NSW Police Service
Rose Bay Local Area Command
ATTN: SGT. Graeme Nicholas
34 Jersey Road
Paddington, NSW 2021

RE: Summary of wave and current conditions for Bondi/Tamarama Headlands for the period July21 – August 20, 1989 and November 22 – 24, 1989

5/4/02

Dear Sgt. Nicholas,

I have examined all of the information you have provided regarding reconstructing potential nearshore currents in the vicinity of the Bondi/Tamarama headland for the periods July 21 – August 20, 1989 and November 22 – 24, 1989 and have included my summary of conditions. Please bear in mind that without specific wave data of the local area, it is impossible to completely surmise actual conditions at that location. It is also extremely difficult to determine and predict currents in the vicinity of headlands in general. However, after careful consideration of available wave, tide, wind and synoptic weather data, I feel that I can provide you with an accurate description of likely conditions present during the times of interest.

I have included a brief summary of the available data followed by an overall description of the area in question and finally, a summary of potential current and drift directions under a number of environmental conditions.

1) SUMMARY OF ENVIRONMENTAL DATA

Rainfall

Rainfall records are limited in extent and only show minor rainfall at Rose Bay (1.5 mm) for July 20 and approximately 2 mm of rain on July 24. The main impact that rainfall would have on the nearshore waters would be a reduction in visibility associated with storm runoff. To my knowledge there are no major storm drains in MacKenzies Bay or on the north side of Marks Park. Discharges from storm drains may cause a very localised current in the direction of outflow, but only during major discharges. Such discharges would require much greater and intense rainfalls than those described above. The effect on currents during the time in question would therefore be negligible.

Wind

Airport Winds:

July 21-July 24 : light and variable winds from the west
July 25-July 26 : strong southerly
July 27-July 29 : light northerly winds
July 29: moderate northerlies

July 30- Aug 1: moderate NW winds
Aug. 1 – Aug 4 : light northerlies
Aug. 5 – Aug. 10: light to moderate NW winds
Aug. 10 – Aug. 13 : moderate southerlies
Aug. 13 – Aug. 22 : light and variable easterly winds

Nov 22 – Nov. 25: Light to moderate NE winds in late afternoons

Sydney Observatory Hill Winds:

July 21 – July 24 : light westerly winds
July 25 – July 26: light southerly winds
July 27 – July 28 : light westerly
July 28 – July 31: light north-westerlies
July 31 – Aug. 1 : moderate westerlies
Aug 1 – Aug 5 : light and variable westerlies
Aug 5 – Aug 8 : moderate westerlies
Aug 9 – Aug. 13: variable light to moderate southwesterlies
Aug 14 – Aug. 22: light and varialbe westerlies/easterlies

Nov 22 – Nov 25: light to moderate easterlies

The period in question was primarily characterised by relatively light winds primarily from the west. Westerly winds are offshore at the coast, and would promote the offshore drift of any floating surface object, regardless of their strength. Extended periods of offshore winds may also induce localised surface upwelling, where water is brought up to the surface from depth (and causing a reduction in surface water temperature). This may have occurred to a limited extent during the periods in question.

Waves on this section of coastline are primarily generated by S and SE winds. Given the strong southerly winds from July 25-26, it is highly likely that large waves were present on the coast at this time.

Tides

The period of July 21-24 coincides with spring tides with tide ranges of approximately 1.5 m. Spring tides are always associated with stronger tidal currents which may act to alternatively enhance both onshore and offshore transport. This period was followed by neap tides and then spring tides again on Aug 1-3. In general, however, on micro-tidal coasts, such as Sydney's, tidal currents are considered negligible.

Waves

Unfortunately I cannot access the data provided to me on disk with my software. The wave data provided for July 21-22 indicates that offshore wave heights were on the order of 1.58 m which represents average conditions for the Sydney coast. The wave data does not include direction.

Synoptics

The prevailing wind and wave directions for the Sydney coast is from the south-east. These are typically associated with the semi-regular passage of mid-latitude cyclones across the southern Tasman Sea. The coast is also affected by east coast cyclones which will also produce predominantly E, SE waves. From the synoptics, it is apparent that SE waves were present for much of the time. In particular, lows would have generated larger SE swell during the periods July 24-26, July 31-Aug 4, Aug 6 – 7, Aug 11- 12, and Aug 22-23. There is also a low off the northern coast of NSW that would have produced NE waves from Aug 19-21. It therefore appears that consistent and moderate-energy SE wave conditions were likely present during the month following July 21.

The period of November 22 – 24 was characterised by a pronounced high pressure system over much of the Tasman. Wave conditions would likely have been relatively calm.

2) DESCRIPTION OF THE PHYSICAL SETTING AND NEARSHORE PROCESSES OF THE BONDI/TAMARAMA HEADLAND

Headlands are a natural focus for wave energy due to patterns of wave refraction. Higher waves break on the seaward extremity of the headland with lower waves breaking in the more sheltered lee/sides of the headland. This typically produces a net drift along the sides of the headland towards the beach. However, in the case of the Bondi/Tamarama headland, this scenario is complicated by the fact that MacKenzies Bay does not usually have a beach present and has an additional headland between it and Tamarama Beach. Therefore, such a scenario as described above likely does not apply. Similarly, on the north side of Marks Park, there is another headland outcrop near the Bondi Icebergs, which would create additional focussing of wave energy. Therefore, it is unlikely that there would be a natural onshore drift from the headland to the beach on either side of the Bondi/Tamarama headland. This is simply a fundamental control due to the geological configuration of the headland topography itself.

The headland(s) in question are also fronted by shore platforms. The region immediately seaward of shore platforms is extremely energetic and turbulent, even under fair weather wind and wave conditions. This is largely due to the fact that shore platforms are characterised by wave breaking and wave reflection. When waves are reflected seaward from the platform, they interact with the incoming waves to produce an area of intense turbulence. This is one reason why it is often difficult for swimmers and rock-fisherman to swim back onto the platform after having fallen off. Under large wave conditions, this becomes almost impossible. This area of turbulence does not necessarily move objects in a net direction parallel to the shore platform. However, it can induce a general drift perpendicular to the platform, which in most cases is offshore. It may also act to keep drifting objects in suspension for extended periods of time due to greater turbulence, whereupon they can be acted on by any other net currents in the area.

Rip currents are another factor of importance. Although more common off of sandy beaches, Mackenzies Bay is quite commonly characterised by an offshore flowing rip, even under average wave energy conditions. This is largely due to the fact that it is a small embayment and is not protected from waves from the SE. Water entering the bay from the SE has nowhere to go and is deflected along the southern side of the Marks Park headland. Predominant flow is therefore offshore. The northern side is slightly different. It is largely protected from SE swell waves and is more exposed to NE waves. The latter would likely push water towards the Bondi Icebergs. This drift will likely not reach the beach, however, because there is a permanent natural rip a the southern end of Bondi Beach which would carry water and objects back offshore.

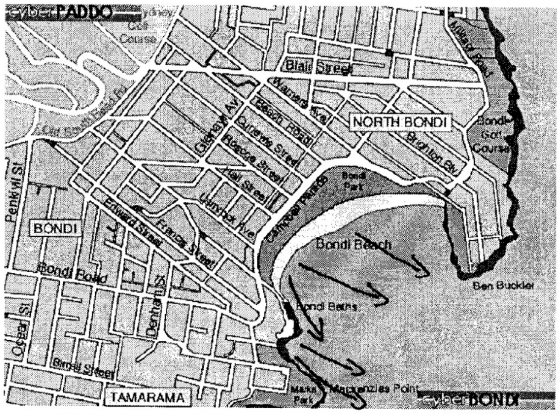
3) SUMMARY OF NEARSHORE CURRENTS IN THE BONDI/TAMARAMA AREA FOR THE PERIODS IN QUESTION

In summary, my opinion is that the dominant drift direction around the Bondi/Tamarama Headland is **offshore**. This is promoted by : i) offshore westerly winds; ii) rip currents on the south side of the headland caused by SE waves; and iii) a strong rip at the southern end of Bondi Beach. Given that turbulence in the immediate offshore vicinity of shore platforms would likely keep an object in suspension or locally mobile, all of the above drift mechanisms would lead to offshore transport. In my opinion it is highly unlikely that any body in the water off the shore platforms, or on the bed, would move landward in this region.

The following figures provide general patterns of drift direction for the various environmental conditions that were present during the periods of time in question.

Figure 1: Drift directions during conditions of offshore winds (westerlies) for: a) the north side of Marks Park headland; and b) the south side. Arrows indicate drift directions.

a)



b)

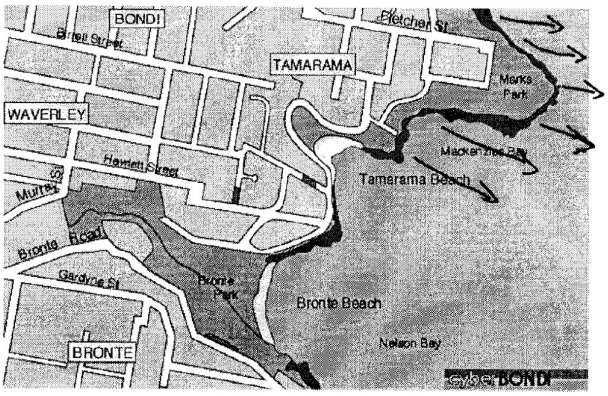
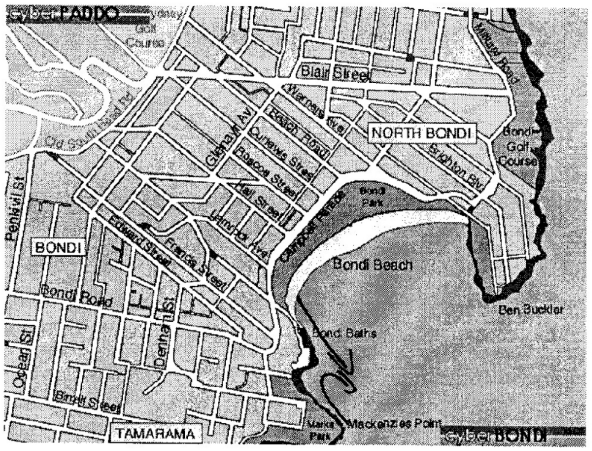


Figure 2. Drift directions during conditions of SE waves for: a) the north side of Marks Park headland; and b) the south side. Arrows indicate drift directions.

a)



b)

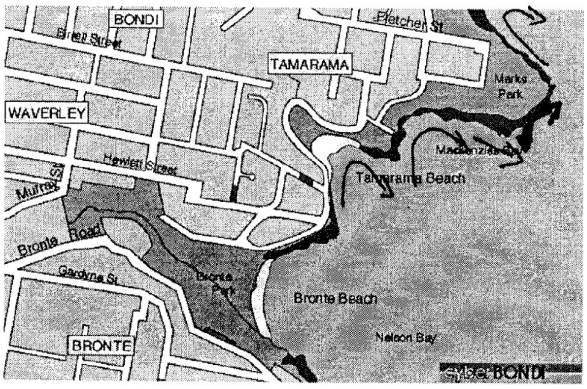
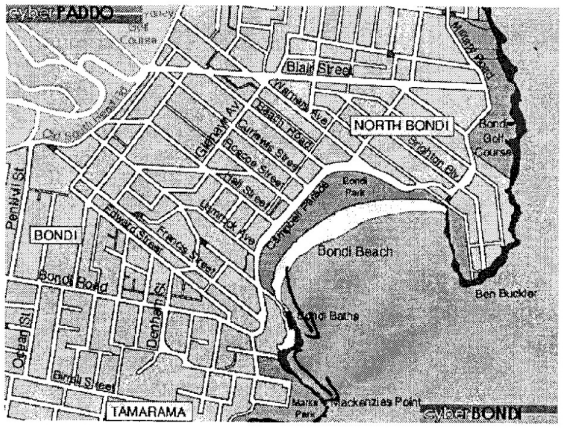
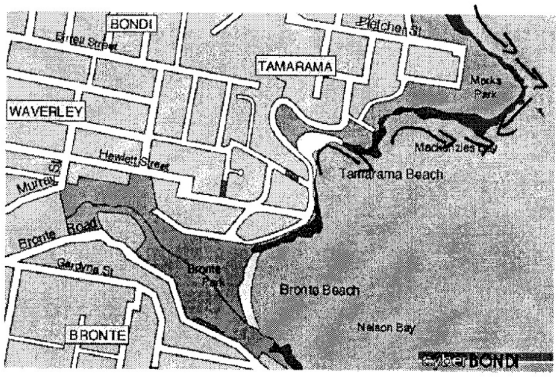


Figure 3. Drift directions during conditions of NE waves for: a) the north side of Marks Park headland; and b) the south side. Arrows indicate drift directions.

a)



b)



Please note that the larger the wave and wind energy, the stronger these drift currents will be, but the patterns and direction will be the same.

Please contact me if you require further clarification.

Yours Sincerely,

Dr. Rob Brander
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