts and from previous experience living and surfing around Tamarama as well as a scientific understanding of the wave climate of the NSW coast.

The Manly Hydraulics Laboratory operates a network of offshore wave rider buoys. I requested offshore wave data for the period May 1 to August 31, 1989 from the Sydney Buoy and received this information from Mark Kulmar on 15/12/2016. The Sydney Buoy is located approximately 10 km offshore of Dee Why Beach in Sydney where the water depth is approximately 85 m. As such, the Buoy is only representative of offshore wave conditions. However, it is the standard used for all studies involving waves in the Sydney region. I requested all data during this period relating to significant wave height (H_s), which is the average of the highest 1/3 of waves, and the wave period (T_p) which is the time between wave crests. Unfortunately the Sydney directional buoy was not deployed until March 1992 so no directional data is available for this period. Figure 6 shows a time series of significant wave height between May and August, 1989 with the period July 21 - August 20 highlighted.

Witness: [redacted] Signature:

Robert Williams BRANDER

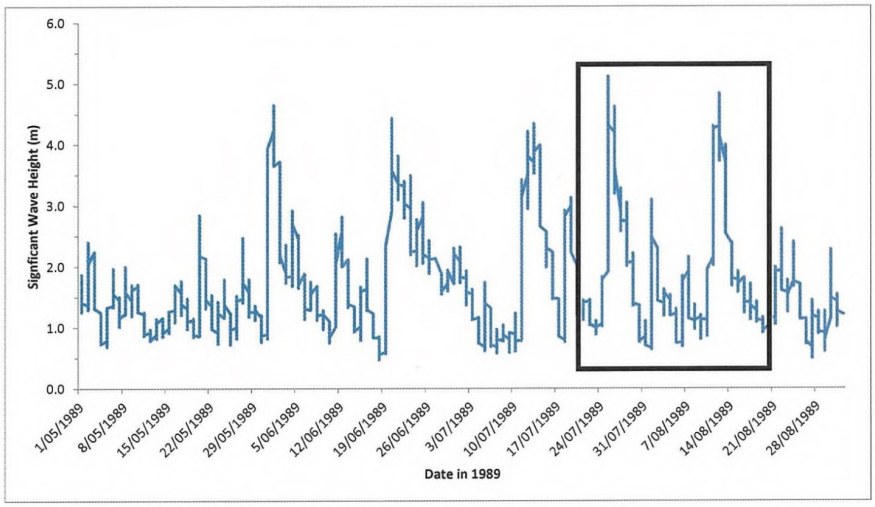

Figure 6. *Time series of offshore Sydney Wave Buoy significant wave height data from May 1, 1989 to August 31, 1989. Black box highlights the period July 21 – August 20, 1989 (date courtesy of Manly Hydraulics Laboratory).*

I wanted to look at wave data starting from May to see what the antecedent wave conditions were like as these will help understand the frequency of occurrence of large wave events which would impact on the sand volumes in the region. The wave characteristics appear typical of a La Nina phase whereby a distinct storm season exists between May-August. This is evident from 5 large storm events during this period with offshore significant wave heights in excess of 4 m. The frequency of these events would suggest that sand volumes along the South Bondi-Marks Park-McKenzie's-Tamarama region would be low due to enhanced offshore sand transport.

In terms of the highlighted period between July 21 and August 20, small waves (< 1.0 m) occurred from July 21 to July 24 followed by a large wave event beginning on July 25. Large waves continued for several days before becoming quite small again around July 31. A period of moderate wave energy existed for the first 7-10 days of August until another large storm wave event occurred on August 12/13 which lasted for several days before decreasing again.

Witness: [redacted] Signature:

Robert Williams BRANDER

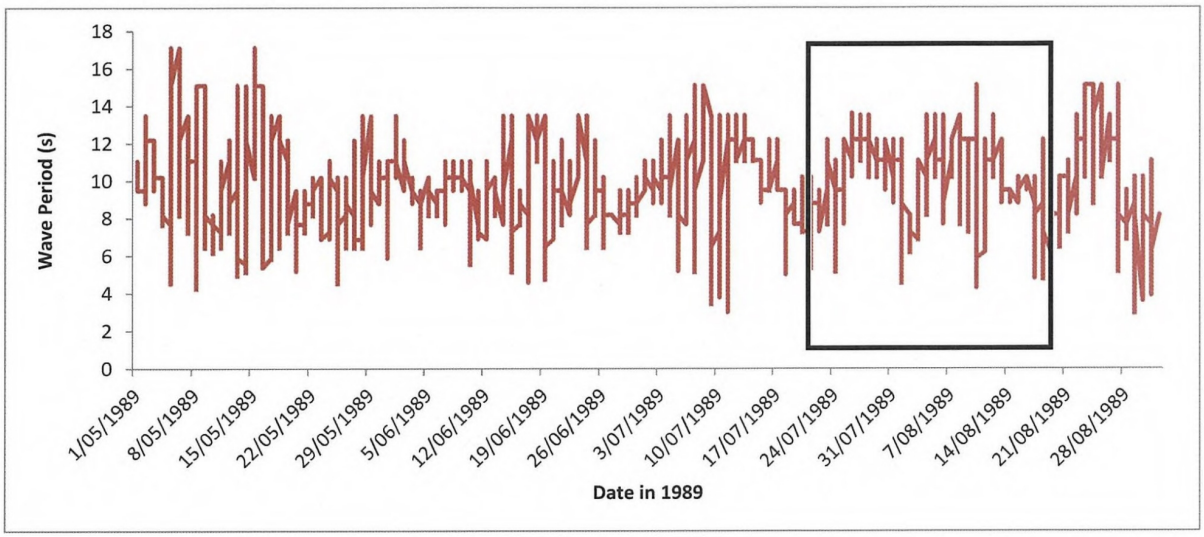

Figure 7. *Time series of offshore Sydney Wave Buoy wave period data from May 1, 1989 to August 31, 1989. Black box highlights the period July 21 – August 20, 1989 (date courtesy of Manly Hydraulics Laboratory).*

In terms of wave period (Figure 7), there is nothing particularly unusual about the wave periods (the long term average is about 8 s), however during the highlighted period between July 21 to August 20, the wave period was longer than average (often 10-12 s). Longer period waves tend to be associated with longer offshore drift associated with the passage of wave troughs. This would also seem to promote offshore transport of any object at the seabed.

Aside from this offshore wave information, it would be useful to see if any Waverley Council lifeguard records are available, as they often record wave conditions. If Bondi Beach was patrolled year round by lifeguards at that time, then records should be with Waverley Council. However, as July was winter, Surf Life Saving Clubs would not have been on patrol and no information can be gained from them.

17. Is Dr. BRANDER able to provide colour satellite images of the area (circa July 1989)

I have contacted Mr David Hanslow from the Office of Environment and Heritage (OEH) who is based in Newcastle, NSW and is in charge of existing archived aerial photographs of the NSW Coast. He has sent me copies of the only available aerial photographs of the area around this time (see Figures 8,9). The closest (Figure 8) is taken just over 1 month (Sept 9, 1989) after the incident occurred at Marks Park Headland.

Based on my own experience of surveying Tamarama Beach on a monthly basis from August 2000 to June 2004 and from my own experience living in the area from 1993 to 2005, Tamarama Beach shows a typical

shoreline position and sand volume and McKenzie's Bay is absent of sand, which is the most common situation. Similar conditions are observed a year later in August 1990. I was not able to obtain any satellite images of this coastline for this period and am not sure if any are available.

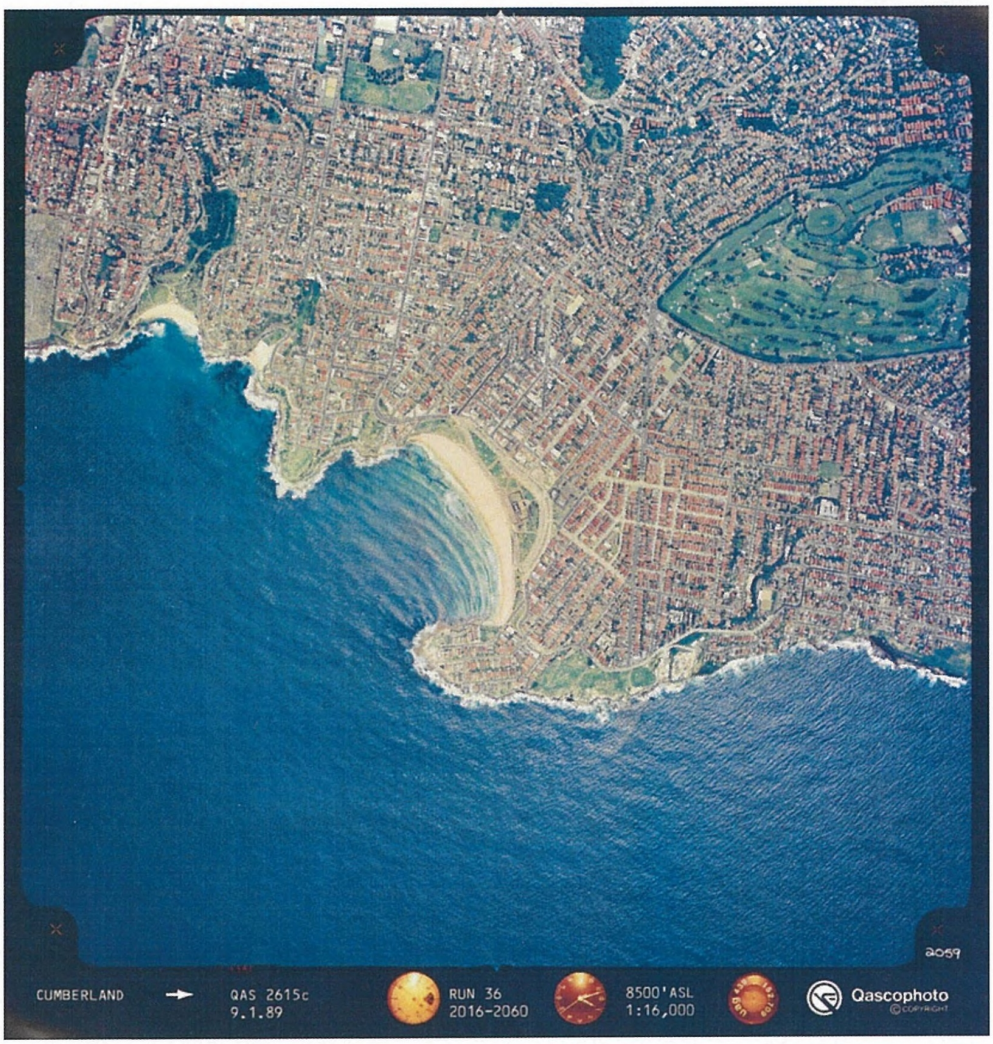

Figure 8. *Aerial photograph of Bondi-McKenzie's-Tamarama coastal region taken on Sept 9, 1989 (source: Office of Environment and Heritage).*

Witness: [redacted]

Signature: _____

Robert Williams BRANDER

Figure 9. Aerial photographs of Bondi-McKenzie's-Tamarama coastal region taken on August 19, 1990 (source: Office of Environment and Heritage).

Witness: [redacted] Signature: _____

Steven MORGAN
Detective Sergeant
Homicide Squad
15 February 2017

Witness: _____ Signature: _____

Robert Williams BRANDER