3 Additional assessment

A number of additional assessments have been undertaken since public exhibition of the EIS. These include:

- Additional historic heritage archaeological investigations at the intersection of George Street and Bridge Street.
- Archaeological investigation options for Thompson Square
- Revised flood modelling of the project.

Details of these additional assessments are provided below.

Further noise investigations were also undertaken to address design changes and include a number of additional residential properties identified during exhibition of the EIS. These are discussed in **Section 5.1.4**.

3.1 Additional historic heritage archaeological investigations

3.1.1 Scope and purpose of additional investigations

Following ongoing consultation with the Department of Planning and Infrastructure and Heritage Branch, RMS undertook further historic heritage archaeological investigations in the area that would be impacted by the George Street/ Bridge Street signalised intersection works. This section summarises the findings of the additional investigations. The full report of the investigations is attached in **Appendix B**.

The investigations focussed on the George Street/ Bridge Street intersection, including the footpaths and the south-eastern corner of the Thompson Square upper parkland area. The purpose of the investigations was to provide further information on the impacts of the proposed signalised intersection works on historic archaeology. (At the time of the archaeological investigations for the EIS, signalised intersections were not proposed). More specific objectives included:

- To determine if an archaeological profile survives in the project area and, if it does, the nature and chronological range of that resource and its potential depth.
- To investigate the presence or absence of physical evidence of the 1803 Commissariat building on the south-eastern side of the intersection.

The results of the investigation were intended to compliment the results of previous archaeological tests undertaken within Thompson Square. The results of the previous archaeological tests are presented in the EIS.

3.1.2 Archaeological evidence gained from the test excavations

The key information provided by the additional archaeological investigations is as follows:

- The topography recorded in the earliest nineteenth century images of the Green Hills settlement is accurate in its depiction of a high, exposed ridge line stepping steeply down to the river.
- The ancient sand dunes recorded in test pits on the northern side of the river do not appear to have covered the peak of the ridge that corresponds to the current

alignment of George Street. The peak of this ridge is likely to have been exposed bedrock or only thinly covered with sand or soil. Furthermore, if a thin soil cover existed, it may have been removed in the earliest days of settlement to provide a hard and impervious surface for pedestrian traffic and construction projects. The exposed bedrock in this location may have been cut and shaped in places for the construction of building foundations, drains or other structural works.

- No clear evidence was found of the 1803 Commissariat building. Furthermore, the impact of road works and laying of services in the footpath on the eastern side of Bridge Street make it unlikely that any evidence of this building remains. If, however, the technique of cutting and shaping bedrock was used to construct the building foundations, some evidence of this work could survive within the bedrock.
- By the mid-nineteenth century, the alignment of George Street had been altered at least twice and soils had been imported to build up the area in the vicinity of the George Street/ Bridge Street intersection. The accumulated soils at this location were removed in c. 1889 to allow for a major program of infrastructure, including installation of services and creation of a new road surface comprising a locally sourced clay base and a cobble stone surface. It is not possible based on current information to determine if this work was also carried out in Bridge Street.
- The same locally sourced clay appears to have been used to create a pedestrian area along Bridge Street adjoining the School of Arts when changes were made to the road alignment. There are similarities between this clay and that recorded in the test trench at the northern end of Thompson Square, where it was used to help raise the ground level for the new approach for the bridge when the bridge was raised in 1894.
- Based on information from document archives, there was a paved footpath on at least part of the southern side of George Street adjoining Stearn's premises. Some evidence of this surface might be preserved within the garden area at the junction of George Street and Bridge Street but insufficient archaeological investigation has been made here to confirm the date of this feature.
- A bitumen paved road was laid in George Street by 1938. This surface might remain as the present day surface or it may have been replaced later in the twentieth century. The paved footpath along Bridge Street probably dates from this same period and a comparable footpath did exist on the southern side of George Street. No evidence of this path was found and it is possible that the construction the present footpath and garden removed evidence of this development.
- The introduction of services in the footpaths has had a substantial impact on the preservation of archaeological evidence.

3.1.3 Potential impacts of the intersection works

The following conclusions have been drawn regarding the impacts of the proposed intersection works, in addition to the conclusions presented in the EIS:

- The information provided by the investigations, combined with the information from archival sources, allows for a reasonable interpretation of the pattern of development in the project area.

- Generally, any features that can be positively attributed to the earliest settlement of Green Hills and of the Macquarie period town would be of State significance. The evidence of later nineteenth and early twentieth century infrastructure, including the creation of roads and footpaths, would be of local significance for what it can document about the growth of the town. The paved area and garden created at the south-western corner of the intersection in the last thirty year period would have at best local significance.
- The excavation required for the intersection works will impact historical archaeological resources. The depth of the archaeological profile on the ridge top is shallow, being little more than half a metre. The works required for the project extend beyond that depth, including into the bedrock where it is possible that evidence of early nineteenth century building foundations could be preserved.
- The archaeological evidence that would be impacted by the project could include some works that predate c. 1810. This evidence would be of State significance.
- The majority of the soil profile revealed by the investigations dates from c.1889 onwards and this component of the profile will be the main component impacted by the works. This area is of local historic significance, with the possible exception of the most recent paved footpath and garden area at the south-western corner of the intersection.
- The project would result in the fragmentation of large units such as road surfaces and bedding. It is unlikely to completely remove all archaeological evidence because there are large areas of archaeology that probably extend beyond the areas of impact.
- While the excavation did not provide any evidence for the presence of the Commissariat Store of 1803, there is still a possibility that intact evidence exists outside the investigated road area. It is not possible from the investigations conducted to determine if the project would impact evidence of this type. Any remaining evidence of this building would be of State significance.
- It is difficult to assess the potential for the project to impact bedrock modifications that may have been made for historic building foundations. The practice of modifying bedrock for building foundation has not been confirmed, although the results of the test excavations provide some indication that it has occurred. Because of the random and largely undocumented location of many of the early structures, it is not possible to predict if the project would impact any historical bedrock modifications of this type.

3.2 Archaeological investigation options for Thompson Square

At the request of the Department of Planning and Infrastructure and Heritage Branch, RMS has also undertaken a detailed examination of options for the archaeological investigation of Thompson Square that would be undertaken should the project be approved. This examination expands on the need for open area salvage that was identified in the EIS.

The *Archaeological Investigation Options for Thompson Square* report is provided in **Appendix F**. An overview of the identified options is provided below, together with RMS' proposed approach. Additional detail on the management of archaeological resources is also provided, as well as details on proposed public interpretation.

3.2.1 Assessment of archaeological options

As discussed above, RMS engaged specialist archaeologists to identify potential archaeological investigation options for Thompson Square. The investigation identified three potential options as follows:

- Option 1 – which was restricted to the footprint of construction disturbance only, leaving 'islands' of deposit within the construction zone untouched.
- Option 2 – as above but seeking to maximize the recovery of information where disturbance was anticipated, removing all deposit including the 'islands' and service trenches to allow any archaeological evidence to be recorded. It would also include extensive continuous excavation across the junction of Bridge and George streets to understand the distinctive archaeology recovered from test pits in this area
- Option 3 – involving excavation of the entirety of the open space and roadways in Thompson Square.

RMS has considered the archaeological outcomes that each option offers, as well as anticipated community, environmental, traffic management, and construction impacts. Each option was shown to involve considerable excavation within Thompson Square.

Option 1 requires retaining standing pedestal 'islands' of archaeological deposit some metres high in a construction environment. Option 1 presents a real risk that these retained areas will sever or mask the evidence needed to make sense of the complex archaeological stratigraphy of the site, resulting in a less reliable and comprehensive understanding of the site's history. The Option 3 proposal is contrary to archaeological ethics, which require minimising the loss of unique resources, maximising the results from the impact achieved and retaining sufficient archaeological evidence to allow future techniques and technologies to be used.

Option 2 represents the most effective means of realising the archaeological potential of Thompson Square, by predominately digging a large area as a single integrated investigation area, which is the appropriate means of investigating a complex, heavily dissected archaeological landscape. However, one element of the proposed design – extensive continuous excavation across the Bridge and George Street intersection – would cause unacceptable traffic closures, including access to the bridge.

To avoid these impacts, RMS proposes a "modified Option 2" involving staged investigations within George Street and adjoining areas of the intersection that leave Bridge Street trafficable and would provide comparable archaeological outcomes. The investigations in George Street will be planned to minimise impacts on traffic and access to adjacent businesses.

RMS requires that the research design specifies the appropriate methods of archaeological investigation outside the core area of the lower parkland and under what circumstances total recovery of archaeological evidence may be varied to sampling recovery. The proposed horizontal extent of archaeological investigations proposed by RMS is identified in **Figure 3-1**. Investigations within this area would include archaeological salvage or monitoring, as appropriate.

While complete recovery of all historic period deposits within the excavation footprint is desirable, this needs to be continually assessed as the most appropriate strategy while excavation is in process. The depth of excavation proposed should be considered in the archaeological research design. RMS proposes that the depth of

excavation will be:

- Within the lower parkland 'footprint' of the southern approach/ abutment – seek complete recovery of archaeological evidence to base of deposits.
- Outside this area – the depth of excavation is to be specified by the archaeological research design, taking into consideration the nature of known archaeological deposits, the construction impact and its depth, the desired and likely information to be obtained from different archaeological methods, including remote sensing, monitoring and salvage.

The research design should set out under what circumstances this approach should be varied to take advantage of unexpected ground conditions, archaeological deposits and so on.

3.2.2 Managing the archaeological excavation

RMS recognises that Thompson Square is a place of high State heritage significance, particularly for its archaeological potential. Approval of the Windsor Bridge replacement project will require, as a minimum, a major archaeological investigative program to realise the archaeological potential of the site. This will take place as a component of a broader Heritage Conservation Management Plan if approval is granted.

As the site requires the active participation of three strands of archaeology – terrestrial and maritime historical archaeology and Aboriginal archaeology, it is important that the project proceed as a single integrated investigation. Close cooperation with regulators, stakeholders and the archaeological profession will be essential to maximising the opportunity afforded to investigate this unique site. The significance of the site requires that interpretation be used both during and after the investigation to tell the story of the site and its human history.

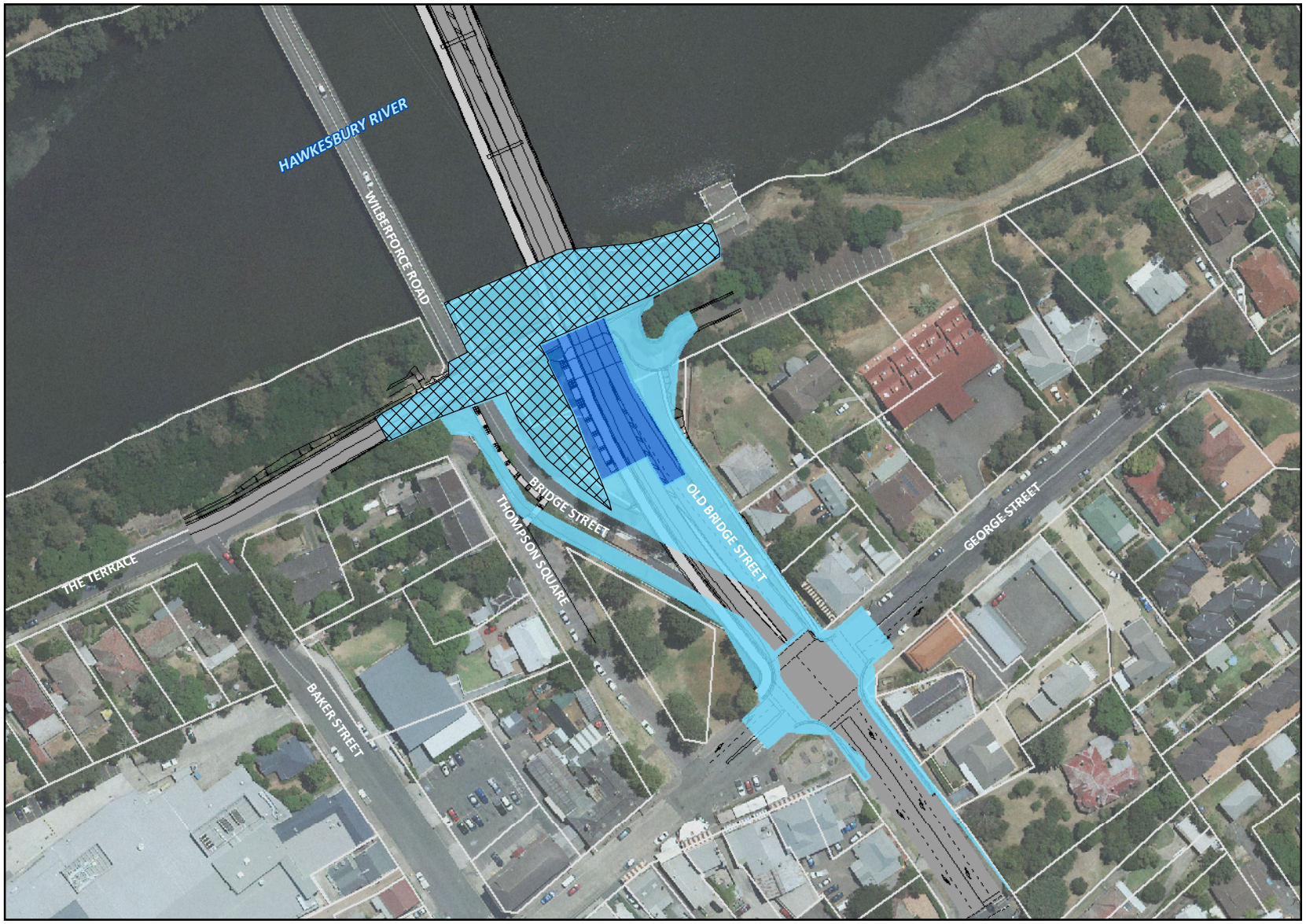
To achieve these aims RMS commits to the following archaeological program objectives:

- To maintain regular liaison with heritage stakeholders - Office of Environment and Heritage, Heritage Council of NSW, Department of Planning and Infrastructure and Hawkesbury City Council - to ensure they are fully informed about the progress of the excavation and analysis.
- To develop a single overarching research design that meets best practice standards, with relevant input from the three strands of archaeology for heritage stakeholder endorsement
- To conduct an archaeological excavation and salvage operation that is appropriate to the project footprint and its archaeological potential
- To put together an integrated archaeological team, including Aboriginal sites
- To make sure artefact analysis adheres to current archaeology digital database standards.

To ensure the proposed archaeological research design and salvage operation represents best practice standards, RMS will consider implementing the following initiatives:

- Hosting a specialist workshop to provide the most up to date current framework from comparable sites as part of research design preparation.

- Establishing an Archaeology Reference Panel consisting of three senior researchers in historical archaeology, Aboriginal heritage and early colonial history. The heritage stakeholders and the Archaeology Reference Panel may be used to review proposed variations to the research design, and consider proposals for retention of *in situ* archaeological evidence. They may also be used to review interpretation plans and other planning documents.



LEGEND

- Windsor Bridge concept design
- Cadastre
- Lower parkland footprint of the southern approach/abutment - complete recovery of the archaeological evidence to base of deposits and bedrock
- Depth of excavation to be specified by the archaeological research design, considering the nature of known archaeological deposits, the construction impact and depth, the desired and likely information to be obtained from different archaeological methods
- Subject to further design assessment and consultation with community and stakeholders

Indicative only – subject to detailed design

DATA SOURCES
Imagery: AUSIMAGE 2011
Cadastre: LPI

0 50
Metres

Area of potential archaeological investigation

AUSIMAGE

SKM

19/04/2013 | I:\NBIF\Projects\NB11459\Technical\GIS\GIS_Directory\ArcMap\Submissions_Report\NB11459_001_Archaeological_Footprint.mxd
Sydney Spatial Team - Prepared by : LW
Checked by : JC

3.2.3 Public interpretation

In addition to the archaeological investigations proposed above, RMS proposes to develop a public interpretation program to maximise opportunities for people to understand the process of archaeology and witness revelation of the site's significance during and after the archaeological investigation program.

RMS has held preliminary discussions with the Hawkesbury Regional Museum, which is keen to be involved in archaeological interpretation programs that build on the interest generated by the archaeological work. RMS will also seek to work with Engineers Australia to develop suitable on-site interpretation to promote engineering education through the opportunity to observe a major civil construction project as it proceeds.

An interpretation plan will be prepared for the archaeological investigation program with the involvement of heritage stakeholders. It will consider a range of commonly used interpretation methods, including:

- Static explanatory signage erected at points around the work perimeter.
- Archaeological 'explainers' to interact with interested community members.
- Information sheets available as handouts and internet downloads.
- Scheduled open days when the archaeological site can be visited.
- A web-log that documents the progress of the dig.
- Time-lapse photography, video and other documentary research.
- Changing 'what's on' display in the Museum to alert visitors to the range of interpretation opportunities and the latest discoveries.
- Identification of any archaeological evidence to be retained *in situ* for permanent interpretation purposes.
- Talks by specialists on artefact topics.

Following the completion of the excavation an updated interpretation plan will be prepared, identifying what enduring elements of the archaeological investigation should be promoted. These may include display of *in situ* archaeological remains, the use of recovered materials or forms as design elements in the final landscaping and works as well as museum displays, and publications for a range of audiences.

3.3 Revised flood modelling

To respond to the concerns of the OEH, and to further assess the requirements for scour protection, the flood modelling for the project has been revised using a more accurate two dimensional hydrological model and the most up to date bridge design. The latest bridge design has a shallower profile, a lower number of piers in the river and less bulky piers compared to the bridge design used in the flood modelling for the EIS. It was recognised in the EIS the flood modelling presented in the document was conservative and tended to over-estimate potential flooding impacts. This has been confirmed by the results of the revised flood modelling

The EIS predicted increases in flood levels for the 5 year flood event of around 0.12 metres immediately upstream of the bridge and around 0.06 metres up to five kilometres upstream. The OEH raised concerns about these increases in flood levels in their submission on the EIS and it was recognised that flood mitigation works for affected properties would be required if these predicted increases were correct.

Preliminary results from the revised modelling using the latest design of the bridge indicates, however, that there would be no increase in upstream flood levels for events greater than the 20 year event and the maximum increase for smaller events would be 0.01 metres for the 10 year event (see **Table 3-1**). An increase of 0.01 metres is negligible and at the limit of the accuracy of the hydrological model. Based on the preliminary results from the revised modelling, no additional consideration of flood mitigation works would be required.

Table 3-1 Comparison of existing and proposed case flood levels upstream of the existing bridge

	Flood level (m AHD)		Difference
Design event	Existing	Proposed	(m)
5 year	11.00	10.98	-0.02
10 year	12.25	12.26	+0.01
20 year	13.80	13.80	0.00
50 year	15.97	15.97	0.00
100 year	17.77	17.77	0.00
2000 year	23.19	23.19	0.00
PMF	26.76	26.76	0.00