Figure 32: Remains of the singular waler on the eastern side of the wharf remains. Scale in 200 mm increments. (Photograph: Cosmos Archaeology).

Figure 33: Location of drilled holes for the location of bolts (no longer present). Scale in 200 mm increments (Photograph: Cosmos Archaeology).

Approximately 5 m to the east of these structural remains another singular wale beam protrudes from the riverbank (see Figure 31). Only a small section of this timber still remains with no other timbers located around it.

To the east of these structural remains is a single pile. The pile was located close to shore, and was difficult to access. The pile is 0.3 m in diameter and stands approximately 1 m tall from the riverbed.

A section of a former retaining wall was also visible in the riverbank. The retaining wall is located approximately 20 m to the west of the existing wharf at the eastern end of the study area, and approximately 15 m to the east of the extant above water wharf remains (Figure 24). The retaining wall consisted of two iron girders 2 m apart with two timber cross pieces (Figure 34). The “I” shaped iron girders stand 1.5 m above the riverbank, and are 0.20 m wide (Figure 35). The two timber cross pieces are approximately 2.5 m long x 0.30 m wide and 0.11 m thick, and are spaced close together. Material behind the wall consists of dressed sandstone blocks, bricks and broken up concrete deposited up the riverbank. A concrete cap has been placed over the top of the fill at one stage, possibly to create a surface or to contain the backfilled material (Figure 36).

Figure 34: Remains of the retaining wall to the east of the above water wharf remains. Scale in 200 mm increments (Photograph: Cosmos Archaeology).

Figure 35: Iron girder that forms part of the retaining wall present on the riverbank. Scale in 200 mm increments (Photograph: Cosmos Archaeology).

Figure 36: Example of the fill present behind the retaining wall. Scale in 200 mm increments (Photograph: Cosmos Archaeology).

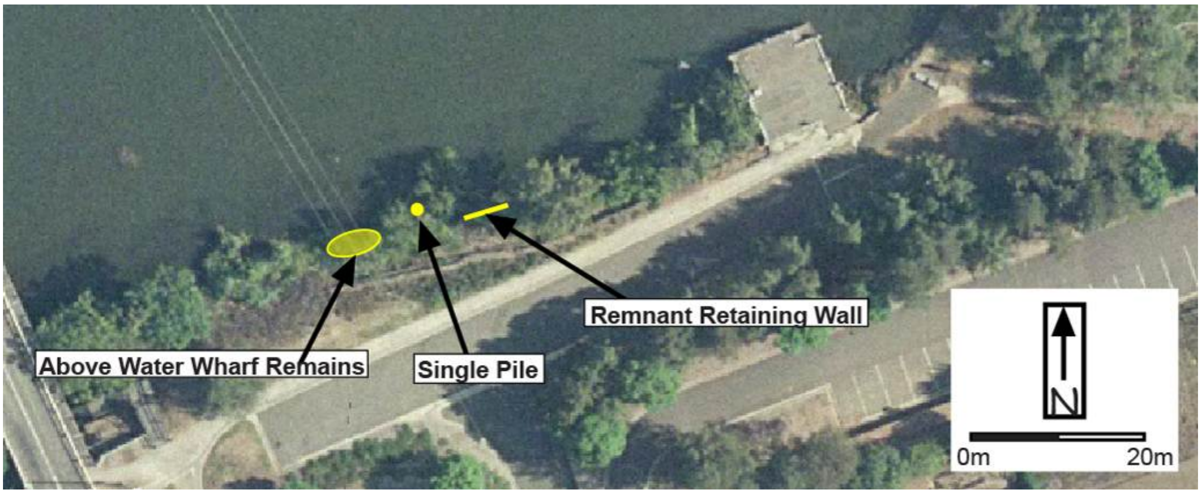

Figure 37: Location of former wharf remains identified from the above water survey.

A brief examination was made on the northern bank adjacent and downstream of the bridge for any evidence of the punt site. Though there was evidence of a cutting, it angles towards the water ending at the base of the bridge abutment. This suggests that the cutting may have been made during the building of the bridge to assist in its construction. Thick vegetation precluded any detailed examination of the area.

Below the low water line limited structural remains or other relics were recorded; however, rock ballast was present in a very defined location. The recording of very few timber remains or other relic remains on the riverbed could not be attributed to the general survivability of this material underwater, but was attributed to poor water visibility at the time. Timber remains were located in one of the transects (T9).

The timber beam was similar to those seen on the above water remains, measuring 2.0 m long x 0.3 m wide x 0.3 m thick and snapped at the near shore end. A single bolt was present within the beam that also included a square washer, which was also similar to the bolt and washers recorded on the above water remains (Figure 38).

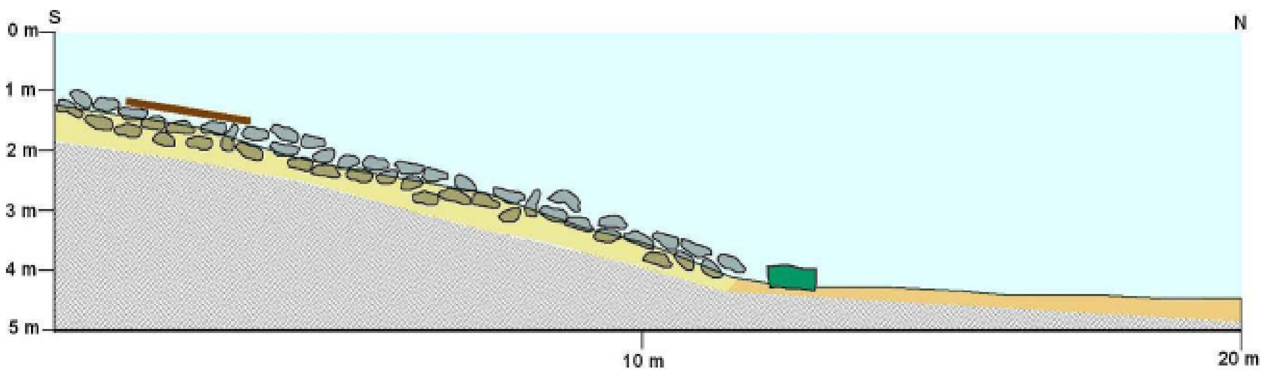

Figure 38: Profile drawing of Transect 9.

The archaeological survey also recorded rock rubble present in transects 1 to 6, including transect 9 (Figure 39). The rock began at the toe of the southern bank and extended out 12 m. The rocks were rounded, like river cobbles, and were predominantly sandstone. There was the occasional 'mudstone' type rock in the mix. The maximum size of these rocks was around 0.3 m. This indicates that they were very likely collected and deposited by hand as opposed to some mechanical means such as a dump truck or excavator. If this were the case, then this rubble would most likely have been deposited anytime between the late 18th and early 20th centuries. The dimensions of these cobbles are reminiscent of what sailing ships would carry as ballast. It is possible that this rock was also transported to the area by vessel rather than brought, and/or deposited from land. It is unlikely, however not impossible that the sandstone was a re-use stone from a former structure and redeposited as ballast for the former wharf. The size of the sandstone suggests it may have been quarried as a particular size to be used as ballast.

Ballast was used in wharf construction during the 18th and early 20th centuries around piles, which could not penetrate with sufficient depth into harder substrates, which gripped the timbers and kept them from 'floating'. This was done primarily as the existing or available pile driving technology was not adequate for the task. The rock was deposited around the piles after they had been driven in to help 'weigh' them down; effectively compacting the riverbed around the piles helping to hold the piles in position.[38] Ballast was also deposited around lattice or box jetties – where piles were checked into bed logs. This was a common form of timber jetty/wharf construction in Australia prior to the 1850s.[39]

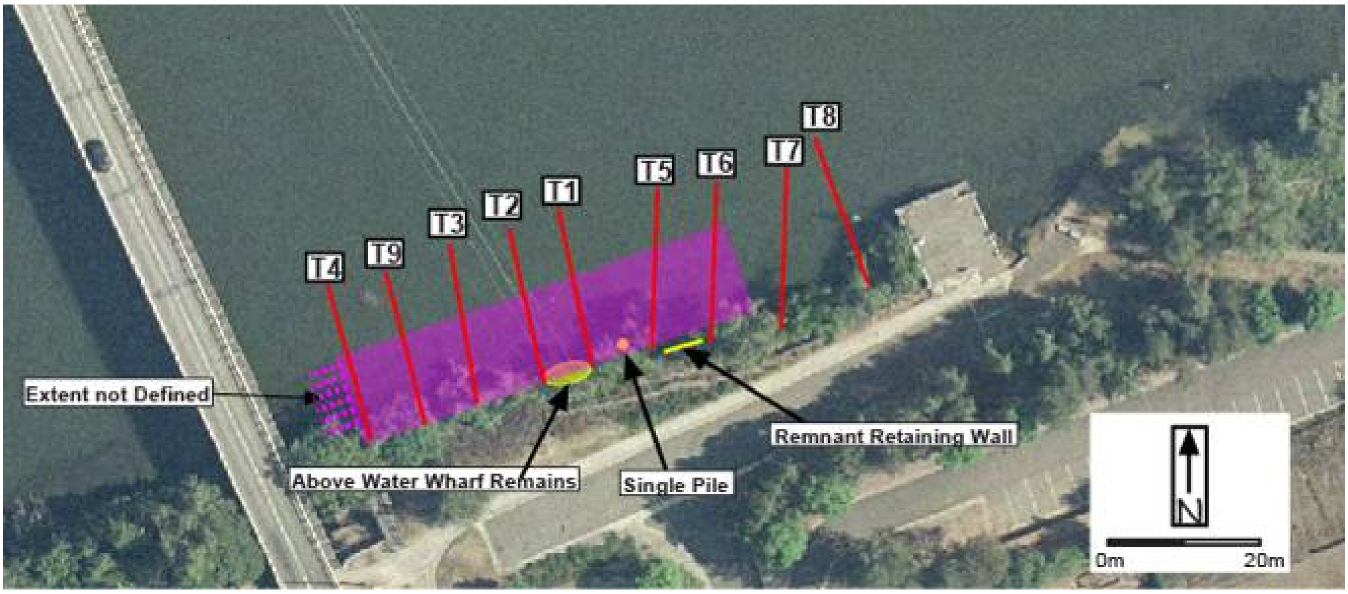

Figure 39: Plan showing the location of the ballast rock (*in pink*) recorded during the field survey in 2008/09.

The ballast extended out from the riverbank approximately 12 m. Ballast was likely deposited just beyond the outermost piles, to assist in the stability of the structure, so it can be inferred

[38] For a similar example of a small river wharf see **Cosmos Archaeology June 2006** *River Heart Phase 1: Maritime Archaeological Investigation*. Prepared for Ipswich City Council (in section 4.2.2 of this report). For an example of a large wharf complex see **Cosmos Archaeology May 2000** *Demolition of Pier 6/7, Walsh Bay Maritime Archaeological inspection Preliminary report.* Prepared for Tropman and Tropman Architects.
[39] **Cosmos Coroneos, 2004** 'The Maritime History and Archaeology of Port Arthur'. In *A Harbour Large To Admit a Whole Fleet*. Port Arthur Occasional Papers No. 1.

that the edge of the wharf was approximately up to 10 m (30 ft) out from the present configuration of the river bank.

No ballast was recorded on or below the riverbed in transects 7 and 8, located on the eastern side of the study area, close to the present day wharf. It is believed the eastern edge of the wharf would have been around the location of Transect 6, where ballast rock was recorded. The ballast extended upstream towards the bridge, past where the extant above water timber wharf remains were observed. This is likely due to additional ballast being deposited to assist with supporting the piles of the wharf to prevent scouring. Another possibility is the ballast may be associated with the original 1795 jetty, which appears to have been in the same area. Figure 38 shows the interpolated extent of the ballast recorded during the field survey.

The attribution of the remnant timber and steel retaining wall on the southern bank is not certain. It most likely dates from the second half of the 20th century. It may have formed part of a river wall, which passed underneath the last upgrade of the wharf, but much more likely was constructed after the wharf fell into disrepair, using elements of the wharf in its construction and in the fill behind it.

4.2 Side Scan Sonar Survey

A side scan sonar (SSS) survey was carried out along the Hawkesbury River within and immediately adjacent to the existing bridge and proposed new bridge at Windsor (Figure 43). The survey was carried out by RMS Hydrographical department in June 2012. The images were collected using a mounted unit attached to the rear of the survey vessel.

A SSS can be used to identify man-made objects or other similar features on a riverbed. A SSS uses a mounted or towed sonar dragged behind a vessel that sends out sound (acoustic pulse or ping) downward and outwards towards the riverbed as the vessel travels along a predetermined survey transect (Figure 40). The sound is then reflected off the riverbed and any other objects that are present. The strength of the sound that is reflected from the material on the riverbed depends on the material itself. For example rock is highly reflective and has a strong return, while sediment types such as clay are not and have a very weak return. The data is converted into a grey scale map of the surveyed area, with highly reflective material indicated as light grey and less reflective material is shown in black. The recording of a scan is done with a differential global positioning system so the accurate positions of any anomalies detected in the scan can be relocated.[40]

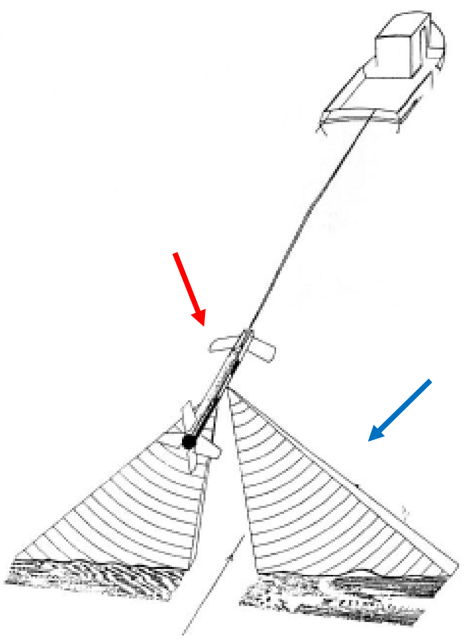

Figure 40: Example of a towed Side Scan Sonar (*red arrow*). The *blue arrow* shows the acoustic sonar – or ping) that is sent out from the sonar. (Source: Dean et al. Archaeology Underwater: 137).

he NAS guide to principles and practices. Nautical Archaeological