PAD2

Pit Number	Spit Number	Depth (cm)	Description	Artefacts
1	GPS Location: 307827.6240110 GDA			
	1	0-10	Grey brown sandy loam with tree roots.	0
	2	10-20	Grading to compacted fine yellow brown sand.	0
	3	20-30	Clear transition to brown stiff clay at 29-30cm	0
2	GPS Location: 307806.6240092 GDA			
	1	0-10	Grey brown sandy loam; highly compacted, tree roots throughout.	0
	2	10-27	Grading to yellow grey-brown sand, tree roots continue.	0
	3	27-38	Paler yellow brown sand, less tree roots, increasing gravels	0
	4	38-48cm	As above, traces of clay at base	0
	5	48-53	Clear transition to stiff brown gravelly clay at base	0
3	GPS Location: 307793.6240083 GDA			
	1	0-10	Grey brown humic sandy loam.	0
	2	10-20	Yellow brown compacted sand, traces of clay at base.	0
	3	20-25	Clear but irregular transition to brown clay at 20-25cm.	0
4	GPS Location: 307776.6240061 GDA			
	1	0-10	Grey brown humic sandy loam - moderate compaction.	0
	2	10-20	Pale yellow grey sand.	0
	3	20-32	As above.	0
	4	32-40	As above.	0
	5	40-49	As above with clear transition to brown clay at 48-48 cm.	0
5	GPS Location: 307717.6240016 GDA			
	1	0-10	Compacted pale grey brown sand-sandy loam with tree roots, yellow brown sand at base. Some sandstone gravels coming through.	0
	2	10-20	Fine pale yellow sandy loam, increasing sandstone gravels, brown clay coming through at base	0
	3	20-25	Grading to stiff brown clay at 23-25cm.	0

Pit Number	Spit Number	Depth (cm)	Description	Artefacts
6	GPS Location: 307694.6240003 GDA			
	1	0-10	Dark brown humic sandy loam grading to a grey brown loamy sand: less compacted sediment.	0
	2	10-20	Grey brown sand.	0
	3	20-30	Grading to pale yellow brown sand.	0
	4	30-34	Grading to a dark yellow red mottled clay base	0
7	GPS Location: 307530.6239978 GDA			
	1	0-13	Grey brown silty sand; vegetated, loose compaction, tree roots throughout.	0
	2	13-20	Grading to yellow brown sand; mottled yellow brown base.	0
	3	20-30	Grading to browny-yellow sand; occasional orange clay nodules, occasional charcoal.	0
	4	30-40	As above with increasing orange clayey sand pellets.	0
	5	40-50	As above with increasing pellets.	0
	6	50-60	Grading to compacted clayey sand with high levels of coffee rock gravels	0
	7	60-70	Compacted yellow brown sand with increasing coffee rock gravels, grading to yellow grey sandy clay.	0
8	GPS Location: 307547.6239966 GDA			
	1	0-10	Grey brown humic sandy loam.	0
	2	10-20	Grading to mottled pale grey brown sand.	0
	3	20-32	Grading to pale yellow brown sand with increasing gravels/clay pellets.	0
	4	32-42	As above with increasing orange clayey sand pellets/concretions - coffee rock gravels across base.	0
	5	42-50	As above with increasing coffee rock gravels	0
	6	50-60	As above with increasing gravels and increasing clay content.	0
	7	60-70	Grading to mottled yellow grey and orange sandy clay	0
9	GPS Location: 307574.6239948 GDA			
	1	10-20	Fine grey humic sandy loam with high ash content - lots of tree roots - spit begins at 10cm - 0-10cm=fill	0

Pit Number	Spit Number	Depth (cm)	Description	Artefacts
	2	20-30	Fine grey sand with occasional subangular gravels.	0
	3	30-40	A s above grading to a paler grey colour, decreasing ash content.	0
	4	40-50	As above; pH:6.0	0
	5	50-60	Clear undulating transition to coffee rock at 50-60cm.	0
	6	60-70	Coffee rock continues interspersed with pale grey-yellow-brown sand.	0
	7	70-80	Coffee rock - gives onto yellow brown sand with coffee rock gravels; pH: 6.0.	0
	8	80-90	Clean yellow grey-yellow brown sand; pH 6.0-6.5.	0
	9	90-100	As above, giving onto mottled orange sandy clay at base.	0
10	GPS Location: 307597.6239932 GDA			
	1	20-30	Fine dark grey humic sandy loam with high ash content and lots of tree roots. Spit begins at 20 cm, beneath cap of mixed clay fill.	0
	2	30-43	Dark grey brown sand.	0
	3	43-51	Soft grey brown sand grading to mottled yellow and brown sand, southern half dominated by dark brown sandy loam with organic material.	0
	4	51-63	Brown sand with high levels of coffee rock.	0
	5	63-73	As above, giving onto yellow grey sand at base.	0
	6	73-83	Brown to grey brown sand with pocket of charcoal in eastern wall.	0
	7	83-93	Soft/loose mottled yellow grey and yellow brown sand.	0
	8	93-100	Mottled yellow grey and green-grey clayey sand - anaerobic, almost at water table – end of pit.	0
11	GPS Location: 307616.6239906 GDA			
	1	0-10	Grey brown sandy loam interspersed with tree roots and clay fill.	0
	2	10-20	Mix of fill and sand, grey brown sand dominant at base of pit.	0
	3	20-30	Grey brown sand.	0
	4	30-40	Grades to yellow grey - yellow brown sand.	0

Pit Number	Spit Number	Depth (cm)	Description	Artefacts
	5	40-50	Mottled yellow brown and yellow grey sand, pocket of grey ashy sand in western corner.	0
	6	50-60	Coarse yellow grey sand with occasional charcoal and coffee rock gravels.	0
	7	60-70	Course yellow grey sand, increasing compaction, dark yellow mottling coming through with occasional charcoal.	0
	8	70-80	As above.	0
	9	80-90	Grading to mottled yellow and yellow grey clayey sand with increasing coffee rock.	0
	10	90-100	Grading to orange grey sandy clay.	0
12	GPS Location: 307631.6239895 GDA			
	1	na	Compacted clay and rock encountered to a depth of 30 cm – area highly disturbed, abandoned pit.	0
13	GPS Location: 307643.6239880 GDA			
	1	15-25	Grey brown sandy loam to loamy sand with charcoal flecks. Spit begins at 15cm, below a cap of fill.	0
	2	25-33	Grey brown sand - grading to yellow at base.	0
	3	33-45	Mottled yellow brown sand with coffee rock gravels starting to appear at base.	0
	4	45-53	Yellow brown sand, increasing compaction and slight increase in coffee rock gravels.	0
	5	53-65	Increasing gravels, orange clayey sand-sandy clay and coffee rock at base.	0
14	GPS Location: 307817.6240210 GDA			
	1	0-10	Grey brown humic sandy loam with rootlets and tree roots.	0
	2	10-20	Diffuse transition to yellow-grey-brown sand with tree roots, few charcoal flecks at base.	0
	3	20-32	Compacted yellow sand, moderate density of charcoal at eastern end (20cm band) - probably bushfire event. Coffee rock gravels starting to appear at base of spit.	0
	4	32-40	Increasingly compact pale yellow grey sand with increasing orange-brown coffee rock gravels; tree root across northwest end of pit.	0
	5	40-50	As above- did not excavate western third of pit (30cm width) due to tree root obstruction.	0

Pit Number	Spit Number	Depth (cm)	Description	Artefacts
	6	50-60	Grades to orange and yellow compacted clayey sand with coffee rock gravels.	0
15	GPS Location: 307793.6240227 GDA			
	1	0-13	3-5cm of clay fill, giving onto grey brown sandy loam, grading to yellow grey sand at base.	0
	2	13-28	Yellow grey sand, gravels coming through at base.	0
	3	28-40	As above, increasing coffee rock gravels at base.	0
	4	40-50	As above with increasing coffee rock gravels on sandy clay at base.	0
16	GPS Location: 307768.6240227 GDA			
	1	0-10	Grey brown humic sand, grading to yellow grey, tree roots across southern half.	0
	2	10-20	Grades to pale yellow grey sand with tree roots.	0
	3	20-29	Grading to more yellow brown sand, tree roots continuing.	0
	4	29-40	As above.	0
	5	40-50	Yellow brown sand with increasing compaction, decreasing tree roots.	0
	6	50-55	Grades quickly to mottled orange and brown clay.	0
17	GPS Location: 307470.6239891 GDA			
	1	0-10	Grey brown humic sandy loam with leaf litter.	0
	2	10-22	Grading to yellow brown sand with occasional coffee rock gravels and tree roots.	0
	3	22-32	Yellow grey brown sand with occasional coffee rock gravels.	0
	4	32-40	As above with increasing coffee rock gravels.	0
	5	40-50	As above.	0
	6	50-61	as above, becoming paler with depth	0
	7	61-70	As above.	0
	8	70-75	Clear transition to orange and brown mottled sandy clay at base of pit.	0
18	GPS Location: 307497.6239881 GDA			
	1	0-10	Grey brown humic sandy loam with leaf litter.	0

Pit Number	Spit Number	Depth (cm)	Description	Artefacts
	2	10-20	Grey brown sand, becoming paler with depth.	0
	3	20-30	Yellow grey-brown sand with tree roots.	0
	4	30-40	Pale yellow grey sand.	0
	5	40-50	Pale yellow grey-brown sand with occasional tree roots, coffee rock gravels coming through at base.	0
	6	50-60	As above.	0
	7	60-70	As above with increasing coffee rock at base of spit - very compacted.	0
	8	70-80	Grading to mottled yellow, orange and brown sandy clay at 75-80cm.	0
19	GPS Location: 307519.6239872 GDA			
	1	0-10	Grey brown humic sandy loam with leaf litter.	0
	2	10-22	Grey brown loamy sand, mottled yellow at base, lots of tree roots.	0
	3	22-31	As above.	0
	4	31-41	Becoming paler and sandier with depth.	0
	5	41-52	Pale yellow grey sand, coffee rock starting to appear at base of spit.	0
	6	52-62	As above with increasing coffee rock gravels.	0
	7	62-70	Yellow brown sand with increasing coffee rock.	0
	8	70-76	Increasing compaction and increasing coffee rock gravels, orange sandy clay coming through at 73-76cm.	
20	GPS Location: 307604.6239881 GDA			
	1	0-10	Cap of clay fill to 3-5cm, sharp transition to grey brown sandy loam.	0
	2	10-20	Grey brown sand, becoming more mottled.	0
	3	20-30	Grading to yellow grey-brown sand.	0
	4	30-40	As above.	0
	5	40-50	As above with increasing coffee rock gravels.	0
	6	50-60	Grading to yellow brown sand with orange clayey sand mottling across base.	0
	7	60-70	Mottled orange and yellow grey sand, slightly clayey.	0

Pit Number	Spit Number	Depth (cm)	Description	Artefacts
	8	70-80	As above.	0
	9	80-90	Coarse yellow grey sand.	0
	10	90-100	As above with increasing orange sandy clay pellets.	0
	11	100-110	Grading to mottled orange, grey and yellow clayey sand - coffee rock - and sandy clay.	0
21	GPS Location: 307620.6239883 GDA			
	1	20-30	Grey brown humic sandy loam to sand – spit begins at 20 cm below cap of clay fill.	0
	2	30-40	Pale yellow grey sand.	0
	3	40-50	As above with increasing compaction.	0
	4	50-60	Grading to darker mottled yellow orange compacted sandy clay.	0

Figure A1.16 Southern wall of PAD2-Pit 1-Spit 3.

Figure A1.17 Western wall of PAD2-Pit 9-Spit 9 showing layer of coffee rock capping sands and clay at base and layer of fill at top of pit.

Figure A1.18 Northeastern wall of PAD2-Pit 13-Spit 5 showing cap of fill at top of profile.

Figure A1.19 Northern wall of PAD2-Pit 17-Spit 8.

Figure A1.20 Northern wall of PAD2-Pit 21-Spit 11, showing truncated soil profile capped by thick layer of fill.

APPENDIX 8

SIGNIFICANCE ASSESSMENT

Detailed significance assessment

Moorebank Intermodal Terminal Project Area

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

The project area as a whole was originally assessed as not having significance against this criterion.

However the Unit 1 and Unit 2 deposits at MAPAD2 have been assessed to have heritage value against this criterion in terms of their association with the course of Australia's natural and cultural history, in particular their connection to environmental conditions prior to and subsequent to European settlement.

The significance of the Unit 1 and Unit 2 deposits is predicted to be such that it confers a degree of significance for the entire study area against this criterion. While the majority of the project area is assessed as not having significance against this criterion, the significance of the Unit 1 and Unit 2 deposits is interconnected with the environmental evidence that exists across the broader study area.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

The project area as a whole is assessed as not having significance against this criterion.

However the Georges River corridor and terraces are assessed as having significance against this criterion as they are relatively rare examples of undisturbed portions of the river corridor and Tertiary terrace that contain Aboriginal archaeological deposits.

Furthermore, the sequence identified in the northern Powerhouse land study area is unique in that no other major floodplain adjustments and ecological shifts due to construction from a convict constructed weir are known in Australia.

The Unit 1 and Unit 2 deposits at MAPAD2 have been assessed to have heritage value against this criterion due to the fact that they appear to comprise a hitherto unrecorded example of changes in flood regime that appear to archive:

- regional properties in the catchment sediment record; and
- a record of recent sand aggradation and vertical accretion superimposed on the earlier floodplain surface caused by the construction of the Liverpool Weir in 1836.

Individual sites MA12 and MA13 contribute to the significance of the Unit 1 and Unit 2 deposits against this criterion.

The significance of the Unit 1 and Unit 2 deposits is predicted to be such that it confers a degree of significance for the entire study area against this criterion. While the majority of the project area is assessed as not having significance against this criterion, the significance of the Unit 1 and Unit 2 deposits is interconnected with the environmental evidence that exists across the broader study area.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

The project area as a whole is assessed as not having significance against this criterion.

However, the Georges River corridor and terraces are assessed as having significance against this criterion as this landscape has an archaeological deposit that has the potential to yield information that will contribute to an understanding of Australia's natural and cultural history.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

i) A class of Australia's natural or cultural places, or

ii) A class of Australia's natural or cultural environments.

The Georges River corridor and terraces are assessed as having significance against this criterion as they are representative of the scientific (natural and cultural) research potential that exists in relatively undeveloped and undisturbed landforms bordering the Georges River. The river corridor and the sites identified along it contribute to the overall significance of the Moorebank IMT study area against this criterion.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

The project area as a whole is assessed as not having significance against this criterion.

However, the Unit 2 deposits at MAPAD2 appear to be the direct result of early nineteenth century innovation and technical achievement with regard to modification of a river system in order to secure a fresh water supply for Liverpool. As such, these deposits are potentially of importance as an indirect demonstration of that early nineteenth century technical achievement.

The Unit 2 deposits within the Georges River corridor are assessed as having potential heritage significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

The project area as a whole was originally assessed as not having significance against this criterion.

However, the Unit 1 and Unit 2 deposits at MAPAD2 are likely to be of importance to both the Aboriginal community and the local Liverpool community in terms of the record they appear to archive of ecological change, flooding patterns and potential information regarding the pre-European landscape.

Individual sites MA6, MA7, MA8, MA9, MA10, MA11, MA12 and MA13 also contribute to the overall significance of the Georges River corridor and terraces against this criterion as well as the significance of the Moorebank IMT study area as a whole.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

The project area as a whole is assessed as not having significance against this criterion.

However, the Unit 2 deposits at MAPAD2 appear to be the direct result of construction of the Liverpool Weir, which was designed by David Lennox, an engineer who was also important within NSW and Victoria due to his involvement in bridge design and construction. The life and works of David Lennox are thus important in the context of local history, as well as the history of infrastructure within NSW and Australia as a whole. As such, these deposits are potentially of importance as direct evidence of the effect of the works of David Lennox.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

The project area as a whole is assessed as not having significance against this criterion.

However, the Georges River corridor and terraces are assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Statement of heritage significance:

The majority of the Moorebank Intermodal Project Area does not meet the Commonwealth Heritage List criteria. However, the undisturbed portions of the Georges River corridor and tertiary terrace are assessed to be of moderate to high significance at local and regional levels due to the research potential that exists in these areas. The Moorebank IMT portions of the Georges River corridor and terraces are also relatively unique examples of such archaeological resources in the context of the broader southern Sydney region. Furthermore, the Unit 1 and Unit 2 deposits identified at MAPAD2 are potentially of high scientific, educational, natural, representative and Aboriginal cultural value at local, State and National levels.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This Georges River corridor and terraces meets the threshold for listing on the Commonwealth Heritage List under criteria A, B, C, D, F, G, H and I.

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having significance against this criterion as the site has an archaeological deposit that has the potential to yield information that will contribute to an understanding of Australia's cultural history.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

iii) A class of Australia's natural or cultural places, or

iv) A class of Australia's natural or cultural environments.

This item is assessed as not having significance against this criterion.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

This item has been disturbed by subsequent land use that has affected the vertical integrity of archaeological material. The loss of site integrity also impacts on the potential research value of the items and consequent changes in significance that may have come from intactness. There is low archaeological significance at a local level.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site does not meet the threshold for listing on the Commonwealth Heritage List.

Recording ID: **MA2**

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

i) A class of Australia's natural or cultural places, or

ii) A class of Australia's natural or cultural environments.

This item is assessed as not having significance against this criterion.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

This item has been disturbed by subsequent land use activities in the area and is no longer in situ. The loss of site integrity also impacts on the potential research value of the item and consequent changes in significance that may have come from intactness. There is low archaeological significance at a local level.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site does not meet the threshold for listing on the Commonwealth Heritage List.

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

i) A class of Australia's natural or cultural places, or

ii) A class of Australia's natural or cultural environments.

This item is assessed as not having significance against this criterion.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

This item has been disturbed by subsequent land use activities in the area and is no longer in situ. The loss of site integrity also impacts on the potential research value of the item and consequent changes in significance that may have come from intactness. There is low archaeological significance at a local level.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site does not meet the threshold for listing on the Commonwealth Heritage List.

Recording ID: **MA4**

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

i) A class of Australia's natural or cultural places, or

ii) A class of Australia's natural or cultural environments.

This item is assessed as not having significance against this criterion.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

This item has been disturbed by subsequent land use activities in the area and is no longer in situ. The loss of site integrity also impacts on the potential research value of the item and consequent changes in significance that may have come from intactness. There is low archaeological significance at a local level.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site does not meet the threshold for listing on the Commonwealth Heritage List.

Recording ID: **MA5**

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having significance against this criterion as the site has an archaeological deposit that has the potential to yield information that will contribute to an understanding of Australia's cultural history.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

i) A class of Australia's natural or cultural places, or

ii) A class of Australia's natural or cultural environments.

This item is assessed as having significance against this criterion as it is representative of the archaeological research potential that exists in undisturbed sections of tertiary terraces bordering the Georges River.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

At this site deposit disturbance has been restricted to upper stratigraphic units and/or layers of fill. Below these levels disturbance is low. Consequently, the item is able to demonstrate its associated lifeways. Site MA5 is representative of the archaeological research potential that exists in undisturbed sections of tertiary terraces bordering the Georges River. As such this site could be considered relatively rare in a local and regional context. There is moderate to high archaeological significance at a local level, and moderate to high representative level at local level.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site meets the threshold for listing on the Commonwealth Heritage List under criterion C and D, with potential for G and I.

Recording ID: **MA6**

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having potential significance against this criterion as the item may be able to yield information about the use of bark/wood by Aboriginal people in the past. An assessment of the tree is required to confirm its status as an Aboriginal object.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

i) A class of Australia's natural or cultural places, or

ii) A class of Australia's natural or cultural environments.

This item is assessed as not having significance against this criterion.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.

This item is assessed as not having significance against this criterion.

Criterion (i): The place has significant heritage value because of the place's importance as part of Indigenous tradition.

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

An assessment of the tree is required to confirm its status as an Aboriginal object. This item may have low archaeological significance at a local level.

The item may have significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site does not meet the threshold for listing on the Commonwealth Heritage List.

Recording ID: **MA7**

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having potential significance against this criterion as the item may be able to yield information about the use of bark/wood by Aboriginal people in the past. An assessment of the tree is required to confirm its status as an Aboriginal object.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

i) A class of Australia's natural or cultural places, or

ii) A class of Australia's natural or cultural environments.

This item is assessed as not having significance against this criterion.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

An assessment of the tree is required to confirm its status as an Aboriginal object. This item may have low archaeological significance at a local level.

The item may have significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site does not meet the threshold for listing on the Commonwealth Heritage List.

Recording ID: **MA8**

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having potential significance against this criterion as the item may be able to yield information about the use of bark/wood by Aboriginal people in the past. An assessment of the tree is required to confirm its status as an Aboriginal object.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

i) A class of Australia's natural or cultural places, or

ii) A class of Australia's natural or cultural environments.

This item is assessed as not having significance against this criterion.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

An assessment of the tree is required to confirm its status as an Aboriginal object. This item may have low archaeological significance at a local level.

The item may have significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site does not meet the threshold for listing on the Commonwealth Heritage List.

Recording ID: **MA9**

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having significance against this criterion as the item has an archaeological deposit that has the potential to yield information that will contribute to an understanding of Australia's cultural history.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

i) A class of Australia's natural or cultural places, or

ii) A class of Australia's natural or cultural environments.

This item is assessed as having significance against this criterion as it is representative of the archaeological research potential that exists in undisturbed sections of tertiary terraces bordering the Georges River.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

At this site deposit disturbance has been restricted to upper stratigraphic units and/or layers of fill. Below these levels disturbance is low. Consequently, the item is able to demonstrate its associated lifeways. This item is representative of the archaeological research potential that exists in undisturbed sections of tertiary terraces bordering the Georges River. As such this item could be considered relatively rare in a local and regional context. There is moderate to high archaeological significance at a local level, and moderate to high representative level at local level.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site meets the threshold for listing on the Commonwealth Heritage List under criterion C and D, with potential for G and I.

Recording ID: **MA10**

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having significance against this criterion as the item has an archaeological deposit that has the potential to yield information that will contribute to an understanding of Australia's cultural history.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

i) A class of Australia's natural or cultural places, or

ii) A class of Australia's natural or cultural environments.

This item is assessed as not having significance against this criterion.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

This item is assessed as having significance against this criterion as it has importance as part of

Statement of heritage significance:

This item has been disturbed by subsequent land use that has affected the vertical integrity of archaeological material. The loss of site integrity also impacts on the potential research value of the item and consequent changes in significance that may have come from intactness. There is moderate to low archaeological significance at a local level.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site may meet the threshold for listing on the Commonwealth Heritage List. The site requires further investigation at western end to fully determine significance.

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

iii) A class of Australia's natural or cultural places, or

iv) A class of Australia's natural or cultural environments.

This item is assessed as not having significance against this criterion.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

This item has been disturbed by subsequent land use that has affected the vertical integrity of archaeological material. The loss of site integrity also impacts on the potential research value of the items and consequent changes in significance that may have come from intactness. The item comprises artefacts of unknown provenance in a disturbed context. There is low archaeological significance at a local level.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site does not meet the threshold for listing on the Commonwealth Heritage List.

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as having significance against this criterion. The item contributes to the significance of the Unit 1 and Unit 2 deposits at MAPAD2.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having significance against this criterion. The item contributes to the significance of the Unit 1 and Unit 2 deposits at MAPAD2.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

v) A class of Australia's natural or cultural places, or

vi) A class of Australia's natural or cultural environments.

This item is assessed as having significance against this criterion. The item is representative of Aboriginal land use along the Georges River and the environment that existed prior to European settlement.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h):	*The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.* This item is assessed as not having significance against this criterion.
Criterion (i):	*The place has significant heritage value because of the place's importance as part of Indigenous tradition.* This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

This item displays high stratigraphic integrity however the artefacts are interpreted to be present in these deposits as the result of fluvial reworking of sediments during flood events of the nineteenth/twentieth centuries. There is low archaeological significance at a local level.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site meets the threshold for listing on the Commonwealth Heritage List under criteria b, c, d, g and i.

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as having significance against this criterion. The item contributes to the significance of the Unit 1 and Unit 2 deposits at MAPAD2.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having significance against this criterion. The item contributes to the significance of the Unit 1 and Unit 2 deposits at MAPAD2.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

vii) A class of Australia's natural or cultural places, or

viii) A class of Australia's natural or cultural environments.

This item is assessed as having significance against this criterion. The item is representative of Aboriginal land use along the Georges River and the environment that existed prior to European settlement.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

This item displays high stratigraphic integrity. A single small artefact was recovered from the upper portion of the Unit 1 deposits at MAPAD2. However, given that the age and nature of the Unit 1 deposits is yet to be determined, the circumstances surrounding the deposition of the recovered artefact cannot be accurately inferred. There is low to moderate archaeological significance at a local level.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site meets the threshold for listing on the Commonwealth Heritage List under criteria b, c, d, g and i.

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as having heritage value against this criterion in terms of its association with the course of Australia's natural and cultural history, in particular its connection to environmental conditions prior to and subsequent to European settlement.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as having heritage value against this criterion due to the fact that it appears to comprise a hitherto unrecorded example of changes in flood regime that appear to archive:

- regional properties in the catchment sediment record; and
- a record of recent sand aggradation and vertical accretion superimposed on the earlier floodplain surface caused by the construction of the Liverpool Weir in 1836.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having heritage value against this criterion due to its potential to:

- yield information on the nature of the hydrological adjustment of the river – an ongoing process – where better understanding of the trajectory of change in the last 180 years provides baselines and context for present riparian ecological issues and management;
- yield information on the types of floodplain vegetation present in the period 1790-1830 that may be well preserved in Unit 1 sealed by the Unit 2 sands; and
- contain evidence of the prior condition of the floodplain preserved in the sequence (e.g. as microfossil inclusions such as pollen, diatoms) or as larger features (tree burn outs, flood event layers).

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

ix) A class of Australia's natural or cultural places, or

x) A class of Australia's natural or cultural environments.

This item is assessed as having significance against this criterion. The item appears to demonstrate the principal characteristics of a pre-European/early contact floodplain that has been capped by overflow sands as the result of floodplain adjustments in response to the construction of the Liverpool Weir.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion. The item is likely to be of importance to both the Aboriginal community and the local Liverpool community in terms of the record they appear to archive of ecological change, flooding patterns and potential information regarding the pre-European landscape.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion. The item has the potential to contain archaeological and paleo-environmental evidence that would be of importance in terms of understanding Indigenous traditions and life-ways. Such evidence would be of importance as a connection between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

This item displays high stratigraphic integrity, however it should be noted that the majority of stratigraphic units investigated during the subsurface testing program appear to relate to sedimentation processes during the past 200 years. There potentially high scientific, educational, natural, representative and Aboriginal cultural value at local, State and National levels.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

The item requires further investigation to fully determine significance.

This site meets the threshold for listing on the Commonwealth Heritage List under criteria a, b, c, d, g, h and i.

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as having heritage value against this criterion in terms of its association with the course of Australia's natural and cultural history, in particular its connection to environmental conditions prior to and subsequent to European settlement.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as having heritage value against this criterion due to the fact that it appears to comprise a hitherto unrecorded example of changes in flood regime that appear to archive:

- regional properties in the catchment sediment record; and
- a record of recent sand aggradation and vertical accretion superimposed on the earlier floodplain surface caused by the construction of the Liverpool Weir in 1836.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having heritage value against this criterion due to its potential to:

- yield information on the nature of the hydrological adjustment of the river – an ongoing process – where better understanding of the trajectory of change in the last 180 years provides baselines and context for present riparian ecological issues and management;
- yield information on the types of floodplain vegetation present in the period 1790-1830 that may be well preserved in Unit 1 sealed by the Unit 2 sands; and
- contain evidence of the prior condition of the floodplain preserved in the sequence (e.g. as microfossil inclusions such as pollen, diatoms) or as larger features (tree burn outs, flood event layers).

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

xi) A class of Australia's natural or cultural places, or

xii) A class of Australia's natural or cultural environments.

This item is assessed as having significance against this criterion. The item appears to demonstrate the principal characteristics of a pre-European/early contact floodplain that has been capped by overflow sands as the result of floodplain adjustments in response to the construction of the Liverpool Weir.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as having significance against this criterion. It appears to be the direct result of early nineteenth century innovation and technical achievement with regard to modification of a river system in order to secure a fresh water supply for Liverpool. As such, these deposits are potentially of importance as an indirect demonstration of that early nineteenth century technical achievement.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion. The item is likely to be of importance to both the Aboriginal community and the local Liverpool community in terms of the record they appear to archive of ecological change, flooding patterns and potential information regarding the pre-European landscape.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as having significance against this criterion. This item appears appear to be the direct result of construction of the Liverpool Weir, which was designed by David Lennox, an engineer who was also important within NSW and Victoria due to his involvement in bridge design and construction. The life and works of David Lennox are thus important in the context of local history, as well as the history of infrastructure within NSW and Australia as a whole. As such, these deposits are potentially of importance as direct evidence of the effect of the works of David Lennox.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as not having significance against this criterion.

Statement of heritage significance:

This item displays high stratigraphic integrity, however it should be noted that the majority of stratigraphic units investigated during the subsurface testing program appear to relate to sedimentation processes during the past 200 years. There potentially high scientific, educational, natural, representative and Aboriginal cultural value at local, State and National levels.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

The item requires further investigation to fully determine significance.

This site meets the threshold for listing on the Commonwealth Heritage List under criteria a, b, c, d, f, g and h.

APPENDIX 9

UNANTICIPATED DISCOVERY PROTOCOLS

Protocol to be followed in the event that previously unrecorded Aboriginal object(s) are encountered

In the event that one or more Aboriginal objects are revealed during development works, the following protocol will be actioned:

1. The discoverer of the find(s) will notify machinery operators in the immediate vicinity of the Aboriginal object so that work can be halted in the area of the find(s).

2. The find will be reported to the site supervisor and the Principal/Project Manager.

3. Immediately notify the following authorities or personnel of the discovery:

    a. The Heritage Branch of the Department of Planning and Infrastructure;

    b. An archaeologist or Aboriginal Heritage Officer from the Office of the Environment and Heritage (OEH), Environment Protection and Regulation Group, Metropolitan Branch (02 9995 5000), or call the OEH Environment Line: 131555 (excluding mobiles); and

    c. Representative(s) from the RAPs (as appropriate).

4. The approximate extent, nature, associated archaeological potential and likely significance of the Aboriginal object(s) will be determined by an appropriately qualified person or persons such as the project archaeologist, in consultation with sites officer(s) and/or representatives nominated by the RAPs.

5. The appropriately qualified person(s) will determine if the find(s) belong to a previously recorded site or potential archaeological deposit. If the location of the finds is consistent with a previous recording, construction work can proceed provided that any required mitigative actions defined in an approved management Plan which addresses cultural heritage impacts have been completed.

6. If the find is a new recording then the Heritage Branch of the Department of Planning and Infrastructure and OEH will be notified of the find and an appropriately qualified person or persons (such as the project archaeologist), accompanied by, and in consultation with RAP representatives will record the finds, and assess the likely significance of the finds and any associated deposits.

7. The new recording will be documented on a OEH site card and lodged with OEH.

8. The recording and assessment results will be reported to the Proponent/Project Manager and an appropriate management strategy will be developed and instigated, in consultation with RAP representatives, the Heritage Branch of the Department of Planning and Infrastructure, , and where appropriate OEH. The management of the find(s) may involve:

    a. The conduct of an archaeological salvage excavation with the aim of recovering a sufficient sample of the deposit to allow an analysis which is commensurate with the assessed potential of the deposit, or

    b. Collection of surface artefacts and any other required samples; and

    c. The temporary storage of recovered Aboriginal objects by the project archaeologist pending the completion of analysis.

9. In the event of the collection of Aboriginal artefacts from the project area:

    a. The artefacts will be appropriately recorded and collected.

       The location of the recovered artefacts will be recorded using a hand-held GPS, (if available and where necessary), or alternatively, by noting road project chainage intervals;

b. The collected artefacts will be placed in a clear-plastic bag and placed in temporary secure storage at the site office

Each bag should have the following information marked on it using a broad nib permanent spirit pen:

- The site location;
- The date (day/month/year);
- The collector's name; and
- Any other relevant information (such as a GPS reference or description of contents);
- Where necessary, the Proponent is responsible for the temporary and secure storage of recovered Aboriginal objects prior to their long term management (refer step 10).

10. Following the completion of those construction works in which Aboriginal objects may potentially be revealed, the project archaeologist will analyse the data from collected artefacts, together with any data and finds from salvage excavations, (conduct any radiocarbon dating determinations, where appropriate) and prepare a report.

11. The post-analysis management of any recovered items will be the subject of discussion and a potential resolution(s) of the Aboriginal Focus Group, and liaison with and approval from OEH.

Protocol to be followed in the event that suspected human remains are encountered

1. All ground surface disturbance in the area of the finds should cease immediately the finds are uncovered.

   a. The discoverer of the find(s) will notify all field workers and machinery operators in the immediate vicinity of the find(s) so that work can be halted; and

   b. The excavation director, site supervisor and representatives of Parsons Brinckerhoff (PB) and the Moorebank Project Office (MPO) will be informed of the find(s).

2. If there is substantial doubt regarding a human origin for the remains, then consider if it is possible to gain a qualified opinion within a short period of time. If feasible, gain a qualified opinion (this can circumvent proceeding further along the protocol for remains which turn out to be non-human). If conducted, this opinion must be gained without further disturbance to any remaining skeletal material and its context (Be aware that the site may be considered a crime scene containing forensic). If a quick opinion cannot be gained, or the identification is positive, then proceed to the next step.

3. Immediately notify the following people of the discovery:

   a) The local Police (this is required by law);

   b) Department of Planning and Infrastructure

   c) An archaeologist or Aboriginal Heritage Officer from the Office of the Environment and Heritage (OEH), Environment Protection and Regulation Group, Metropolitan Branch (02 9995 5000), or call the OEH Environment Line: 131555 (excluding mobiles);

   e) Representative(s) from the registered Aboriginal parties (as appropriate); and

   f) The project archaeologist (if not already present).

4. Facilitate the evaluation of the find(s) by the statutory authorities and comply with any stated requirements. Depending on the evaluation of the find(s), the management of the find(s) and their location may become a matter for the Police and/or Coroner.

5. Excavation works in the area of the find(s) may not resume until the proponent receives written approval from the relevant statutory authority: from the Police or Coroner in the event of an investigation, or from OEH in the case of Aboriginal or Non-Aboriginal remains outside of the jurisdiction of the Police or Coroner.

In the event that the proponent continues an active role in the evaluation and/or management of the find(s), via a direction or advice from the Police, Coroner and/or the OEH or Heritage Council, then all or some of the following steps *may* be conducted:

6. Facilitate, in co-operation with the appropriate authorities, the definitive identification of the skeletal material by a specialist (if not already completed). This must be done with as little further disturbance to any remaining skeletal material and its context as possible.

7. If the specialist identifies the remains as non-human then, where appropriate, the protocol for the discovery of Non-Aboriginal or Aboriginal artefacts should be followed.

8. If the specialist determines that the remains are human, then the proceeding course of action may be of three types:

a. The remains are of an Aboriginal or non-Aboriginal person who died less than 100 years ago. All further decisions and responsibilities regarding the remains and find location rest with the Police and/or the State Coroner.

b. The remains are of a non-Aboriginal person who died more than 100 years ago. In this case, and where the Police have indicated that they have no interest in the find(s), the following steps may be followed:

   i. Ascertain the requirements of the Heritage Branch (OEH), the proponent, the project archaeologist, and the views of any relevant community stakeholders;

   ii. Based on the above, determine and conduct an appropriate course of action. Possible strategies could include one or more of the following:

      1. Avoiding further disturbance to the find and conserving the remains in situ (this option may require relocating the development and this may not be possible in some contexts);
      2. Conducting (or continuing) archaeological salvage of the finds following receipt of any required statutory approvals;
      3. Scientific description (including excavation where necessary), and possibly also analysis of the remains prior to reburial;
      4. Recovering samples for dating and other analyses; and/or
      5. Subsequent reburial at another place and in an appropriate manner determined by the Heritage Council and in consultation with other relevant stakeholders.

c. The remains are of an Aboriginal person who died more than 100 years ago. In this case the following steps may be followed:

   i. Ascertain the requirements of the relevant registered Aboriginal parties, the OEH, the proponent, and the project archaeologist;

   ii. Based on the above, determine and conduct an appropriate course of action. Possible strategies could include one or more of the following:

      1. Avoiding further disturbance to the find and conserving the remains in situ, (this option may require relocating the development and this may not be possible in some contexts);
      2. Conducting (or continuing) archaeological salvage of the finds following receipt of any required statutory approvals (e.g. AHIP issued);
      3. Scientific description (including excavation where necessary and where an AHIP has been issued), and possibly also analysis of the remains prior to reburial;
      4. Recovering samples for dating and other analyses; and/or
      5. Subsequent reburial at another place and in an appropriate manner determined by the registered Aboriginal parties and the OEH.

   iii. No removal of human remains will take place unless an AHIP has been issued.

Reference/Sources:

Donlan, D., McIntyre-Tamwoy, S. and A. Thorne 2002 Aboriginal Skeletal Remains Manual. NSW National Parks and Wildlife Service, Hurstville.

Heritage Office, NSW 1998 *Skeletal Remains Guidelines for the Management of Human Skeletal Remains under the Heritage Act 1977*.

Protocol to be followed in the event that previously unrecorded (non Aboriginal) relics (historical artefacts) are encountered

In the event that historical sites/objects are revealed during construction works, the following protocol will be actioned:

1. The discoverer of the find(s) will notify machinery operators in the immediate vicinity of the find(s) so that work can be halted in the area of the find(s).

2. The find will be reported to the site supervisor and the Principal/Project Manager.

3. Immediately notify the following authorities or personnel of the discovery:

    a. The Heritage Branch of the Department of Planning and Infrastructure; and

    b. An archaeologist or appropriate staff member from the Heritage Branch, Office of the Environment and Heritage (OEH) (02 98738500).

4. The approximate extent, nature, associated archaeological potential and likely significance of the find(s) will be determined by an appropriately qualified person, such as the project archaeologist.

5. The appropriately qualified archaeologist will determine if the finds belong to a previously recorded site. If the location of the finds is consistent with a previous recording, construction work can proceed provided that any required mitigative actions defined in an approved management Plan which addresses cultural heritage impacts have been completed.

6. If the find is a new recording then the Heritage Branch of OEH will be notified of the find and an appropriately qualified person or persons (such as the project archaeologist), will record the find(s), and assess the likely significance of the finds and any associated deposits.

7. The recording and assessment results will be reported to Proponent/Project Manager and an appropriate management strategy will be developed and instigated, in consultation with the Heritage Branch. The management of the find(s) may involve

    a. No further action,

    b. Collection of surface artefacts and any other required samples; or

    c. The conduct of an archaeological salvage excavation with the aim of recovering a sufficient sample of the deposit to allow an analysis which is commensurate with the assessed potential of the deposit, and

    d. The temporary storage of recovered items by the project archaeologist pending the completion of analysis.

8. In the event of the collection of non-Aboriginal artefacts from the project area:

    a. The artefacts will be appropriately recorded and collected.

       The location of the recovered artefacts will be recorded using a hand-held GPS, (if available and where necessary), or alternatively, by noting road project chainage intervals;

    b. The collected artefacts will be placed in a clear-plastic bag and placed in temporary secure storage at the site office

       Each bag should have the following information marked on it using a broad nib permanent spirit pen:

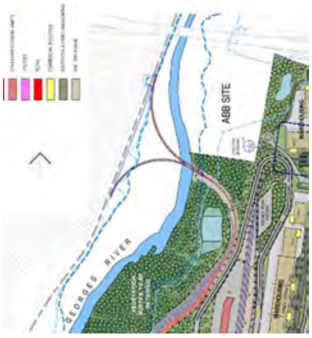
- The site location;
- The date (day/month/year);
- The collector’s name; and
- Any other relevant information (such as a GPS reference or description of contents);
- Where necessary, the Proponent is responsible for the temporary and secure storage of recovered non-Aboriginal artefacts prior to their long term management (refer step 9).

9. Following the completion of those construction works, the project archaeologist will analyse the data from the collected artefacts, together with any data from the recorded sites and prepare a report as per standard NSW Heritage Branch reporting guidelines.

10. The management of any recovered items will be the subject of liaison with the Heritage Branch of OEH.

APPENDIX 10

LIVERPOOL CITY COUNCIL NORTHERN POWERHOUSE LAND ADDENDUM REPORT



Moorebank Intermodal Terminal – Liverpool City Council Northern Powerhouse Land

Aboriginal Subsurface Testing

April 2014

Navin Officer

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EXECUTIVE SUMMARY

In May 2010 the Australian Government tasked the Department of Finance n (DoF) (formally known as the Department of Finance and Deregulation) to conduct a Feasibility Study into the potential development of an intermodal terminal (IMT) at Moorebank in south western Sydney (it should be noted that the project proponent is now the Moorebank Intermodal Company (Limited) which has been established to deliver this project and is acting as the agent for DoF). The proposed IMT site is currently occupied by the Department of Defence including the School of Military Engineering (SME) to the west of Moorebank Avenue. The Government has determined that the SME will relocate to new purpose-built facilities at the nearby Holsworthy Barracks with the move to be completed by around mid-2015.

Navin Officer Heritage Consultants Pty Ltd (NOHC) was commissioned in 2010 by Parsons Brinckerhoff to undertake the Aboriginal cultural heritage assessment for the Moorebank IMT site on behalf of DoFD as part of the Environmental Impact Statement (EIS) for the project.

The area subject to assessment consists of the land that would potentially be directly impacted by the construction and operation of the proposed Moorebank IMT. This is collectively defined as the project area for the purposes of this study. These lands and the corresponding scope of the assessment fall into three categories:

- The Defence lands situated to the east of the Georges River, owned and managed by the Commonwealth (Lot 3001 DP1125930);
- Lands to the west of the Georges River, owned and managed by the Liverpool City Council (LCC) known as the Northern Powerhouse Land (Lot 10 DP881265); and
- A small portion of the Georges River, being unalienated Crown land.

In February 2012, the NSW Department of Planning and Infrastructure (DP&I) issued Director-General's Requirements (DGRs) for the project.

The results of heritage studies conducted to date (surface & built environment), including field survey, the identification and assessment of heritage values, a review of potential development constraints, and Aboriginal and non-Aboriginal heritage assessments including subsurface testing have been documented in the following reports:

- A scoping report which presented a summary of known and potential constraints based on a desktop review (NOHC 2011);
- A report on existing Aboriginal and European Heritage (Commonwealth Department of Finance (DoF Aug 2011) which supported a Preliminary Project Environmental Overview (DoF Dec 2011);
- Aboriginal Heritage Assessment (NOHC 2013a) which formed part of the EIS submission; and
- European Heritage Assessment (NOHC 2013b) which formed part of the EIS submission.

However, at the time of those studies, access to the Northern Powerhouse Land was not possible and so the land was subject to desk study only. Since that time, access to the land has become available.

This report is a Technical Paper that provides the results of subsurface testing undertaken within the Northern Powerhouse Land, referred to hereafter as the study area. It provides an Aboriginal heritage assessment of the Northern Powerhouse Land that will be submitted as additional documentation to support the EIS. Assessments of cultural heritage significance, and potential impacts to heritage values, have been undertaken.

This assessment includes:

- an Aboriginal consultation program;
- literature and database review;
- an archaeological field survey of the project area;
- predictive assessment; and
- an archaeological test excavation program.

Geomorphological Context

The study area lies on a low north-south aligned and undulating bench of sandy alluvial topography on the western bank of the Georges River, near Casula. The area is low-lying, at around 7-11 m AHD[1]. The Georges River forms the eastern boundary of the LCC study area. The majority of the study area is undulating ground, comprising levee bank and swale topography on the river margin.

The deposits under investigation represent an inset deposit within the broader ancient valley side alignment. The narrow valley topography severely limits the capacity of the Georges River to meander through this section. Within geomorphic models used to classify inset valley deposits e.g. the disequilibrium-stripping model of Nanson (1986), – the topography and deposits would best fit the "building" phase where levee aggradation overlies older eroded floodplain surfaces. This matches the observed inset deposit architecture.

Aboriginal Cultural Context

Aboriginal consultation has been undertaken in various stages for this project.

The Interim *Guidelines for Aboriginal Consultation* (DEC 2005) were enacted in 2010. This was in response to the requirements outlined by the then Department of Planning.

In 2012 DoF as the proponent for the project restarted the Aboriginal consultation and instigated the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW DECCW 2010). This was done so as to ensure that the consultation process was as thorough and up to date as possible.

Aboriginal representatives from the registered Aboriginal parties participated in both the field survey of the study area and the subsurface testing program.

Aboriginal Archaeological Context

Survey of the Moorebank IMT Project area was undertaken during 2010 and 2013 (NOHC 2011, 2013).

The 2010 field survey focused on all components of the Project area east of the Georges River (NOHC 2011). It identified eight Aboriginal archaeological recordings comprising five artefact occurrences (MA1-MA5), and three scarred trees of possible Aboriginal origin (MA6-MA8). In addition, three potential archaeological deposits (PADs) were identified (MAPAD1, PAD1 and PAD2) and three archaeologically sensitive landform types were defined (NOHC 2013).

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[1] Precise AHD relationships remain to be confirmed across the testing area. Elevations across the test area of the test pits were surveyed, once the flood-lain nature of the deposits across the test grid was established. Precise elevation relationships are required to interpret the significance of the deposit sequences encountered. A key element in the interpretive model developed in this report – is the relationship between AHD at Liverpool Weir and the elevations of upstream sediment overbank sequences encountered in this study. The Heritage significance of the deposits requires a precise understanding of the height relationships of the flooding surfaces seen in the ground, and datum relationships to the sill height and maximum flood levels reported at Liverpool Weir.

The field survey within the Northern Powerhouse land identified an additional area of PAD (MAPAD2) within one of the previously identified sensitive landform types (NOHC 2013).

In 2012 subsurface testing was undertaken at sites, PADs and archaeologically sensitive landforms within the Moorebank IMT Project area east of the Georges River. Fifty-nine (59) test pits were excavated across the following six test locations:

- MA1 (4)
- PAD2 (21)
- MA5 (11)
- MAPAD1 (10)
- MRSA1 (6)
- MRSA3 (7)

Two hundred and sixty-four (264) artefacts were recovered from 26 pits with the majority of artefacts recovered from MAPAD1 (N[2]=130) and MA5 (N=110). No artefacts were recovered from MRSA3 or PAD2. The majority of artefacts (N=245) were recovered from spits 1-5, i.e. within the upper 50 cm of intact deposits. The highest artefact incidence was at MA5 Pit 7, where 62 artefacts were recovered; the average artefact incidence was 20.31 artefacts per square metre.

Ten distinct artefact categories were identified within the Moorebank test excavation assemblage. The dominant assemblage elements were flakes (N=183 – including retouched [N=13] and utilised flakes [N=7]) and flaked pieces (N=55). Cores were the next most common artefact type (N=12), followed by backed artefacts (N=6);

The assemblage was dominated by silcrete (N=135), followed by quartz (N=46), quartzite (N=40) and basalt (N=10); smaller amounts of siltstone, fine grained siliceous (FGS), indurated mudstone, dolerite, tuff, fine grained igneous, limestone and chert were also present.

On the basis of the test excavation results within the Moorebank IMT study area land east of the Georges River, it was predicted that the river would have been a primary focus of Aboriginal activities such as camping, and food and resource procurement. It was further predicted that this may have resulted in the formation of archaeological deposits on the banks and flats. The extent to which such deposits may have been removed by subsequent flood scour and channel movement was identified as an active research question.

Subsurface Testing Program Results

A program of archaeological subsurface testing was undertaken at site MAPAD2. The subsurface testing program was undertaken following the methodology and research design that was used in the subsurface testing program for the rest of the Project and is described in Appendix 2.

Summary:

- Forty-five (45) test pits were excavated across MAPAD2 comprising 37 by-hand test pits and eight (8) mechanical pits;
- Detailed geomorphological analysis was undertaken at Pits 28, 29, 30, 31, 36, 41 and 42;
- Three additional pits were excavated for the purposes of geomorphological investigation within a portion of MAPAD2 that had proved to be archaeologically sterile in the upper 120 cm;
- Deposits excavated across MAPAD2 comprised three groups:

[2] N=number of artefacts

- poorly sorted clayey gravels that have been introduced in some areas, most notably across the southern and northern extremities of the test area, as fill (Unit 3);
- well sorted light grey or light brown clean sands with well-preserved bedding structures and minimal soil development (Unit 2); and
- dark grey-brown silty sands with abundant charcoal (Unit 1).

- 14 artefacts were recovered from 9 pits (Pits 1, 5, 9, 10, 12, 13, 14, 34 and 42);
- The majority of artefacts were recovered from the southern portion of MAPAD2 (N=13) and the 125 m long section from Pit 9 to Pit 14 (including Pit 42) was the area where artefacts were most consistently recovered (artefacts recovered from 6 out of 10 test pits excavated across this portion of MAPAD2);
- The highest artefact incidence was at Pits 1 and 5, where three artefacts were recovered from each pit;
- The average artefact incidence was 3.11 artefacts per square metre;
- The majority of artefacts (N=10) were recovered from spits 1-7, i.e. within the upper 70 cm of deposits, usually in association with the Unit 3 fill or Unit 2 sands;
- The artefact assemblage from MAPAD2 comprised four complete flakes, seven incomplete flakes, two flaked pieces and one broken core; and
- The assemblage was dominated by silcrete (N=8), followed by fine grained siliceous material (N=5), and quartz (N=1).

Excavation Analysis

General Properties of the deposits across the study area

Stratigraphic profiles observed in the test pits are broadly consistent with the geological mapping for the area, namely showing components of a very recent (Holocene) floodplain alluvial landscape. The test pits show a very high degree of well-preserved bedding structure. This was not expected, and is interpreted as reflecting very recent active sand mobilization and re-deposition associated with 19th and 20th century flood events.

Site Designations

Artefacts were recovered from the following test pit locations at MAPAD2:

- Pits 1, 5, 9, 10, 12, 13, 14, 34 and 42.

However, the deposits from which these artefacts were recovered appear, on the basis of geomorphological analysis, to be the result of recent deposition (Unit 2 - post 1836) and/or mechanical reworking of deposits (Unit 3).

On the balance of evidence it would appear that there are three sites present within the area defined as MAPAD2. These sites comprise:

- MA 11: artefacts associated with the Unit 3 fill that has been reworked and deposited as the result of mechanical earth works at the southern end of MAPAD2 (Pits 1 and 5);
- MA12: artefacts associated with Unit 2 fluvial sands across the central southern portion of MAPAD2 (Pits 9, 10, 12, 13, 14 and 42); and
- MA13: a single artefact associated with the Unit 1 silts at the northern end of the test area (Pit 34, Spit 9).

Given that it was not possible, to fully test the nature of the Unit 1 deposits, due to their depth (i.e. over 1.2 m deep and beyond the safe work depth), within the scope of the existing test excavation methodology, the area of archaeological potential identified as MAPAD2 remains

Significance Assessment

See Appendix 7 for a detailed assessment of the Northern Powerhouse land against the Commonwealth Heritage list criteria.

Initial desktop assessment and field survey (NOHC 2013) identified an area of archaeological potential along the western bank of the Georges River (MAPAD2). Subsurface testing within the upper 120-150 cm of deposits at MAPAD2 has revealed an intermittent and low density of stone artefacts within deposits that are thought to have formed during the past 200 years (MA11 and MA12). These artefacts are interpreted as not being *in situ*. A single small silcrete flake was also recovered from lower deposits thought to relate to the pre-1836 floodplain (MA13).

The identified sites (MA11-MA13), together with the broader area of archaeological potential in which they are situated, contribute to the overall significance of the Northern Powerhouse land and the Moorebank IMT study area as a whole.

The test excavation program within the Northern Powerhouse land has demonstrated that while the archaeological significance of the upper 120-150 cm of deposits is generally low, these deposits are likely to have significance in terms of being a representative example of environmental changes that resulted from European settlement, in particular the construction of the Liverpool Weir. The Unit 1 and Unit 2 deposits have the potential to be of significance in terms of their scientific value, natural value, educational value, representativeness and social value (importance to the Aboriginal community and the broader Australian community) at local, State and National levels.

The Georges River Corridor and terraces have previously been assessed to meet the threshold for listing on the Commonwealth Heritage List (NOHC 2013a), the results of the current subsurface testing program at MAPAD2 indicate the potential for increased significance of these landforms.

Assessment of Impacts

Impacts to Heritage across the Study Area

MAPAD2 and subsurface artefact occurrences MA12 and MA13, together with the Georges River Corridor and terraces meet the threshold for listing on the Commonwealth Heritage List.

The construction footprint encompasses the northern third of MAPAD2 (Georges River Corridor), inclusive of the identified site MA13. This is the area where the proposed north and south railway tie in lines would come in onto the bridge across the Georges River. Potential impacts in this area would include substantial surface modifications as well as pylons for the bridge itself. The pylons would have the potential to cause disturbance to Unit 1 and Unit 2 deposits within that portion of MAPAD2. The extent of potential disturbance will not be known until the detailed design has been completed.

The construction area to the south of the construction footprint would be utilised as a laydown and stockpile area as well as for vehicle parking. Vegetation within this area would be retained where possible. Potential exists for disturbance to Unit 2 deposits across this area and depending upon the nature of site preparation works, there may be disturbance to some sections of the Unit 1 deposits in this area.

Potential exists for disturbance to sites MA11 and MA12, however as noted above, these sites are of low archaeological significance due to the redeposited context in which the artefacts occur.

Impacts to Aboriginal Recordings

The proposed Moorebank IMT would have impacts on Aboriginal sites within and adjacent to the proposed construction footprint.

Site Number	Type of Harm	Degree of Harm	Consequence of Harm
Georges River Corridor	Partly within construction footprint	partially impacted	potential destruction of part of site
MAPAD2	Partly within construction footprint	directly impacted	potential destruction of part of site
MA11	within construction footprint	directly impacted	potential destruction of whole or part of site
MA12	within construction footprint	directly impacted	potential destruction of whole or part of site
MA13	within construction footprint	directly impacted	potential destruction of whole or part of site

<u>Management and Mitigation Strategies</u>

The proposed concept plan for the Moorebank IMT has the potential to directly impact the majority of the identified Aboriginal sites within the study area. Further assessment of the potential impacts of the Project and more detailed development of mitigation measures would be conducted during the detailed design phase of the Project, and future development assessments.

Given that the proposed impacts to Aboriginal heritage have the potential to result in the total loss of heritage values, a range of mitigation strategies need to be considered and implemented where applicable, i.e. where it is not practicable to avoid impacts, the following mitigation strategies will help minimise and/or offset the loss of heritage values.

Basis for Mitigation Measures

The following mitigation measures are considered appropriate to manage the impacts of the proposed Moorebank IMT:

- conservation areas;
- interpretation;
- additional testing of archaeological deposits;
- a stepwise strategy - phased improvement of the information base for assessment of heritage significance and mitigative planning at Northern Powerhouse land (Moorebank IMT); and
- care and management of recovered artefacts.

Impact Mitigation

For the Moorebank IMT Northern Powerhouse land it is recommended that:

- Immediate further data gathering, in a stepped progressive build of information should be undertaken to fill the following knowledge gaps regarding MAPAD2:
  - desktop study (of geotechnical borehole data and levels);
  - drilling to recover undisturbed sediment core (for assessment and dating and as an archive sequence); and
  - subsurface bulk sample retrieval (using augered mud bucket) to assess preservation conditions and artefact presence/absence at depth.
- Information recovered from future investigations at MAPAD2 should be incorporated into an Aboriginal heritage interpretation strategy for the project as a whole, developed in close consultation with the registered Aboriginal parties. The strategy could consider combining both European and Aboriginal interpretation within the project area;
- Consultation should be ongoing with the Registered Aboriginal parties throughout the life of the project and would include:
  - consultation on the future care and management of recovered Aboriginal objects;
  - methodologies for any future investigations;
  - finalisation of management and mitigation strategies subject to detailed design; and
  - the provision for comments on a draft version of this report.
- The unanticipated discoveries protocol at Appendix 10 should be followed in the event that Aboriginal objects or suspected burials are encountered during construction works.

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1. INTRODUCTION

1.1 Project Background

In May, 2010, the Australian Government tasked the Commonwealth DoF to conduct a *Feasibility Study* into the potential development of IMT at Moorebank in south western Sydney. The Moorebank Intermodal Company (Limited) (MIC) has been established to deliver this project and is acting as the agent for DoFD.

The IMT site is currently occupied by the School of Military Engineering (SME) the Department of Defence (Defence) to the west of Moorebank Avenue. The Government has approved the relocation of SME to new purpose-built facilities at the nearby Holsworthy Barracks with the move to be completed by around mid-2015.

Navin Officer Heritage Consultants Pty Ltd (NOHC) was commissioned in 2010 by Parsons Brinckerhoff to undertake a cultural heritage assessment for the Moorebank Defence precinct on behalf of the Commonwealth Government (DoFD) as part of the Environmental Impact Statement (EIS) for the project.

In April 2012 the Australian Government approved the development of the Moorebank IMT Project after reviewing the findings of a detailed business case for the facility (DoFD 2012). The project was subject to planning approval with an Environmental Impact Statement to be displayed in late 2013/early 2014 to enable public feedback. Both Commonwealth and NSW planning approvals are being sought.

DoE has determined that the Moorebank IMT Project is a ‘Controlled Action’ requiring the development of an EIS for assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). The DoF has lodged a submission under the EPBC Act and elected to make a submission under Part 4.1 of the New South Wales *Environmental Planning and Assessment Act 1979* (NSW) EP&A Act. Pursuant to the provisions of S 83(B) of the EP&A Act, a staged development application is proposed. This application is for a Stage 1 development application for the entire IMT. A staged development application sets out the concept proposals for the development of a site for which detailed proposals for separate parts of the site are to be the subject of subsequent development applications.

In February 2012, the NSW Department of Planning and Infrastructure (DP&I) issued Director General’s Requirements (DGRs) for the project.

The results of heritage studies conducted to date (surface & built environment), including field survey, the identification and assessment of heritage values, a review of potential development constraints, and Aboriginal and non-Aboriginal heritage assessments including subsurface testing have been documented in the following reports:

- a scoping report which presented a summary of known and potential constraints based on a desktop review (NOHC 2011);
- a report on existing Aboriginal and European Heritage ((DoFD 2011) which supported a Preliminary Project Environmental Overview (DoFD 2011);
- Aboriginal Heritage Assessment (NOHC 2013a) which formed part of the EIS submission; and
- European Heritage Assessment (NOHC 2013b) which formed part of the EIS submission.

This report is a Technical Paper that provides the results of a program of archaeological subsurface testing undertaken within the western portion of the project area, a location that was not included in the previous testing program (NOHC 2013a) due to constraints accessing the NPL. It provides an

Aboriginal heritage assessment of the western portion of the Project area that will be submitted as additional documentation to support the EIS.

This report was commissioned by Parsons Brinckerhoff.

1.2 The Project Site

The Project is situated on land in the south-western Sydney suburb of Moorebank, NSW (refer Figure 1.1). The Project Site is approximately 220 hectares (ha) in area, and is located within a locality that includes the residential suburbs of Casula, Wattle Grove and North Glenfield, as well as industrial, commercial and Department of Defence (Defence) land. The Project would provide connectivity to Port Botany by rail, and would connect to major regional and interstate roads and highways via the M5 and M7 Motorways.

The project site also includes a parcel of land on the western side of the Georges River where a rail crossing of the Georges River is proposed, connecting to the Southern Sydney Freight Line (SSFL). This land is currently owned by Liverpool City Council (LCC).

It is the land west of the Georges River (Lot 10 DP881265), referred to as the 'Northern Powerhouse land', that is the subject of the heritage assessment in this report.

1.3 Planning and assessment process

The purpose of this Technical Paper and the overall EIS is to seek approval for the Moorebank IMT Project 'concept' under both the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) as a controlled action; and the NSW *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act), as a Stage 1 state significant development (SSD) (see Appendix 1).

In seeking approval, DoF is seeking to establish a staged approval process, whereby successive stages of development on the Project Site would be subject to further environmental assessment and separate planning approval once further detailed Project information is developed. That is, the DoFD is currently seeking approval for the Project 'concept' (i.e. the broad parameters of the Project), sufficient to satisfy both:

- a Stage 1 SSD development application under the EP&A Act; and
- Commonwealth EPBC Act requirements for the Project, in relation to impacts of the proposed controlled action on matters protected under the EPBC Act (which comprise listed threatened specials and communities and impacts on the environment by a Commonwealth agency).

Therefore, this technical paper and the EIS assess the impacts of all three proposed development stages of the Project (Stages 1A, 1B and 2) to a concept level, and also provides a detailed assessment of matters protected under the EPBC Act. Further details of the Project would be the subject of future development applications under the NSW EP&A Act as those details are developed, with environmental impact assessments to be conducted in detail at that time. Impacts and mitigation measures would be confirmed following detailed design.

1.4 Environmental impact assessment requirements

This Technical Paper has been prepared by NOHC to address environmental impact assessment requirements of both the Commonwealth Government under the EPBC Act (the 'Final EIS Guidelines'); and the NSW Government under the EP&A Act ('the Director-General's Requirements (DGRs)')

Specifically this Technical Paper addresses the requirements outlined in Table 1.1 as they apply to the Northern Powerhouse land.

Table 1.1 EIS requirements addressed within this technical paper

Requirement	Where addressed in the technical Report Section #
EPBC Act – Final EIS Guidelines	
Provide descriptions of the existing environmental values, including social, historical, cultural and recreational values, of the site which may be affected by the proposal. The existing condition of those values will serve as a baseline against which impacts and management of the proposal and alternatives can be assessed.	4, 5, 6, 8 and 9
Identify, describe and map all places and items of indigenous cultural value.	5,6, 7, 8 and 9
Describe the impacts the proposed action would have on Indigenous cultural values including the continuing practice of traditional beliefs and access to sites. Provide evidence of an understanding of potential impacts to Indigenous heritage values through appropriate consultation.	3, 5, 10, Appendix 5
NSW EP&A Act - DGRs	
Outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the measures) generally consistent with the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC 2005).	5, 11
Be undertaken by a suitably qualified heritage consultant(s).	3
Demonstrate that an appropriate archaeological assessment methodology, including research design (where relevant), has been undertaken to guide physical archaeological test excavations of areas of potential archaeological deposits. The full spatial extent and significance of any archaeological evidence shall be established and results of excavations are to be included.	3, 7, 8, 11, Appendix 2

The draft DoE Guidelines for the Content of a Draft EIS states that:

> *Consultation with Indigenous stakeholders is an essential component for identifying and assessing the presence and significance of indigenous heritage items and places. Each of the following sections must include reference to how consultation with Indigenous stakeholders has informed the impact assessment process.*

1.5 Scope of this Report

This report comprises an Aboriginal heritage assessment for the Northern Powerhouse land within the Moorebank IMT study area that will form part of the submissions report; it includes the results of the subsurface testing program at Moorebank Aboriginal Potential Archaeological Deposit 2 (MAPAD2) within the Northern Powerhouse land west of the Georges River.

For information relating to the project area as a whole and the sites east of the Georges River the reader is referred to the Aboriginal Heritage Assessment Technical Paper (NOHC 2013a) that accompanied the EIS.

1.5.1 Report Outline

This report:

- Describes the proposed development/works etc. (Section 2);
- Describes the methodology employed in the study (Section 3);
- Provides details of an Aboriginal cultural context and the Aboriginal consultation program undertaken as part of the study (Section 5);
- Describes the results of the, archaeological sub-surface testing program and excavation analysis conducted in the context of the assessment (Sections 6-8);
- Provides an assessment of heritage significance for items identified within the study area (Section 9);
- Provides an assessment of potential development impacts to sites (Section 10); and
- Provides management and mitigation strategies based on the results of the investigation (Section 11).

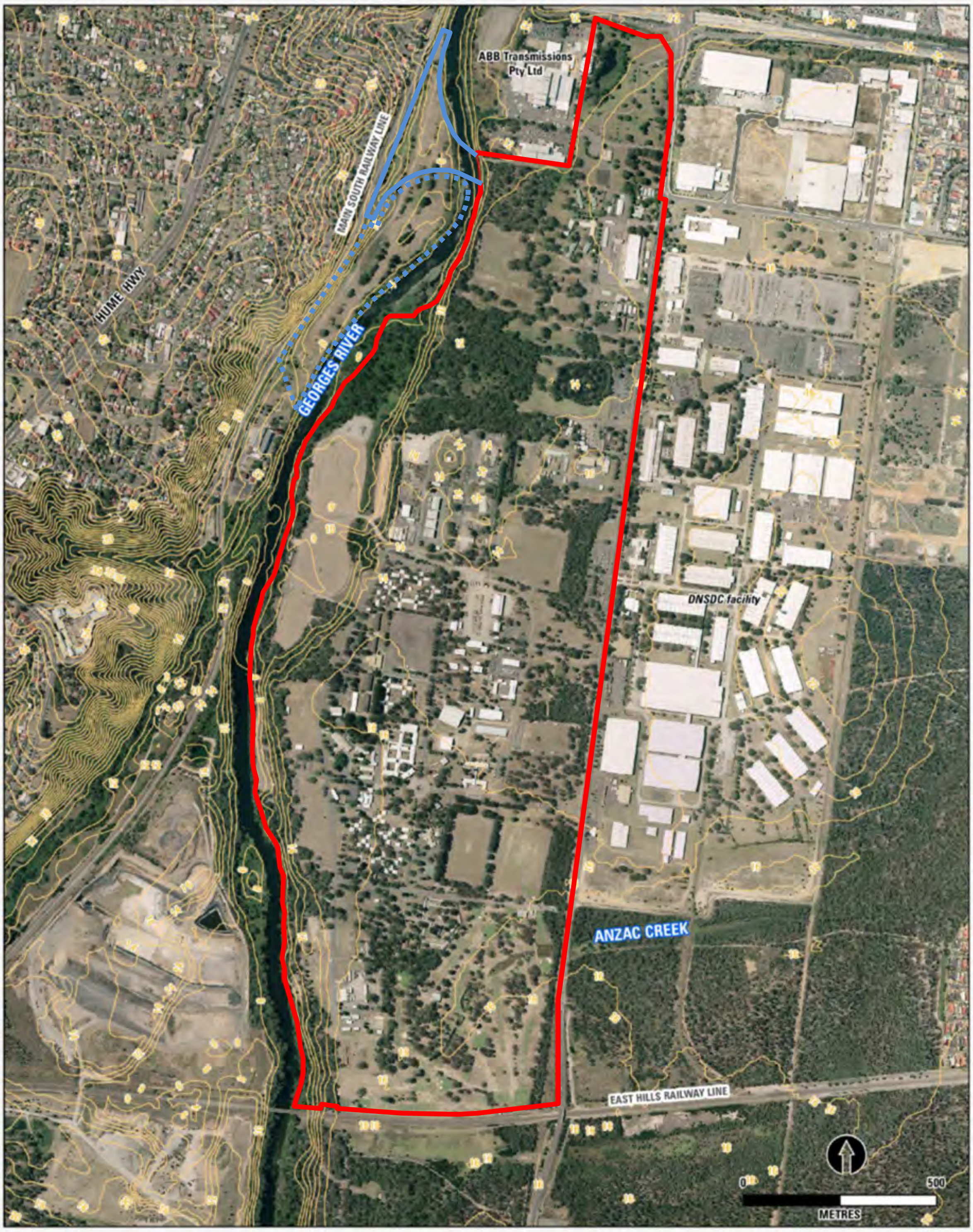
1.5.2 Copyright

Copyright to this report rests with DoF except for the following:

- the NOHC logo and business name (copyright to this rests with NOHC Pty Ltd);
- generic content and formatting which is not specific to this project or its results (copyright to this material rests with NOHC Pty Ltd);
- descriptive text and data relating to Aboriginal objects which must, by law, be provided to OEH for its purposes and use;
- information which, under Australian law, can be identified as belonging to Indigenous intellectual property;
- content which was sourced from and remains part of the public domain

1.5.3 Restricted Information

Information in this report relating to the exact location of Aboriginal sites should not be published or promoted in the public domain.



Moorebank Intermodal Terminal study area

Proposed construction area for rail tie-in to SSFL (assessed during Northern Powerhouse Land survey)

LCC Lands study area

Figure 1.1 Liverpool City Council Land Study area, Project site and context

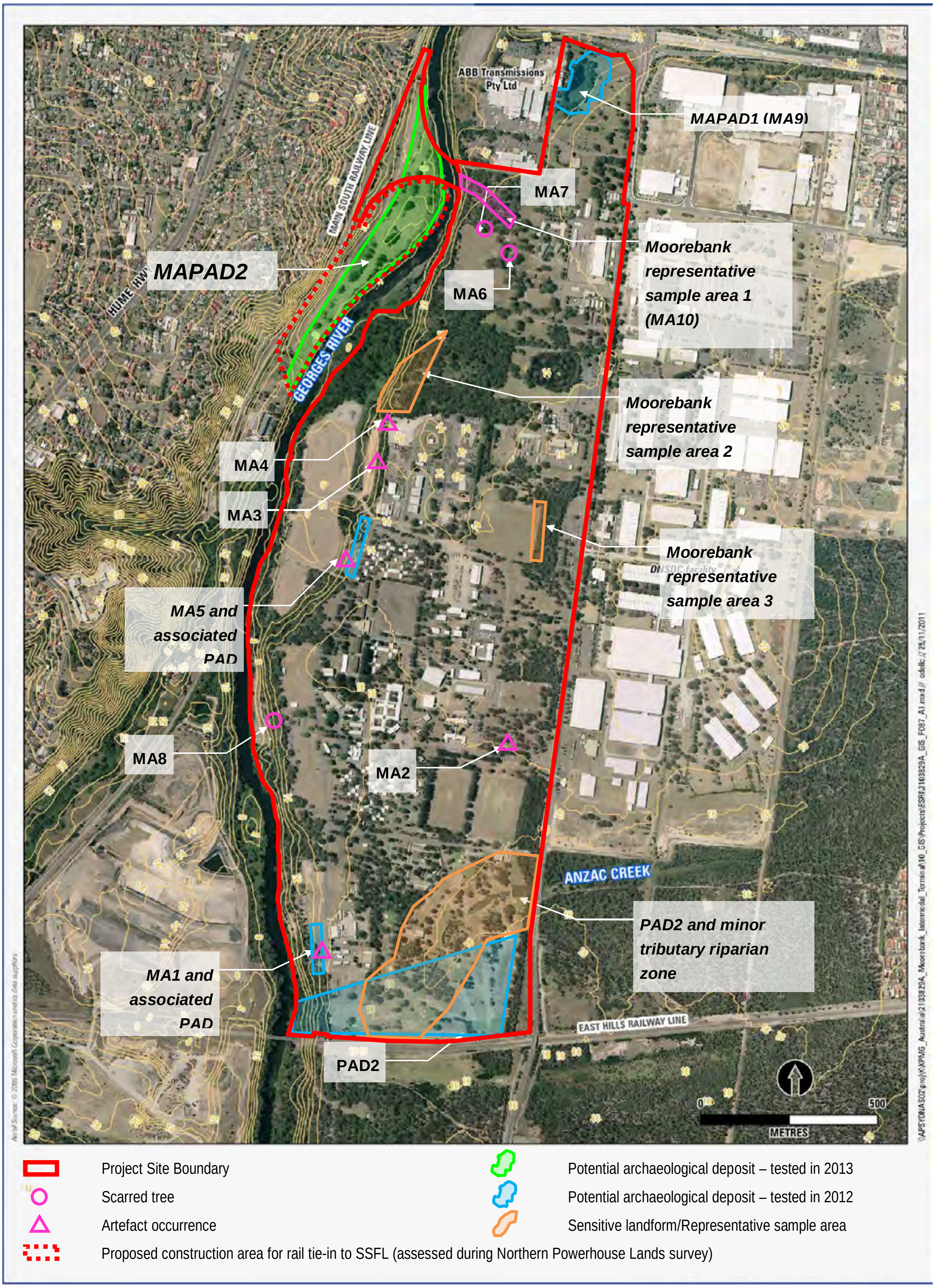


Figure 1.2 Location of Aboriginal test excavation areas – green, orange and blue shading – relative to recorded Aboriginal sites and the Project Boundary.

2. PROPOSED DEVELOPMENT

The Moorebank IMT involves the development of freight terminal facilities linked to Port Botany and the interstate freight rail network by rail. It also includes associated commercial infrastructure, a rail bridge connecting the site to the planned Southern Sydney Freight Line (SSFL) and road entry and exit points from Moorebank Avenue.

When completed, the Moorebank IMT would include:

- an import/export (IMEX) freight terminal where freight to and from Port Botany is handled;
- an interstate freight terminal where freight is received or handled prior to distribution outside the Sydney metropolitan region; and
- a warehousing development along Moorebank Avenue.

A concept plan has been developed (Figure 2.1) that places each of the above services within the project area. The concept plan also includes a conservation area or vegetation buffer between the Georges River and the IMT developed land. This area would be excluded from development and those areas within this zone that are currently cleared would be rehabilitated.

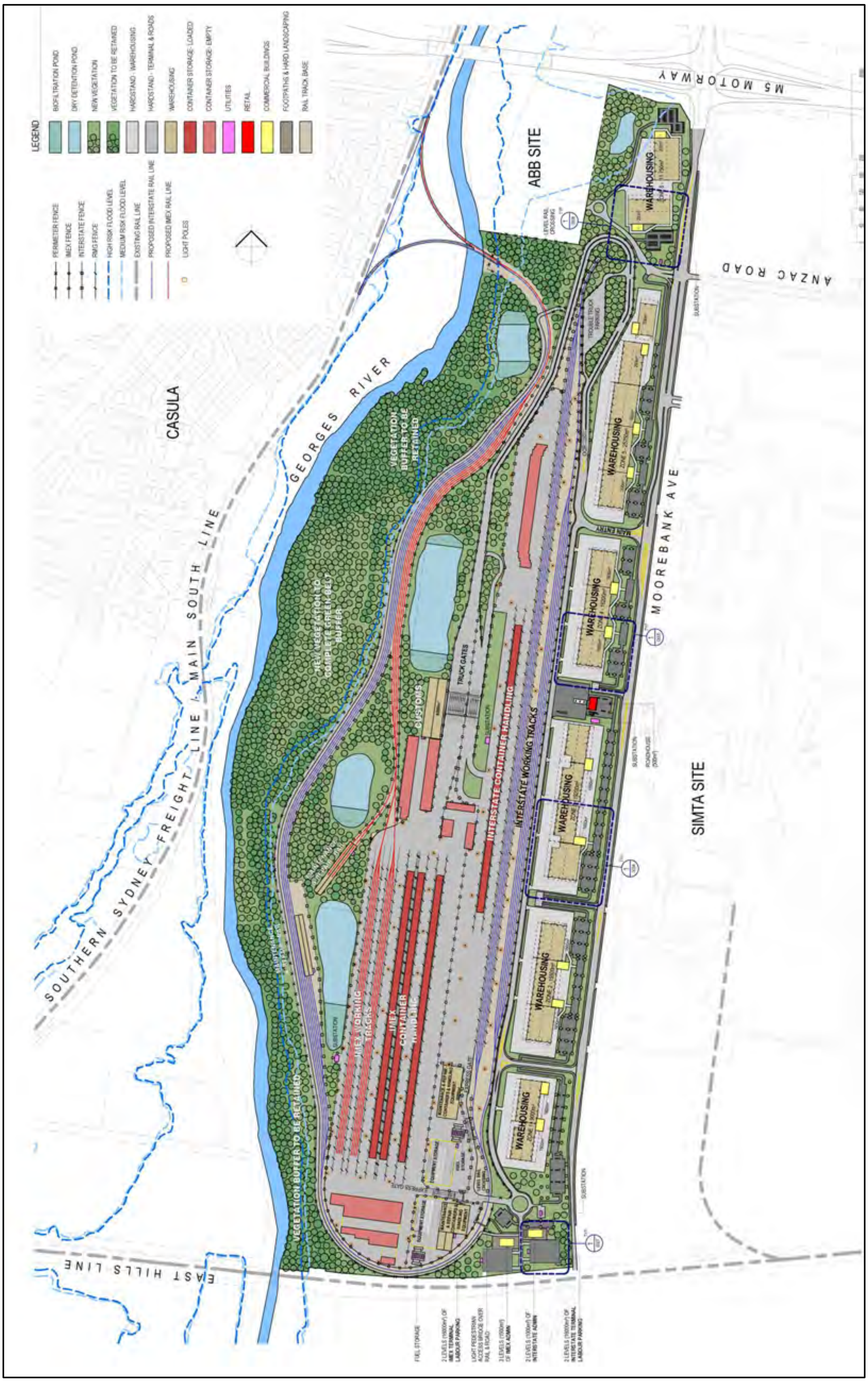


Figure 2.1 Moorebank IMT Concept Plan
(Suters 2011)

3. STUDY METHODOLOGY

3.1 Contributors

Preliminary field survey of the Northern Powerhouse land was undertaken by Rebecca Parkes and Adrian Cressey, and historical research for the preliminary investigations was conducted by Rebecca Parkes and Kelvin Officer in February 2013(NOHC 2013).

The excavation methodology and research design was developed by Rebecca Parkes and Kelvin Officer.

Test excavations were directed by Rebecca Parkes, field assistants included Jo Dibden, Deirdre Lewis-Cook, Damian Tybussek and Adrian Cressey.

Specialist reports on geomorphology and lithics analysis were provided by Anthony Barham and Oliver Macgregor respectively.

This report has been prepared by Rebecca Parkes, Anthony Barham and Nicola Hayes.

3.2 Land Access and Scope of Assessment

The assessment of the Northern Powerhouse land provided in the EIS was based on archaeological survey only as access to the land to the west of the river, the LCC Northern Powerhouse land, was not initially available. Direct physical inspection and archaeological survey was undertaken in February 2013.

The area subject to this assessment comprises the land to the west of the Georges River owned and managed by the Liverpool City Council. The assessment of the Northern Powerhouse land has been comprehensive and based on a review of archival sources and existing information, direct physical inspection, archaeological survey and test excavations.

An assessment of cultural heritage significance, and potential impacts to heritage values, has been undertaken for the Northern Powerhouse land and is documented in this report. It also includes an assessment of how the Northern Powerhouse land contribute to the overall cultural heritage significance of the study area.

3.3 Literature and Database Review

A range of archaeological data was reviewed for the Moorebank IMT study area and its surrounds. This literature and data review was used to determine if known Aboriginal sites were located within the area under investigation, to facilitate site prediction on the basis of known regional and local site patterns, and to place the area within an archaeological and heritage management context.

Aboriginal literature sources included the Aboriginal Heritage Information Management System (AHIMS) maintained by the NSW Office of Environment and Heritage (OEH) and associated files and catalogue of archaeological reports; and theses held in the library of the School of Archaeology and Anthropology, the Australian National University. Sources of historical information included regional and local histories, heritage studies and theses; parish maps; and where available, other maps, such as portion plans.

3.4 Subsurface Testing Program

3.4.1 Development of Subsurface Testing Methodology

The methodology for the subsurface testing program was developed in consultation with the Department of Planning and Infrastructure (DP&I), the NSW Office of Environment and Heritage

(OEH) and the Registered Aboriginal Parties (RAPs). This was in keeping with the Director General's Environmental Assessment Requirements for the Moorebank IMT project (SSD – 5066), which specified that, the research designs and methodologies for any physical archaeological works undertaken as part of initial heritage assessments should be reviewed by the DP&I and the OEH Environmental Protection Authority.

A draft version of the methodology was forwarded to the DP&I in July 2012, it was then forwarded by DP&I to OEH. Comments were received from OEH on 26/7/2012. Responses to comments and a revised draft were sent to the DP&I in August 2012 and a meeting held with NOHC, PB and DP&I on 29/8/2012. A final draft, before Registered Aboriginal Parties comment, was forwarded to DP&I in September 2012.

Consultation with the RAPs formed part of the Aboriginal consultation procedure required by OEH (DEC 2005, DECCW 2010) and is documented in Section 5.3.

A final version of the methodology was forwarded to DP&I in October 2012.

Additional details regarding the proposed test pit locations within the Northern Powerhouse land were forwarded to the DP&I in July 2013.

See Appendix 2 for the final agreed methodology.

3.4.2 Objectives and Research Questions

The primary objectives of the test excavation program were to:

- Conduct an investigation of sufficient scope, to gain a representative sample of the likely archaeological resource present at the test locations;
- Determine the nature and significance of any Aboriginal archaeological evidence within the test locations;
- Where necessary, determine appropriate strategies for the management of cultural heritage values related to any confirmed archaeological evidence, relative to the proposed Moorebank IMT development.

The test excavation program was directed at the following research questions

- How can the anticipated development impact of the Moorebank IMT project on any significant Aboriginal heritage values be effectively avoided or mitigated?
- What do the test results indicate about the past Aboriginal occupation of the project area and the Sydney region?
- How do the test results compare with other local and regional archaeological results and models?
- Does the subsurface archaeological resource accurately reflect the predictions on which the sensitive landform mapping is based?
- Based on the test excavation results, how can the local predictive model be refined or corrected?

3.4.3 Excavation Methods

Two excavation methodologies were used (NOHC 2012):

- mechanical test pit excavation using an excavator; and

- by-hand test pit excavation.

The mechanical test pit methodology was employed initially at the southern end of MAPAD2 where disturbance levels appeared to be greatest[3]. Following completion of excavation at the first six test pits it was decided to change to by-hand excavation as the extent of disturbance was significantly reduced and there appeared to be good potential for *in situ* deposits. The remainder of test pits were excavated by-hand with the exception of the following three pits:

- Test Pit 7, where disturbed fill extended down to such a depth that mechanical excavation of the lower, more intact, deposits proved more efficient;

- Test Pit 30, where excavation of compacted clayey deposits below a disturbed cap of fill proved virtually impossible to excavate by-hand; and

- Test Pit 45, was excavated to test deposits below 80 cm, following geomorphological confirmation that the upper sterile sandy deposits were most likely the result of recent flooding events.

Machinery was also used to remove fill and/or recent sand deposits to establish a safe surface for hand excavation of intact deposits at the following pits:

- Test Pit 7 – cut down 10 cm to natural deposits;

- Test Pit 10 – cut down 10 cm to natural deposits;

- Test Pit 11 – cut down 20 cm to natural deposits;

- Test Pit 28 – cut down 40 cm to natural deposits;

- Test Pit 39 – cut down 30 cm to natural deposits;

- Test Pit 40 – cut down 25 cm to natural deposits;

- Test Pit 41 – cut down 60 cm through sterile sand deposits to test deposits at greater depth; and

- Test Pit 42 – cut down 60 cm through sterile sand deposits to test deposits at greater depth.

See Appendix 2 for detailed methodology.

3.5 Scope of Test Excavation Pits

Archaeological test excavation occurred within the following landscape categories and combinations, where direct impact from the Moorebank IMT development is anticipated (Figure 1.2):

- Georges River riparian zone: MAPAD2.

Wherever possible, test pits were arranged in straight line transects and situated within the anticipated development footprint (the area subject to direct construction impact). The distance between test pits on transects was normally 25 m, except in the following circumstances:

- the avoidance of an erosional or other disturbance feature required a one-off larger or smaller interval;

[3] The extent of subsurface disturbance was based on surface survey and information provided through ground penetrating radar survey undertaken to check for underground services.

- an on-site appreciation of landform and archaeological potential indicated that a larger or smaller interval was necessary; or
- an in-field assessment of initial test pit results supported the conduct of additional (contingency) test pits at closer intervals or outside of a formal transect configuration.

3.6 Geomorphological analysis

Geomorphological analysis of soil profiles at selected test pits was undertaken as a component of the subsurface testing program. This was done in order to inform conclusions regarding the depositional origin, integrity and likely age of archaeological deposits.

In areas where test pits yielded no artefacts or site evidence, selected pits were extended/opened by machine excavation as geomorphological test pits (GTPs). The aim was to:

- establish stratigraphic relationships by exposing longer sections; and
- allow safe examination of deposits to greater depths.

These trenches were benched and extended down to up to 3 m below surface. The deeper stratigraphy confirmed that upper sands across the testing area are of very recent age, burying parts of an earlier historic/prehistoric floodplain surface. The earlier floodplain surface is only exposed in deeper parts of test pits, and at lower elevations across the site (e.g. in the surfaces of chute channels/swales).

Detailed records of the sequences were made in the field. Recording comprised detailed section drawing, photography and pH testing of units, and examination of sections and inclusions. Reference sediment sampling of drawn sections was undertaken prior to backfilling.

All test pits examined were between 100 cm and 120 cm, except where extensions were cut by machine. Selected sections were cleaned before being described and drawn.

Observation conditions were excellent, with light sun or slightly overcast conditions. Soils were damp to slightly damp when freshly cleaned. The water table was only encountered in one deep excavation completed by machine at GTP1, at > 2.5 m below surface.

3.7 Laboratory Analysis

3.7.1 Aims of the artefact analysis

One of the primary aims of the analysis of the lithic items retrieved from the test location was to assist in the assessment of the significance of the site/deposits and to identify appropriate management strategies.

The lab analysis of stone objects also aimed:

- To characterise the objects recovered in terms of the number of identifiable prehistoric stone artefacts.
- To assess the variability within the artefact assemblage in terms of the types of stone material that were used, and the types of artefacts the prehistoric artisans created.
- To determine if possible whether the distribution of artefacts across the site, and the physical attributes of the artefacts themselves, are indicative of the existence of a prehistoric site at the study area – or conversely whether the artefacts have been deposited at the study area through fluvial transport by the George's River.

3.7.2 Method of artefact analysis

The method employed to record the nature of the stone artefact assemblage was developed to answer the aims of the analysis. The variables measured were accordingly selected to enable questions relating to the raw material composition of the assemblage, technological patterns of artefact production, and spatial distribution of artefacts to be answered. The variables recorded for each stone specimen in the assemblage are outlined in Table 3.1.

Table 3.1 Variables recorded on artefacts, with a description of how observations were recorded for each variable

Variable	Observation recorded
ID	Each specimen was allocated a sequential number.
Pit	Pit number
Spit	Spit number
Technological type	Flake, core, retouched flake, flaked piece, indeterminate shatter, hammer, eraillure, anvil, ground artefact
Completeness	Complete, proximal fragment, medial fragment, distal fragment, LCS left, LCS right
Raw material	Silcrete, quartz, quartzite, chert, FGS, volcanic, sandstone
Colour	Grey, beige, red, white, grey/beige, grey/pink, clear, brown, beige mottled, pink mottled, grey mottled, red/yellow, white/yellow, orange, purple.
Initiation	Conchoidal, bending, axial
Platform type	Cortical, single, multiple, facetted, focalised, shattered
Termination	Feather, step, hinge, inflex, retroflex, outrepasse
Dorsal scars	Number of dorsal scars
Retouched	Retouch scars present or absent
Cortex	Percentage of cortex on dorsal surface (recorded to nearest 10%)
Weight	Weight in grams (to nearest 0.1 g)
Length	Length along percussion axis in mm (to nearest 0.1 mm)
Width	Width perpendicular to percussion axis in mm (to nearest 0.1 mm)
Thickness (percussion)	Thickness perpendicular to length and width in mm (to nearest 0.1 mm)
Platform thickness	Thickness of platform in mm (to nearest 0.1 mm)
Platform width	Width of platform in mm (to nearest 0.1 mm)

Variable	Observation recorded
Maximum dimension	Artefact's maximum dimension in mm (to nearest 0.1 mm)
Maximum width	Maximum width perpendicular to, and half-way along, the maximum dimension in mm (to nearest 0.1 mm)
Thickness	Perpendicular to maximum dimension and maximum width in mm (to nearest 0.1 mm)
Core type	Single platform, multiple platform, bipolar
Implement type	Typological category (if any) within which the artefact could fall
Non-artefactual	Non-artefactual shatter, Pebble, Cobble, Gravel, Potlid
Notes	Any points of interest not recorded elsewhere

Further definition of the variables and attributes listed in Table 3.1 are provided below to assist readers with interpretation of the results of the artefact analysis.

Technological type: Classification of artefacts was based on technological criteria. The term "technological type" is used instead of "type" in this document, as type is often used to refer to formal tool types such as backed artefacts. The following categories have been identified in the assemblage:

Core: Cores are a piece of rock from which flakes have been detached. Cores are characterised by negative flake scars where flakes have been detached.

Flake: A sharp edged piece of stone detached from a core by the application of force. Flakes are characterised by a number of features which may include a platform, bulb of percussion, a bulbar scar, ripple marks and fissures on the ventral surface and negative flake scars on the dorsal surface.

Retouched flake: A flake which has had flakes removed from it, subsequent to its original manufacture. A retouched flake has an identifiable ventral surface, and negative scars that are derived from or intrude onto this ventral surface.

Flaked piece: A flaked piece is an artefact that exhibits negative flake scars, and one surface which could possibly be a ventral surface. A flaked piece does not have any other features that would enable identification as a flake, a retouched flake or core. This category is therefore an ambiguous one, and is used only for artefacts which cannot confidently be categorised more specifically.

Hammer: A piece of stone, usually a pebble, which possesses pitting or furrowing indicative of hammer impacts.

Anvil: A piece of stone which possesses pitting usually on a wide flat surface, indicating that it was struck repeatedly.

Ground artefact: Any piece of stone showing an area or areas which have been ground or polished.

Eraillure: A lens-shaped piece of stone which shatters off the bulb of a flake as the flake is struck (Faulkner 1972).

Raw material - The raw material of each artefact is categorized according to the following:

Colour – The purpose of recording the colour of raw material is to assist during analysis in identifying source material (if possible), related objects within an episode or episodes of stone reduction and to infer heat treatment.

Raw material – The following raw materials were identified in the assemblage:

Chert: A cryptocrystalline siliceous rock of organic or inorganic origin. Chert is isotropic and brittle (Domanski, et al. 1994). It is accordingly a highly favoured rock for artefact manufacture.

Quartz: The mineral quartz is crystalline silica with a hardness value of 7 (Mohs hardness scale). Given this property quartz flakes possess highly durable sharp edges (Domanski, et al. 1994). However given quartz possesses internal flaws and cleavage planes it typically flakes in an unpredictable manner (Cotterell and Kamminga 1987).

Silcrete: This rock is formed by the impregnation of a sedimentary layer with silica; it consists of quartz grains in a matrix of either amorphous or fine-grained silica. The fracture properties of silcrete are dependent on the size of the quartz grains (Domanski and Webb 1992; Domanski, et al. 1994).

Quartzite**:** Quartzite is formed by the cementing together of siliceous grains through pressure, heat and chemical processes. Fracture properties and flaking quality are variable, depending on how cohesively the individual grains have been cemented together.

FGS**:** Acronym for fine grained siliceous rocks, covering chert, siltstones, mudstones, tuff etc where identification is unclear without petrological analysis.

Sandstone: sand grains cemented together by a siliceous matrix. Usually friable and crumbly.

Initiation type – The type of primary fracture initiation, recorded as one of the following:

Hertzian: (also known as conchoidal fracture) Formed when stone is struck by a hammer forming a ringcrack; the ringcrack forms a cone that bends backward towards the surface of the core (Cotterell and Kamminga 1987; Crabtree 1972a).

Bending: (also known as opening fracture) Formed when the angle between the platform and surface of the core is acute. Initiation results from a simple opening fracture which forms on the platform surface. Flakes do not possess clear ringcracks or well defined bulbs of percussion (Cotterell and Kamminga 1979; Tsirk 1979).

Axial**:** (also known as wedging fracture) Formed as a result of the compressive stress created by the hammerstone or indenter pressing into the platform surface. This compressive stress causes the material under the indenter to bifurcate in a symmetrical fashion, which leaves no ringcrack or bulb of force as found on Hertzian initiations. Axial initiations are commonly called "wedging" initiations by archaeologists (Cotterell and Kamminga 1979, 1987; Cotterell, et al. 1985).

Platform type - The platform surface is the surface from which fractures begin propagating. The following classifications of platform surfaces were used:

Single: Single flake scar.

Multiple scars: With two or more scars.

Cortical: Retaining evidence of cortex.

Shattered: Sheared away during flake production: platform attributes cannot be identified.

Facetted: Three or more relatively small flake scars in uniform arrangement.

Focalised: Fracture initiates close to the edge of the platform, and only a very small platform surface is present (usually no more than twice the area of the ringcrack formed at the initiation point).

Termination type – Termination refers to the manner in which the fracture ceases to propagate by running to meet a free surface. The termination type is classified according to how the fracture surface and the free surface (i.e. the distal surface of the flake) meet (Cotterell and Kamminga 1987).

Feather: Exhibits minimal thickness at the distal end and acute angle between ventral and dorsal surface.

Hinge: Forms when the fracture curves sharply and meets the surface of the core at c. 90º to the longitudinal axis of the flake.

Step: Forms when flake terminates abruptly in a right angle break.

Inflex: A hinge termination on which the fracture surface deviates in the distal direction just before termination, leaving a "finial" or "lip" on the flake (Cotterell and Kamminga 1986; Sollberger 1986). Also known as a "languette" fracture (Lenoir 1975).

Retroflex: Similar to an inflex, except that the deviation of the fracture surface is toward the proximal end of the flake: that is, the fracture curves back in the direction of the platform surface (Cotterell and Kamminga 1979, 1986).

Outrepassé: Forms when the fracture plane curves away from the face of the core and terminates on the opposite side of the core, removing the core's base. Also known as a plunging termination.

Percentage of cortex – An estimate of the percentage of cortex present on an artefact. On flakes the estimate refers to the dorsal surface only.

Completeness: This category records whether an artefact is complete or a fragment of a complete artefact. Cores were coded simply as complete or incomplete. Flakes (including retouched flakes) were coded as one of the following categories:

Complete: A complete flake, in which the platform surface and all original flake margins are intact.

Distal fragment: A broken flake which is missing its proximal end. These fragments do not possess their original platform surface.

Medial fragment: A broken flake that is missing its proximal and distal ends. This fragment is the original flake's mid-section, exhibiting dorsal scars and ventral surface features.

Proximal fragment: A broken flake which is missing its distal margin, but retains the platform and initiation.

Longitudinal cone spit (LCS left and right): A flake broken longitudinally, in which the break bifurcates the bulb of force and the ringcrack. This distinctive breakage pattern occurs during flaking event. Separate categories for left and right LCS portions were used to facilitate artefact number estimates. Note that the LCS category can only be applied if the bifurcated ringcrack and bulb of force are present.

Marginal fragment: A flake broken transversely or longitudinally, which is lacking both its initiation and termination, and has a section of only one of the original flake's lateral margins.

Margin missing: A flake which has been broken and is missing a portion, or several portions of its lateral margins, but which has retained both its platform and its distal margin.

Length: On flakes (including retouched flakes) this measurement was taken from the initiation point, along the percussion axis (Figure 3.1)

Width: On flakes (including retouched flakes) this measurement was taken perpendicular to length, and half way along length, from one margin of the flake to the other (Figure 3.1).

Thickness (percussion): On flakes (including retouched flakes) this measurement was taken at the intersection of length and width, and perpendicular to both length and width.

Platform width: On flakes (including retouched flakes) this measurement was taken across the platform, from one margin of the flake to the other (Figure 3.1).

Platform thickness: On flakes (including retouched flakes) this measurement was taken perpendicular to platform width, from the initiation point to the dorsal surface of the flake.

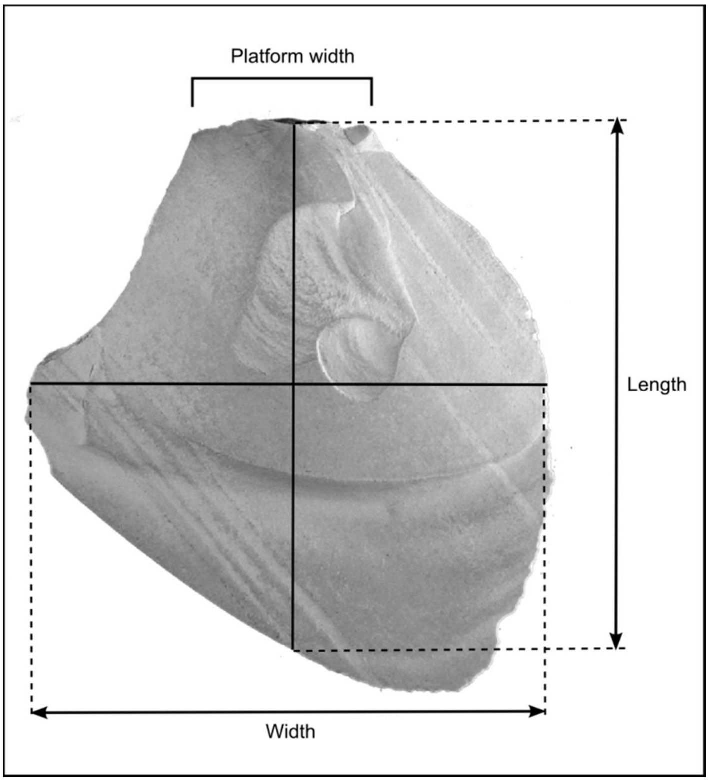


Figure 3.1 Length, width and platform width measurements on a flake

Maximum dimension: Taken on all artefacts, along the maximum dimension between any two points on the artefact (Figure 3.2).

Maximum width: Taken on all artefacts, along the maximum distance perpendicular to the maximum dimension measurement, and halfway along the maximum dimension measurement (Figure 3.2).

Thickness: Taken on all artefacts, at the intersection of the maximum dimension measurement and the maximum width measurement, and perpendicular to both these measurements.

Core attributes: these are recorded for cores only:

Type of core: Refers to number of platforms and/or the initiation type of the flake scars on the core. Categories were:

> Unidirectional: Flake scars are all initiated from the same platform surface, and run in the same direction.
>
> Bidirectional: Flake scars are initiated from two different platform surfaces, and run in two directions. In other words, the core has been rotated once.

Multidirectional: Flake scars are initiated from more than two different platform surfaces. In other words, the core has been rotated more than once.

Bipolar: A core which has at least one flake scar which is bipolar. A flake scar was judged to be bipolar if it exhibited battering or damage to its distal end indicating that its distal end was supported on a hard object while the flake was removed.

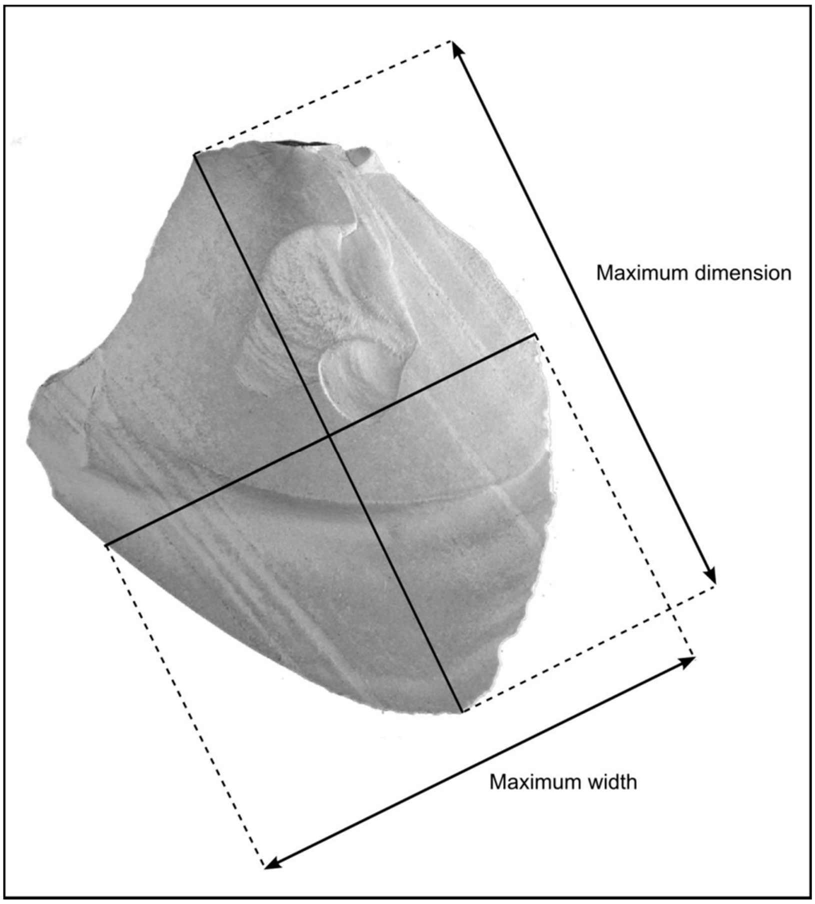


Figure 3.2 Maximum dimension and maximum width measurements

Non artefacts – In any archaeological excavation, some of the specimens collected are not artefactual in the sense that they have no fracture surfaces that can be confidently identified as having been produced by humans. These were classified as gravel, cobbles or pebbles if they had no clear fracture surfaces at all. Potlids (round lens-shaped pieces of rock broken off during heat-fracturing of larger rocks) were recorded. Fragments of rock with other heat fracture surfaces, such as exfoliation scars or crenated fracture, were also recorded. Pieces of rock with fractures that were not identifiable having been created by humans or by heat were recorded as non-artefactual shatter.

Implement type: If artefacts had a suitable morphology to be classified into any existing formal tool types, this was recorded. Only types which are commonly in use in Australia were employed. These include backed artefacts (triangles, trapezes, crescents, trapezoids, woakwines), juan knives, tula adzes, burren adzes, gravers, horsehoof cores, thumbnail scrapers, unifacial points, pirri points and bifacial points.

4. GEOMORPHOLOGICAL CONTEXT

The following sections provide a geomorphological context for the Northern Powerhouse land study area. Particular attention has been given to the context of the subsurface test excavations conducted as a component of this heritage assessment. This background informs the available landform and deposit mapping – which in turn underpins the definition of the archaeologically sensitive landforms that have been targeted for subsurface testing.

Key issues considered in this report are:

- the likely historic (mainly late 19th and 20th century) ages of the overlying river sands
- the heritage significance of the sands as flood records (natural and cultural)
- the heritage significance of the earlier floodplain soil and deposits buried at depth beneath the sands (natural and cultural)
- the environmental archaeological record and historic archaeology potentially preserved in the deposits which lie close to or below the watertable

The watertable has probably been raised by the construction of the Liverpool Weir in 1836. The preservation conditions and deposit context across the study area may be unique when evaluated against the upper tidal limits of other river systems entering Port Hacking, Botany Bay and Port Jackson. This is a consequence of it being located within the reach of the river which has adjusted to the reduction in gradient caused by the weir construction.

4.1 Geographical Context of the Site

The investigated locations lie on a low north-south aligned and undulating bench of sandy alluvial topography on the western bank of the Georges River, near Casula. The area is low-lying, at around 7-11m AHD[4]. The Georges River forms the western boundary of the study area. The majority of the study area is undulating ground, comprising levee bank and swale topography on the river margin.

At Casula, the Georges River is above the tidal limit on the Georges River, now artificially positioned at Liverpool Weir. Prior to construction of the weir in 1836 the study area would have been in the estuarine upper reach of the Georges River.

The Georges River catchment is large, over 960 km^2 with a 30 km long tract of estuarine channel extending from Botany Bay upstream to Liverpool. The study area is therefore located at an important natural transition point, between the upstream catchment extending south and southeast to the watershed with the Cumberland Plain, and a vast area of estuarine and wetland environments downstream.

Estuarine areas have been heavily impacted by development and experienced major ecological shifts as a consequence of urban 19^{th} and 20^{th} century development (Haworth 2002). Prior to European contact the resources available to Aboriginal people upstream and downstream of Casula

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[4] Precise AHD relationships remain to be confirmed across the testing area. Elevations across the test area of the test pits were surveyed, once the flood-lain nature of the deposits across the test grid was established. Precise elevation relationships are required to interpret the significance of the deposit sequences encountered. A key element in the interpretive model developed in this report – is the relationship between AHD at Liverpool Weir and the elevations of upstream sediment overbank sequences encountered in this study. The Heritage significance of the deposits requires a precise understanding of the height relationships of the flooding surfaces seen in the ground, and datum relationships to the sill height and maximum flood levels reported at Liverpool Weir.

will have been considerable (Attenbrow 2002). Food and water supplies will have been relatively abundant, varied and at this point on the river, dependable in terms of water availability.

The riverine tract at Casula is narrow, marking the upper limit of the deeply incised valley systems cut into the Triassic sandstone block which have become drowned valleys since inundation by rising eustatic sea levels (Roy 1984). The north-flowing reach of the Georges River at Casula is constrained within a relatively narrow linear gorge, with steep sides and locally deeply weathered saprolite and bedrock close to the site.

The deposits under investigation represent an inset deposit within the broader ancient valley side alignment. The narrow valley topography severely limits the capacity of the Georges River to meander through this section.

Within geomorphic models used to classify inset valley deposits e.g. the disequilibrium-stripping model of Nanson (1986) – the topography and deposits would best fit the “building” phase where levee aggradation overlies older eroded floodplain surfaces. This matches the observed inset deposit architecture.

4.2 Recent and historic geomorphological changes in the Georges River

Landforms on the immediate east side of the river from the study area (Figure 4.1) are significantly lower in altitude than on the west bank, and form a low-lying (recently wooded) bench. Channel migration associated with levee breaching and avulsion during floods, appear to have been active, probably within the last century.

In the study area, on the west bank, the river bank is formed by a sand levee system, with highest topography adjacent to the channel, and upstream. Land surface elevations decrease westwards through the testing area (see Figure 4.2) into low swales between the levee banks and the railway, and also northwards through the testing area.

Most test pits lie at between 7 and 9.5 m AHD. Numerous historic floods will have reached an overbank condition along this reach, in the last 100 years, overtopping levee surfaces.

Figure 4.1 Aerial view of the MAPAD2 study area
(LPI SiX Maps 2013)

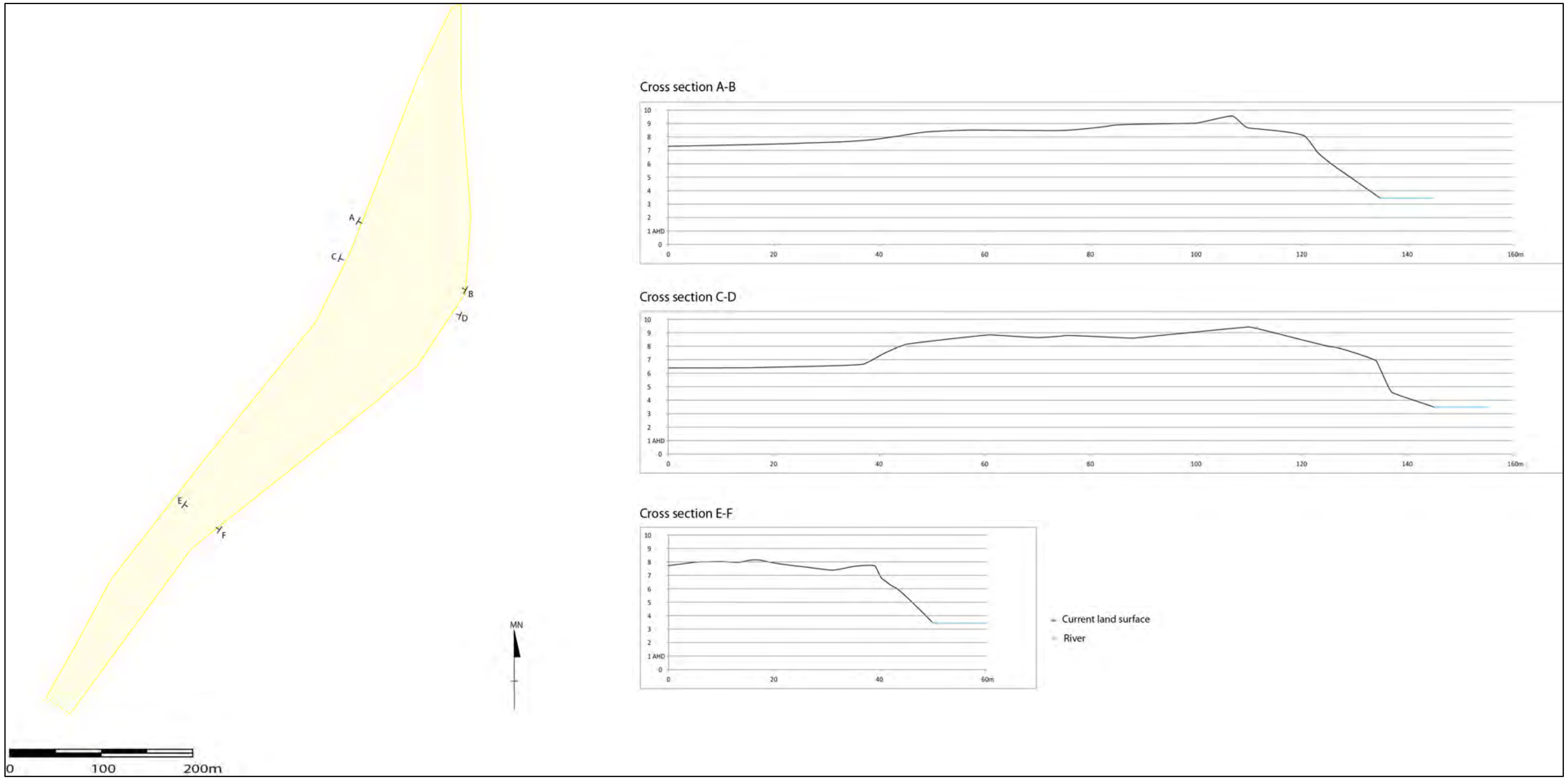

Figure 4.2 Cross section levelling data for surface levels across the study area

Two separate levee landforms appear to exist across the study area. A higher and larger levee, which extends upstream, has been breached, and now exists as two blocks. Test Pits 1-7 sample the upstream block and (southern) end of the higher levee. This area produced most of the artefacts recovered. A levee breach (crevasse) exists in the vicinity of Test Pits 9-12 and 41-42. North of the crevasse breach, across the area sampled, this levee continues as the higher ground of the area (Test Pits 14-18). This area is eroded on its western margin in the southern block by the chute channel edge, produced by avulsion through the breach. A second lower levee forms the near-channel ridge in the northern part of the testing grid (sampled by Test Pits 26-29, and Test Pits 32-40).

Unconsolidated sediments form channel lags, flood sand banks, mid-channel bars, shoals and silt flats in the present channel and floodplain floor adjacent to the study site. Extensive alluvium deposits occur throughout the low gradient reaches of the Georges River upstream of the present day tidal limit (DIPNR 2004). A plentiful supply of sands has existed in the channel to deposit in the levee systems during floods.

Mid-channel bars can be seen in the 1943 aerial photograph. The 1943 aerial photograph of the study area (see Figure 4.3) shows the breaching of the levee bank in the south of the testing area, and the avulsion chute west of the levee. Extensive areas of un-vegetated sand, spread northwards. This means the main levee breach pre-dates major floods in 1956, 1986 and 1988. Much of the surface topography may, therefore, relate to the late 19th century or earlier. Low lying areas in the swales and the breach areas may have been re-activated during the later 20th century floods.

Weirs and flood protection infrastructure, along with dam construction in parts of the upper catchment, have extensively altered the natural flood discharge regime (NSW Govt 2005). The weir constructed at Liverpool in 1836 now marks the tidal limit upstream. The natural tidal limit will have shifted vertically and laterally during the Holocene – a factor of considerable significance in relation to prehistoric use of the area. Deposits identifying this process of movement in the tidal regime have natural and cultural heritage significance, and scientific value.

In the past alluvium deposits have been mined for aggregate on the Georges River (DIPNR 2004; Dunston 1990; Haworth 2002). Specific historic aggregate removal from the study area is not known, but remains a possibility. Local extraction and machine movements of sands across the study area may have taken place when the Golf Course was created. Stratigraphic evidence for this was not encountered during testing, except for deposition of imported clayey fill.

The sediments seen in the Georges River today reflect disturbance throughout the catchment since the 1830s. Massive mobilization of both sandy and silt-rich sediments has occurred from upper tributary catchments to estuary in the last 200 years (Gale et al. 2004) in the Sydney region, and on most catchments with pastoral farming across NSW (Erskine 1994; van Dijk 1959).

Sediments deposited in floodplains reflect river flow conditions (as beds). floodplain landform relationships with channels (as groups or sets of beds and as trends in deposits) and broader environmental changes (e.g. climate, tectonic movements, land use) as broader stratigraphic units (Brown 1997; Fritz and Moore 1988; Miall 1992; Reid and Frostick 1994).

Alluvium also has capacity to archive records of catchment disturbance (e.g. from fire or human interventions such as construction or mining), climate (Nesje and Dahl 2003) and preserve whole land surfaces with archaeology on those surfaces (see Barham et al 1995, 1996; Bridgland 1994; Brown 1997; Needham 1985).

The sediment environments (and sources) in the Georges River are directly relevant to the archaeological record (and heritage significance) of the study area in at least three ways;

- they illustrate the dynamic nature of the contemporary fluvial environments of the George River as a baseline against which to compare the historic and prehistoric floodplain settings and ecology;
- they represent sediments sources which may have episodically contributed to the stratigraphy across the study area during extreme floods and by wind (aeolian) action;

- the sedimentary environments may archive a record of the range of floodplain habitats available to Aboriginal people in the past as resources, and also changes on slopes and floodplains arising from the activities of early European settlers; and
- The Georges River floodplain and estuarine limit were key areas historically, in the often hostile engagement between settlers and indigenous Aboriginal groups, for which direct archaeological evidence is limited (Attenbrow 2002).

Figure 4.3 1943 Aerial image of the study area
(LPI SiX Maps 2013)

Preservation of historic structures e.g. bridges, wharves, fences and buildings commonly results from rapid deposition of alluvium during major floods, especially during periods of major flood channel change (avulsion flow). Such circumstances are most common where the floodplain is actively aggrading. Detecting archaeology beneath alluvium requires special approaches for site discovery (Barham et al. 1996; Bates and Barham 1995; Brown 1997; Needham 1985) especially during archaeological mitigation of impacts of large industrial or transport infrastructure.

Mitigating effects of deep vibrocoring, piling and dewatering on deeply buried archaeological deposits (potential or identified) requires close collaboration between engineers and archaeologists (Bates et al. 2000).

Defining the environments present in this area of the Georges River, and the impacts and processes of change which took place from the 1790s to mid-1840s, is important historically. Sediments and stratigraphy which record such events and time frames through to the 20th century therefore have considerable potential natural and cultural heritage significance.

Establishing the natural local environments present historically, and prior to European insurgency, also has considerable community value in providing baseline information for ecological management and habitat conservation of riparian environments. Local Registered Aboriginal Parties may see significant value in heritage outcomes which seek to preserve evidence of floodplain "country" which existed before European clearance.

4.2.1 Geomorphological context over later Quaternary timescales

During the last 250,000 years several glacial-interglacial cycles, involving mean sea level changes in excess of 120 m, have periodically altered the base levels and locations to which the lower (now estuarine) parts of the Georges River grade.

Oscillations in sea level drive periodic gutting out of sediments from the floors of lower river floodplains and estuaries during low sea levels, leading to the formation of ravines across the continental shelf. Rising sea levels lead to stepwise re-filling of the incised river channel systems on the continental shelf and infilling of the lower estuarine tract of the river systems during marine transgression.

The deposits lying within the valley floor of the testing area will have been influenced by these changes to sea-level and climate changes, human impacts and associated soil and vegetation changes altering runoff and discharge from the catchment (Nanson et al. 1992; 2003). Episodic flooding will have been ubiquitous, causing repetitive cutting and gutting of deposits and realignment of channel forms.

The largest floods over such late Quaternary timescales will include "mega-floods" likely to be orders of magnitude larger than those known since European monitoring of flooding in the Georges River, and greatly exceeding the Probable Maximum Flood (PMF) used in catchment flood management engineering modeling (e.g. see Bewsher Consulting 2004 Fig 2.1) for this part of the Georges River.

Over late Pleistocene to Holocene timescales sediment availability will also have exerted strong controls on the deposition of source-bordering sand accumulations on the lower river terraces, and up onto the river bluffs overlooking the floodplain at Casula. Dust inputs to soil stratigraphy on the floodplain bluff and plateau edge may also be significant, derived from flood deposits (Cattle et al. 2009).

The natural deposit sequence in the area may also archive evidence of the past estuarine limits during the present Holocene interglacial (i.e. since about 7000 years BP) and possibly from previous interglacial high sea levels (e.g. Marine Isotope Stage 5)[5]. Such deposits, if encountered, would have high natural heritage significance and high scientific importance (Brocx 2008; Gray 2003; Nichol and Murray-Wallace 1992).

The narrow reach of the Georges River, and thus high potential for deposit working during floods, makes the longer-term survival of older deposits across broad extensive areas unlikely. Patch survival of a range of alluvial terrace, estuarine and low sea level floodplain soils and deposits is however, quite likely, given the existence of mapped Tertiary gravels in the area. Interglacial deposits may well occur within the lower reaches of the Georges River area (eg see Roy et al. 1980); it is less likely (but possible) they occur at depth in the study area.

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[5] Incision and down-cutting during glacial low sea level stands are likely to have gutted out much of the floodplain floor, which coupled with periodic mega-floods make the survival of significant areas of older deposits unlikely in this relatively narrow constrained reach. Deposits of the type known at Narrawallee Inlet (Nichol and Murray-Wallace 1992) or Maroubra (Pickett 2002) would be heritage significant if located at depth in the study area.

The implications for this study area are:

i) the late Quaternary geological record of infilling and deposition at this point in the river system has potential scientific significance (deposits recording the last interglacial could be present as terrace remnants above and below the present level of the floodplain).

ii) geotechnical information on the depth and nature of the deposit sequence at depth below the floodplain area, at depths below the levels tested archaeologically has potential heritage value.

The geomorphology, hydrology and wetland habitats of the Georges River seen today close to the study site are probably poor analogues for the river floodplain at European contact or earlier (Nanson et al. 2003). This is important when interpreting features seen in the test pits, and for generally understanding the archaeological record of this area in terms of past environments which would have been contemporary with the archaeological evidence.

4.2.2 Flooding history and archaeological heritage significance assessment of the area of investigation

The Georges River catchment has the capacity to flood to very high levels in the lower reaches. Precise maximum flood datums and relationships to flood history have not been researched for this short report. However, maximum historic flood levels, flood frequency and duration of high discharges are directly relevant to the interpretation of archaeology and deposits across this area.

Maximum historic floods only indicate minimum likely flows during the Quaternary and Holocene. High magnitude - low frequency mega-floods and climate effects on river discharge will determine prehistoric flood heights. River damming from trees is a common significant trigger factor determining where avulsion (flow leaving the low discharge channel) and breaching of levee banks occurs.

Historic floods are relatively well described for Georges River from the late 19th century onwards. The reach between Campbelltown and Liverpool is relatively low gradient, river banks are high and all but large floods are contained in-bank (Bewsher Consulting 2004: 10).

Prior to construction of the weir at Liverpool, the river banks at Casula would have been higher above normal base flow datum. The cross-section flood capacity of the river channel will have probably reduced since 1836 in the study area downstream to the Liverpool Weir.

Recent large floods occurred in 1986 and 1988 with levels of 7.2 m and 7.4 m AHD at Liverpool Weir. These, while destructive, are quite regular events, estimated at about a 20 year recurrence (probability) interval (Bewsher Consulting 2004:14). At Liverpool Weir ten flood events reached levels of 7.0 m AHD or greater in the twentieth century, the largest a flood level of 8.3 m in February 1956. Much larger floods are known from the late 19th century – with estimated flood datums of 9.0m AHD (Feb 1898), 9.2 m AHD (April 1887), 9.7m (May 1889) and the largest recorded flood in February 1873 recording a maximum level of 10.5m AHD at Liverpool Weir.

The February 1873 event washed away houses, and a resident farmer near the weir reportedly fell into the river (Sydney Morning Herald 27 Feb 1873). The 1873 and 1889 events just exceed the 100 Year Flood estimate for the river at Liverpool Weir (Bewsher Consulting 2004: Figure 2.3).

The size and upper catchment topography means that rainfall events of high magnitude persisting over several days can quickly produce very large floods. Discharges are sustained and considerable – the August 1986 flood producing discharges > 500 cumecs (m^3/sec) for over 30 hours and > 700 cumecs for 12 hours either side of the flood peak. Bedloads in the catchment are silts and fine sands from shales, and medium to coarser sands from Hawkesbury Sandstone. Floods of this size can move very large volumes of these fine grain sediments (Reid and Frostick 1994; Wentworth 1922; Taylor and Eggleton 2001).

4.2.3 Archaeological implications of the flooding regime

The study area will have been inundated by floods greater than a 1:20 exceedance probability. The effects of the late 19th century floods will have been considerable, and, as is argued later, may in fact have created the landforms forming the present landscape across the study area, based on stratigraphic data obtained for this test pit program.

The implications for archaeological site preservation are not simple to model. Flooding, and sedimentation by floods across a floodplain, may act to preserve land surfaces across large areas. Flooding also has local erosive and destructive effects, through channel bank erosion, sediment reworking and channel re-alignments (Brown 1997).

Vertical floodplain aggradation – due to hydrological changes, channel migration or changes in sediment load in the catchment, may produce excellent conditions for sealing and preserving archaeological sites, and landsurfaces with evidence of past environments.

A further complication is that flood flows sufficient to entrain gravels as bedload and re-deposit gravels, commonly also entrain archaeological stone artefacts of hydraulic equivalent sizes and re-deposit them, sometimes with bone and other larger organic materials (Gale and Hoare 1991; Reid and Frostick 1994). Both old and younger alluvial gravel sequences have been shown globally to preserve reworked but often significant archaeological assemblages (e.g. see Oakley and Leakey 1937; Bridgland 1994).

While some artefacts may show evidence of transport, this is by no means always the case and pristine "mint" stone artefacts may occur in reworked gravels having been moved some distance (Brown 1997: 164-166).

The implications for this study are:

- The unabraded or abraded condition of stone artefacts should not be viewed as definitive evidence of an *in situ* versus a reworked context in fluvial deposits. Stratigraphic context will be equally important and often more diagnostic.
- Reworked archaeological materials can be focused and concentrated by flood flows as well as dispersed.
- Stone artefacts, when reworked, are commonly re-deposited with other gravel sized materials of hydrodynamic equivalent size. Lithic artefacts located in lenses of natural gravels are a common occurrence.
- Where a floodplain landform is aggrading (accreting vertically) there is a high probability that land surfaces and associated archaeological and environmental evidence will be well preserved by flood events.
- Surface surveys will not reliably establish presence/absence of archaeological material in the area.
- Archaeological contexts and materials may preserve at considerable depths, and above and below a contemporary modern water table.
- Alluvial valley-floor contexts may preserve time periods, events and archaeological site types which are uncommon on adjacent hill slopes, sub-aerial landforms, or soils.

The flood deposits and their depositional chronology may also be important in interpreting other sites in the area, at elevations above the 100 year flood recurrence levels. Aeolian accession of sands and silts from exposed flood deposits in the valley floor, may contribute to the sediment records of sites investigated on the higher elevation areas, investigated in previous phases of the Moorebank IMT Project (Cattle et al. 2009; NOHC 2013a).

The deposit sequence identified and investigated on the Northern Powerhouse land is therefore relevant to interpretation of other archaeological sites in adjacent land blocks. Deflating sands and silts off channel floor deposits may be an important contributing soil forming agent, and a process, contributing to archaeological context formation on marginally higher areas (eg on the west bank). Accession of fine sediments into soil profiles from flooding and wind may also be important if dating of sediments is considered in this area (see Field and Humphreys 2002; Humphries et al. 2002)[6].

Mapping of the three archaeologically sensitive landforms identified by NOHC (2013a) as a) the Georges River Riparian Corridor b) Minor Tributary Riparian Zones (e.g. along Anzac Creek) and c) Elevated slopes, bluffs and riverside margins of the elevated Tertiary alluvial Terrace edge adjacent to Georges River (NOHC Research Design 2012) are examples of areas where understanding channel floor environments (this study) has relevance.

Soils and stratigraphy might be expected to co-vary with these landforms. Given the complex geological history of the area soils and sediments of varying ages and sequences will be expected. A regolith landscape approach (see Ollier and Pain 1996; Taylor 2008) where soils may develop and then rework many times as part of landform change will best match archaeological requirements of understanding complex issues of soil and sediment age, and storage of parcels of older stratigraphy across the landscape.

4.2.4 Geological and Soil Mapping information

A brief review was undertaken for this report of maps and reports on the soils, regolith and bedrock in the vicinity of the site. Further searches of NSW mapping and archived sources at Geoscience Australia may be valuable. Mapping precision and resolution are insufficient at 1:100,000 to be precise about geological boundaries across the study area or to have certainty regarding unmapped/unrecorded geology and deposits in the study area.

Geotechnical data generated for the development proposal and concept design may be extremely useful for improving understanding of the context, significance and widespread /local nature of sediments and stratigraphy located during this phase of archaeological testing.

4.2.5 Geological Mapping

The 1:100,000 sheet mapping shows the study area mostly capped by Tertiary alluvial clayey quartz sands, silty sands and clays (Ta), inferred to be possibly Pliocene in age. That age estimate is probably based on relative stratigraphic and elevation data only. For archaeological purposes age designations relating gravels and terraces to Pliocene or later Quaternary (last two million years) ages should not be regarded as reliable.

Younger sediments and deposits will be locally present in the upper parts of the mapped units, Many soil features (potentially preserving archaeological evidence) seen across the area are substantially younger, and may be developed as soils on mapped older deposits and soil profiles. The defined mapped age of Tertiary does not preclude near surface deposit sequences being present which might be dated to the Holocene or Quaternary. The underlying bedrock units are mapped as Triassic-age beds of the Ashfield Shales (Rwa) with outcrops of the underlying Hawkesbury Sandstones located close to the study area, to the south and southwest in particular.

Local bedrock, from which *in situ* regolith and soils in the area will derive, are variably Triassic sandstones, mudstones and shales, of the same lithology and mineralogy to the rocks from which the Georges River alluvium and dusts derive. This makes identification of the depositional origin of the deeper weathered soils in the area potentially difficult, especially in deep quartzose sand sequences.

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6 Detection of such aeolian inputs, once admixed into the soil profile, may be best achieved using soil thin-section analysis, or soil micromorpholgical techniques, especially where the sequence may be archaeologically significant (Courty et al. 1989; Davidson and Simpson 2001; Kemp 1985).

Some archaeologically sensitive landforms may contain complexes of stratigraphic sequences. Older weathered alluvial units, and soils developed on alluvium of Quaternary or even Tertiary age may be compositionally similar to saprolite, or mixtures of saprolite and alluvium of Tertiary age.

The testing program (see below) located no stratigraphy showing proximity to bedrock or saprolites/ soils developed on bedrock. All deposits encountered appear to be Holocene alluvial or estuary (waterlain) sediments, sometimes with weak developed soil features. The alluvial deposits clearly abut and overlie surface residual slopes and soils to the west, in the area of the railway embankment, and to the south near the Powerhouse. Stratigraphic relationships are not known, and may well be missing, as a consequence of railway construction.

However, the inset nature of the alluvial deposits across the test area, as a low level floodplain sequence infilling a topography cut into older alluvial and regolith units, is clearly seen when compared with sequences exposed in the higher bench across the river in eroded low bluffs (see Figures 4.4 and 4.5)

Soils and Regolith Mapping

The 1:100,000 Penrith Soils Landscape Series is the main source of information on soils for the area (Bannerman and Hazleton 1990). That mapping shows a narrow strip of Richmond (Ri) Soils landscape abutting the river for 1.5- 2 km north of Casula, adjacent to floodplain mapped as South Creek landscapes (Sc) upstream, and locally as Freemans Reach (Fr) landscapes only 1.0 - 1.2 km upstream of the Power House.

Figure 4.4 Steep bank cut by migration of channel into
older regolith units on east bank of river across from testing area.

Upslope of the channel marginal study site on the Casula side, soil landscapes are mapped as erosional. Luddenham Soil Landscape (lu), – (i.e. inferred as developed on Wianamatta Shales bedrock), while the less steep slopes and channel marginal steeper bluffs visible from the area of the test grid on the eastern bank of the Georges River are mapped as Blacktown Soil landscapes (bt) ie residual developed on Wianamatta Shales geology or as Berkshire Park (bp), – (i.e. inferred to be developed on Tertiary Terrace) as the underlying geology.

The Berkshire Park (bp) soils landscape unit is characterized as forming on alluvium, often on elevated terraces and comprising shallow clayey sand soils, with frequent ironstone pisoliths. Gravels are also likely to be associated with the Tertiary deposits, and may be significant to the area of investigation a) as potential sources of lithic raw materials for making artefacts and b) as the potential sources of gravels reworked by floods into the deposits investigated across the test grid.

The geological mapping on which the Soils Landscape map is based is insufficiently precise to make the defined soil landscape units of any archaeological predictive value. The mapping does demonstrate that deposits in the relatively narrow confined reach of this part of the Georges River are complex, and will be expected to show sudden variation in bedrock (at rockhead) and overlying superficial deposits across short distances.

Most importantly, at local scales, deposits at the surface will reflect recent geomorphological depositional processes, especially alluvial flood deposition, with soils therefore having no soil development relationship to underlying bedrock.

Geotechnical data produced for this development proposal, which is specific to the area of investigation, therefore has considerable value for assessing potential archaeological and historic heritage significance. Such data should be consulted when final planning of heritage mitigation on the stratigraphy described here is considered.

Soil Landscape Mapping usually correlates with pre-determined bedrock mapping and inferred alluvial terrace age(s). If parts of the terrace deposits at Moorebank were re-assigned a Pleistocene age the soil mapping unit would be logically re-assigned to the South Creek Soils Landscapes unit[7]. Given the lack of direct data on ages of Quaternary deposits in the area – all outcrops of gravels or older alluvium should be regarded as having tentatively known age.

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[7] When using NSW Soil Landscapes mapping for archaeological investigations/heritage management purposes it should be remembered that the primary goal of the NSW Soil Landscape mapping lies in soil conservation and management. Soil landscapes are conceived as areas of land which have recognizable and specifiable topographies and that may be presented on maps and described by concise statements. The mapping does not investigate or re-consider deposit ages or the time periods over which soil attributes may have developed on either sediments developed by bedrock weathering *in situ,* or soils developed on previously transported sediments eg alluvium or colluvium.

Figure 4.5 Test Pit 29 located on lower recent sandy alluvial deposits on western bank with higher level older regolith on eastern bank in background

5. ABORIGINAL CULTURAL CONTEXT

5.1 Ethno-history

References to the Aborigines of the Sydney region are found in the journals, diaries and general writings of the early colonists, explorers and settlers. The 'natives' were one of the main subjects of interest to those who arrived in the First Fleet and 'all the journals contain frequent references to them' (Fitzhardinge 1961:102).

Accounts written by early visitors to Australia which document the more obvious details of Aboriginal life include Bradley (1786), Collins (1798), Hunter (1793), Phillip (1789), Tench (1789, 1793, 1961) and White (1790). Although these early commentators were not trained in anthropology or linguistics they provided some useful information regarding the Aborigines around the Sydney region.

Tench (1789:79) describes the equipment of the Aborigines as 'Exclusive of their weapons of offence, and a few stone hatchets very rudely fashioned, their ingenuity is confined to manufacturing small nets, ...and to fish-hooks made of bone, neither of which are skilfully executed'. Tench also notes the use of bark canoes for fishing (Tench 1789:81-82).

Comments were made on the types of Aboriginal shelters observed. These were described as consisting 'only of pieces of bark laid together in the form of an oven, open at one end, and very low, though long enough for a man to lie at full length in … they depend less on them for shelter, than on the caverns with which the rocks abound' (Tench 1789:80). Collins observed that the huts were 'often large enough to hold six to eight people' (Collins 1798:555). These shelters were often grouped together.

Within a short period of time after white settlement the Sydney Aboriginal population was greatly reduced as a result of two epidemics (most probably) smallpox. The first occurred only a short time after settlement in 1789 and the second in 1829-1831 (Butlin 1983). The first outbreak of the disease is believed to have killed 50% of the Aboriginal population (Collins 1798:53, Ross 1988:49, Tench 1961:146, Turbet 1989:10). Loss of life on such a scale caused a major social reorganisation of Aborigines around the area (Ross 1988:49) with 'remnants of bands combining to form new groups' (Kohen 1986:30). Therefore the anthropological observations and other observations by chroniclers of the time do not depict the pre-settlement situation accurately.

There are other accounts dating from the early 1800s that provide more detailed references to Aboriginal life in the Sydney region. However the information must be interpreted and used with caution due to the immense changes that occurred in the Aboriginal population and society during the early years of settlement (McDonald 1994:34).

Detailed anthropological work focussing on a systematic documenting of Aboriginal society was not undertaken until the late 19th century, beginning with R.H. Mathews' work (Mathews 1895, 1898, 1901a, 1901b, 1901c, 1904, 1908, Mathews and Everitt 1900). His anthropological work was, however, undertaken with a greatly changed population of people after more than a hundred years of contact. It does not therefore represent the situation at the time of contact or reflect pre-contact society. He documented some myths and also vocabulary of Aboriginal groups around the Sydney region.

5.2 Tribal and Cultural Affiliations

The exact boundaries between Aboriginal groups that existed in 1788 are impossible to reconstruct because of the lack of reliable data available from that time. There have been numerous attempts at mapping the pre-contact and contact territories of Aboriginal people in the Sydney region (Capell 1970, Eades 1976, Kohen 1986, 1988, Mathews 1901a and b, Ross 1988, Tindale 1974). The primary data is limited, as the early observers (members of the First Fleet and settlers) did not document how Aboriginal people perceived of their own groups or how they differentiated themselves from one another.

Early anthropological work that was carried out is also not totally reliable. The population of Aboriginal people around Sydney was depleted by disease and aggression by Europeans and many of the survivors would have relocated and/or probably joined other groups.

The linguistic and tribal boundaries and size of areas attributed to the various Sydney region Aboriginal groups vary between different interpreters. Tindale (1974) places the Tharawal tribe in the area south from Botany Bay and Port Hacking to the Shoalhaven River and inland to Campbelltown, Picton and Camden. To the west of this tribal area, Tindale placed the Gandangara tribe, and to the north the Daruk tribe. Tindale has an Eora tribe, which was closely linked to the Tharawal tribe, extending from the northern shores of Port Jackson to the edge of the plateau overlooking the Hawkesbury River and south to Botany Bay and the Georges River. Tindale earlier referred to the Aborigines on the northern side of Botany Bay as the Kameraigal horde, while others refer to this group as the Cadigal or Biddigal.

5.3 Aboriginal Consultation

Aboriginal consultation has been undertaken in various stages for this project.

The DECCW Interim (2005) *Guidelines for Aboriginal Consultation* were enacted in 2010. This was in response to the requirements outlined by the then Department of Planning.

In 2012 the proponent for the project restarted the Aboriginal consultation and instigated the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW DECCW 2010). This was done so as to ensure that the consultation process was as thorough and up to date as possible. The 2010 guidelines are consistent with and indeed exceed the requirements of the 2005 draft guidelines and therefore meet and exceed the Director Generals Requirements for the project.

Aboriginal representatives from the RAPs participated in both the field survey of the study area and the subsurface testing program.

See Appendix 4 for all correspondence received from the RAPs.

5.3.1 DECCW Interim *Guidelines for Aboriginal Consultation*

Aboriginal parties were invited to register an interest in the project through public notice (Liverpool Leader 27 Oct 2010) and through direct invitation protocols as defined by OEH requirements, (DEC 2005).

The following Aboriginal parties registered an interest in the project through the Interim Guidelines:

- Tharawal Local Aboriginal Land Council (TLALC);
- Cubbitch Barta Native Title Claimants Aboriginal Corporation (CBNTCAC);
- Darug Land Observations (DLO);
- Darug Custodian Aboriginal Corporation (DCAC);
- Darug Aboriginal Cultural Heritage Assessments (DACHA);
- Darug Aboriginal Landcare Incorporated (DALI); and
- Banyadjaminga.

RAPs and those persons/groups whose names were included on a list of Aboriginal parties known to the NSW Office of Environment and Heritage (OEH) that may have an interest in the project, were informed about the methodology for the Aboriginal archaeological surface field survey. This correspondence (10 January 2011, and 11 March 2011) included an invitation to read the project methodology and then provide comments and suggestions back to NOHC.

The methodology explained that the primary aim of the field survey was to identify cultural heritage sites and areas of archaeological sensitivity/potential that are present within the project area, and that the field survey aimed to achieve a level of ground surface coverage that would enable an informed assessment of potential construction impacts on any sites that may be identified.

Correspondence with comments on the methodology was received from all of the registered Aboriginal parties registered except the TLALC and Banyadjaminga.

The TLALC responded to the initial public notice requesting registration, but did not provide a subsequent submission regarding the methodology (correspondence 8 /11/10).

The DLO provided a registration of interest in response to the methodology and sought involvement in any and all consultation meetings and fieldwork. The DLO advised that they do not support organisations which are not from the Darug nation, and do not attend fieldwork or meetings without payment (18/1/11).

The DCAC provided a registration of interest in response to the methodology and sought involvement in the project. DCAC specifically noted support of the methodology proposed (correspondence 18/1/11).

The DACHA provided a registration of interest in response to the methodology and expressed a wish to be consulted at all times, and to be involved in all fieldwork. Support was expressed for the proposed methodology (correspondence 25/1/11).

The DALI provided a registration of interest in response to the methodology and expressed a desire to take part in field work. The proposed methodology was agreed to (correspondence 27/1/11)

The CBNTCAC responded to the initial public notice requesting registration (correspondence 5/12/10), and subsequently provided comment on the methodology (correspondence 29/1/11). The response questioned why the Interim Guidelines for Aboriginal consultation were being complied with when these had been made obsolete by new guidelines issued by DECCW in 2010. The proposed methodology was stated to be fine, apart from the stated compliance with the Interim Guidelines. A list of the identified parties to the project was requested, together with a description of their involvement.

5.3.2 Aboriginal cultural heritage consultation requirements for proponents 2010

In 2012 the proponent for the project restarted the Aboriginal consultation and instigated the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW DECCW 2010). This was done as part of the preparations for subsurface testing within the project area, as specified under the Director General's Requirements for "physical archaeological test excavations of areas of potential archaeological deposits".

Again Aboriginal parties were invited to register an interest in the project through public notice (Liverpool Leader and Liverpool City Champion 25 July 2012) and through direct invitation protocols as defined by OEH requirements.

The following RAPs registered an interest in the project through the 2010 Guidelines:

- Gandangara Local Aboriginal Land Council; and
- Tocomwall Pty Ltd.

A site visit and presentation was held with the RAPs on the 26 September 2012. The purpose of this visit was to present information to the RAPs including the presentation of the proposed subsurface testing methodology.

The following RAPs attended the site visit**:**

Ben Staples (BS) - Darug Land Observations

Des Dyer (DD) - Darug Aboriginal Land Care Inc

Glenda Chalker (GC) – Cubbitch Barta Native Title Claimants Aboriginal Corporation

Gordon Morton (GM) - Darug Aboriginal Cultural Heritage Assessments –

Gordon Workman (GW) - Darug Land Observations

Justine Coplin (JC) - Darug Custodian Aboriginal Corporation

Luke Masters (LM) - Gandangara Local Aboriginal Land Council

Neale Samson (NS) - Tharawal Local Aboriginal Land Council

Scott Franks (SF) - Tocomwall Pty. Ltd.

A draft of the proposed subsurface testing methodology was distributed to all RAPs on 13th September 2012 with a comment period of 28 days. Responses were received from:

Cubbitch Barta Native Title Claimants Aboriginal Corporation (CBNTCAC);

Darug Aboriginal Landcare Incorporated (DALI);

Darug Custodian Aboriginal Corporation (DCAC); and

Darug Aboriginal Cultural Heritage Assessments (DACHA).

Archaeological subsurface testing was undertaken within the Northern Powerhouse Land, in accordance with the abovementioned methodology, from the 22 of July to the 1st of August 2013. All RAPs were invited to take part, with the following RAP representatives participating in the subsurface testing program:

Glenda Chalker, Kirsty-Lee Chalker and Donna Whillock (GC) – Cubbitch Barta Native Title Claimants Aboriginal Corporation

Daniel Smith and Baidyn Dermott - Darug Land Observations

Timothy Wells - Darug Aboriginal Cultural Heritage Assessments

Justine Coplin and Alyce Mervin - Darug Custodian Aboriginal Corporation

Toni Joe Whillock - Tharawal Local Aboriginal Land Council

Danny Franks and Malcolm Franks - Tocomwall Pty. Ltd

Dave Mason and Shaun Lynch - Uncle Des (group formerly known as Darug Aboriginal Land Care Inc)

A late registration of interest was received from Gundungurra Aboriginal Heritage Association Inc on 6 September 2013. This organisation has been included in all subsequent consultation.

5.3.3 Comments on the draft report

A draft of this report was distributed to all RAPs on 27 November 2013 with a comment period of 28 days. Responses were received from:

Cubbitch Barta Native Title Claimants Aboriginal Corporation (CBNTCAC);

Darug Aboriginal Cultural Heritage Assessments (DACHA); and

Darug Custodian Aboriginal Corporation (DCAC).

A copy of each response is in Appendix 4.

Table 5.1 summarises all responses from the RAPs on the project, particularly as they relate to the cultural values of the project area and how these have been addressed in this assessment.

Table 5.1 RAP Comments[8] and Responses

Organisation	Comment	Response
CBNTCAC	It is hard to assign significance when the full nature of the deposits is unknown.	Noted
	The test excavation results are not of sufficient significance to prohibit development. The few artefacts that were recovered during test excavations appear not to be *in situ* and thus their context does not reflect their use by Aboriginal people in the past.	The significance has been assessed as both scientific and cultural, therefore the recommendations apply to both of these aspects.
	I would recommend that those artefacts recovered be allowed to be reburied somewhere within the proposed development, where they will be recorded and not impacted by any future development.	It is recommended that consultation be ongoing throughout the life of the project for the future care and management of recovered Aboriginal objects.
DACHA	We fully support the aims and objectives outlined in this report and we note that the area is important to the Darug people.	Noted
	We wish to be consulted at all times and be involved in any future investigations.	Noted
DCAC	We support the research methodologies that were implemented during test excavations. The draft report has recorded the findings accurately and extensively.	Noted
	Our group finds all of our sites and objects significant, we support the recommendations set out in this report.	Noted
	The main aim of our group is to conserve and protect our site, where this is not possible we strongly recommend interpretive strategies.	An interpretive strategy is recommended for the project.

[8] The comments from the RAPs have been paraphrased for simplicity, full details of the comments received can be found in Appendix 4.

5.6 Cultural Knowledge and Values

Consultation with the RAPs regarding cultural knowledge and values has been an ongoing process. It has included formal invitations to contribute via written form and verbal discussions during field survey (2013), excavation program (2013), telephone conversations and the provisions of a draft of this report.

To date, the following information has been received verbally and in writing, in the course of the February 2013 site survey and subsequent subsurface testing program, regarding cultural knowledge and values of identified sites at Moorebank:

- the RAPs consider all sites and objects significant; and
- as well as the objects the whole area is considered significant particularly as it relates to the Georges River and past land use practices.

6. ABORIGINAL ARCHAEOLOGICAL CONTEXT

The following section provides an overview of previous archaeological research in the local region. This literature review, together with the search of the AHIMS database, has informed the development of the predictive model for the Moorebank IMT study area.

6.1 The Sydney Basin

The Sydney Basin has been the subject of intensive archaeological survey and assessment for many years. This research has resulted in the recording of thousands of Aboriginal sites and a wide range of site types and features. The most prevalent sites or features include: isolated finds, open artefact scatters or camp sites, middens, rock shelters containing surface artefacts and/or occupation deposit and/or rock art, open grinding groove sites, and open engraving sites. Rare site types include scarred trees, quarry and procurement sites, burials, stone arrangements, carved trees, and traditional story or other ceremonial places.

Archaeological studies in the Sydney Basin have generated hundreds of reports and monographs and a number of academic theses. Studies generally fall into four categories - projects which have been carried out within a research-oriented academic framework, larger scale planning and management studies (e.g. regional heritage studies) archaeological surveys carried out by interested amateurs, and impact assessment studies which have been carried out by professionals within a commercial contracting framework. The latter deal with specific localities subject to development proposals and constitute a large proportion of the archaeological research carried out to date.

Aborigines have lived in the Sydney region for at least 20,000 years (Stockton & Holland 1974). Late Pleistocene occupation sites have been identified around the fringes of the Sydney Basin at Shaws Creek (13,000 BP [Before Present]) in the Blue Mountain foothills (Kohen et al 1984), and at Mangrove Creek (11,000 BP) at Loggers Shelter (Attenbrow 1981). Nanson et al (1987) have suggested that artefacts found in gravels of the Cranebrook Terrace indicate Aboriginal occupation over 40,000 years ago, however there is some doubt as to the contextual integrity of these artefacts.

The majority of both open and rockshelter sites in the Sydney region date to within the last 3,000 years. A similar trend in occupation age occurs in dated deposits in NSW coastal sites. This has led many researchers to propose that population and occupation intensity increased from this period (Attenbrow 1987, Kohen 1986, Smith 1986, McDonald & Rich 1993, McDonald 1994). The increased use of shelters postdates the time when sea levels stabilised after the last ice age around 5000 years ago (the Holocene Stillstand).

Following the stabilisation of sea levels, the development of coastal estuaries, mangrove flats and sand barriers would have increased the resource diversity, predictability, and the potential productivity of coastal environments for Aborigines. In contrast, occupation during the late Pleistocene (prior to 10,000 BP) may have been sporadic and the Aboriginal population relatively small.

The stone technologies used by Aborigines within the Sydney Basin have not remained static and a sequence of broad scale changes through time has been consistently identified. This is known as the Eastern Regional Sequence and can be applied with various degrees of success and allowances for regional differences, to sites throughout eastern seaboard of Australia. Within the Sydney Basin the Sequence can be characterised using the following terminology and phases (based on McDonald 1994):

The Capertian: Artefacts from this period consist mostly of large heavy artefacts including unifacial pebble tools, scrapers, core tools, denticulate saws, and hammerstones. Some bipolar tools and burins also occur. The Capertian is present up to around 5000 years BP.

The Early Bondaian: Within this phase characteristics of the Capertian continue but tools on smaller blades are introduced and become predominant. Blades that are backed (one edge blunted by fine trimming) and ground edge implements are notable introductions. There is a major shift in the type of rocks used for tool manufacture to fine-grained siliceous materials (such as silcrete, chert and tuff/indurated mudstone). The Early Bondaian has been identified in deposits dating between around 5000 and around 3000 years BP.

The Middle Bondaian: In this phase the percentage of Bondi points (a type of backed blade) increases and remains greater than the percentage of bipolar artefacts. Edge ground artefacts are present in higher proportions as are quartz artefacts. This phase dates from around 3000 to as late as 1000 years BP.

The Late Bondaian: This phase is characterised by quartz either becoming the predominant rock type used or markedly increasing in proportion. Bondi points and most types of backed blades become rare or are no longer found. Eloueras, bipolar artefacts and edge ground hatchets are the dominant tool types. Bone and shell implements including fishhooks appear in this phase, particularly in some coastal sites. This phase dates from around 1600 (Attenbrow 1987), or 1000 years BP (McDonald 1994), to the cessation of stone working following contact with European Society.

McDonald notes that the introduction of ground implements around 4000 BP and shell fishhooks in the last 1,000 years were major technological innovations (McDonald 1994:69). The significance and possible reasons for the technological changes in the Eastern Regional Sequence has been the subject of considerable research and debate since their identification. Contemporary theories postulate various changes in social behaviour, group interactions, and population dynamics either as contributing causes or as consequences of these technology changes (e.g. Attenbrow 1987, Beaton 1985, Lourandos 1985, Walters 1988, McDonald 1994). McDonald for example interprets the introduction of the Bondaian in the Sydney Basin as a manifestation of social change brought about by population pressure promoted by sea level rise (1994:347).

6.2 Upper Georges River

The study area is situated within the upper Georges River, which marks a transition zone between the Wianamatta shale country that typifies the Cumberland Plain to the west, and Hawkesbury Sandstone terrain extending from the upper Georges River to the coast. These zones exhibit respective archaeological characteristics that have potential to be found in combination in the study area.

In the early 1980s, Koettig and Hughes (1983) and Haglund (1984) undertook surveys along the proposed route of the East Hills-Glenfield railway and at Glenfield respectively. While no Aboriginal sites were recorded in these areas, it was acknowledged that surface visibility was very low and may have played a role in obscuring surface evidence.

Boot (1990; 1992; 1993; 1994a; 1994b) carried out a series of archaeological investigations at Wattle Grove directly to the east of the study area. Survey was undertaken to the east of Anzac Creek and north of the East Hills Railway Line, incorporating cleared country and patches of bushland. Several artefact scatters were identified, all situated on low ridgelines adjacent to drainage lines or swampy areas. Sites were generally small, low-density scatters containing flaked artefacts and cores primarily composed of volcanics and smaller quantities of silcrete and quartz. An area of remnant bushland in the study area's south was identified as archaeologically sensitive in that it had potential to contain undisturbed artefact scatters (Boot 1992: 9).

Two of the sites recorded by Boot, WGO3-1 and WGO3-2, were subsequently re-investigated by Haglund (1995). This work involved test pitting of the sites in order to determine their subsurface extent and spatial distribution of artefacts. Haglund (1995) concluded that the sites were representative of a single original archaeological complex composed of discrete concentrations of artefacts, most likely specific knapping areas. While the level of disturbance was generally quite high in the area, one part of Site WGO3-2 was deemed likely to contain in situ archaeological deposit and preservation of the location was strongly recommended.

Mills investigated the route of a proposed sewerage pipeline and the location of an effluent reuse rising main and pumping station at Holsworthy in 1995. The pipeline route passed through a combination of existing road easements and heavily disturbed areas. Five isolated artefacts deemed to have low significance were found to the east of Heathcote Road. Two areas of archaeological potential were identified, including the proposed thrust bore exit-point on the northern bank of Georges River. Archaeological monitoring was recommended for these locations.

In 1997 an archaeological survey of an approximately 50 ha area of land spanning the upper reaches of Maxwells Creek at The Crossroads in Liverpool identified a zone of archaeological potential along the Creek (Officer 1997). Twenty one test pits were subsequently excavated along the banks of Maxwells Creek as part of a subsurface archaeological investigation (NOHC 1998). A total of ninety two artefacts were recovered from 16 of the 21 test pits. Six different types of stone material were identified in the lithic assemblage – silcrete, rhyolitic tuff, chert, chalcedony, quartz and quartzite.

The sandstone dominated terrain within the Holsworthy Military Area has been the subject of considerable archaeological interest, particularly in relation to its notable suite of 'sandstone ' sites including rock shelters, pigment art sites, rock engravings and grinding groove complexes.

While important Aboriginal sites have been known in the area since the 1800s, comprehensive surveys in this country commenced with the formation of the Sydney Prehistory Group in the early 1970s. The group, comprising around 20 interested amateurs, recorded 64 sites in the Campbelltown area, including 44 sites in the Holsworthy Military Area and the remainder in sandstone contexts to the west of the Georges River. Their study area included the upper portions of Harris and Williams Creeks, a majority of the Georges River corridor within the Training area, and the terminal portion of Punchbowl creek and the whole of Kalibucca Creek. Site types were primarily rock shelters with archaeological deposit, pigment art sites and grinding grooves.

The Sydney Prehistory Group described site densities of between 0.6 and 1.5 per square kilometre in the Holsworthy Military Area. Variation in site density was interpreted as a function of environmental conditions, particularly the greater density of available shelters due to a higher drainage line density and weathering rates in the interior (Sydney Prehistory Group 1983).

Other formal investigations and site surveys undertaken within the Holsworthy Military Area, or which analysed data pertinent to the area, include Officer (1984), Sharp (1994), Sefton (1994), Axis Environmental/Australian Museum Business Services Consulting (1995) and Mitchell McCotter (1995).

However the most comprehensive and extensive Aboriginal archaeological surveys and assessment of the area were undertaken in 1996 for the Second Sydney Airport EIS (NOHC 1997). Nineteen open artefact scatters, forty eight scarred trees, sixty four open sites containing grinding grooves, fifteen open sites with engraved art, and one hundred and fifty three shelter sites containing archaeological evidence of Aboriginal occupation (art, cultural deposit) were recorded in the course of the field surveys of the area.

6.3 Moorebank IMT Study Areas

Five previous archaeological assessments are directly relevant to the study area. These include an Environmental Management Plan compiled in 1996 by Dames and Moore, an archaeological survey conducted by Dallas and Steele (2004), an archaeological assessment of the Southern Sydney Freight Line conducted by Cultural Heritage Connections (2006), a desktop review of the current Moorebank IMT study area (NOHC 2011) and an Aboriginal cultural heritage assessment for the Sydney Intermodal Terminal Alliance undertaken by AHMS (2012). These studies have each included some or all of the current study area.

The Dames and Moore plan (1996) identified an isolated surface artefact (SMEIF1) 160 m south of the study area, on the edge of an elevated terrace formation adjacent to the Georges River. The Dallas and Steele study identified a low density scatter of 16 stone artefacts situated 800 m east of the study area on the slopes of an elevated knoll adjacent to a swamp.

The Dames and Moore plan (1996) provided minimal information on the visibility encountered and coverage achieved during the survey. In contrast, the Dallas and Steele study (2004) presented a breakdown of survey visibility and coverage constraints and went on to identify zones of archaeological sensitivity based on visibility constraints, subsurface potential, and the exclusion of areas displaying substantial past land surface disturbance. Three zones were recognised and associated with recommended management strategies:

- Low sensitivity – (consisting of areas of lesser land surface disturbance, mostly indicated by remnant forest vegetation). Archaeological monitoring of future ground surface disturbance is recommended in this zone.

- Unknown – (consisting of riparian (river margin) areas where the ground surface was obscured by dense vegetation at the time of survey). Further site inspection and assessment is recommended in this zone.

- No sensitivity – (consisting of substantially altered land surfaces such as landscaped, built up urban landscapes). It is recommended that no further assessment is required in these areas.

The Cultural Heritage Connections (2006) assessment of the Southern Sydney Freight Line (SSFL) includes desktop review and targeted field survey of a corridor extending from south of Macarthur Railway Station to east of Sefton Park Junction. It included a portion of the Northern Powerhouse land that form part of the current study area, on the western side of Georges River. This area was not inspected during the 2006 field survey.

A desktop review of cultural heritage constraints was undertaken by NOHC (2011) for the Moorebank IMT. The review showed that while there were no previously recorded Aboriginal sites at that time, there were areas of predicted sensitivity along the Georges River corridor, the margins of adjacent terraces and the margins of tributary creek lines.

Most recently, AHMS (2012) conducted an assessment of the proposed Sydney Intermodal Terminal Alliance (SIMTA) site immediately to the east of the current study area. That investigation also incorporated assessment of the proposed rail corridor to the SIMTA site, along the southern boundary of the current study area. A series of survey transects were inspected within and adjacent the Moorebank IMT study area; two areas of PAD were identified. These comprised a section of alluvial terrace at PAD1 and elevated flats adjacent Anzac Creek at PAD2. Two “possible artefacts” (AHMS 2012: 76) were also recorded in association with PAD1.

Other local areas which have been subject to archaeological survey include the Second Sydney Airport study area, situated one kilometre to the south (NOHC 1997) and the Wattle Grove residential development areas located one kilometre to the east (Boot 1990, 1992). The archaeological assessments of these adjacent areas provide a body of comparative site data upon which predictive statements on the likely incidence of Aboriginal sites within the project area can be based.

Survey of the Moorebank IMT study area was undertaken during 2010 and 2013 (NOHC 2011, 2013).

The 2010 field survey focused on the land to the east of the Georges River (NOHC 2011). It identified eight Aboriginal archaeological recordings comprising five artefact occurrences (MA1-MA5), and three scarred trees of possible Aboriginal origin (MA6-MA8). In addition, three potential archaeological deposits (PADs) were identified (MAPAD1, PAD1 and PAD2) and three archaeologically sensitive landform types were defined (NOHC 2013).

The field survey within the Northern Powerhouse Land identified an additional area of PAD (MAPAD2) within one of the previously identified sensitive landform types (NOHC 2013).

In 2012 subsurface testing was undertaken at sites, PADs and archaeologically sensitive landforms within the Moorebank IMT study area east of the Georges River. Fifty-nine (59) test pits were excavated across the following six test locations:

- MA1 (4)
- PAD2 (21)

- MA5 (11)
- MAPAD1 (10)
- MRSA1 (6)
- MRSA3 (7)

Two hundred and sixty-four (264) artefacts were recovered from 26 pits with the majority of artefacts recovered from MAPAD1 (N=130) and MA5 (N=110). No artefacts were recovered from MRSA3 or PAD2. The majority of artefacts (N[9]=245) were recovered from Spits 1-5, i.e. within the upper 50 cm of intact deposits. The highest artefact incidence was at MA5 Pit 7, where 62 artefacts were recovered; the average artefact incidence was 20.31 artefacts per square metre.

Ten distinct artefact categories were identified within the Moorebank test excavation assemblage. The dominant assemblage elements were flakes (N=183 – including retouched [N=13] and utilised flakes [N=7]) and flaked pieces (N=55). Cores were the next most common artefact type (N=12), followed by backed artefacts (N=6);

The assemblage was dominated by silcrete (N=135), followed by quartz (N=46), quartzite (N=40) and basalt (N=10); smaller amounts of siltstone, fine grained siliceous (FGS), indurated mudstone, dolerite, tuff, fine grained igneous, limestone and chert were also present.

On the basis of the test excavation results within the Moorebank IMT study area land east of the Georges River, it was predicted that the river would have been a primary focus of Aboriginal activities such as camping, and food and resource procurement. It was further predicted that this may have resulted in the formation of archaeological deposits on the banks and flats. The extent to which such deposits may have been removed by subsequent flood scour and channel movement was identified as an active research question.

[9] N=number of artefacts

7. SUBSURFACE TESTING PROGRAM RESULTS

This section provides the results of the subsurface testing program including an overview of the test results, a summary of test pits excavated in each test location and summaries of the geomorphological field inspection and artefact analysis.

7.1 Summary

- Forty-five (45) test pits were excavated across MAPAD2 comprising 37 by-hand test pits and eight (8) mechanical pits;
- Detailed geomorphological analysis was undertaken at Pits 28, 29, 30, 31, 36 41 and 42;
- Three additional pits were excavated for the purposes of geomorphological investigation within a portion of MAPAD2 that had proved to be archaeologically sterile in the upper 120 cm;
- Deposits excavated across MAPAD2 comprised three groups:
  - poorly sorted clayey gravels that have been introduced in some areas, most notably across the southern and northern extremities of the test area, as fill (Unit 3);
  - well sorted light grey or light brown clean sands with well preserved bedding structures and minimal soil development (Unit 2); and
  - dark grey-brown silty sands with abundant charcoal (Unit 1).
- 14 artefacts were recovered from 9 pits (Pits 1, 5, 9, 10, 12, 13, 14, 34 and 42);
- The majority of artefacts were recovered from the southern portion of MAPAD2 (N[10]=13) and the 125 m long section from Pit 9 to Pit 14 (including Pit 42) was the area where artefacts were most consistently recovered (artefacts recovered from 6 out of 10 test pits excavated across this portion of MAPAD2);
- The highest artefact incidence was at Pits 1 and 5, where three artefacts were recovered from each pit;
- The average artefact incidence was 3.11 artefacts per square metre;
- The majority of artefacts (N=10) were recovered from Spits 1-7, i.e. within the upper 70 cm of deposits, usually in association with the Unit 3 fill or Unit 2 sands;
- The artefact assemblage from MAPAD2 comprised four complete flakes, seven incomplete flakes, two flaked pieces and one broken core;
- The assemblage was dominated by silcrete (N=8), followed by fine grained siliceous material (N=5), and quartz (N=1);

[10] N=number of artefacts

7.2 MAPAD2 Excavation Area

7.2.1 MAPAD2 Site Description

Map Grid References (GDA): Approximate perimeter points *307591.6242466*
307146.6241582
307221.6241559
307644.6242093

The potential archaeological deposit is made up of a portion of the archaeologically sensitive landform identified by NOHC (2011) as the Georges River Riparian Corridor. This PAD is located on the western banks of the Georges River.

Disturbance within this PAD is moderate, and is mostly related to previous use as the Liverpool Golf Course. The most common impacts to the original ground surface of this landform are earthworks, resulting in both cutting into and capping the PAD (see Figures 7.1-7.4). These impacts are in the form of bunkers and built up tees.

In addition to impacts relating to past use, the area is currently used as public access/parkland, with a concrete path following the alignment of the Georges River, and within approximately 10 m of the current edge of the river bank. These impacts cover localised portions of this PAD, with many areas appearing relatively intact and undisturbed by comparison.

Figure 7.1 MAPAD2 - looking north

Figure 7.2 MAPAD2 - looking north

Figure 7.3 MAPAD2 - looking southeast

Figure 7.4 MAPAD2 - looking south

The depth of deposit at this PAD is considered to be in excess of one metre and is made up of alluvial grey and yellow sands.

Such deposit depths suggest archaeological subsurface potential exists in both disturbed (cut into and capped) and undisturbed areas of this PAD. Overall, potential for intact deposits at depth is considered moderate, while potential for artefacts subsurface is moderate to high.

The adjacent tertiary terrace to the west of this PAD is heavily impacted by both rail and road construction, and is considered too disturbed to contain archaeological deposits with research potential.

7.2.2 MAPAD2 Test Pits

Surface survey across MAPAD2 indicated that localised areas of disturbance could be expected with a substantial build-up of fill over natural deposits and/or truncated soil profiles where deposits had been cut into. Disturbance such as this was predicted to be greatest along the margins of the cycle path along the river margin and around the remnant golf tees and sand traps.

Prior to commencement of test excavations, MAPAD2 was surveyed for the presence of underground services, which included the use of ground penetrating radar (GPR) to inspect areas of proposed test pits. The results of the GPR survey indicated that the southern portion of the PAD (the southernmost 150-200 m) displayed the greatest evidence of disturbance and that the remainder of the proposed test locations were relatively undisturbed.

Forty-five test pits, comprising eight mechanical test pits and 37 hand excavated pits, were excavated at MAPAD2 (Figure 7.5). The first six test pits at the southern end of MAPAD2 were excavated by machine, mechanical excavation was also undertaken at Pit 7 due to the extent of disturbed fill in that location, and at Pit 45 in order to test deposits at depth.

Mechanical excavation was also attempted at Pit 30 when hand excavation proved too difficult, however the flat edged bucket of the mechanical excavator refused against the compacted clayey deposits. Excavation of that pit for archaeological purposes was abandoned and a toothed bucket was used to inspect the extent of the clayey deposits.

Geomorphological analysis was undertaken at Pits 28, 29, 30, 31, 36, 41 and 42. Three additional trenches were excavated by machine for the purposes of geomorphological analysis (GTP1-3; Figure 7.5), samples of silty deposits retrieved from the base of GTP2 were also sieved to check for the presence of artefacts or organic materials.

The geomorphological test pits (GTP) were conducted across the central portion of MAPAD2 in the vicinity of the second east-west transect of test pits. Excavation of the geomorphological test pits was undertaken following completion of archaeological testing across this section of MAPAD2, which had confirmed the complete absence of archaeological material in the upper 120 cm of deposits across this area.

Between 10 cm and 65 cm of disturbed fill was removed by machine from the top of Pits 7, 10, 11, 28, 30, 39 and 40 before excavation proceeded by hand to a total depth of between 130 cm and 160 cm. Pits 41 and 42 were initially cut down by machine to a depth of 60 cm and then continued by hand to a total depth of 180 cm.

All other by-hand pits were excavated to a standard depth of 120 cm, this being the limit of safe and effective excavation in a 1 x 0.5 m pit without shoring or stepping out the excavation walls.

The mechanical test pits were excavated to depths of between 117 cm (Pit 1) and 245 cm (Pit 6), with pits stepped out through areas of modern fill in order to cut down to natural deposits.

At Pit 3 soil samples were collected and sieved from Spits 1-4 (40 cm), when it became evident that a substantial cap of fill was present. The pit was explored to a depth of 120 cm but no further samples taken as the test location was too disturbed and the modern fill continued throughout the pit.

Excavation within the hand excavated pits was normally terminated at the base of the twelfth spit (120 cm) as this was the limit of safe and effective excavation.

The test pits were initially placed at 25 m intervals. Exceptions to this were where additional intermediary pits were added at 12.5 m spacing (Pits 41, 42, 43, 44 and 45) to further investigate site stratigraphy and patterns in artefact distribution; and between Pit 19 and Pit 23 on the main north-south transect, where a section of 60 m was not tested due to the extent of localised disturbance from the golf course.

Fourteen (14) artefacts were recovered from MAPAD2; artefacts were recovered from nine of the 45 archaeological test pits (Figure 7.6).

No artefacts were recovered from the samples sieved from GTP2, nor were any artefacts or cultural features observed within any of the geomorphological test pits.

Artefacts were recovered from Spits 1 through 12, with the majority (N=8) recovered from the upper four spits. Two artefacts were recovered from Spit 12; no artefacts were recovered from any of the deposits below 120 cm. Artefact numbers per pit varied from one at Pits 9, 12, 13, 14, 34 and 42 to three at Pits 1 and 5.

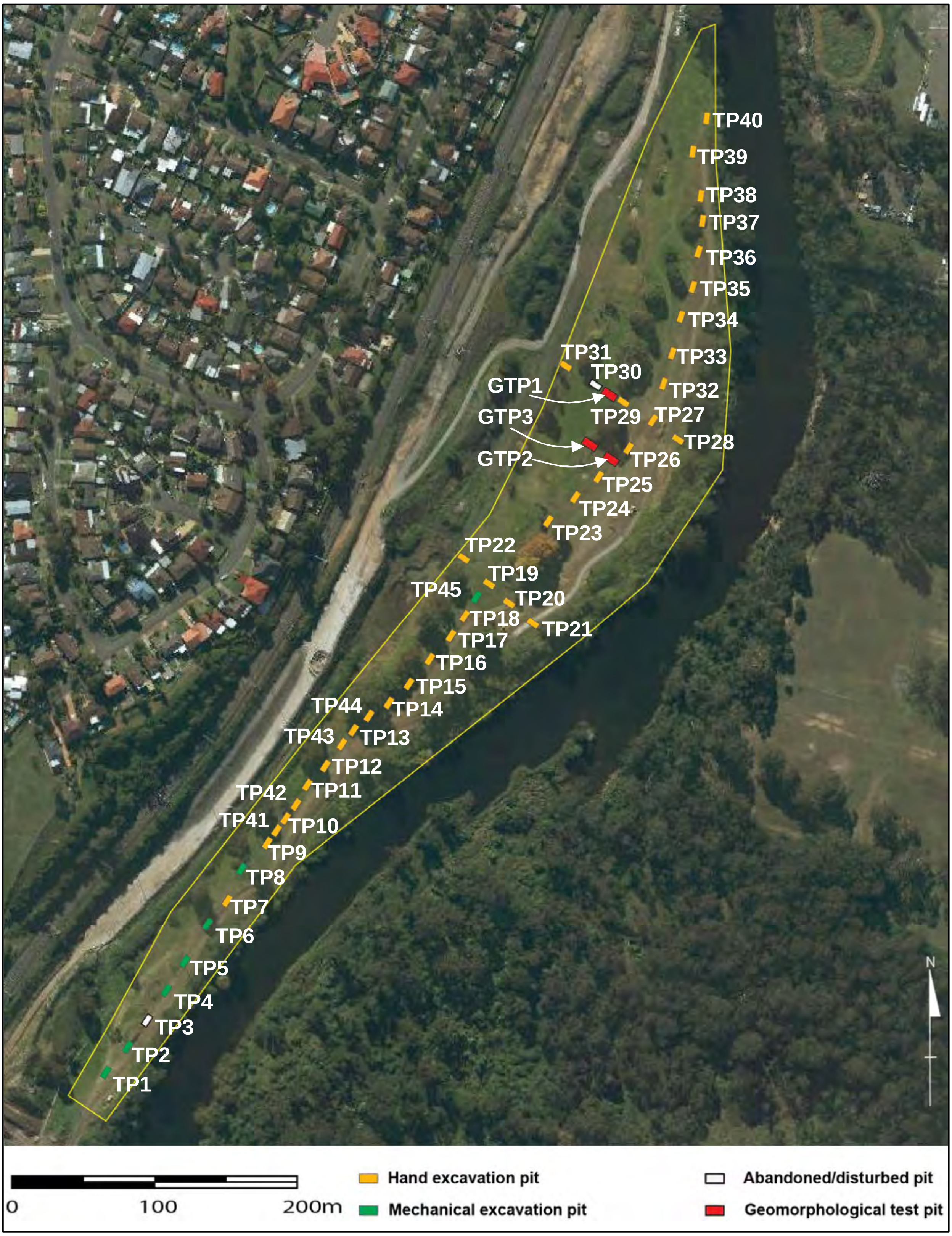


Figure 7.5 Location of test pits at MAPAD2
(Base image: NSW LPI 2013)

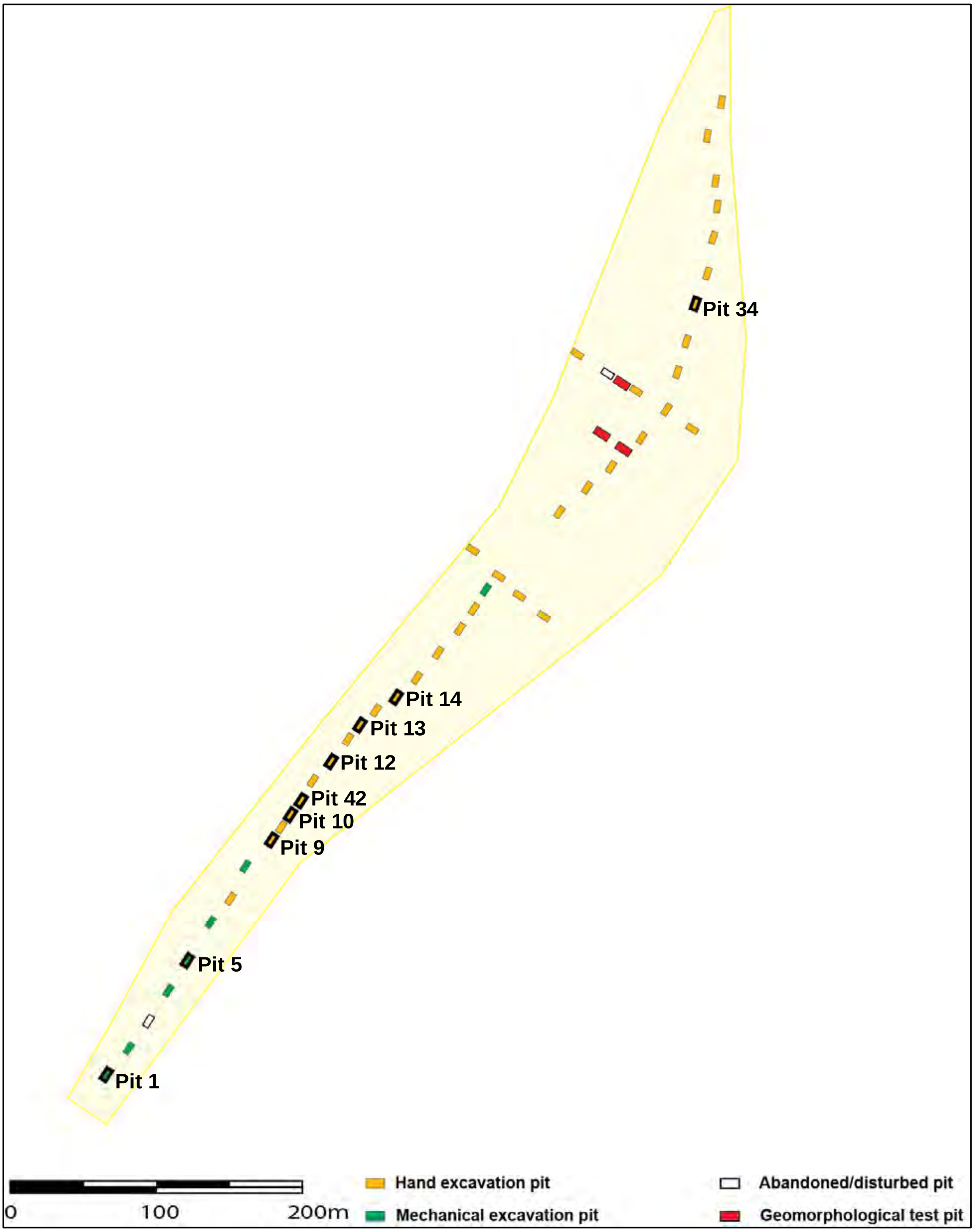


Figure 7.6 Overview of the location of test pits containing artefacts.

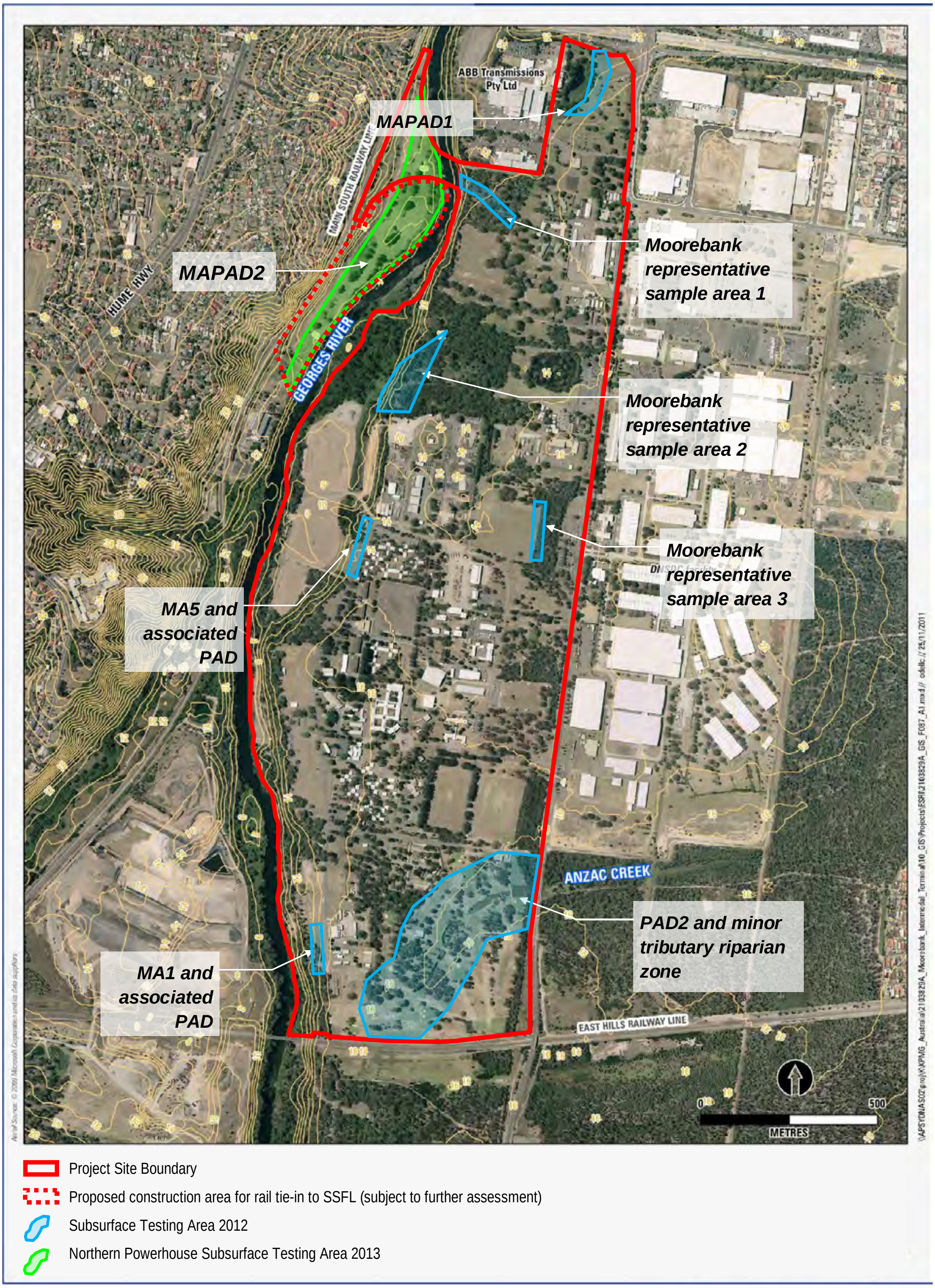


Figure 7.7 Location of all subsurface testing areas within the Moorebank IMT study area.

7.3 Summary of Stratigraphy

Deposits excavated across MAPAD2 comprised three groups:

- **Fill** - poorly sorted clayey gravels that have been introduced in some areas, most notably across the southern and northern extremities of the test area, as dumped fill deposits (Unit 3);

- **Avulsion Sands** - Well sorted bedded clean medium to fine sands (flood avulsion sands) (post-European levees and point bar deposits) (Unit 2); and

- **Buried Floodplain Deposits** - Organic silty sands with pedal soil capping dark – pre-European floodplain deposits (Unit 1).

The Unit 3 clayey gravels were encountered as a cap of 10-135 cm and were mainly present within pits at the far southern (Pits 1-8, 10 and 11) and northern ends (Pits 38-40) of MAPAD2. Fill was also encountered at the top of Pit 28, on the eastern margin of the test area between the cycle path and the river and at Pit 30, in a lower lying area away from the river (Figure 7.5).

Unit 2 sands were encountered either at the surface or directly below the Unit 3 fill. These sands were present in the majority of pits, the only exceptions being Pits 1 and 6 where disturbance from introduced fill had resulted in a cap of clayey gravels in excess of one metre. The thickness of the Unit 2 sands varied but was generally in the range of 50-200 cm; in many of the test pits, particularly the hand excavated pit, the base of this unit was not encountered.

The Unit 1 silty sands were encountered directly below the Unit 2 sands at a depth of one to two metres below surface. Excavation down to this unit was only achieved in 22 of the 45 test pits (Pits 4-8, 10, 18, 28-35, 37, 38-42 and 45) and excavation into this unit was rare with the top of the dark grey-brown silty sands often only appearing at the base of the limit of safe works (120 cm).

Relatively uniform pH levels were found throughout the stratigraphy with both the Unit 2 sands and Unit 1 silts tending to be slightly alkaline, with a pH of 7.5-8.0.

Detailed geomorphological analysis was undertaken at Pits 28, 29, 30, 31, 36, 41 and 42.

7.4 Artefact Analysis

7.4.1 Assemblage size and spatial distribution

Only 14 artefacts were recovered from across the 45 test pits at MAPAD2. Only three pits yielded more than one artefact (Table 7.1), these being Pit 1 (N=3); Pit 5 (N=3); and Pit 10 (N=2). One broken core, made from white fine grained material, was recovered, and two artefacts could only be identified as flaked pieces.

All other artefacts were un-retouched flakes. The diversity of materials present was high, given the small size of the total assemblage, with quartz, silcrete and fine grained siliceous materials being present in a range of different colours.

None of the artefacts could be refitted to one another, but there is a possibility that the proximal fragment made from red silcrete in Pit 12, Spit 1 could be derived from the same flake as the distal fragment in Pit 10, Spit 12, or the distal fragment in Pit 9, Spit 12.

The minimum number of artefacts which could have produced this assemblage is therefore 13 complete artefacts (following the criteria outlined in Hiscock 2002).

The spatial distribution of artefacts shows an interesting association with the sedimentary composition of the spits. The three artefacts from Pit 1 were recovered from a gravelly sediment (Spit 2) and the fill deposit (Spit 4). The three artefacts from Pit 5 were all recovered from a deposit of mixed fill where gravel was abundant (Spit 3). One of the two artefacts from Pit 10 was also recovered from a spit with a gravel band (Spit 7). In all pits which yielded more than a single artefact, therefore, there was an association of artefacts with gravel-rich sediments. This is consistent with the interpretation that the artefacts were deposited by fluvial transport, since the energy required to transport stone artefacts would also be sufficient to transport gravel-sized non-artefactual pieces of rock.

Table 7.1 Summary of artefacts recovered.

Pit #	Spit #	Technological type	Completeness	Comments
1	2	flaked piece	complete	grey, fine grained siliceous material, small flake scars on two edges
1	4	flake	complete	dark grey fine grained siliceous material
1	4	flake	LCS left	dark grey fine grained siliceous material
5	3	flake	complete	red silcrete
5	3	flaked piece	complete	white fine grained siliceous material
5	3	core	broken	white fine grained siliceous material, bi-directional core.
9	12	flake	distal	red silcrete
10	7	flake	complete	white quartz
10	12	flake	distal	red silcrete
12	1	flake	proximal	red silcrete
13	1	flake	marginal	dark grey silcrete
14	6	flake	margin missing	red silcrete
34	9	flake	complete	white silcrete
42	9	flake	medial	orange silcrete

The distribution of stone material types is similarly associated with the sediments from which the artefacts were recovered. Artefacts made from fine grained siliceous materials were only found in Pit 1, Spits 2 and 4 (fill deposit) and Pit 5 Spit 3 (fill deposit).

All of the artefacts found in other spits, whose composition varied from silty sand to sand, were made from quartz or silcrete. This could indicate that the fill deposits are derived from a different source area than the other, silty or sandy deposits. It is, however, difficult to be confident that this interpretation is correct, given the small sample size of artefacts found in the different deposits.

7.4.2 Variability of artefact attributes

Due to the small number of artefacts recovered in these excavations, it is impossible to confidently assess whether the assemblage exhibits a particularly high or particularly low variability in the range of the artefacts' physical attributes.

Very small sample populations, such as the assemblage being considered, are vulnerable to being perturbed by random sampling effects, which can misrepresent the variability of the meta-population being sampled. In this case, the meta-population would be the entire population of stone artefacts spread across the study area. Because the sample obtained is small (presumably because the meta-population is distributed very sparsely across the study area) each artefact in the sample has a large effect on the sample's overall makeup or appearance. For example, adding an extra complete flake to the sample would increase the proportion of complete flakes in the assemblage by almost 10% (see Table 7.2).

Because each single artefact has such a large effect on the sample assemblage's makeup, it is possible that chance events in the sampling process (such as the number of pits excavated, the placement of these pits in the landscape, and the distribution of artefacts across the landscape being sampled) will affect the makeup of the sample assemblage, and that these effects will cause the sample assemblage to be unrepresentative of the underlying meta-population. The smaller a sample is, the more probable it becomes that random sampling effects will perturb the sample in ways that make it dissimilar to the meta-population being sampled.

Only a single core was recovered from the test excavation (Pit 5, Spit 3). This core is made from white, fine grained, siliceous material, and is truncated by a snap fracture. Three negative flake scars have been struck from the same platform surface. The platform surface has been created by several earlier flake scars, making this a bi-directional core in that flakes have been struck from the core in two orientations, from two separate platform surfaces.

Eleven (11) flakes were recovered from the excavations, and these flakes show a range of variation in terms of all recorded attributes (Table 7.2). The majority of flakes are incomplete (64%). Silcrete is the dominant material (72% of flakes), Hertzian initiations are much more common (88%) than bending initiations, feather terminations are more common (63%) than other termination types, and the majority of flakes have no dorsal cortex (81%).

The majority of the flakes in the assemblage are small, with artefact weight being concentrated in the 0-0.3 gram range (Figure 7.8). Only two flakes are above this weight, at 3.7 and 4.7 grams. The core and 3 flaked pieces recovered are all above 0.3 grams, which is evident when they are added to the sample (Figure 7.9). The sample of all artefacts is still heavily dominated by artefacts in the 0-0.3 gram range.

Table 7.2 Summary of the technological attributes exhibited on the flakes in the assemblage.

Variable	Attribute	Number of flakes	Percentage of assemblage
Completeness	Complete	4	36
	Proximal fragment	1	9
	Distal fragment	2	18
	Medial fragment	1	9
	LCS	1	9
	Marginal fragment	1	9
	Margin missing	1	9
Material	Silcrete	8	72
	FGS	2	18
	Milky quartz	1	9
Initiation type	Hertzian	7	88
	Bending	1	12
Platform type	Single	2	29
	Cortical	2	29
	Facetted	1	14
	Shattered	2	29
Termination type	Feather	5	63
	Step	1	13
	Shattered	2	25
Dorsal cortex coverage	0 percent	9	81
	20 percent	1	9
	100 percent	1	9

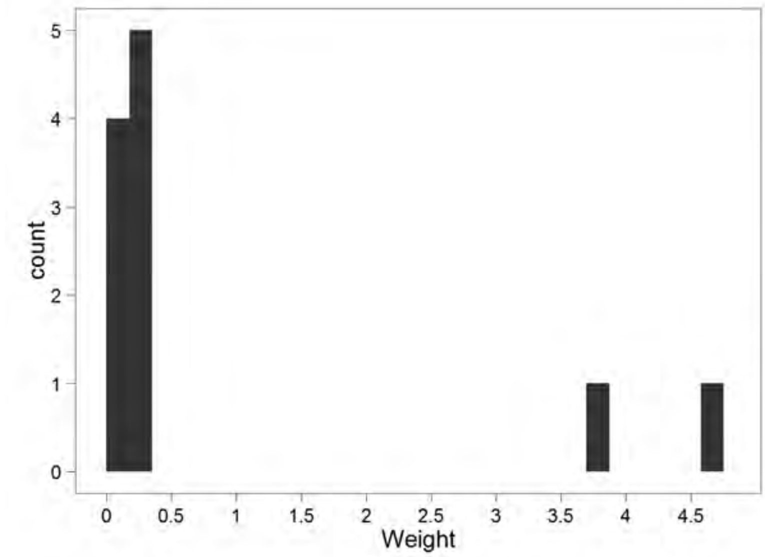


Figure 7.8 Histogram of distribution of artefact weights, flakes only.

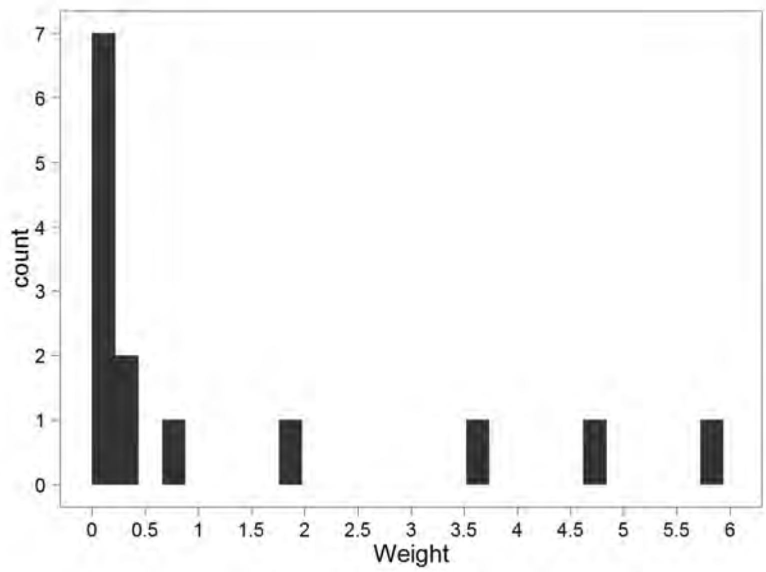


Figure 7.9 Histogram of distribution of artefact weights, all artefacts.

The distribution of artefact weights shows an interesting association with the sediments from which the artefacts were recovered (Table 7.3). All of the artefacts whose weights are above 0.3 grams (the isolated outliers in Figure 7.10) are derived from spits that were gravel or mixed fill. Three of the five heavy artefacts are from Pit 5, Spit 3, which was composed of mixed fill sediments. One artefact is from Pit 1, Spit 2, which was composed of clay with large angular gravels. One artefact is from Pit 1, Spit 4, which was also composed of clay with large angular gravels.

These data are consistent with the interpretation that the artefacts were deposited by fluvial transport, since the energy required to transport stone artefacts would also be sufficient to transport gravel-sized non-artefactual pieces of rock.

To examine the distribution of artefact size and shape, a new variable was computed by averaging each artefact's maximum length and its width. This variable provides a measurement that is proportional to the 2-dimensional area of the artefact (along its two major dimensions). This new variable is called the artefact's *average major dimension*, and is a useful measurement of an artefact's overall size. Plotting the average major dimension against the artefact's thickness provides data on the artefact's shape as well as on its size. An artefact that is spheroid in shape will have a thickness equal to its average major dimension, because its three dimensions are roughly equal. A thin, plate-shaped artefact will have a thickness that is small in proportion to its average major dimension.

The artefacts show a linear distribution of average major dimension relative to thickness, with small artefacts being thinner and larger artefacts being thicker (Figure 7.10). Most of the artefacts are tightly clustered around the line of best fit. All of the artefacts have an average major dimension that is large relative to their thickness, indicating that they are plate-shaped rather than spheroid.

Table 7.3 Summary of artefacts recovered, showing their provenance, weight and description of the associated sediments.

Pit	Spit	Artefact weight	Sediment description (summary)
1	2	1.9	Compacted orange brown clay fill with large angular gravels
1	4	3.7	Compacted orange brown clay fill with large angular gravels
1	4	4.7	Compacted orange brown clay fill with large angular gravels
5	3	0.3	mixed clay fill
5	3	0.8	mixed clay fill
5	3	5.9	mixed clay fill
9	12	0.1	coarse sand
10	7	0.2	silty sand, 3cm band of large gravels
10	12	0.1	dark brown silty sand
12	1	0.2	silty sandy loam, mottled sand coming through at base
13	1	0.2	silty sandy loam, mottling of sand coming through at base
14	6	0.1	sand
42	9	0.3	silty sand
34	9	0.1	sandy silt - silty sand

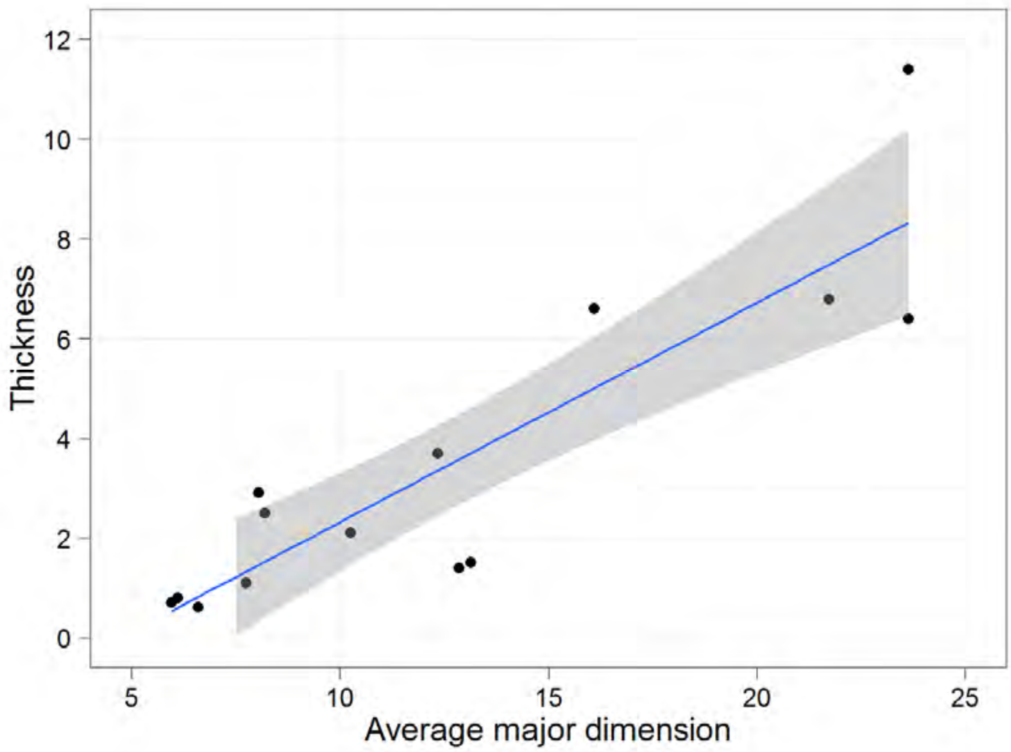


Figure 7.10 Thickness plotted against average major dimension. All artefacts.

When the artefacts recovered from spits made up of fill deposits or gravel-rich deposits are removed from the plot in Figure 7.10, it is evident that these artefacts are not only the largest artefacts in the assemblage, but also that they are more spheroid in shape than artefacts recovered from other sediments (Figure 7.11).

The artefacts remaining on the graph, which are from sand and silty sand deposits, are clustered towards the lower end of the x-axis.

These artefacts all have small average major dimensions, indicating that their overall size is small. They are also clustered at the low end of the y-axis, indicating that they all have low values of thickness.

The relationship between these two variables, indicated by the line of best fit on the graph, shows that these artefacts are also thinner relative to their average major dimension.

The gradient of the line of best fit is lower than in Figure 7.10, meaning that these artefacts have low values of thickness as their overall size (indicated by their average major dimension) increases.

As overall size increases, artefact thickness remains low, signalling that these artefacts are all thin and plate-shaped relative to the artefacts that have been removed from the graph.

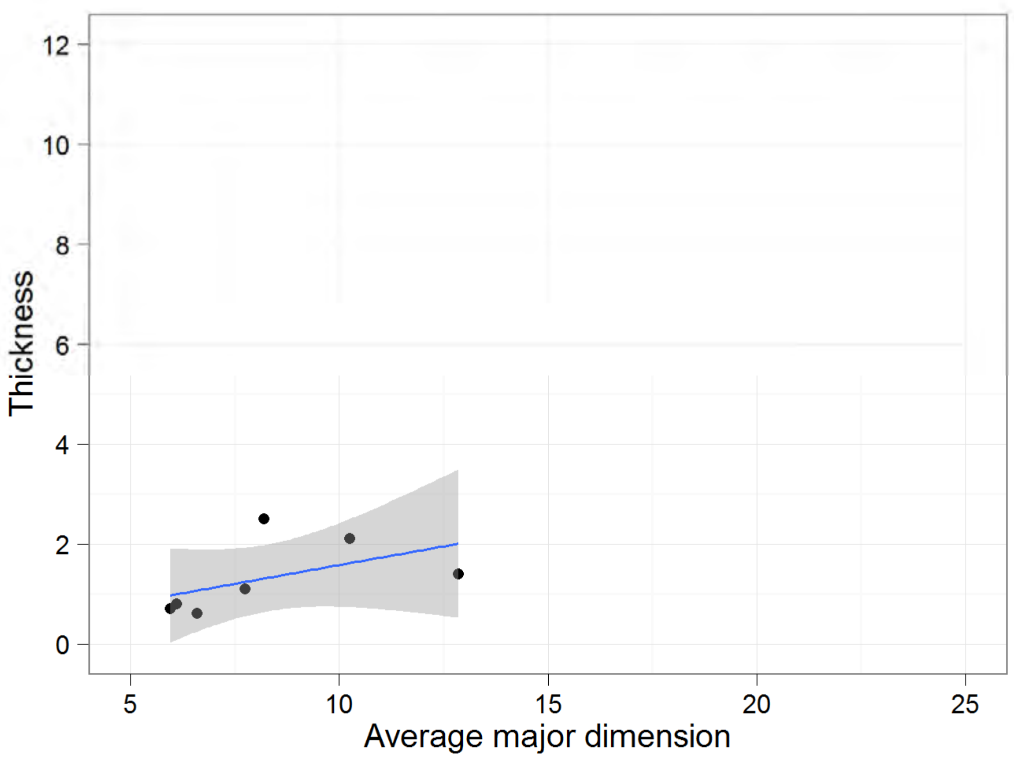


Figure 7.11 Thickness plotted against average major dimension.
Artefacts from gravel deposits and fill deposits omitted.

The data in Figures 7.10 and 7.11 are consistent with the interpretation that the artefacts recovered have been deposited on the study area by fluvial action.

The smaller artefacts, which are also the thinnest and most plate-shaped of the artefacts recovered, are found in sandy and silty deposits.

The larger artefacts, which are also slightly more spheroidal (being thicker relative to their average major dimensions) were recovered from gravel-rich deposits or from fill deposits.

This is a pattern which would be expected if the artefacts had been deposited by fluvial transport – the larger and more spheroidal artefacts are found in gravel-rich deposits, because these deposits would have been transported by higher energy water flow.

The smaller and more plate-shaped artefacts are found in sandy deposits, because these deposits would have been transported by lower energy water flow, which would not have been sufficient to transport larger artefacts.

These data do not prove that the artefacts were transported on to the study area by fluvial action, however they are consistent with this interpretation.

The artefacts showed no clear signs of physical wear or damage that would indicate they had experienced a great amount of water-rolling during their life histories. One artefact from Pit 5, Spit 3 had some edge damage scars on its margins, which could be a result of being transported fluvially but which could equally be due to other processes involving impacts, for example trampling or being driven over by vehicles.

None of the artefacts showed features such as edge rounding or grinding on high points, which would be indicative of long periods of being transported in a river system.

7.4.3 Summary of artefact analysis findings

In total, 14 artefacts were recovered from all excavated squares, clearly signalling that the average density of stone artefacts across the study area is extremely low.

While the low number of artefacts makes it impossible to develop any strong interpretations about assemblage composition, due to the random perturbing effects that small samples are prone to, the artefacts do show a number of strong and interesting patterns when the sedimentary units from which they were recovered is considered.

The artefacts recovered from spits composed of fill deposits were substantially larger than those artefacts recovered from other (silty sand or sand) deposits.

The proportion of materials between these two types of deposit was markedly different: fine grained siliceous artefacts were only found in fill deposit spits, while other deposits had no fine grained siliceous artefacts.

The shapes of artefacts showed a slight difference according to sediment type, with artefacts from the fill deposit being slightly more spheroid in shape, and artefacts from other deposits being thinner and more plate-shaped.

These data, though limited in their interpretive power due to the small sample sizes involved, are consistent with the interpretation that the artefacts were transported onto the study area by fluvial action of the Georges River, rather than being deposited *in situ* by Aboriginal occupants.

8. EXCAVATION ANALYSIS

This section provides an overview of the excavation analysis for the subsurface testing program within the Northern Powerhouse land of the Moorebank IMT study area. For further details relating to the lithics analysis the reader is referred to Appendix 3 .

8.1 General properties of the deposits across the study area

Stratigraphic profiles observed in the test pits are broadly consistent with the geological mapping for the area, namely showing components of a very recent (Holocene) floodplain alluvial landscape. The test pits show a very high degree of well-preserved bedding structure (see below). This was not expected, and is interpreted as reflecting very recent active sand mobilization and redeposition associated with 19th and 20th century flood events.

Relatively thick (1-3 m deep) very clean sandy sediments occur across most of the higher parts of the tested area. Primary depositional structures of the sands are well preserved, with soil formation restricted to weakly developed organics in the upper 20 cm of some test pit profiles. Only minor soil development has occurred. Soil properties relate to complex organic staining and minor bioturbation/mottling associated with siltier units and thin beds at greater depths. These organic units/thin beds are likely to represent slackwater deposition and short duration (e.g. seasonal) soil processes around ponded water and revegetation of clean sand surfaces following floods.

Beneath the predominantly clean light grey and light brown quartzose well sorted medium and fine alluvial sands a sharp near horizontal surface is commonly encountered. Organic firm sandy charcoal-rich silts are much more consolidated below the contact, also showing more developed pedal structures below the contact and fire/heat influenced clayey peds.

The soil complex caps a deep sandy silty fining upwards sequence, which extends to well below the water table and >3 m below surface. The soil and underlying sequence are provisionally identified as the pre-European floodplain sequence. Floodplain alluvium overlies, and probably interdigitates with, sandy units which may have been deposited under tidally influenced flow, or brackish water estuarine conditions.

Observation of the lower sandy silty sequence were limited to brief deeper observations of material brought up from machine cut sondages within the test pit extensions. Closer observation, investigation and possibly dating of these lower units would be required to confirm interpretations made here.

The upper sand sequences are typical of very recently deposited alluvium with minimal soil features. The units cold be described as weakly developed entisols (USDA classification) or as arenic rudosols (Australian Soil Classification).

The only exceptions to this are where mottling/clay illuviation is present in dumped subsoil clays present near surface. The “freshness” of the well-developed subsoil properties retained within the upper fills again demonstrates very recent deposition/dumping. In most cases the lower contact of the dumped fill has not been mixed at all by bioturbation into the underlying unit as seen at TP 30 (see Figure 8.1).

The patchy nature of the fill across the testing areas, the coincidence of thick fill with low-lying areas suggest the dumping was purposive and aimed to raise the datums ,and possibly improve drainage, in areas of former swale/slough. The fact that the fills in swales shows no burial by waterlain sands, or reworking, indicates that some fills post-date the floods in the 1980s. The dumping involves importation of fill.

As abundant sands were available to infill the depressions, the phase of filling may relate to activity after the golf course was built. However, rather than move sand off the levee areas to infill topography it appears that imported material was used in order to avoid impact on the established greens situated on higher areas.

Figure 8.1 A thick (60cm deep) clayey and shaley (subsoil derived) dumped fill deposit overlying *in situ* upper floodplain deposits attributed to the pre-European floodplain surface at Test Pit 30.

The upper part of the alluvium shows local patch evidence of heating/firing as reddened clay-silts and is rich in particulate charcoal. Inclusions in the upper fill of 30 mm plastic pipe and 50 mm metal pipe confirm recent age of the dumping. Note absence of any mixing across the interface, and absence of deformation of the upper surface of the dark grey alluvium. This indicates a) burial was rapid and b) the surface was well consolidated/capable of load bearing when dumping took place (i.e. dumping was onto a dry surface in a depression into a thin veneer of fines had recently washed.

All the stratigraphy across the test grid can thus be conveniently summarised and assigned to three stratigraphic units.

- **Unit 3 – Fill** (dumped deposits)
- **Unit 2 – Avulsion Sands**. Well sorted bedded clean medium to fine sands (flood avulsion sands) (post-European levees and point bar deposits)
- **Unit 1 – Buried Floodplain Deposits**. Organic silty sands with pedal soil capping (pre-European floodplain deposits)

Historic artefacts were recovered from a wide range of pits and from both Unit 3 (fill) and Unit 2 (avulsion sands). Stone artefacts, mostly silcrete, or fine-grained siliceous rock types, which may be either of historic or pre-European age, were also found in gravelly fill, and within Unit 2 sands, including co-associations with gravelly lenses in that sand body.

Proportionally more artefacts were recovered from the higher elevation parts of the testing grid in the upstream areas closer to the Powerhouse. This may reflect better preservation of older levee surfaces in the south of the testing grid, and higher ground elevations above flood events.

The pattern of artefact recovery may reflect a) primary *in situ* discard on higher parts of older levee b) proximity to higher energy flows and gravelly bed-load deposition coinciding with the river bend and crevasse area and/or c) the northern (downstream) part of the testing area being dominated by recent flood reworking (1980s), new levee landform creation and finer grain deposition.

The spatial pattern of artefact recovery will not be free of flood hydrological effects given a) the coincidence of artefacts with fine natural gravel deposition and b) the abundant evidence for deposition of most of the upper stratigraphy by overbank river flow during floods (Brown 1997).

That evidence is discussed in detail below.

8.1.1 Sedimentology and stratigraphy encountered during testing

The stratigraphy encountered during test pitting provided important indications of the depositional environments under which the three main sediment units accumulated.

In many cases the test pits revealed complex bedding structures, not commonly encountered during archaeological testing of sub-aerial soil environments. These bedding structures are in some cases textbook examples of the diagnostic stratigraphy produced where river flood flows have an abundant supply of sand and silts, and where flood discharge mobilise sands across the surface of levees, point bars and adjacent low sloughs.

The stratigraphy recorded in the test pits illustrates the effects of levee breaching and the resultant formation of crevasse splays and chutes (see Allen 1965; Brown 1997; Gibling and Rust 1993; Miall 1992).

Unit 3 – Fill

Considerable quantities of fill have been brought into the area as dumped deposits, and attain thicknesses of up to 1.2m in some low-lying depressions. The fill is typically composed of subsoil clayey deposits with some sand, and frequent shale gravel and cobble inclusions. The fill is very poorly sorted and the particles show no preferred orientation or grading through the profile (the deposit is a diamict). Red-grey mottling and patches are common.

Plastic pipes, metal, some ceramics and wire are relatively common inclusions. A typical profile is seen in Figure 8.2 – the south section of the machine cut extension to Pit 30. The fill is very clayey with mottling and staining typical of subsoils developed on shales. Clasts of shale are angular or subangular (not water transported) and typically in the 60-120 mm size range. Larger clasts and bricks also occur. The clay patches are locally still gleyed, a function of water logging at depth. This suggests the geochemistry of the fill reflects subsoil conditions at the location where it was dug up, and not conditions in its new dumped stratigraphic position. The mottling and gleying properties indicate the deposit has not yet reached a redox equilibrium with soil drainage in the dumped stratigraphy, and so must have been deposited very recently.

Recent deposition is also suggested by a) the weak soil development typically seen in the fill at surface and b) the absence of rooting bioturbation features running through from surface through the fill, or through the fill and the underlying surface.

A further confirmation of the recent age of the fill at Pit 30 is the absence of any sand wash or reworked sands capping the fill. This would be expected if any large floods had impacted the area since the fill was dumped into the depression.

The lack of disturbance or deformation of the very sharp planar surface and contact at 63-65 cm depth (see Figure 8.2) suggest the swale into which the fill was dumped was either dry or had well consolidated deposits in it, just prior to the fill being dumped. Water lain laminates and very thin discontinuous silt and sand partings indicate the depression had filled with water, and received runoff or inwash prior to the dump fill being brought in. These structures would have deformed if the sediments had been wet when the fill was dumped.

Table 8.1 Summary of main stratigraphic units identified across the testing area

Unit	Deposit	Inferred age	Thickness
Unit 3 – Fill	Very poorly sorted clays with silts with some shale gravel and mottled sandy inclusions – often showing mottling typical of gleyed subsoils, with brick, bottle, metal and plastic pipe inclusions.	Post 1950s to present (These deposits may be locally reworked by 1980s floods close to bank - but many appear to postdate last significant overbank flood)	<20cm (as thin incorporated lenses and inclusions on levee high areas) to 60cm as infill to low lying poorly drained depressions (former sloughs and channel chute cut-offs).
Unit 2 – Avulsion Sands	Very well sorted light grey or light brown medium or fine sands. Very well preserved bedding structures as thin beds and laminates – charcoal particulates pick out micro-bedding. Occasional grits or gravel partings/lenses in TPs closer to channel, and upstream (south) near major crevasse breach in levee.	1990s back to 1836 Onset of overbank sand body deposition predicted to relate to Liverpool Weir construction. Multiple flood events and reworking recorded in the deposits	0.5 - > 2.0m depth according to position relative to channel /on levee banks.
Unit 2/Unit 1 interface	Major sharp and planar contact – represents reactivation surface – across the pre-European floodplain surface and alluvial soils. Typically 1.0 to 2.0 m below surface across test area. Levee and point bar deposits have base on this surface – and migrate across it. Surface is locally eroded yielding charcoal, and possibly artefacts, re-deposited into bedding planes of overlying sand sequence.		
Unit 1 – Buried Floodplain Deposits (possibly estuarine at depth)	Fining upwards sequence, with well sorted medium sands at depth grading vertically into variably clayey and silty sands. Well-developed consolidated clayey organic silty fine sands cap sequence as charcoal-rich soil with patches of reddened (heated?) clay-silts (possible tree root burn outs).	European contact age at surface and in upper soil. Possibly much earlier Holocene age at depth. [Estimated ages older than 5000 BP at depth to as young as 1830s (where soils not eroded)]	Minimally 1-2 m – depth not established (possibly grades from mid-Holocene upper estuarine sands at depth) Lower contact not established. [Geotechnical data would be valuable as an aid to determining lateral extent and lower contacts/depth over rockhead. Also to establish presence /absence of peat channel cut-off /buried unconsolidated soils/terrace deposits at depth below modern floodplain.

At other sites across the test grid the fill can be seen to grade and thin out of the low lying swale areas up onto the edges of levee sand bodies. Figure 8.3 shows a deeper 0.6 -1.3 m sequence of fill at GTP 1, deepening off the levee bank to the east (towards George River) and into the swale. Again the fill is underlain by waterlain thin laminates and sands, forming an undisturbed water-lain deposit, which in turn caps the underlying buried organic silty sands and clayey sandy silts of the Unit 1 buried floodplain deposits.

At the east end of the GTP 1 section, a sequence of thickening sands marks the distal edge of the sand levee bank. These sands are *in situ* where they overlie the upper soil of Unit 1. Clear dipping beds are present as Unit 2 flood over bank deposits in the section, which are reworked, possibly by gravity collapse to the east.

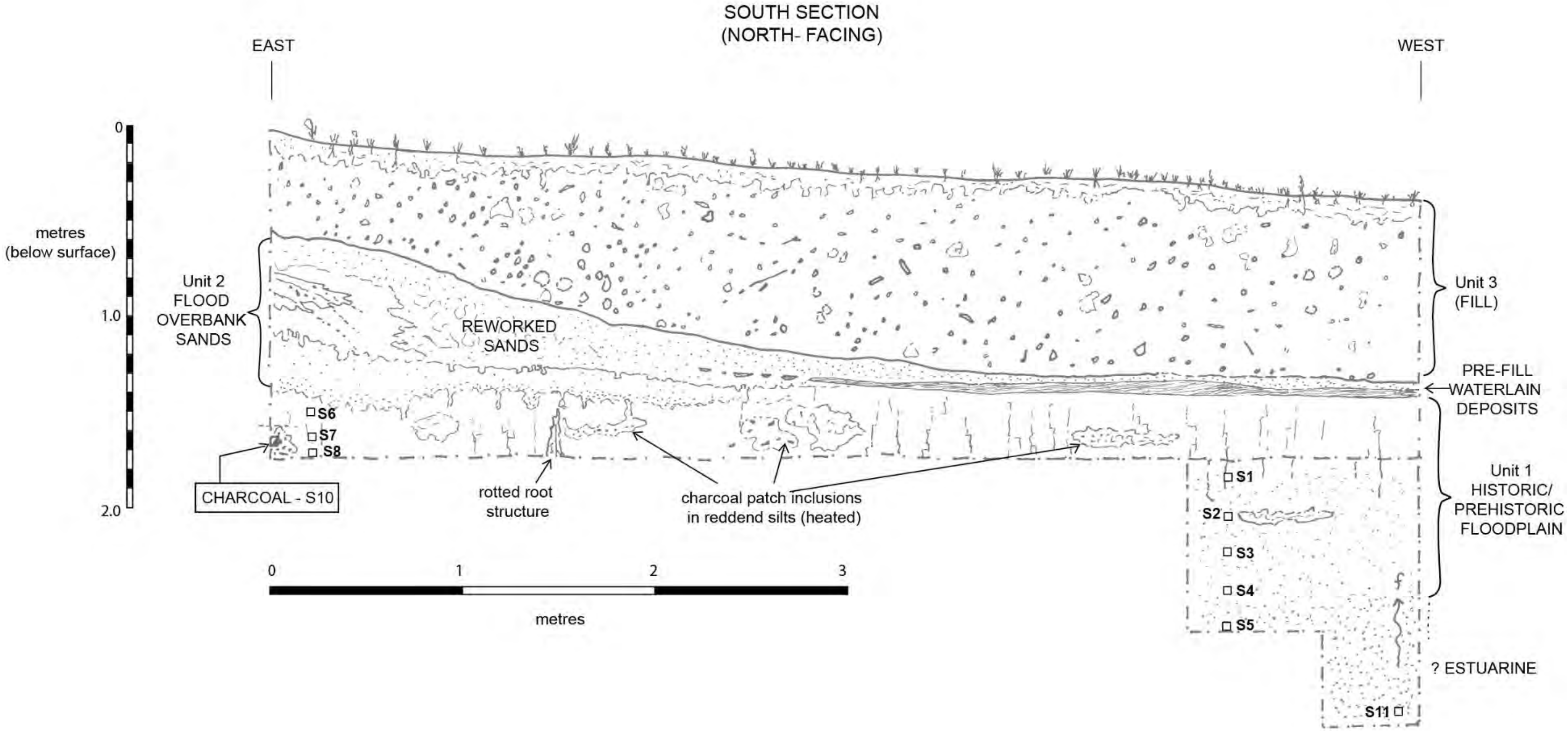


Figure 8.2 Pit 30 - South Section (North Facing)

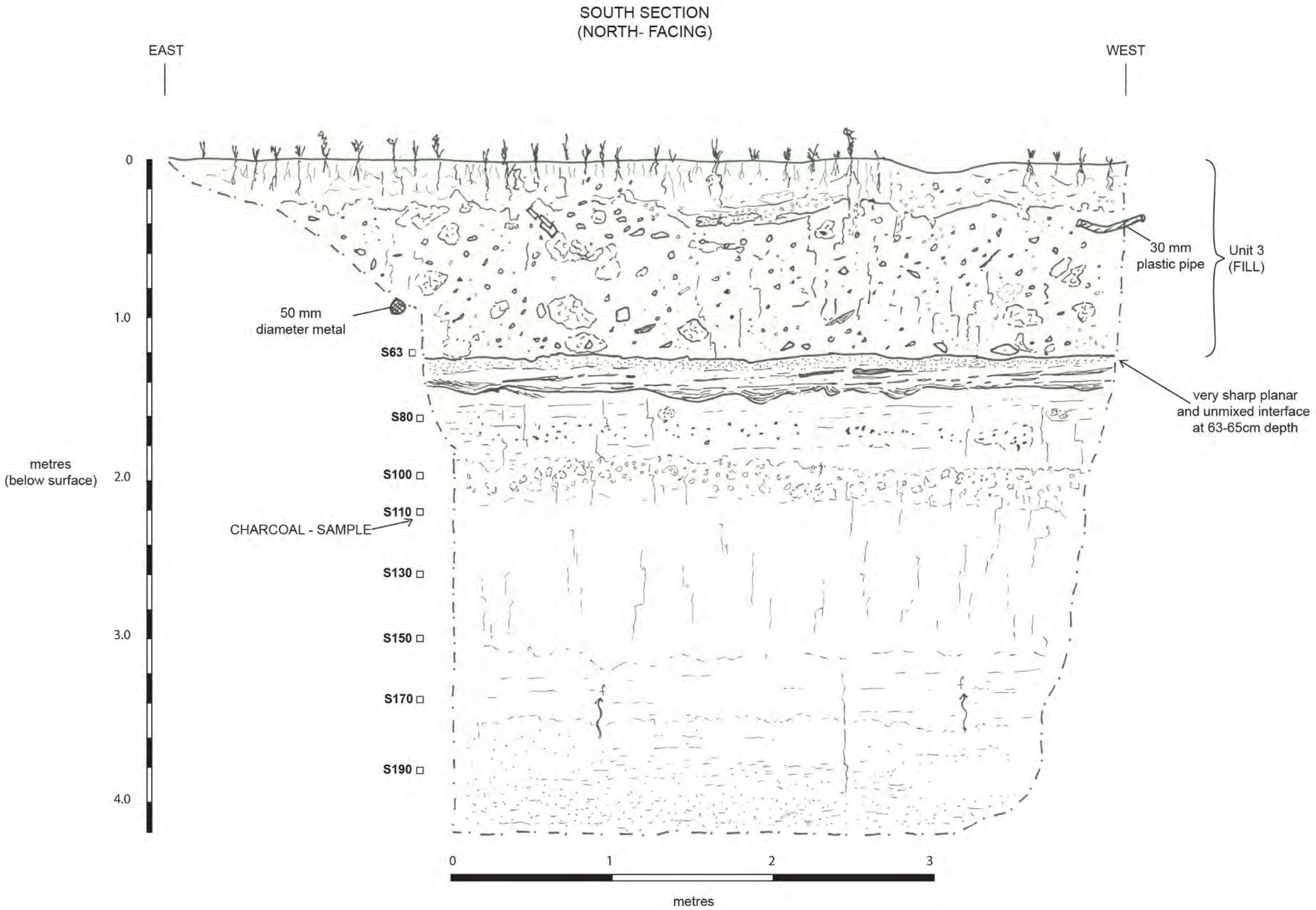


Figure 8.3 GTP1 - South Section

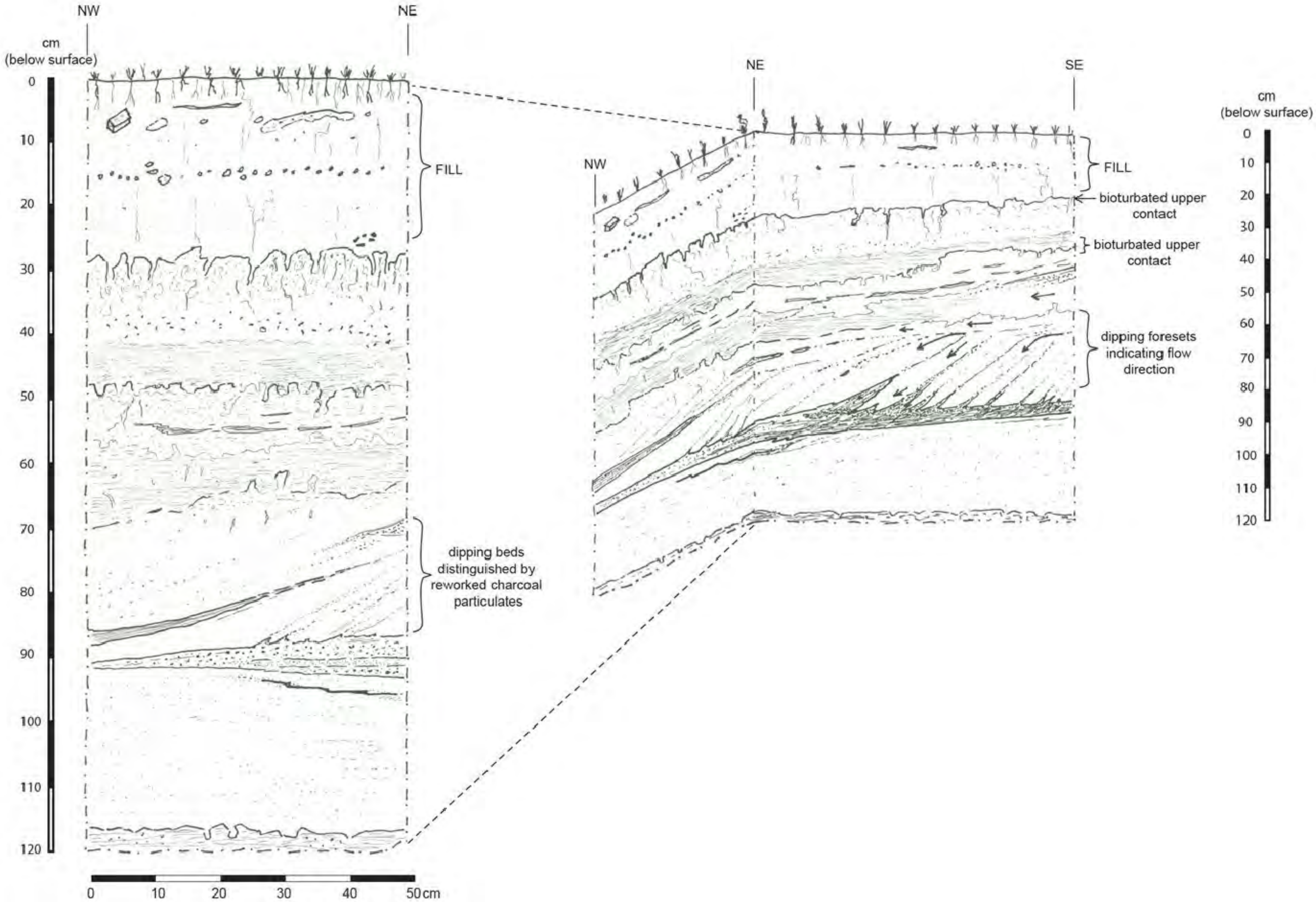


Figure 8.4 Pit 36 - Box Section showing complex three-dimensional bedding structures being revealed in the Test Pits

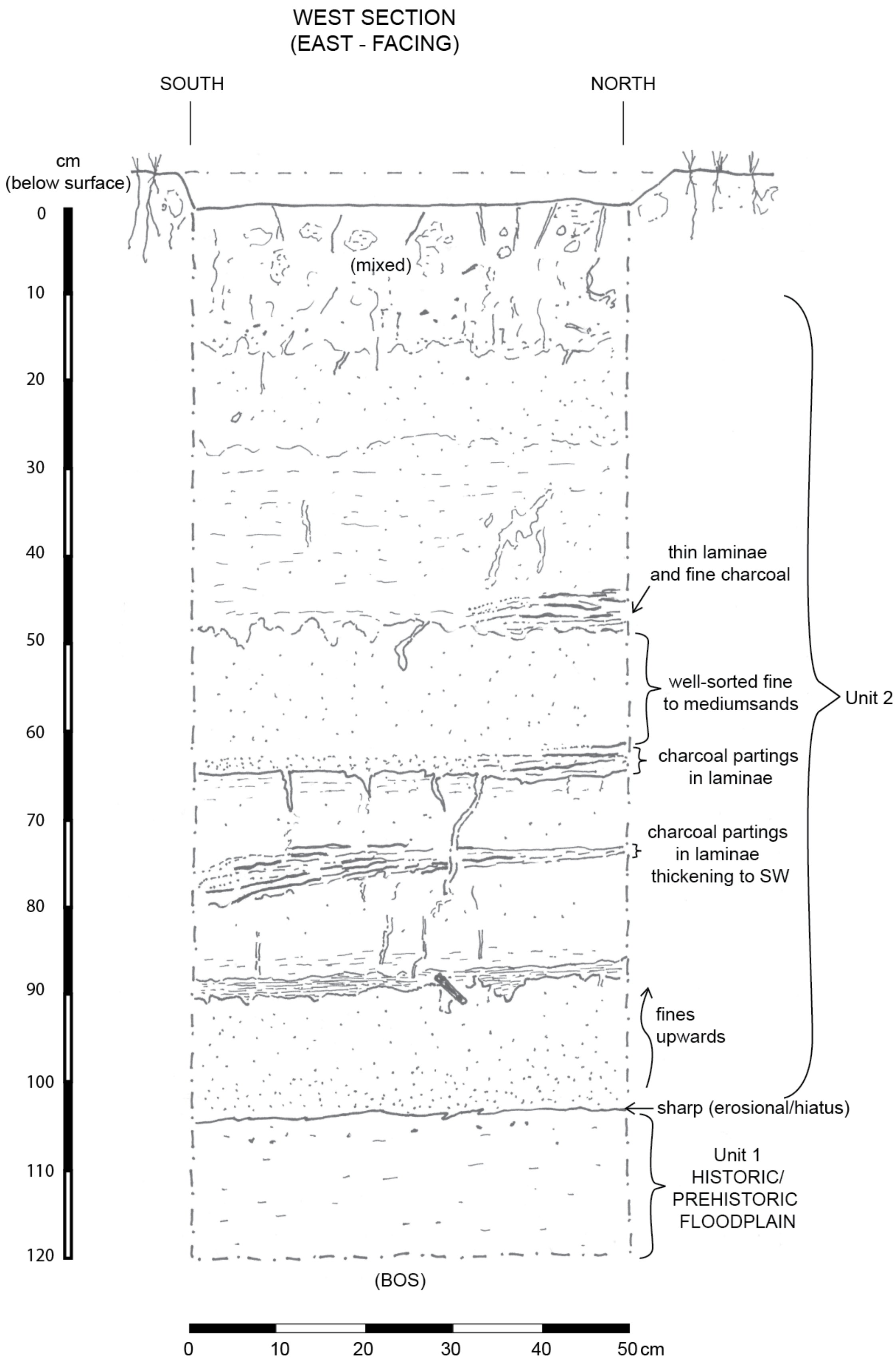


Figure 8.5 Pit 31 - West Section

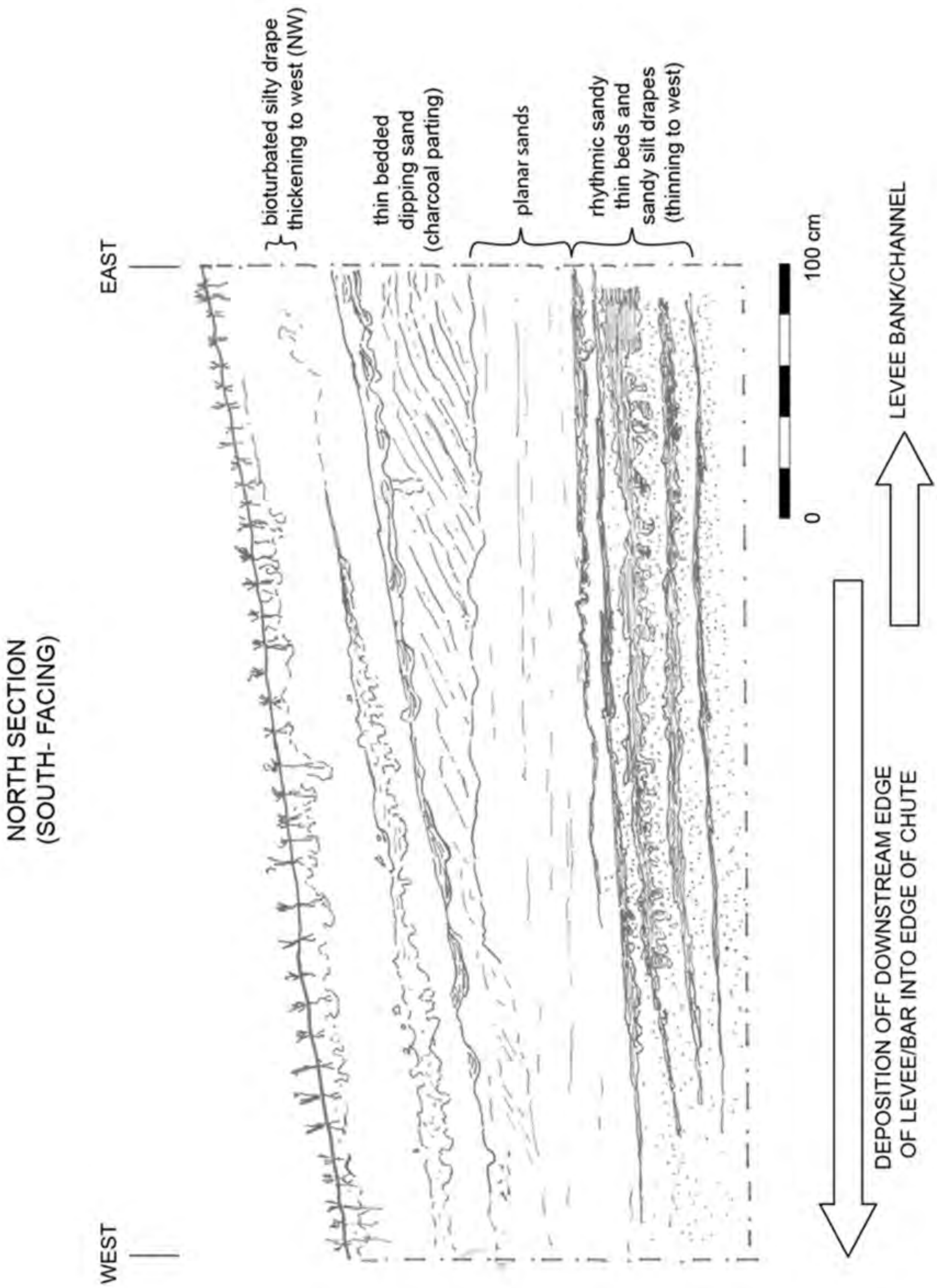


Figure 8.6 GTP3 showing movement of fines (charcoal particulates) which are the hydrodynamic equivalent of very fine sands and silts, picking out lateral fining into coarser sands, at the edge of a chute channel infill.

This stratigraphic sequence at GTP 1 (see Figure 8.3) indicates a phase of flood overtopping of a pre-existing sand (Unit 2) levee bank to the east, which itself predates both reworking of the levee edge sands and the deposition of the laminates in the depression to the west. Dumping of the fill postdates all of these events.

Charcoal patch inclusions, buried rotted-out roots and soil features in the upper 40 cm of the buried floodplain deposits (Unit 1) are all undisturbed by the later events.

Unit 2 – Avulsion sands forming point bars and levees.

Numerous test pits across the grid revealed very thin organic topsoils (Ao horizons) capping deep sequences of very well sorted fine to medium sands, where sands were typically light brown to light grey brown in colour when damp, drying to very light grey. In some cases e.g. Pit 36 the sands often extended to the base of limit of safe excavation at 1.2 m, or become organic and siltier with some clay in the silts below a sharp contact at the base of the sands. In some areas the upper sequence included some reworked fill.

The very complex three-dimensional bedding structures being revealed in the test pits are exemplified in Pit 36 (Figure 8.4). Here stratigraphy in the south facing (NW-NE) section of Pit 36 is shown along with the section running orthogonal to it – the NE-SE section (west facing) which runs broadly parallel to the present river channel.

Again the eroded surface of the underlying floodplain alluvium appears at the base of the pit overlain by sands. At 95 cm in the south facing section a planar surface is overlain by steeply dipping beds, again picked out as partings by reworked charcoal.

The same structures can be traced into the NE-SE section as dipping foresets migrating in the direction of flow (see Figure 8.4 Box section). These are text book structures, produced by migrating bedforms, moving in the direction of flow, over a reactivation surface (see Allen 1965; Gibling and Rust 1993; Miall 1992). In the case of this sequence two parallel reactivation surfaces exits at 118 cm – on the eroding buried floodplain alluvium, and at 93 cm on the sand base, suggesting rapid overall accretion.

These sands exhibited minimal signs of soil development, and normally preserved several well defined thin beds (as bands) of darker grey-brown more organic and very slightly silty sands. The lower bounding contacts of these darker slightly silty bands was normally slightly bioturbated, but sharp, and the upper contacts of the organic bands (thin beds) graded into clean pale grey sands which become better sorted.

An example of the typical sequence can be seen in Figure 8.5 – a drawn profile of the section in TP 31.

To summarise, the majority of the test pits excavated encountered well sorted and stratified sands which show bedding structures typical of flood flows over scroll bar, levee and point bar landforms. Deposition occurs as flood flows exceed the capacity of the normal channel and flow out of that channel (avulsion).

The absence of soil features indicates some recent deposition (perhaps last 20-50 years). There is a very strong probability that combinations of floods known historically in the 1980s, 1950s and especially between 1870 and 1890 are responsible for a) the erosion across the underlying Unit 1 buried floodplain and b) deposition of sands as point bar and levees which now form the topography of the area tested.

Much more detailed deposit mapping would be needed to separate sand units and perhaps assign them to individual flow events (e.g. the 1956 or 1987 floods). The recovery of artefacts, especially as they relate to a downstream gradient in topography and elevation, suggest that the levees show decreasing land surface age downstream. However, the age of the crevasse breach is not known, and was present in 1943. The breach therefore predates the 1956 flood.

The overall interim conclusion is that most of the sand body forming the higher ground across the test area consists of overbank sands forming levees and point bars, deposited during floods. These deposits do not contain significant archaeological contexts, though they do represent an important window on the geomorphological regime, and thus the archaeological record now preserved, along this margin of the Georges River.

The sands cover an important buried landform and deposit sequence – the organic floodplain fill over the river predating the historically known floods responsible for depositing sands across the area by avulsion.

Unit 1 – Buried Floodplain Surface

Most of the test pits on areas of higher elevation, and dug to the maximum safe limit of 1.2 m, only just encountered a very firm to hard organic sandy clayey silt at the base of the pit. In some higher areas this surface was not seen e.g. at Pits 1, 2 and 16.

In lower areas, especially swales, the same unit would be seen close to the surface unless it was obscured by dumped fill. Preliminary levelling data suggest the surface of the unit appears to occur at about 7 m AHD +/1 m across most of the tested area. The unit typically has a sharp eroded upper surface, as a bounding upper surface to sediments which were seen in GTPs to be very deep sequences of variably organic silty and clayey sands.

These organic sandy deposits were proven to a depth > 3.0 m below surface, and grab samples suggest the sequence fines upwards from medium to coarse sands with silt at depth, to a clay-rich and pedal upper soil profile where the upper sequence is less eroded on its upper bounding surface.

In GTP 1 (see above) the unit was sampled to up to 1.4 m below the upper surface and may reflect changes from estuarine to fluvial conditions. Further sampling and assessment for the preservation of indicative microfossils (pollen, diatoms, ostracods), along with detailed examination of cores from the sequence, would be needed to confirm this interpretation.

In GTP 1 the upper part of this unit is rich in large angular pieces of charcoal, which are unlikely to be reworked by floods. They more likely reflect *in situ* burning of plants on the floodplain surface, or root burn-outs below the surface.

Dating charcoal from the upper part of this unit would provide a minimum age estimate for the upper soil and flood plain surface.

Erosion of the upper part of this unit is indicated by the planar sharp interface seen regularly, in GTPs and test pits. Reworking of charcoals as particulates from this unit, appears to be the source of the charcoal particulates seen on partings of laminates and thin beds in the overlying Unit 2 sands[11]. This is seen very clearly in the north section of GTP 3 (see Figure 8.6).

Data from the test grid and transects allow preliminary checks on the shape of the upper floodplain surface, as interpreted here (Figure 9.1). The data shows the surface lies consistently at about 7.5 m +/- 0.5 m except around the breach point in the levee and along the alignment of the chute channel. These data confirm the hypothesis that the best preserved parts of the floodplain surface lie under the highest topography of the levee.

A key question arises. What has caused the area to shift from apparently slow accumulations of clay-rich and probably vegetated alluvium, to erosion across that surface by large floods and deposition of upwardly aggrading sand bodies, as levee landforms and point bars (the Unit 2 sands)?.

[11] If correct, this means dating any charcoal particulates in overlying Unit 2 sands will be wholly unreliable.

This change is sudden. Although examination of the underlying sequence was cursory, and limited by H & S considerations to safe operation by machine sondage, there is no sign of sand dominated deposition as levees in the underlying (Unit 1) sequence. The interim model proposed here is that the sudden stratigraphic change (from Unit 1 floodplain to Unit 2 well sorted avulsion sands) reflects construction of the weir at Liverpool in 1836. This model is explored below,

If correct, the environmental information which may preserve in the Unit 1 sequence may provide valuable insights into the past environments of the Georges River upper estuarine tract, during the Holocene, and up to and including the period when European pastoralists entered the area from the 1790s into the early 1820s. Sealing by the overlying sands, and the probable upward rise in watertable caused by the upstream ponding effect from weir construction, may offer unique preservation conditions of the floodplain surface, dating from prior to 1836.

The stratigraphy can be considered to exhibit both cultural and environmental heritage values.

- The floodplain surface, and the underlying Unit 1 sequence may have both historic, prehistoric and natural heritage significance as an archive of floodplain ecological change on the Georges River.
- Recovery of cores to investigate the chronology and nature of the sequence may be valuable. This approach would allow early assessment of the sequence from above to below the water table, without large excavation.
- Coring would provide indications of the age and nature of the sequence, and some assessment of whether further archaeological excavation (e.g. in coffer-dammed protected areas to the watertable) has justification.

Buried floodplain surfaces can provide important insights into the prehistory of areas and preserve evidence not normally found in terrestrial subaerial contexts (see Brown 1997). Water logging may preserve organic remains, not seen in other sites.

Archaeological exploration of buried floodplains in Sydney and NSW is unusual, but where development impacts are high e.g. through high density vibrocoring, dewatering, or sediment removal across large areas, investigation would be prudent under due diligence. Methods developed for subsurface investigations of floodplains in other parts of the world (e.g. see Bates et al. 2000) would be applicable to the Georges River area.

8.2 Liverpool Weir - and its relationship to the identified deposit sequence

Liverpool Weir was constructed in 1836 to a design by David Lennox. The weir is of considerable historic heritage significance, being one of the first engineered weirs in the country and one of few surviving today. It is one of the last structures in the colony built by a convict labour force[12].

The stone weir was constructed to constrain the saline influence of the tidal reaches of the Georges River beyond the weir. The weir raised the datum of the river bed, creating a stone sill, behind which a reliable potable supply of freshwater was ponded on the upstream side. The river upstream of the weir ceased to be tidally influenced, and its gradient was reduced. The design created a reliable freshwater supply for the new township of Liverpool, as well as providing an all season route-way and crossing point over the river.

[12] Lennox had experience of working on major bridge construction before arriving in Australia in 1832, including Telford's suspension bridge over the Menai Straits. He was responsible for designing many bridges in NSW from 1832 to 1844, before he moved to Victoria as Superintendent of Bridges for the Port Phillip District.

8.2.1 A model of the river channel changes caused by construction of Liverpool Weir

The study area lies within a topographically constrained part of the Georges River, and only 2-3 km upstream of the weir. The river has limited space in which to meander, although the eastern bank shows a bench which may have formed a significant meander track in the past (see Figures 4.1 and 4.3).

Figure 8.7 shows an annotated interpretation of the combined consequences of significant flood flow events, geomorphology and deposit sequence, based on data now gathered in the testing program, superimposed on a schematic plan based on the 1943 aerial image. The breach of the levee, and scouring of the underlying buried floodplain surface, clearly predates 1943. Key geomorphic phases, confirmed by field data from the subsurface testing, appear to be:

- A renewal of aggradation of sands as levees across the study area burying an early floodplain surface – with sands derived from an infilling main river channel which is shallowing and choked by sands
- Reactivation of erosion on hillslopes and banks
- Drowning/ponding/sedimentation of minor tributary channels at entry points into the main river
- Later phases of breaching of the main levee by avulsion, and chute channel scour along a straighter route
- A later phase of new levee formation on a new alignment

The levees align off the point in the channel where the river bends turns north-east, forming a sinuosity in the channel, with the breach point marking a point of avulsion under high flood flow. All these features are consistent with an overall process of quite sudden accretion and raising of the floodplain level at channel margins, *in tandem* with shallowing of the main channel.

The construction of the weir at Liverpool in 1836 will have significantly reduced the channel long profile gradient upstream, and prevented the normal through passage of sands down into the estuarine reaches under base flow[13]. The flood regime will also have changed, as backup of floodwaters behind a rising tidal head would no longer take place above the weir.

The effect of reducing the long profile gradient will be to induce channel instability. The effect of weir construction would be analogous to the natural process of delta front advancement – which likewise decreases the long profile gradient for upstream feeder channels (Fritz and Moore 1988). Instability is induced in channels when long profile gradients are reduced for two reasons. First, water under gravity seeks to flow in the most direct course. If the river can breach its natural levees during large flood discharges it may locate a more direct route increasing the gradient.

Although the sinuosity is low, this process of levee breaching and chute channel creation has occurred at Casula. Secondly, where the channel slope reduces, shear stress on the channel bed will also decrease, resulting in deposition of sediment, raising the channel bed relative to the floodplain surface. This in turn makes it easier for the river to breach levees, because as the channel aggrades progressively less discharge can be accommodated in the main channel, so levee breaching is more common and occurs at lower flood discharges.

[13] It may be major changes in saltmarsh and mangrove distributions observed downstream in the Georges River early to mid-20th century (Dunston 1990) partly connect to the weir construction through sediment starvation. Sand transfer past Casula may have been inhibited under normal flows after 1836.

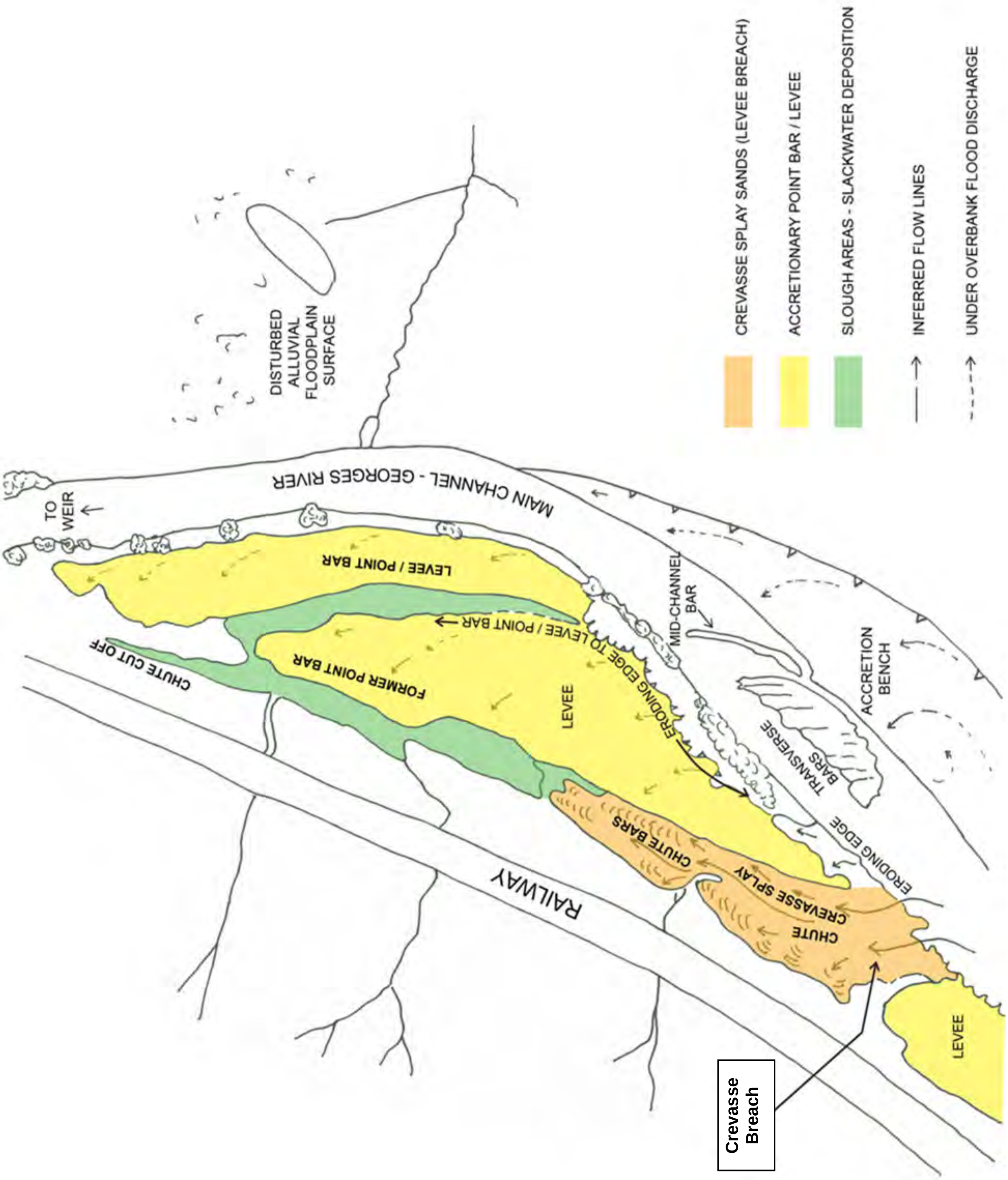


Figure 8.7 Annotated interpretation of the combined consequences of significant flood flow events, geomorphology and deposit sequence, based on data now gathered in the testing program, superimposed on a schematic plan based on the 1943 aerial image

These processes have clearly taken place across the study site, and are attributed here to the reduction in long profile caused by constructing Liverpool Weir.

Figure 8.8 shows an interpretive long section profile down the Georges River from upstream of the Casula Powerhouse, through the study area to Liverpool Weir. The modelled sediment stacks shown assume some depth and accommodation space in which Holocene estuarine facies accumulated when the river was tidal through the mid to late Holocene. Geotechnical data would be needed to calibrate the depth of the stack over rockhead.

The model shows how older stratigraphic river terrace remnants may exist above and below the present floodplain surface. We interpret the rip-up water-rolled gravels located on the testing as confirming such terrace sources close to the study area. The deep machine sondage at GTP1 suggests the existence of an estuarine floodplain–fluvial transition is present at depth in the Unit 1 sequence. The most reliable part of the schema is the upper sands overlying the buried floodplain surface – which is conclusively demonstrated by this study.

8.2.2 Testing the Model

This model can be further improved and tested by a) acquisition of geotechnical data on the sediment sequence below 7.5 m AHD and down to rockhead b) a search of archived borehole records and c) dating the deposit sequence.

A full and adequate assessment of the natural and cultural heritage significance of the full stratigraphic sequence requires additional data. In particular, the age and significance of deposits below the water table is not known.

The unanticipated discovery of what is essentially an historic set of fluvial landforms and stratigraphy produced by early convict construction of the weir downstream is a very successful outcome from the testing. However, it creates a problem in that the project design was not to seek buried archaeology at depths of >1.5 m. The overlying historic landforms clearly may seal and preserve both early historic and prehistoric archaeology at much greater depths than was anticipated.

Two dating techniques could be applied to the sediments at the Northern Powerhouse land (Moorebank). Radiocarbon dating (14C) on charcoals or Optically Stimulated Luminescence (OSL) dating on single quartz sand grains could be used on the sediments observed. However, with both techniques, great care would be needed to ensure ages generated were reliable estimates of artefacts lodged in the deposits. This would require demonstration of processual association; not just of stratigraphic co-association. As is shown in the report, historic objects/artefacts and indigenous stone tools provide relative indications of residence time of the deposits – but need to be interpreted carefully in a flood prone environment.

Much of the land surface of the study area, and the broader precinct, has been extensively modified by landscaping and dumping of fill. Disturbance of this kind was easily identifiable in test pits, with stratigraphy beneath the fill often undisturbed. The history and extent of disturbance of the alluvial sequences which record historic and prehistoric ecology in the reaches of the Georges River in the vicinity of the upper tidal head is not known.

However, it is likely that the buried floodplain surface identified in this study is a relatively intact and rare example of a formerly much more extensive pre-European contact floodplain landscape, much of which has been destroyed by previous development impacts in adjacent areas, and in other river catchments.

Archiving a record of the environmental changes preserved in the buried floodplain sequence emerges as a mitigative priority, and certainly a focus for the next stages of the project assessment process. Immediate next steps are discussed in the recommendations below – but strategically might focus on a) confirming the time sequence in the deposits (through dating) and b) specifying more precisely the preservation conditions at depth.

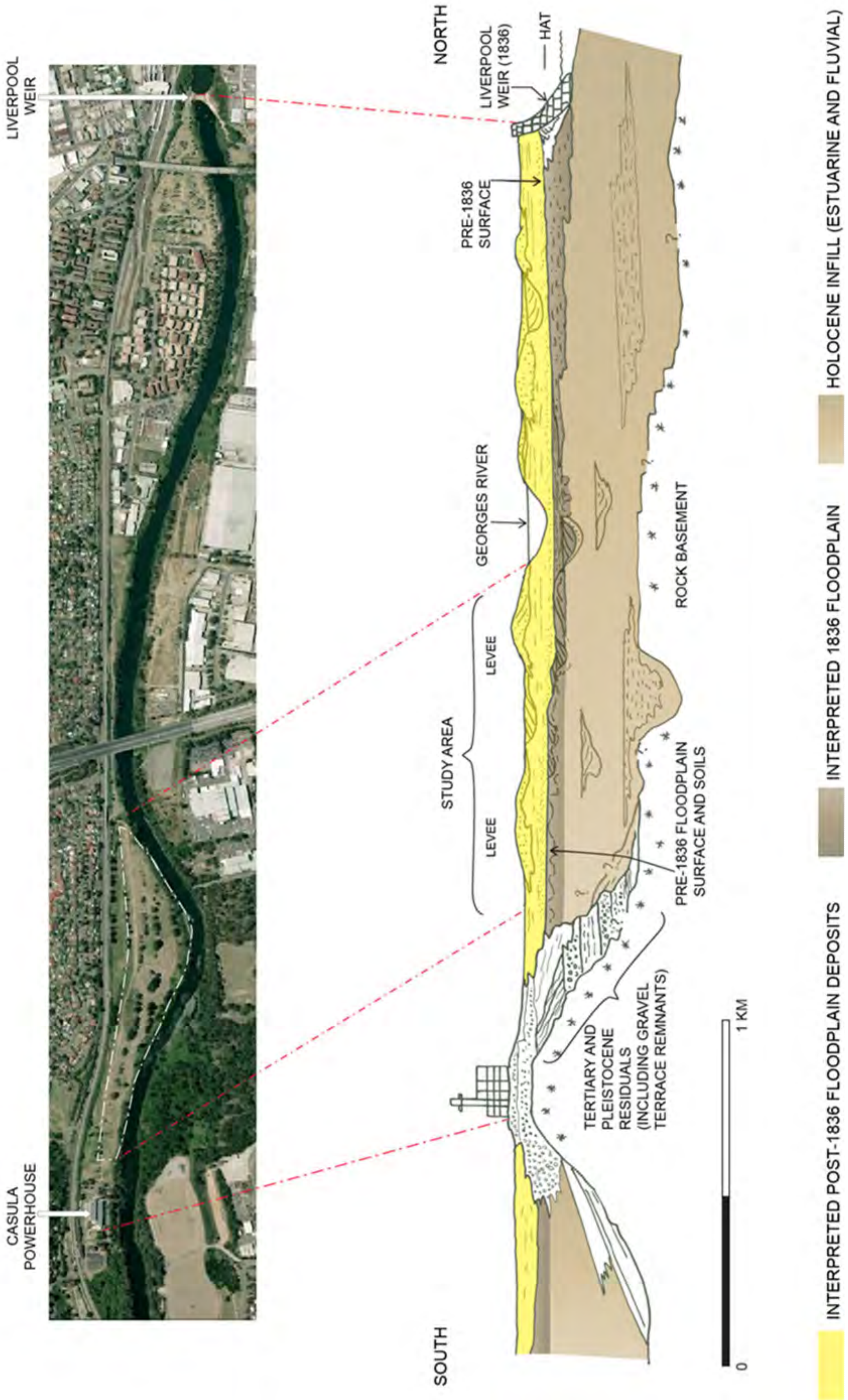


Figure 8.8 Interpretive long section profile down the Georges River from upstream of the Casula Powerhouse, through the study area to Liverpool Weir

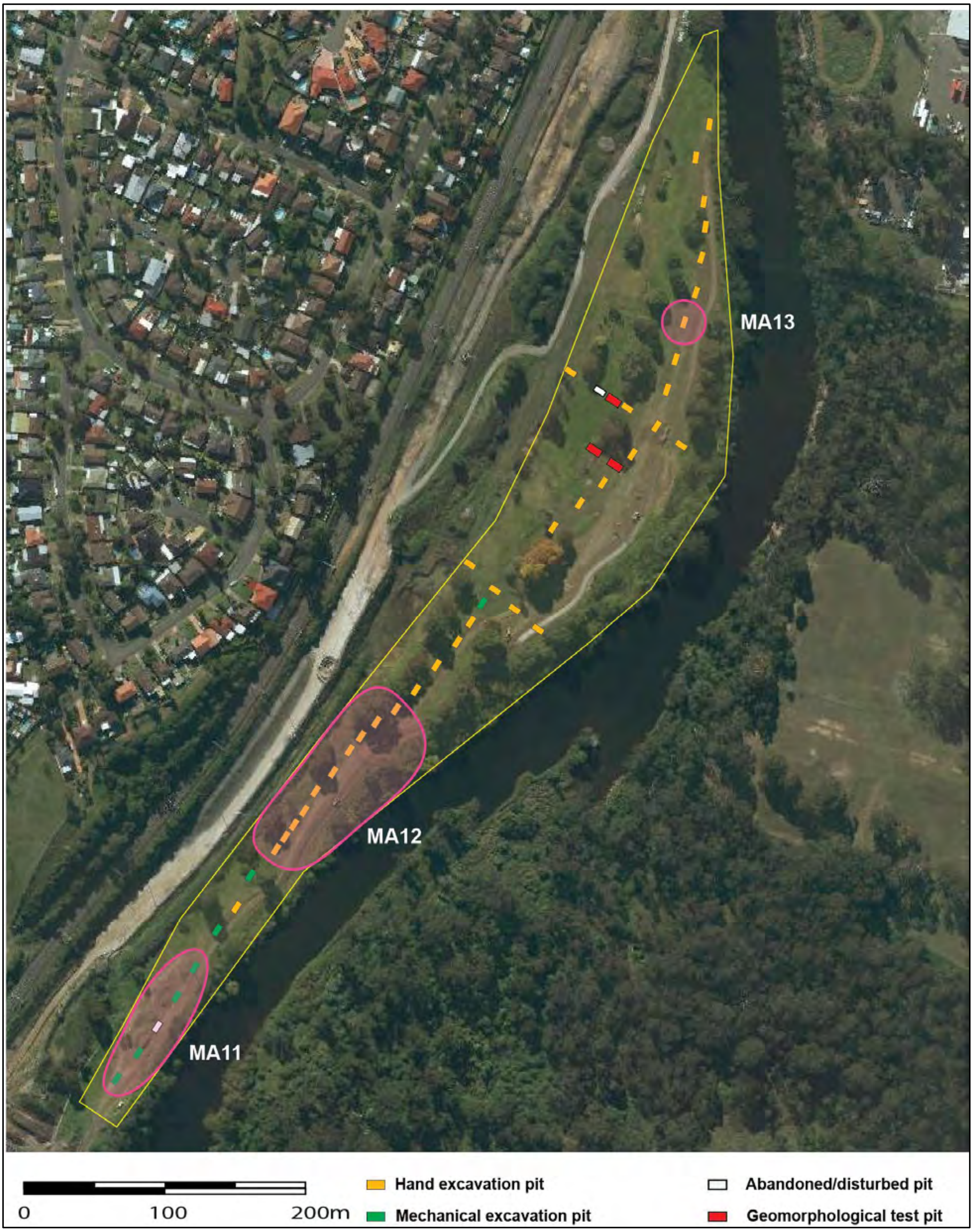


Figure 8.9 Extent of sites defined as a result of the subsurface testing program at MAPAD2.

The extent to which further archaeological testing or excavation to sample the buried floodplain surface is required is difficult to judge on present data. Excavation within a coffer dam protected area might be justified as part of due diligence – especially as chance encounters with historic age materials buried at depth would be a significant risk to scheme.

The testing suggests that the deposits across the area archive, in a physical tangible form, a history of flooding in the Georges River from before European contact through to present. The deposit sequence has considerable potential community and educational values, as physical evidence of the power of the Georges River during floods which occur at cross-generational timescales. The historic artefacts recovered from the flood deposits give the historical narrative immediacy to a wide section of the broader community. The deposit sequence also has scientific significance – as tangible evidence of floodplain change hitherto known only through historical records, and folk memory.

Within the broader project framework, which seeks to satisfy a staged approval process and meeting both EPBC Act and EP&A Act criteria for environmental assessment, the integrated cultural and environmental heritage record of flooding should be highlighted as a significant theme within the broader aims, and proposed outcomes, identified for the overall project.

Educational and community outcomes, for a wide range of stakeholders, can focus thematically on the flood history of the river. This narrative tracks changes from pristine estuarine river, through impacts of European settlers, pastoralism, changes in sediment loads and flooding, into the phase following weir construction at Liverpool. This study demonstrates such a narrative exists as a stratigraphic archive in the study area.

8.3 Site Designations

Artefacts were recovered from the following test pit locations at MAPAD2:

- Pits 1, 5, 9, 10, 12, 13, 14, 34 and 42.

However, the deposits from which these artefacts were recovered appear, on the basis of geomorphological analysis, to be the result of recent deposition (Unit 2 - post 1836) and/or mechanical reworking of deposits (Unit 3).

On the balance of evidence it would appear that there are three sites present within the area defined as MAPAD2 (Figure 8.9). These sites comprise:

- MA 11: artefacts associated with the Unit 3 fill that has been reworked and deposited as the result of mechanical earth works at the southern end of MAPAD2 (Pits 1 and 5);
- MA12: artefacts associated with Unit 2 fluvial sands across the central southern portion of MAPAD2 (Pits 9, 10, 12, 13, 14 and 42); and
- MA13: a single artefact associated with the Unit 1 silts at the northern end of the test area (Pit 34, Spit 9).

Given that it was not possible to fully test the nature of the Unit 1 deposits within the scope of the existing test excavation methodology, the area of archaeological potential identified as MAPAD2 remains

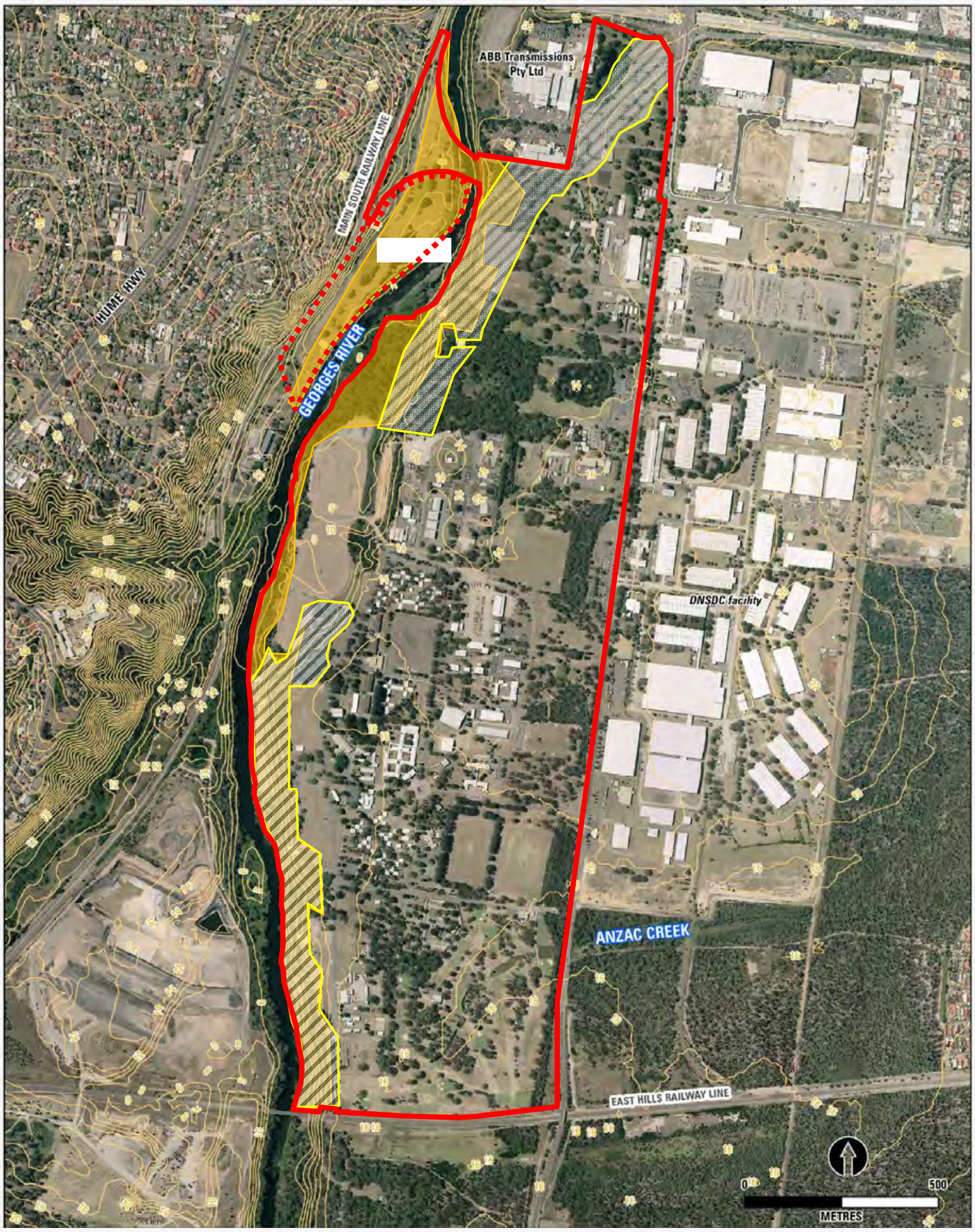
8.4 Responses to Research Questions

Table 8.2 provides an overview of responses to the research questions that were developed for the Moorebank subsurface testing program as they apply to the Northern Powerhouse land.

Table 8.2 Response to research questions

Research question	Response
What do the test results indicate about the past Aboriginal occupation of the project area and the Sydney region?	The lower lying landforms adjacent the Georges River, such as the floodplain area tested at MAPAD2 may not have been a focus of Aboriginal occupation. The results of the test excavation program did not reveal any evidence of areas of high use or focused activity. However, given that the extent of fluvial deposition of sands inhibited the opportunity to test the lower floodplain deposits, the extent of archaeological material within and below the 1836 floodplain is still largely unknown. Additional testing is required in order to establish the geomorphic and archaeological nature of the Unit 1 deposits at MAPAD2.
How do the test results compare with other local and regional archaeological results and models?	As was the case with the results of the test excavations conducted in 2012 (NOHC 2013), the current excavation results have demonstrated that an absence of surface artefacts is not necessarily indicative of an absence of artefacts in a subsurface context, which is in keeping with what is predicted by the local site model. However, as stated above, the test excavation program was unable to satisfactorily test the nature of the Unit 1 (pre-European floodplain) deposits across the study area. Additional testing is required in order to establish the geomorphic and archaeological nature of the Unit 1 deposits at MAPAD2.
Does the subsurface archaeological resource accurately reflect the predictions on which the sensitive landform mapping is based?	The subsurface test results have revealed a lower than predicted incidence of Aboriginal artefacts within the Georges River Riparian Corridor. However, this can be explained by the fact that the testing program was only able to adequately test deposits that appear to be less than 200 years old. The question of whether or not substantial archaeological material exists at depth (>1.2-1.5 m) within the MAPAD2 area is still unknown. Additional testing is required in order to establish the geomorphic and archaeological nature of the Unit 1 deposits at MAPAD2.

Research question	Response
Based on the test excavation results, how can the local predictive model be refined or corrected?	Sandy deposits at or below 10 AHD within the Casula-Moorebank section of the Georges River Riparian Corridor are likely to be the result of sedimentation processes that post-date the Liverpool Weir (1836), as such the archaeological potential of these deposits is limited. Given that the current test excavation methodology did not enable sufficient testing of the Unit 1 deposits (inferred pre-European floodplain surface) below the sandy Unit 2 deposits, the test excavation results have not been able to indicate any refinements or changes to the predictive model with regard to the nature of Aboriginal use of the Georges River Riparian Corridor. However they have refined our understanding of the depth at which potential archaeological deposits relating to Aboriginal use of the river corridor may occur. Additional testing is required in order to establish the geomorphic and archaeological nature of the Unit 1 deposits at MAPAD2.



Project Site Boundary

Proposed construction area for rail tie-in to SSFL

100 m across tertiary terrace edge (elevated ground adjacent to river corridor)

100 m either side of Georges River

Figure 8.10 Predicted Aboriginal archaeological sensitivity following the subsurface testing program

9. SIGNIFICANCE ASSESSMENT

9.1 Burra Charter Assessment Criteria

The Burra Charter of Australia defines cultural significance as 'aesthetic, historical, scientific or social value for past, present and future generations' (Aust. ICOMOS 1987). The assessment of the cultural significance of a place is based on this definition but often varies in the precise criteria used according to the analytical discipline and the nature of the site, object or place.

In general, Aboriginal archaeological sites are assessed using five potential categories of significance:

- significance to contemporary Aboriginal people;
- scientific or archaeological significance;
- aesthetic value;
- representativeness; and
- value as an educational and/or recreational resource.

Many sites will be significant according to several categories and the exact criteria used will vary according to the nature and purpose of the evaluation. Cultural significance is a relative value based on variable references within social and scientific practice. The cultural significance of a place is therefore not a fixed assessment and may vary with changes in knowledge and social perceptions.

Cultural significance can be defined as the cultural values of a place held by and manifest within the local and wider contemporary Aboriginal community. Places of significance may be landscape features as well as archaeologically definable traces of past human activity. The significance of a place can be the result of several factors including: continuity of tradition, occupation or action; historical association; custodianship or concern for the protection and maintenance of places; and the value of sites as tangible and meaningful links with the lifestyle and values of community ancestors. Aboriginal cultural significance may or may not parallel the archaeological significance of a site.

Scientific significance can be defined as the present and future research potential of the artefactual material occurring within a place or site. This is also known as archaeological significance.

There are two major criteria used in assessing scientific significance:

1. The potential of a place to provide information which is of value in scientific analysis and the resolution of potential research questions. Sites may fall into this category because they: contain undisturbed artefactual material, occur within a context which enables the testing of certain propositions, are very old or contain significant time depth, contain large artefactual assemblages or material diversity, have unusual characteristics, are of good preservation, or are a constituent of a larger significant structure such as a site complex.

2. The representativeness of a place. Representativeness is a measure of the degree to which a place is characteristic of other places of its type, content, context or location. Under this criteria a place may be significant because it is very rare or because it provides a characteristic example or reference.

The value of an Aboriginal place as an educational resource is dependent on: the potential for interpretation to a general visitor audience, compatible Aboriginal values, a resistant site fabric, and feasible site access and management resources.

The principal aim of cultural resource management is the conservation of a representative sample of site types and variation from differing social and environmental contexts. Sites with inherently unique features, or which are poorly represented elsewhere in similar environment types, are considered to have relatively high cultural significance.

The cultural significance of a place can be usefully classified according to a comparative scale which combines a relative value with a geographic context. In this way a site can be of low, moderate or high significance within a local, regional or national context. This system provides a means of comparison, between and across places. However it does not necessarily imply that a place with a limited sphere of significance is of lesser value than one of greater reference.

The following assessments are made with full reference to the scientific, aesthetic, representative and educational criteria outlined above. Reference to Aboriginal cultural values has also been made where these values have been communicated to the consultants. It should be noted that Aboriginal cultural significance can only be determined by the Aboriginal community, and that confirmation of this significance component is dependent on written submissions by the appropriate representative organisations.

9.2 Commonwealth Assessment Criteria

The Commonwealth Heritage List (CHL) is a register of natural and cultural heritage places owned or controlled by the Australian Government. These may include places associated with a range of activities such as communications, customs, defence or the exercise of government. The *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) establishes this list and nominations are assessed by the Australian Heritage Council.

In accordance with the EPBC Act a place has a Commonwealth Heritage value if it meets one of the Commonwealth Heritage criteria (section 341D).

A place meets the Commonwealth Heritage listing criterion if the place has significant heritage value because of one or more of the following:

The Commonwealth Heritage Criteria (DoE 2011) for a place are any or all of the following:

a) The place has significant heritage value because of the place’s importance in the course, or pattern, of Australia’s natural or cultural history.

b) The place has significant heritage value because of the place’s possession of uncommon, rare or endangered aspects of Australia’s natural or cultural history.

c) The place has significant heritage value because of the place’s potential to yield information that will contribute to an understanding of Australia’s natural or cultural history.

d) The place has a significant heritage value because of the place’s importance in demonstrating the principal characteristics of:

    i) A class of Australia’s natural or cultural places, or
    ii) A class of Australia’s natural or cultural environments.

e) The place has a significant heritage value because of the place’s importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.

f) The place has significant heritage value because of the place’s importance in demonstrating a high degree of creative or technical achievement at a particular period.

g) The place has significant heritage value because of the place’s strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.

h) The place has significant heritage value because of the place’s special association with the life or works of a person, or group of persons, of importance in Australia’s natural or cultural history.

i) The place has significant heritage value because of the place’s importance as part of Indigenous tradition.

Note: The cultural aspect of a criterion means the Indigenous cultural aspect, the non-Indigenous cultural aspect, or both.

Thresholds

While a place can be assessed against the above criteria for its heritage value, this may not always be sufficient to determine whether it is worthy of inclusion on the Commonwealth Heritage List. The Australian Heritage Council may also need to use a second test, by applying a 'significance threshold', to help it decide. This test helps the Council to judge the level of significance of a place's heritage value by asking 'just how important are these values?'

To be entered on the CHL a place will usually be of local or state-level significance, but must have 'significant' heritage value.

Commonwealth Heritage Management Principles

In addition to the above criteria and thresholds, Schedule 7B of the *Environment Protection and Biodiversity Conservation Regulations 2000* (Regulation 10.03D) lists the Commonwealth Heritage Management Principles. These principles are:

1. The objective in managing Commonwealth Heritage places is to identify, protect, conserve, present and transmit, to all generations, their Commonwealth Heritage values.

2. The management of Commonwealth Heritage places should use the best available knowledge, skills and standards for those places, and include ongoing technical and community input to decisions and actions that may have a significant impact on their Commonwealth Heritage values.

3. The management of Commonwealth Heritage places should respect all heritage values of the place and seek to integrate, where appropriate, any Commonwealth, State, Territory and local government responsibilities for those places.

4. The management of Commonwealth Heritage places should ensure that their use and presentation is consistent with the conservation of their Commonwealth Heritage values.

5. The management of Commonwealth Heritage places should make timely and appropriate provision for community involvement, especially by people who:

   a) Have a particular interest in, or associations with, the place; and

   b) May be affected by the management of the place.

6. Indigenous people are the primary source of information on the value of their heritage and that the active participation of indigenous people in identification, assessment and management is integral to the effective protection of indigenous heritage values.

7. The management of Commonwealth Heritage places should provide for regular monitoring, review and reporting on the conservation of Commonwealth Heritage values.

When assessing the Commonwealth heritage significance of places within the study area in addition to applying the primary and secondary tests of the CHL criteria and the significance thresholds, reference also needs to be made to the above Commonwealth Heritage Management Principles. The latter is particularly relevant to the study area where there are:

- Other heritage values of the place that are the responsibility of the ACT Government (Principle 3); and

- A number of indigenous places for which the primary source of information on the value of their heritage has been provided through the active participation of local Aboriginal communities (Principle 6).

Heritage significance can apply to a building or a place at either local, State or Commonwealth level. The principal mechanisms recognising heritage places located on Commonwealth owned or managed land, the National Heritage List and the CHL. Each list has its own criteria for assessment of significance. As the whole of the project area is owned by the Defence the assessment of cultural heritage significance will be undertaken using the CHL criteria. If the assessment indicates that the place or elements within it meet the criteria for entry on the CHL, preparation of a nomination to the CHL may be recommended for the relevant places.

9.3 The Moorebank IMT Northern Powerhouse Land Study Area

The following sections provide discussions of general values identified at each site and across the study area as a whole.

The assessment of significance across the study area as a whole includes consideration of the implications of the subsurface testing program for identified sensitive landforms.

A summary of significance assessments for all recorded sites is provided in Table 11.1, which includes assessments against the Burra Charter significance values and the Commonwealth Heritage list criteria. Figure 11.1 shows areas within the project area assessed as meeting the threshold for listing on the CHL.

9.3.1 Significance of the Moorebank IMT Northern Powerhouse Study Area

See Appendix 7 for a detailed assessment of the Northern Powerhouse land against the Commonwealth Heritage list criteria.

Initial desktop assessment and field survey (NOHC 2013) identified an area of archaeological potential along the western bank of the Georges River (MAPAD2). Subsurface testing within the upper 120-150 cm of deposits at MAPAD2 has revealed an intermittent and low density of stone artefacts within deposits that are thought to have formed during the past 200 years (MA11 and MA12). These artefacts are interpreted as not being *in situ*. A single small silcrete flake was also recovered from lower deposits thought to relate to the pre-1836 floodplain (MA13).

The identified sites (MA11-MA13), together with the broader area of archaeological potential in which they are situated, contribute to the overall significance of the Northern Powerhouse land and the Moorebank IMT study area as a whole.

The test excavation program within the Northern Powerhouse land has demonstrated that while the archaeological significance of the upper 120-150 cm of deposits is generally low, these deposits are likely to have significance in terms of being a representative example of environmental changes that resulted from European settlement, in particular the construction of the Liverpool Weir. The Unit 1 and Unit 2 deposits have the potential to be of significance in terms of their scientific value, natural value, educational value, representativeness and social value (importance to the Aboriginal community and the broader Australian community) at local, State and National levels.

The Georges River Corridor and terraces have previously been assessed to meet the threshold for listing on the Commonwealth Heritage List (NOHC 2013a); the results of the current subsurface testing program at MAPAD2 indicate the potential for increased significance of these landforms.

9.3.3 Significance of the deposits

Results show the study area preserves a) a highly specific historical and prehistoric record of recent sand aggradation and vertical accretion superimposed on b) an earlier floodplain surface. The cause of the change in sedimentary regime appears to be the construction of the Liverpool Weir in 1836. The sediment record is thus an historic archaeological artefact of European design (ponding behind the weir to create a freshwater supply free of tidal saline influence) while the lower stratigraphy only partly observed in this study records the broader prehistoric changes prior to that impact.

Heritage values of the Unit 3 – Fill

The fill reflects recent historical land use, and land modification. It may have minor educational value, and community interest. It has no particular heritage value as the process it reflects is ubiquitous across the broader area.

Heritage values of the Unit 2 – Avulsion sands.

The key points are that across most test pits the covering deep (Unit 2) sands show:

a) properties of bedding and sequence development reflecting deposition under water flow conditions, depositing sands on levees by avulsion. Significant archaeological preservation is unlikely in these sands. Some older higher levee surfaces may preserve some small prehistoric sites.

b) Specific bedding properties and sediment structures recognised in sedimentological literature as typical of deposition either on a levee, or marginal to a levee or point bar (Brown 1997; Conybeare and Crook 1982; Miall 1992: Reid and Frostick 1994).

c) The soils show very weakly developed pedogenic properties and horizon development.

Many test pits showed evidence of recent disturbance in the upper parts of the profiles observed. The study area has sustained substantial modifications by spreading of fill across the surface. This has been noted in previous evaluations and geotechnical investigations across the broader area (NOHC 2013a; Steele and Dallas 2001).

The Heritage values (natural and cultural) lie in the fact that these upper sands, as flood deposits, geomorphological landforms and land surfaces, provide a tangible physical record of historical events and ecological changes that are of wider significance in the context of the development of Liverpool, the past nature and environment of the Georges River, and as a rare example of early floodplain manipulation and management by a (convict constructed) weir structure.

Scientific values include information on the nature of hydrological adjustment of the river, an ongoing process, where better understanding of the trajectory of change in the last 180 years provides baselines and context for present flood and river ecological issues and management.

Floods and flooding are significant parts of the collective community history and folk memory in Liverpool. Tangible examples of the processes are rarely seen so well preserved in geological archives. The sequence investigated sits on a buried floodplain surface, and so the overall deposit sequence also records the processes of change from the floodplain ecology known for thousands of years to Aboriginal people, and its environmental transformation through to the present day.

The sequence at the study area is also unique in that no other major floodplain adjustments and ecological shifts due to construction from a convict constructed weir are known in Australia. The sequence would fit the heritage definition of a unique geological record of early human impact on a pristine ecosystem comparable in its context with e.g. first manipulation of the Tiber by Roman engineers, or Fenland drainage and transformation initiated by the Earl of Bedford in the 1630s and engineered by Vermuyden.

The upstream landscape consequences of convict weir construction at Liverpool are poorly documented, and this sequence clearly has the capacity to provide illustrations, dates and tangible experiences which illustrate the (unintended) hydrological and landscape "knock-on" effects of the historic construction.

The sequence identified may be part of a broader sequence of deposits. The extent to which the sequence is preserved elsewhere is not known. On present evidence the parsimonious conclusion would be that it is one of the few places where this historic stratigraphic record has survived development impacts.

The overall conclusion is that the heritage values are very considerable, and work should be undertaken to archive the information in the sequence proportional to scheme impacts.

Heritage value of the Buried Floodplain Surface and Alluvium (Unit 1)

Our observations of this unexpected deposit sequence are partial and restricted by on-site safety requirements.

The model of the stratigraphic sequence development presented above suggests this unit has the highest *potential* heritage significance. The floodplain surface appears to be preserving soil and event stratigraphy (particularly massive burning events) which we think relate quite specifically to the period of European insurgence into the river valley, prior to 1836. Records of the types of floodplain vegetation present in the period 1790-1830 may be well preserved as the surface was then sealed by sands.

The composite nature of a floodplain soil surface means we would expect evidence of the prior condition of the floodplain to also be preserved in the sequence (e.g. as microfossil inclusions such as pollen, diatoms) or as larger features (tree burn outs, flood event layers).

It is possible that very early European historic structures, ditches, fences and even river margin structures or boats could be preserved across this stratigraphic surface *if* the age model we infer is correct. Certainly root systems and other *in situ* evidence of floodplain habitats may be well preserved as the consequence of weir construction will have been a raised permanent water table.

Preliminary levelling data suggest the buried surface at 7.5-8.0 m AHD (see Figure 9.1) represents an excellent medium for local organic preservation. Clearly it is not possible to predict the presence/absence of such features, at any level spatial precision. Present data suggest the potential for preservation is high and the risk to scheme from inadvertent impacts on important cultural and natural heritage deposits could be considerable.

This view, it must be emphasised, is based on an *assumed chronology*. To adequately assess *the* heritage significance and the risk to scheme from unexpected impacts *the model needs to be validated.* Dating the main events in the sequence is a pre-requisite to improved heritage management outcomes and will provide better certainty to estimates of Heritage values.

Our present partial and restricted observations of the underlying floodplain alluvium suggest that this predominantly buried bounding surface of the underlying unit has considerable potential heritage significance. Unit 1 deposits may contain significant environmental information on the historic and immediately prehistoric environments at close to the upper tidal limit of the Georges River. Over a broader area archaeological sites may occur on this buried floodplain surface, obscured, but well preserved at depth. These sites could be early European, contact Aboriginal, or pre-contact indigenous Aboriginal sites. A range of time periods will be preserved on a buried flood plain surface.

The assessed significance is high as the deposits reflect a quite rare occurrence sealing of the floodplain due to rapid changes to channel hydrology caused by weir construction.

Stratigraphic integrity

The site identified as MA11 displayed no stratigraphic integrity. All of the artefacts recovered from this site were from introduced fill of unknown provenance.

The site identified as MA12 displayed high stratigraphic integrity however the artefacts are interpreted to be present in these deposits as the result of fluvial reworking of sediments during flood events of the nineteenth/twentieth centuries.

The site identified as MA13 displayed high stratigraphic integrity. A single small artefact was recovered from the upper portion of the Unit 1 deposits. However, given that the age and nature of the Unit 1 deposits is yet to be determined, the circumstances surrounding the deposition of the recovered artefact cannot be accurately inferred.

The stratigraphic integrity at MAPAD2 as a whole was very high, however it should be noted that the majority of stratigraphic units investigated during the subsurface testing program appear to relate to sedimentation processes during the past 200 years. Nevertheless, the potential for intact deposits at depth across MAPAD2 is high.

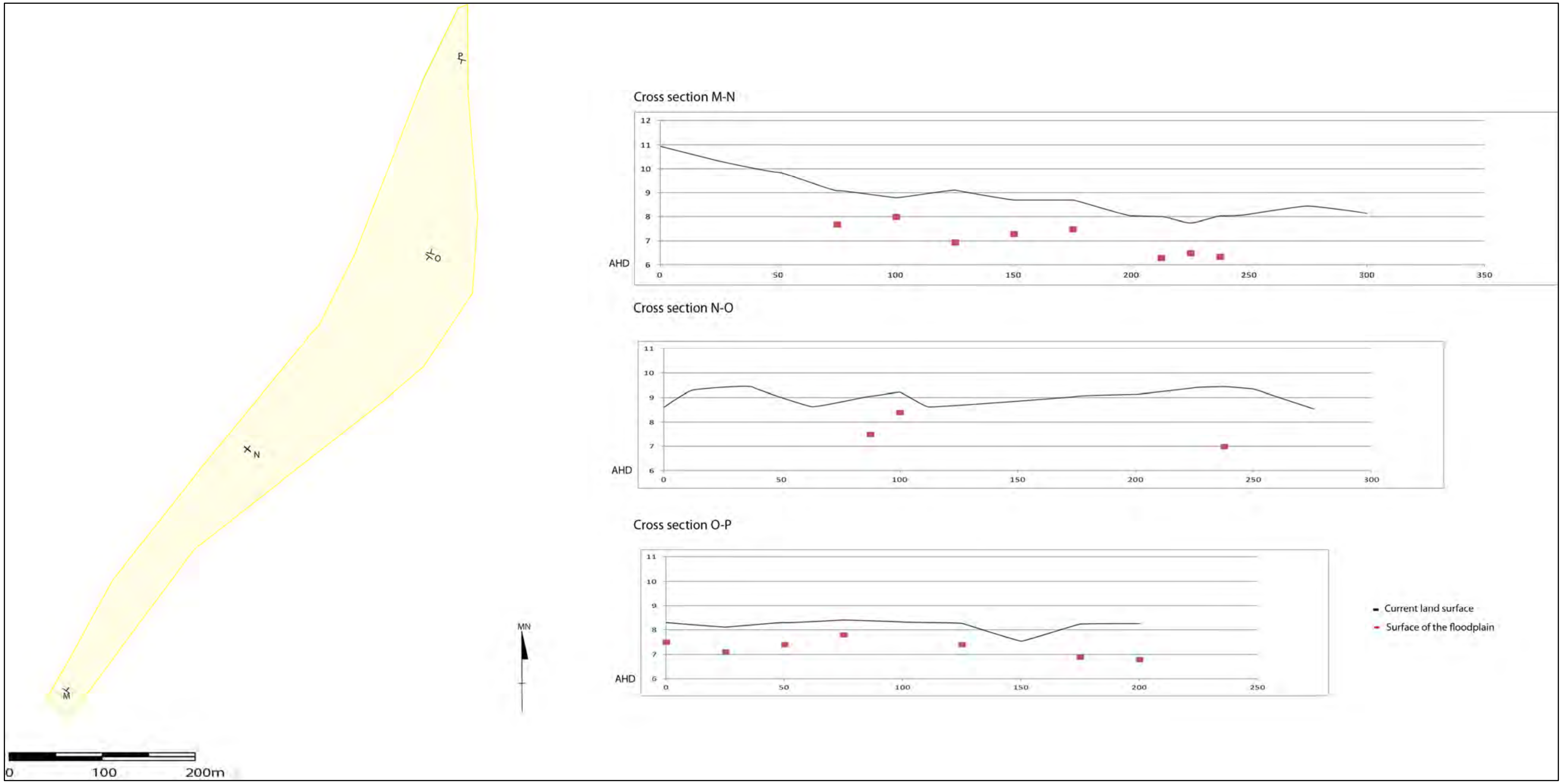


Figure 9.1 Preliminary levelling data at MAPAD2 – Cross sections showing the relationship between surface levels and height of Unit 1 deposits, where encountered within test pits.

Presence of cultural features

No cultural features were found within MAPAD2. Nevertheless, potential exists for cultural features at depth across MAPAD2.

Areal incidence of artefacts

The average areal incidence of artefacts per square metre, where artefacts were present, ranged from 2/m^2 at MA13 to 6/m^2 at MA11. The overall average incidence of artefacts within the Northern Powerhouse land was 3.11/m^2.

Aerial incidence is generally very low and appears to reflect either re-deposition of artefacts disturbed by processes associated with European settlement and/or background scatter that was the result of isolated and discrete events (e.g. maintenance of an item carried through the area).

Information regarding the areal incidence of artefacts within Unit 1 is insufficient for the purposes of characterising its nature or assessing the significance of any archaeological deposits that may be present within Unit 1.

Representativeness (Local and Regional Context)

Site MA11 comprises artefacts of unknown provenance in a disturbed context. This site is not assessed to have heritage significance in terms of its representativeness.

Site MA12 comprises artefacts of unknown provenance within deposits interpreted as being the likely result of flooding events during the nineteenth and twentieth centuries. The artefacts recovered from this site are typical of the local area in that they comprise silcrete and quartz flakes; however the context in which the artefacts were found is not thought to be representative of Aboriginal land use. The context of the artefacts at MA12 is nonetheless interpreted, on the basis of evidence from the test excavation program, to be a well preserved and potentially rare (locally, regionally and nationally) example of the sequence of floodplain adjustments resulting from construction of a weir.

The Unit 1 and Unit 2 deposits at MAPAD2 appear to demonstrate the principal characteristics of a pre-European/early contact floodplain that has been capped by overflow sands as the result of floodplain adjustments in response to the construction of the Liverpool Weir. As noted in the geomorphological analysis of the deposits, Unit 2 displays text book structures produced by migrating bedforms, moving in the direction of flow, over a reactivation surface (see Allen 1965).

Deposits within MAPAD2, in particular the Unit 1 deposits, have the potential to be representative of Aboriginal land use of the Georges River floodplain prior to European settlement and during the contact period of the early to mid-nineteenth century. These deposits also have the potential to yield information that has representative value in terms of the environment that existed prior to European settlement and the environmental effects of European colonisation and settlement.

9.3.4 Aboriginal Cultural Value

An assessment of the Aboriginal Cultural Value of the project area can only be made by the Aboriginal community, therefore, this assessment has included a comprehensive program of Aboriginal consultation (see Section 5.3).

The RAPs for the project have pointed to a number of sites of particular cultural value as well as commenting on the overall value of the area.

The RAPs have previously stated that the project area as a whole has cultural value and significance.

CBNTCAC stated that:

> *There are areas within the proposed development that have cultural significance to Cubbitch Barta ...*

DCAC stated that:

> *The area is significant to our people due to the area and also the resources that would have been in this area. The interesting aspect of this project is the discrepancy of the boundaries of our people(s) areas such as this if investigated sufficiently can give is some answers that our people need. Our group has discussed the boundaries of the Darug people many times and agree that we had large areas that were shared areas, the Georges River would also have been shared.*
>
> and
>
> *This area is highly significant to the Darug people due to the evidence of continued occupation, within this development there is a complex of highly significant sites, this is an Aboriginal (Darug) landscape. The Georges River is part of the landscape that is traditionally known as a border for our traditional area, our group believes that areas that border our boundaries are large shared areas, as this area is the significance for us is very high.*

9.3.5 Overview of Significance against the Commonwealth Heritage List Criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

The Unit 1 and Unit 2 deposits at MAPAD2 have been assessed to have heritage value against this criterion in terms of their association with the course of Australia's natural and cultural history, in particular their connection to environmental conditions prior to and subsequent to European settlement.

The significance of the Unit 1 and Unit 2 deposits is predicted to be such that it confers a degree of significance for the entire study area against this criterion. While the majority of the project area is assessed as not having significance against this criterion, the significance of the Unit 1 and Unit 2 deposits is interconnected with the environmental evidence that exists across the broader study area.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

The sequence at the study area is unique in that no other major floodplain adjustments and ecological shifts due to construction from a convict constructed weir are known in Australia.

The Unit 1 and Unit 2 deposits at MAPAD2 have been assessed to have heritage value against this criterion due to the fact that they appear to comprise a hitherto unrecorded example of changes in flood regime that appear to archive:

- regional properties in the catchment sediment record; and
- a record of recent sand aggradation and vertical accretion superimposed on the earlier floodplain surface caused by the construction of the Liverpool Weir in 1836.

Individual sites MA12 and MA13 contribute to the significance of the Unit 1 and Unit 2 deposits against this criterion.

The significance of the Unit 1 and Unit 2 deposits is predicted to be such that it confers a degree of significance for the entire study area against this criterion. While the majority of the project area is assessed as not having significance against this criterion, the significance of the Unit 1 and Unit 2 deposits is interconnected with the environmental evidence that exists across the broader study area.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

The Unit 1 and Unit 2 deposits at MAPAD2 have been assessed to have heritage value against this criterion due to their potential to:

- yield information on the nature of the hydrological adjustment of the river – an ongoing process – where better understanding of the trajectory of change in the last 180 years provides baselines and context for present riparian ecological issues and management;
- yield information on the types of floodplain vegetation present in the period 1790-1830 that may be well preserved in Unit 1 sealed by the Unit 2 sands; and
- contain evidence of the prior condition of the floodplain preserved in the sequence (e.g. as microfossil inclusions such as pollen, diatoms) or as larger features (tree burn outs, flood event layers).

Individual sites MA12 and MA13 have the potential to contribute to the significance of the Unit 1 and Unit 2 deposits against this criterion in terms of any information that will contribute to the above themes and research potential.

Individual sites MA5 and MA9, together with the Georges River corridor and terraces with which they are associated, were previously identified to have significance against this criterion (NOHC 2013a).

The abovementioned deposits and recordings are assessed as having significance against this criterion as they display the potential to yield information that will contribute to an understanding of Australia's natural and cultural history.

The significance of the Unit 1 and Unit 2 deposits is interrelated with the heritage value of other sites and landforms, within the Moorebank IMT study area as a whole, that are within or form part of the Georges River corridor. Together these sites confer a degree of significance on the study area as a whole against this criterion.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

i) A class of Australia's natural or cultural places, or

ii) A class of Australia's natural or cultural environments.

The Unit 1 and Unit 2 deposits at MAPAD2 appear to demonstrate the principal characteristics of a pre-European/early contact floodplain that has been capped by overflow sands as the result of floodplain adjustments in response to the construction of the Liverpool Weir. As noted in the geomorphological analysis of the deposits, Unit 2 displays text book structures produced by migrating bedforms, moving in the direction of flow, over a reactivation surface (see Allen 1965).

Together with the previously assessed sites MA5 and MA9 (NOHC 2013a), the Unit 1 deposits are representative of Aboriginal land use along the Georges River and the environment that existed prior to European settlement. As such they have significance against this criterion in terms of the ways in which they demonstrate the principal characteristics of the pre-European environment along this section of the upper estuarine limits of the Georges River and some of the principal characteristics of the ways in which this landscape was inhabited by Indigenous Australians.

The Georges River corridor and terraces are assessed as having significance against this criterion as they are representative of the scientific (natural and cultural) research potential that exists in relatively undeveloped and undisturbed landforms bordering the Georges River. The river corridor and the sites identified along it contribute to the overall significance of the Moorebank IMT study area against this criterion.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

Within the IMT project area none of the individual sites have been assessed to have significant heritage value against this criterion.

The project area as a whole is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

The Unit 2 deposits at MAPAD2 appear to be the direct result of early nineteenth century innovation and technical achievement with regard to modification of a river system in order to secure a fresh water supply for Liverpool. As such, these deposits are potentially of importance as an indirect demonstration of that early nineteenth century technical achievement.

The Unit 2 deposits are assessed as having potential heritage significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

The identified sites MA11, MA12 and MA13 and the artefacts recovered from them are assessed as having significance against this criterion as they display a connection for the Aboriginal community to past cultural events.

More broadly, the Unit 1 and Unit 2 deposits at MAPAD2 are likely to be of importance to both the Aboriginal community and the local Liverpool community in terms of the record they appear to archive of ecological change, flooding patterns and potential information regarding the pre-European landscape.

The individual sites MA11, MA12 and MA13, together with the Unit 1 and Unit 2 deposits at MAPAD2 contribute to the overall significance of the Georges River corridor and terraces against this criterion as well as the significance of the Moorebank IMT study area as a whole.

Criterion (h): The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.

The Unit 2 deposits at MAPAD2 appear to be the direct result of construction of the Liverpool Weir, which was designed by David Lennox, an engineer who was also important within NSW and Victoria due to his involvement in bridge design and construction. The life and works of David Lennox are thus important in the context of local history, as well as the history of infrastructure within NSW and Australia as a whole. As such, these deposits are potentially of importance as direct evidence of the effect of the works of David Lennox.

The Unit 2 deposits are assessed as having potential heritage significance against this criterion.

Criterion (i): The place has significant heritage value because of the place's importance as part of Indigenous tradition.

Individual sites MA11, MA12 and MA13 are assessed as having significance against this criterion for the connection they provide between the present Aboriginal community and Indigenous tradition.

The Unit 1 deposits at MAPAD2 have the potential to contain archaeological and paleo-environmental evidence that would be of importance in terms of understanding Indigenous traditions and life-ways. Such evidence would be of importance as a connection between the present Aboriginal community and Indigenous tradition.

The Georges River corridor and terraces have previously been assessed as having significance against this criterion (NOHC 2013a) and the Unit 1 deposits at MAPAD2 are likely to add to the overall significance of the Georges River corridor and the study area as a whole against this criterion.

Table 9.1 Summary of significance assessments for the individual Aboriginal recordings within the Moorebank IMT project area. Significance of each site is assessed in terms of the Burra Charter and the Commonwealth Heritage List criteria.

Site	Burra Charter Significance	CHL Criteria
MAPAD2 (Unit 1)	Potentially of high scientific, educational, natural, representative and Aboriginal cultural value at local, State and National levels	The site requires further investigation to fully determine significance. Potential significance against criteria a, b, c, d, g and i
MAPAD2 (Unit 2)	Potentially of high scientific, educational, natural, representative and Aboriginal cultural value at local, State and National levels	The site requires further investigation to fully determine significance. Potential significance against criteria a, b, c, d, f, g and h
MA11	Low archaeological significance at a local level Aboriginal cultural values at a local level	This site does not meet the threshold for listing on the Commonwealth Heritage List.
MA12	Low archaeological significance at a local level Aboriginal cultural values at a local level	This site meets the threshold for listing on the Commonwealth Heritage List under criteria b, c, d, g, and i.
MA13	Low to moderate archaeological significance at a local level Aboriginal cultural values at a local level	This site meets the threshold for listing on the Commonwealth Heritage List under criteria b, c, d, g, and i.

It should be noted that the identified potential for historical, natural and environmental significance of the Unit 1 and Unit 2 deposits also implies significance against the NSW Heritage Council criteria, however assessment against these criteria was outside the scope of the current investigations.

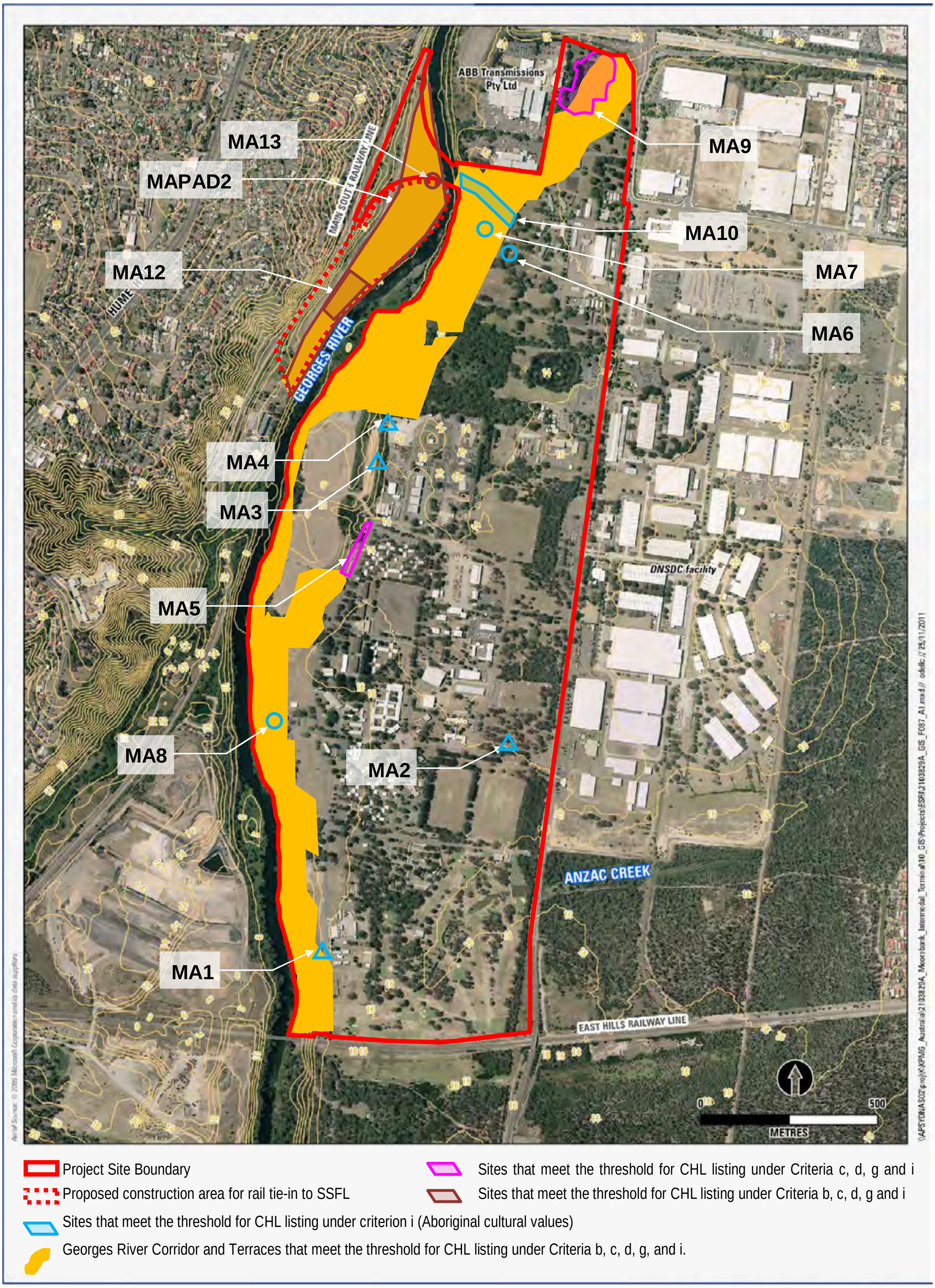


Figure 9.2 Location of sites that meet the threshold for listing on the Commonwealth Heritage List

10. ASSESSMENT OF IMPACTS

The proposed Moorebank IMT would have impacts on Aboriginal sites within the Northern Powerhouse land.

The classification of development impact falls into two broad categories, direct or indirect impact. This classification is made relative to the identified heritage place or item. Where a development would result in physical loss or change to a place or change to a place or item, this is a direct impact. Direct impact may affect a part or all of a place or item.

Where a development would avoid direct impact to a place or item, but would change its context or surroundings, this is termed an indirect impact. This is mostly caused by a development being situated in relative proximity to the place or item, and consequently changing the setting of the place or item to a significant degree. Indirect impacts may reduce the contextual integrity of a place or item, and compromise the interpretation or visual appreciation of the site.

The following sections consider impacts to identified Aboriginal recordings within the Northern Powerhouse land.

10.1 Impacts to Heritage across the Study Area

As discussed above in Section 9.3.3, MAPAD2 and subsurface artefact occurrences MA12 and MA13, together with the Georges River Corridor and terraces meet the threshold for listing on the Commonwealth Heritage List. Figure 10.1 shows the extent of proposed impacts within this area.

As demonstrated in Figure 10.1 the construction footprint encompasses the northern third of MAPAD2 (Georges River Corridor), inclusive of the identified site MA13. This is the area where the proposed north and south railway tie in lines would come in onto the bridge across the Georges River.

Potential impacts in this area would include substantial surface modifications as well as pylons for the bridge itself. The pylons would have the potential to cause disturbance to Unit 1 and Unit 2 deposits within that portion of MAPAD2. The extent of potential disturbance will not be known until the detailed design has been completed.

The construction area to the south of the construction footprint (Figure 10.1) would be utilised as a laydown and stockpile area as well as for vehicle parking. Vegetation within this area would be retained where possible. Potential exists for disturbance to Unit 2 deposits across this area and depending upon the nature of site preparation works, there may be disturbance to some sections of the Unit 1 deposits in this area.

Potential exists for disturbance to sites MA11 and MA12, however as noted above, these sites are of low archaeological significance due to the redeposited context in which the artefacts occur.

10.2 Impacts to Aboriginal Recordings

Table 10.1 summarises the nature and extent of potential impacts to recorded Aboriginal sites that would result from the current Moorebank IMT concept design. A visual representation of the location of Aboriginal recordings relative to the proposed construction footprint is provided in Figure 10.1.

Table 10.1 Impact Assessment

Site Number	Type of Harm	Degree of Harm	Consequence of Harm
Georges River Corridor	Partly within construction footprint	partially impacted	potential destruction of part of site
MAPAD2	Partly within construction footprint	directly impacted	potential destruction of part of site
MA11	within construction footprint	directly impacted	potential destruction of whole or part of site
MA12	within construction footprint	directly impacted	potential destruction of whole or part of site
MA13	within construction footprint	directly impacted	potential destruction of whole or part of site

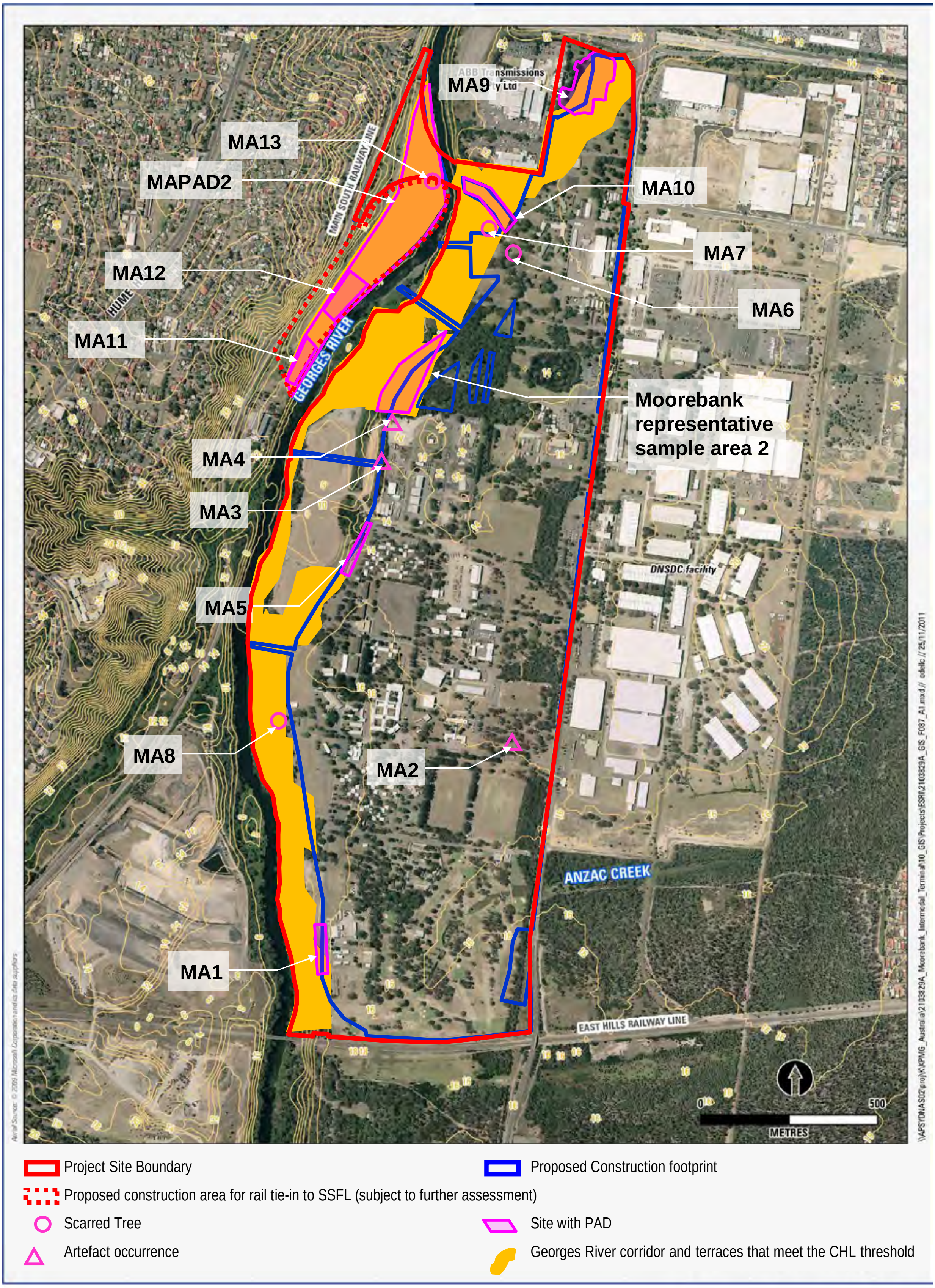


Figure 10.1 Location of recorded Aboriginal sites and remaining untested sample areas relative to the Moorebank IMT proposed construction footprint and archaeologically sensitive landforms.

11. MANAGEMENT AND MITIGATION STRATEGIES

The proposed concept master plan for the Moorebank IMT has the potential to directly impact the majority of the identified Aboriginal sites within the study area. Further assessment of the potential impacts of the Project and more detailed development of mitigation measures would be conducted during the detailed design phase of the Project.

Given that the proposed impacts to Aboriginal heritage have the potential to result in the loss of heritage values, a range of mitigation strategies need to be considered and implemented where applicable, i.e. where it is not practicable to avoid impacts, mitigation strategies will help minimise and/or offset the loss of heritage values.

11.1 Basis for Mitigation Measures

One of the primary research questions that drove this heritage assessment, including both the survey and excavation components, was the question of how the proposed development impact of the Moorebank IMT project on any significant Aboriginal heritage values might be effectively avoided or mitigated.

The following mitigation measures are considered appropriate to manage the impacts of the proposed Moorebank IMT:

- Conservation areas
- Interpretation
- Additional testing of archaeological deposits
- A stepwise strategy - phased improvement of the information base for Heritage assessment of significance and mitigative planning at Northern Powerhouse land (Moorebank IMT)
- Care and management of recovered artefacts

11.1.1 Conservation Areas

Pending the results of further investigations at MAPAD2 (see below) consideration should be given at the detailed design stage to the *in situ* conservation of portions of MAPAD2. The strategy for realising this objective would be developed following completion of additional investigations to confirm the potential heritage significance of the Unit 1 and Unit 2 deposits.

11.1.2 Interpretation

The Moorebank IMT Aboriginal and European heritage assessment reports (NOHC 2013a and 2013b) recommend the development of a heritage interpretation strategy.

The results of the testing program within the Northern Powerhouse land indicates that there is considerable potential for developing an understanding of the interrelationship between the pre-European and post-contact landscapes of the Georges River.

Any information recovered from MAPAD2 would potentially make a very important contribution to the recommended strategy, and increases the need for a combined Aboriginal and European approach.

11.1.3 Additional Testing of Archaeological Deposits

A fuller assessment would require further investigations. To assess the risk of archaeological sites and features being preserved on the surface, substantial excavation trenches would be required. Excavation close to the water table, and at depth, would require construction of coffer dam protected excavation areas, pumps and related specific excavation strategies tuned to excavation of waterlogged soils. This will be expensive, and would not be justified until scheme design impacts are finalised.

In the interim – it may be prudent to consider earlier interventions designed to acquire generic information on the status of the buried floodplain surface. Data on preservation conditions (redox especially), geochemistry, the age of the units (by radiocarbon dating) and microfossil and macrofossil preservation can all be acquired by combinations of undisturbed core recovery and deep machine sondage, with minimum disturbance to the surface.

Options for mitigation are set out below. The approach recommended here would aim to utilise the phased nature of the environmental assessment and approvals process set for the overall concept design.

Mitigation should be hierarchical, and proportional to scheme impacts as designs are refined. This will lead to sound planning outcomes as the engineering proposed is finalised. It will allow specific heritage interventions and mitigation if linked to a sound understanding of the subsurface deposits across the area being impacted.

At present knowledge gaps are considerable, and first steps to plug those gaps should drive the next steps in mitigations.

11.1.4 A stepwise strategy - phased improvement of the information base for heritage assessment of significance and mitigative planning at Northern Powerhouse land (Moorebank IMT).

It is neither sensible nor practicable to attempt to predict with certainty archaeological site presence/absence under deeply stratified (and water logged) alluvium. A sound approach, which will aim to meet due diligence criteria, and final EIS guidelines under the EPBC and EP & A, is to progressively acquire information at a generic level. Ideally this process will simultaneously:

- Improve description and ranking of environmental values and cultural heritage values
- Interact with scheme design to reduce the need for expensive archaeological salvage interventions and aid preservation of sensitive valued stratigraphy *in situ*.
- Provide security of timeline planning for both concept design, geotechnical investigations and engineering design process.
- Acquire information and data in formats which a) inform design decisions by adequately filling knowledge gaps in timely manner b) archive that data to inform community consultation, educational and public outreach outcomes, and c) which ideally may feed in to medium term social and community benefits and yield long-term(archived) heritage resources in the public domain.

The study area shows considerable potential for high heritage significance as an archive of floodplain change, across historic and prehistoric timescales, and cultural historic, prehistoric and natural values.

However, significant unknowns include:

- Time periods represented in the buried floodplain
- Preservation conditions above and below the water table
- Past environments present/absent in the sequence
- The presence/absence of earlier Holocene deposits eg mangrove/saltmarsh at depth (e.g. perhaps at +1.5 to -3.0m AHD). Such deposits would, as records of environmental change,

add to the heritage significance of the sequence. Such data would also be important to recognise as part of geotechnical considerations – as likely Acid Sulphate Soils (ASS).

- Presence/absence of significant rare deposits e.g. buried soils predating sea level rise/transgression up valley 7000 years ago; last interglacial deposits.

The case for further investigation of the buried floodplain surface, and the unknown unconsolidated deposits beneath (over rockhead) emerges as a mitigation issue for careful consideration. The merits and justifications for this also hinge on:

a) on the nature and scale of the impacts on this surface by the proposed scheme

b) the extent of the deposit under threat

c) the engineering procedures (e.g. dewatering/piling) that may form part of the scheme design impacting on the deposits

d) the likelihood of similar deposits sequences existing elsewhere, in areas likely to be preserved e) the degree to which the deposit sequences are demonstrably unique, in the Georges River, when compared to other river-estuarine areas in the broader area.

Early assessment of geotechnical data from an archaeological perspective is an advisable pathway to follow, to aid informed mitigation design, and as due diligence. Some dating of the deposit sequence would also greatly assist the evaluation of significance of the lower deposit sequence, and define the need for phased mitigation.

Table 11.1 illustrates a range of mitigative options and approaches which may need to be considered in order to adequately assess and archive the heritage values of the alluvial sequence at the study site. These are ordered according to a structure which will progressively build information, in a timely manner. It also offers a means of planning mitigation in a phased, progressive and cost-effective manner.

11.1.5 Care and Management of Recovered Artefacts

After examination and measurement, all recovered artefacts have been stored individually in standard resealable plastic bags. These containers are labelled in permanent black pen with the item's unique identification number (where generated and appropriate), and/or details of its provenance within the excavation (as appropriate).

The containers will be stored at the NOHC laboratory until the final location of the artefacts is decided.

It is proposed that all Aboriginal objects be repositioned back into the landscape ('returned to country') within reserved open space, in as close a position (as is feasible and safe) to their original find locations. Suitable locations would include those sections of the Georges River corridor that will not be impacted by the construction footprint (Figure 12.1). Ongoing consultation with the registered Aboriginal parties would be necessary in order to secure agreement on the exact location(s). This will also be informed by the subsequent detailed design stages of the project.

The manner, format and containment of the artefact repositioning would be subject to agreement by the registered Aboriginal parties.

All locations of repositioned artefacts would be recorded on appropriate OEH forms and lodged with the AHIMS, administered by OEH.

In the event that the registered Aboriginal parties resolve to retain some (or all of the artefacts) in the care and custody of one or more individuals or organisations, then this would be subject to the approval of a Care Agreement by the OEH.

In the event that there is no agreement or consensus by the registered Aboriginal parties regarding the long term management of the recovered artefacts, then an application will be made to the Australian Museum (Sydney) for lodgement of the collection. If this application is rejected, then a management solution will be finalised through negotiation between the Moorebank Intermodel Company, Department of Defence, OEH and the Registered Aboriginal Parties.

Table 11.1 Phased Heritage Approach for consideration at Northern Powerhouse land – a basis for developing a heritage management plan. This applies to the Northern Powerhouse land only.

Phase A: Immediate/early Priority tasks These tasks aim to refine the knowledge base and remove knowledge gaps/risk to scheme. Some tasks are prioritized as early land access is essential. Some tasks might be aligned to coincide with other project tasks e.g. contaminated land/ASS/geotechnical investigations. Not all options may be required. Others might be identified.

Task Code	Task/activity	Knowledge gap	Decision trigger	Approach	Heritage outcomes
A1	Topographic surface and subsurface mapping (DTM model) to AHD	Precision on present flood inundation and historic flood inundation datums	Adequacy of present interpretive model + heritage significance assessment improvement	Desk top integration of client/project data and heritage field survey data	Baseline mapping of surface improved prediction of deposits at depth/preservation
A2	Desktop research of boreholes from study area and adjacent lands	Areal extent of similar deposits and sequence stratigraphy at depth/depth to rockhead	Adequacy of present interpretive model + heritage significance assessment improvement	Desk top integration of client/project data and heritage field survey data	Three 3-D visualization of deposit sequence in study + preservation conditions at depth
A3A	Purposive bulk sampling of buried floodplain surface at defined high points under levee	Preservation conditions + artefact presence/absence on buried floodplain	Adequacy of present data /interpretive model + heritage significance assessment improvement	Bulk sampling with powered auger mud bucket	Quantification and recovery for archive of artefacts/plant remains/charcoals/midden remains
A3B	Drilling for undisturbed core samples	Sequence properties through deposits and past environments preserved (to rockhead)	Adequacy of present data /interpretive model + heritage significance assessment improvement	Hydraulic drill recovery of 1m lengths of undisturbed core + assessment of potential of core	Archive sample of complete sequence (research archive) + preliminary data on preservation at depth (scopes possibility of detailed environment record).

Task Code	Task/activity	Knowledge gap	Decision trigger	Approach	Heritage outcomes
A4	Radiocarbon dating	Age of buried floodplain sequence	Adequacy of present data /interpretive model + heritage significance assessment improvement	Accelerator Mass Spectrometry (AMS) dating of charcoal /organics from well-defined contexts	Improved certainty over age /depth properties of buried floodplain Significance assessment completion
A5	Core scanning	Suitability/justification for sequence having very high significance/ heritage values	Adequacy of data – design of salvage options/requirements	ITRAX core scanning – X radiographic imaging, magnetic susceptibility	Options for preservation through archive of representative sequence and/or decision on need for any further investigations/mitigation
A6	Data synthesis from Group A tasks	Requirements for mitigation	Approvals process milestone	Report completion	Milestone advice on requirements for further investigations/mitigation based on Group A tasks completed.

Phase B: Intermediate – medium term tasks These tasks will normally be triggered by results and knowledge outcomes, achieved in Phase A. A raising of heritage significance through information developed in Phase A will be the expected trigger. Tasks at this stage are indicative – not all would be expected to be triggered.

Task Code	Task/activity	Knowledge gap	Decision trigger	Approach	Heritage outcomes
B1	Paleo-environmental analysis e.g. of microfossils/ macrofossils in deposits	Specification of past environmental changes and events identified in the deep alluvial sequence – deemed heritage significant	Demonstration through prior assessment (phase A) that high quality proxy data are preserved and sequence has high heritage significance/natural and cultural values	Analysis by specialist	Proxy narratives of floodplain environmental change through time and human interactions with the ecologies and habitats identified. Preservation through analysis and archive. Feeds into the overall interpretation strategy.
B2	Radiocarbon dating	Ages of defined contexts of significance – calibration of floodplain sequence development and proxy environmental records eg pollen and charcoal sequences in the floodplain record.	Demonstrated significance of the deposit/context and need to define age	Accelerator Mass Spectrometry (AMS) dating of charcoal /organics from target levels and events in the deposits – commercial laboratory	Improved certainty over age /depth properties of buried floodplain and past environments/events Completion of narrative of changes in floodplain ecology; human use of floodplain; ecological changes dated. Feeds into the overall interpretation strategy

Task Code	Task/activity	Knowledge gap	Decision trigger	Approach	Heritage outcomes
B3	Open area excavation of large plan areas at depth near watertable	Requirement to salvage and archive properties of a highly significant object/context by hand excavation	Excavation salvage preferred over conservation *in situ* of identified remains/contexts – highly significant / sensitive context (e.g. buried levee with signs of bone preservation/burials)	Coffer dam protected excavations with pumps	Preservation through excavation and archive Feeds into the overall interpretation strategy
B4	Post-excavation analysis, finds analysis, AMS dating, and public dissemination of results from major excavation of buried floodplain surface	Requirement to salvage and archive properties of a highly significant object/context by hand excavation - in preference to scheme redesign or conservation *in situ*	Excavation salvage preferred over conservation *in situ* of identified remains/contexts Exceptional levels of impact on pre-determined contexts of national/international significance	Multi-skilled team delivering project analysis and write up to publication.	Preservation through excavation and archive + wide public dissemination of results. Feeds into the overall interpretation strategy
B5	Site avoidance	Uncertainty of number or extent of sites, or absence of salvage options in areas where high sensitivity is proven	Determination that preservation *in situ* is optimum scheme design	Engineering and geotechnical project team design reduced impacts on subsurface deposits at risk – including e.g. avoidance of dewatering/vibrocoring impacts etc.in buffer zone around deposits at risk	Long term preservation *in situ* + monitoring of groundwater with remediation planning and/or groundwater intervention options (pumped water; pH control)

Phase C: Advanced tasks –high level/high impact/ high significance mitigation tasks These tasks will be triggered only by exceptional circumstances such as unexpected finds of international /national heritage significance (e.g. discovery of *in situ* 1820s boat preserved on the floodplain surface, or human burials on floodplain levees) or by scheme design/ impact resulting in complete destruction of highly significant deposits/sites. Normally the phased design approach should prevent Phase C tasks being triggered (e.g. by scheme design avoidance of high impacts or design of adequate preservation *in situ*) or at least prevent unscheduled interventions.

Tasks at this stage are indicative – few would be expected to be triggered.

Task Code	Task/activity	Knowledge gap	Decision trigger	Approach	Heritage outcomes
C1	Open area excavation of large plan areas at depth near water table	Requirement to salvage and archive properties of a highly significant object/context by hand excavation	Inadvertent discovery or exceptional levels of impact on pre-determined contexts of national/international significance	Coffer dam protected excavations with pumps	Preservation through excavation and archive Feeds into the overall interpretation strategy
C2	Post-excavation analysis, finds analysis, AMS dating, and public dissemination of results from major excavation of buried floodplain surface	Requirement to salvage and archive properties of a highly significant object/context by hand excavation	Inadvertent discovery or exceptional levels of impact on pre-determined contexts of national/international significance	Multi-skilled team delivering project analysis and write up to publication.	Preservation through excavation and archive + wide public dissemination of results. Feeds into the overall interpretation strategy
C3	Conservation of remains form excavation – possibly involving specialist techniques to conserve wood, or skeletal remains including tissue.	Not applicable	Location of archaeological materials through excavation	Delivery by specialists in analysis of human remains, wood remains and conservation	Museum curation, conservation and possible display, or curation in keeping places, or re-burial. Feeds into the overall interpretation strategy

C4	Engineered and monitored stability conditions at depth	Not applicable	Location of archaeological materials through excavation	Geotechnical interventions to maintain in situ preservation at depth e.g. by coffer dam protection of areas with maintained redox/pH/throughflow/ dissolved oxygen saturation conditions	In situ preservation

11.1.6 Effectiveness of Mitigation Measures

While the heritage significance of MAPAD2 has not yet been fully determined the approach outlined in section 11.1.4 includes a comprehensive range of strategies that would adequately mitigate heritage impacts at a number of levels.

Most importantly impacts to Units 1 and 2 will be partial in the first instance and opportunities to limit impacts are available.

There are no heritage constraints posed by the project that cannot be mitigated using the phased approach outlined above.

11.2 Impact Mitigation

This report concludes that the stratigraphic sequence investigated has considerable *potential* historical, archaeological and natural heritage significance.

Subsurface investigations have shown flood lain sands, of likely historic age, exist across the area. This is new information. This can assist heritage management planning, and significance assessment on this precinct and on adjacent land blocks (NOHC 2013a). Previous geological and soils mapping did not identify these deposits clearly, or the underlying sequence, or its heritage potential.

Testing has also demonstrated that *in situ* archaeological sites are unlikely to occur across much of the area, and especially the top 1.0-1.5 m of deposits because of reworking of sediments by floods. Shifts in channel alignment, avulsion through breaches in levees, and overall aggradation of the floodplain surface can be read from the deposit history, indicating substantial landform change, probably in the last few hundred years.

The surface testing undertaken has achieved its objective, acquired valuable data on the landscape changes in the area, and past environments. The programme of testing yielded few artefacts and indicates a low probability of *in situ* sites remaining across the area. The one area where a watching brief or further salvage work might be valuable at some future stage in the project is in the southern higher area, where artefacts were more frequent. Further testing or salvage across the overlying alluvial overbank (avulsion) Unit 2) sands is not otherwise regarded as justified. The information gathered on the upper sands is satisfactory.

The discovery of the underlying organic silty clay deposits, provisionally interpreted as a buried floodplain surface of possible early historic age, was unexpected. Observations of the lower deposits (Unit 1) were necessarily preliminary, and opportunistic, as project scope and safety provisions were not designed to assess potential archaeological deposits at depth and close to, or below, the water table. A fuller assessment of the heritage significance therefore requires preliminary data on the age and preservation conditions present in the lower floodplain surface, alongside data on the overall lateral and vertical extents (and nature) of unconsolidated deposits at depth (to identify heritage values and significance.

Risk to scheme could be considerable without addressing these issues. A stepwise approach is therefore advised. The immediate priorities are:

- Acquiring ages on the buried floodplain sequence.
- Defining preservation conditions at depth, and likelihood of archaeological contexts preserved at depth
- Modeling the extent, nature and preservation conditions in deposits lower than 7.5 m AHD over bedrock at a level of resolution which allows scheme impacts to be assessed.
- Relating mapped deposits to highest impact areas, seeking to identify areas of zero, low and high impact and assessing impact extent.

- Only if significant deposits are proven, defining buffer zones, or areas of stratigraphy at depth that can be preserved *in situ* would then be next steps.

For the Moorebank IMT Northern Powerhouse land it is recommended that:

- The phased approach to further investigations at MAPAD2 outlined above in Table 11.1 should be adopted.

- Immediate further data gathering, in a stepped progressive build of information should be undertaken to fill the following knowledge gaps regarding MAPAD2:

    - desktop study (of geotechnical borehole data and levels);

    - drilling to recover undisturbed sediment core (for assessment and dating and as an archive sequence); and

    - subsurface bulk sample retrieval (using augered mud bucket) to assess preservation conditions and artefact presence/absence at depth.

- Information recovered from future investigations at MAPAD2 should be incorporated into an Aboriginal heritage interpretation strategy for the project as a whole, developed in close consultation with the Registered Aboriginal parties. The strategy could consider combining both European and Aboriginal interpretation within the project area;

- Consultation should be ongoing with the registered Aboriginal parties throughout the life of the project and would include:

    - Consultation on the future care and management of recovered Aboriginal objects;

    - Methodologies for any future investigations;

    - Finalisation of management and mitigation strategies subject to detailed design; and

    - The provision for comments on a draft version of this report.

- The unanticipated discoveries protocol at Appendix 9 should be followed in the event that Aboriginal objects or suspected burials are encountered during construction works.

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APPENDIX 1

STATUTORY AND POLICY CONTEXT

Environmental Protection and Biodiversity Conservation Act 1999 (Cth)

The scope and coverage of the Act is wide and far-reaching. The objectives of the Act include: the protection of the environment, especially those aspects of national significance; to promote the conservation of biodiversity and ecologically sustainable development; and to recognise the role of indigenous people and their knowledge in realising these aims.

The Act makes it a criminal offence to undertake actions having a significant impact on any matter of national environmental significance (NES) without the approval of the Environment Minister. Actions which have, may have or are likely to have a relevant impact on a matter of NES may be taken only:

- In accordance with an assessment bilateral agreement (which may accredit a State approval process) or a declaration (which may accredit another Commonwealth approval process); and
- With the approval of the Environment Minister under Part 9 of the Act. An action that requires this Commonwealth approval is called a 'controlled action'.

Matters of national environmental significance (NES) are defined as:

- A place listed on the National Heritage List;
- World heritage values within declared World Heritage Properties (section 12(1));
- Ramsar wetlands of international importance (s16(1));
- Nationally threatened species and communities (s18);
- Migratory species protected under international agreements (s20);
- Nuclear actions;
- The Commonwealth marine environment (generally outside 3 nautical miles from the coast) (s23(1&2));
- Any additional matters specified by regulation (following consultation with the States) (s25); and
- Commonwealth action (s28).

In addition, the Act makes it a criminal offence to take on Commonwealth land an action that has, will have, or is likely to have a significant impact on the environment (section 26(1)). A similar prohibition (without approval) operates in respect of actions taken outside of Commonwealth land, if it has, or is likely to have a significant impact on the environment on Commonwealth land (s26(2)). Section 28, in general, requires that the Commonwealth (or its agencies) must gain approval (unless otherwise excluded from this provision), prior to conducting actions which has, will, or is likely to have a significant impact on the environment inside or outside the Australian jurisdiction.

The Act adopts a broad definition of the environment that is inclusive of cultural heritage values. In particular, the 'environment' is defined to include the social, economic and cultural aspects of ecosystems, natural and physical resources, and the qualities and characteristics of locations; places and areas (s528).

The Act allows for several means by which a controlled action can be assessed, including an accredited assessment process, a public environment report, an environmental impact statement, and a public inquiry (Part 8).

Section 68 imposes an obligation on a proponent proposing to take an action that it considers to be a controlled action, to refer it to the Environment Minister for approval.

As the Moorebank IMT project has the potential to impact matters of NES under the EPBC Act, the proposed action was referred to and accepted by SEWPaC as a controlled action, to be assessed by preparation of an Environmental Impact Statement (EIS). SEWPaC released guidelines for the content of a draft EIS for this project (2011/6086), which require the EIS to meet the following in relation to heritage:

- identify, describe and map places or items of indigenous cultural value; and
- describe the impacts the proposed action would have on indigenous cultural values including the continuing practice of traditional beliefs and access to sites.

Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and its regulations, schedules and associated guidelines require that environmental impacts are considered in land use planning and decision making. Environmental impacts include cultural heritage assessment. Division 4.1 of Part 4 of the EP&A Act establishes an assessment and approval regime for projects deemed to be State Significant Development (SSD). Division 4.1 applies to development that is considered to be SSD by either a State Environmental Planning Policy (SEPP) or a Ministerial Order published in the Government Gazette (under Section 89C of the EP&A Act).

Under Section 89D of the EP&A Act, the Minister is the consent authority for SSD. Section 23 of the EP&A Act enables the Minister to delegate the consent authority function to the Planning Assessment Commission, the Director-General or to any

APPENDIX 2

DETAILED METHODOLOGY

Research Design and Proposed Methodology

Archaeological Test Excavation Program Aboriginal Heritage

Moorebank Intermodal Terminal

Navin Officer Heritage Consultants *11 October 2012*

The Purpose of this Submission

The purpose of this document is to provide to registered Aboriginal parties, for review and comment, a research design and proposed methodology for the conduct of archaeological subsurface testing at two Aboriginal archaeological sites (MA1 & MA5), three potential archaeological deposits (PAD1, PAD2 and MPAD1) and three sample areas within landforms of differing predicted archaeological sensitivity, all within the Moorebank Defence precinct.

The review forms part of the Aboriginal consultation procedure required by the NSW Office of Environment and Heritage (OEH) (DEC 2005, DECCW 2010). In addition, the Director General's Environmental Assessment Requirements for the Moorebank Intermodal Terminal project (SSD – 5066) specify that the research designs and methodologies proposed for any physical archaeological works to be undertaken as part of initial heritage assessments should be reviewed by: the Department of Planning and Infrastructure (DP&I), the Office of Environment and Heritage (Environmental Protection Authority), and the Heritage Council of New South Wales. This submission is made on behalf of the Moorebank Project Office and the Commonwealth Government (Department of Finance and Deregulation).

Registered Aboriginal parties were invited to provide comments and suggestions back to NOHC or Parsons Brinckerhoff by Thursday 11th October 2012. Four written responses were received during the review period and a site meeting was held on 26th September with the registered Aboriginal parties to discuss the project and the proposed excavation methodology. No requests for changes to the methodology have been received as the result of this consultation process. No changes were made to this methodology following the consultation with the registered Aboriginal parties.

Background to Submission

In May 2010 the Australian Government tasked the Department of Finance and Deregulation to conduct a Feasibility Study into the potential development of an intermodal terminal (IMT) at Moorebank in south western Sydney. The IMT site is currently occupied by the Department of Defence including the School of Military Engineering (SME) to the west of Moorebank Avenue. The Government has determined that SME will relocate to new purpose-built facilities at the nearby Holsworthy Barracks with the move complete by the end of 2014.

Navin Officer Heritage Consultants Pty Ltd (NOHC) was commissioned in 2010 by Parsons Brinckerhoff to undertake a cultural heritage assessment for the Moorebank Defence precinct on behalf of the Commonwealth Government (Department of Finance and Deregulation).

The results of interim heritage studies conducted to date, including the results of surface archaeological field survey (conducted in 2010) and a review of potential development constraints, have been documented in two preliminary reports:

- A scoping report which presented a summary of known and potential constraints based on a desktop review (NOHC 2011); and
- A report on existing Aboriginal and European Heritage (CDFD Aug 2011) which supported a Preliminary Project Environmental Overview (CDFD 2011)

There are currently site access restrictions in place on the Liverpool City Council (LCC) land which have prevented field survey, however a desktop assessment has been undertaken of the LCC land.

Aboriginal participation and consultation conducted to date includes the registration of Aboriginal parties, the preparation and review of an archaeological survey methodology, and the field survey participation of representatives from two selected registered Aboriginal parties. The assessment of site significance in the preliminary reports has been limited to scientific criteria, pending the continuation of the Aboriginal consultation program for the EIS assessment.

An outline of Aboriginal consultation and participation to date is provided in Attachment A.

In April 2012 the Australian Government committed to development of the Moorebank Intermodal Terminal (IMT) Project after reviewing the findings of a detailed business case for the facility (CDFD Feb. 2012). The project is subject to planning approval with an Environmental Impact Statement due to be displayed late in 2012 to enable public feedback. Both Federal and NSW planning approval are being sought.

The Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) has determined that Moorebank IMT Project is a Controlled Action requiring the development of an EIS for assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).* The Commonwealth has lodged a submission under the EPBC Act and elected to make a submission under Part 4.1 of the New South Wales *Environmental Planning and Assessment Act 1979* (EP&A Act). Pursuant to the provisions of S 83(B) of the EP&A Act, a staged development application is proposed. This application is for a Stage 1 development application for the entire IMT. A staged development application sets out the concept proposals for the development of a site for which detailed proposals for separate parts of the site are to be the subject of subsequent development applications.

In February 2012, the NSW Department of Planning and Infrastructure (DP&I) issued Director General's Requirements (DGRs) that are the State equivalent of the SEWPaC requirements.

The DGRs state that the EIS must include an assessment of impacts on Aboriginal heritage. Where impacts to Aboriginal heritage are identified the assessment shall:

- Outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the measures) generally consistent with the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC 2005);

- Be undertaken by a suitably qualified heritage consultant(s);
- Demonstrate effective consultation with Aboriginal communities in determining and assessing impacts and developing and selecting options and mitigation measures (including the final proposed measures); and
- Demonstrate that an appropriate archaeological assessment methodology, including research design (where relevant), has been undertaken to guide physical archaeological test excavations of areas of potential archaeological deposits. The full spatial extent and significance of any archaeological evidence shall be established and results of excavations are to be included.

The NOHC 2010 field survey program identified eight Aboriginal sites (MA1 – 8), one potential archaeological deposit (MAPAD1), and three sensitive landform zones within the project area.

The potential archaeological deposit (MAPAD1) consists of the banks and surrounds of a natural lake basin, now probably overlain with fill. The three archaeologically sensitive landforms are defined as the riparian corridor of the Georges River, the riparian corridors of tributary drainage lines (each consisting of 100m either side of the banks), and the edge and upslope fringing 100m of a continuous Tertiary aged terrace formation.

The recorded sites consist of three isolated surface artefacts (MA1, 2 & 3), two surface artefact scatters, each with three visible artefacts (MA4 & 5), and three scarred trees with a possible Aboriginal origin (MA6, 7 & 8). The 'possible' status of the tree scarring is based on an assessment that a natural or European origin is considered to be at least equally possible based on the scar characteristics. Pertinent to this assessment is the long history of European military activity across the area which could also have caused tree scars.

In 2011, Archaeological & Heritage Management Solutions Pty Ltd (AHMS) conducted an archaeological assessment of a proposed rail corridor situated across the far southern portion of the Moorebank IMT project area, for the Sydney Intermodal Terminal Alliance (AHMS 2012). This assessment recorded two surface Aboriginal stone artefacts in the general area of site MA1 (artefacts 5 & 6), and defined two potential archaeological deposits which roughly correspond to relevant portions of the sensitive terrace and riparian landforms identified in the NOHC survey.

The sites, PADs and areas of sensitivity, identified in the 2011 NOHC and 2012 AHMS assessments form the subject of this test excavation proposal. This further phase of investigation and assessment is required to determine the nature and significance of potentially occurring subsurface archaeological deposits, and allow for effective consultation with the Aboriginal community. This will form part of the cultural heritage component of the forthcoming Environmental Impact Statement for the Moorebank IMT project. The conduct and results of the investigation will be documented in the EIS report.

In preparing this methodology, ongoing consultation has occurred between the project team (comprising the Department of Finance and Deregulation (the proponent), environmental consultants Parsons Brinckerhoff and NOHC), DP&I and the NSW Office of Environment and Heritage. Following this consultation, this methodology has been drafted, and proposes the following approach and assumptions to the investigations:

- A combination of mechanical and hand excavation techniques would be undertaken, provided that areas of predicted high archaeological potential be excavated, at least in the first instance, by hand;
- A flexible field methodology, allowing for modification of excavation techniques and the number and placement of pits is preferable to a rigid or prescriptive methodology[1].

[1] The reference to a flexible field methodology reflects the fact that we will be reviewing excavation results as we go, and where necessary, looking to modify our excavation approach in order to achieve the best levels of information possible in the context of the archaeological deposits present at Moorebank.

For instance, rather than predetermine the exact number of pits, the excavation methodology allows for a minimum number of pits at 25 m intervals with provision for additional pits at closer intervals if additional information is required to answer the research questions regarding the nature and extent of archaeological deposits. The methodology also allows for the excavation technique to change. In particular there is provision for a change from mechanical to by-hand techniques if fine stratigraphic contexts, in situ bone, evidence of a hearth, flaking floor or other significant archaeological deposits are

- Mechanical excavation would be an acceptable means of removing fill that overlies suspected or known archaeological deposits;
- Mechanical excavation in areas of predicted low archaeological potential would be acceptable provided that test results are continuously monitored and a change to by-hand excavation would be triggered in the event that significant[2] archaeological deposits are encountered;
- Mechanical excavation would also be an allowable means of inspecting deposits at depth where:
  - o It is thought possible that archaeological deposits could occur below a depth at which the conduct of by-hand excavation would be unsafe;
  - o information is sought on the nature and extent of deposits below clay (this should only be undertaken at representative pit locations where there is no evidence of significant archaeological deposits in the upper layers;
- Not all Aboriginal sites or landforms necessarily need to be tested. Testing should focus on representative locations and areas of lesser disturbance;
- It would be useful to give consideration to testing, at least one area of predicted low archaeological potential, in an area of minimal or lesser disturbance;
- The size and spacing of test pits needs to achieve a balance between site disturbance through excavation and information recovery at a level commensurate with the excavation aims;
- 0.5 x 1.0 m pits at a spacing of 25 m would be acceptable provided that there is provision for the conduct of additional pits at closer intervals if further information is necessary to address research questions at a given site; and

The Moorebank IMT Project Area

The Project site is Commonwealth-owned land currently occupied by the Department of Defence (Figure 1). It is approximately 220 hectares in size, located within the suburb of Moorebank within the City of Liverpool Local Government Area approximately 30 kilometres south-west of the Sydney Central Business District. The Project site is generally defined as the land bounded by the Georges River to the west, Moorebank Avenue to the east, the M5 Motorway and ABB Medium Voltage Production facility to the north and the East Hills Railway line to the south.

The Project requires additional supporting infrastructure external to the Project site including the development of a rail crossing of the Georges River connecting to the Southern Sydney Freight Line (SSFL). This infrastructure would require some development on land currently owned by Liverpool City Council.

A Staged Assessment Process

This methodology deals primarily with the Commonwealth owned land portion of the project site. As mentioned there are currently site access restrictions in place on the LCC land which have prevented field survey.

It is proposed that the current EIS and planning approval application (Stage 1) will focus primarily on detailed assessments on the Commonwealth owned land and that subsequent staged applications will address the LCC land in greater detail.

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encountered (refer to the full list of events that would trigger such a change in excavation technique, as listed on pages 16-17). There is also provision for excavation to revert to mechanical methods if excavation begins by hand and the test pits show consistent evidence of disturbed contexts (e.g. substantial post-contact mixing of deposits as the result of earthworks or similar activities).

[2] Significant deposits refer to archaeologically intact deposits and/or dense layers/lenses of cultural material; specific examples are defined on pages 16 and 17 of this document.

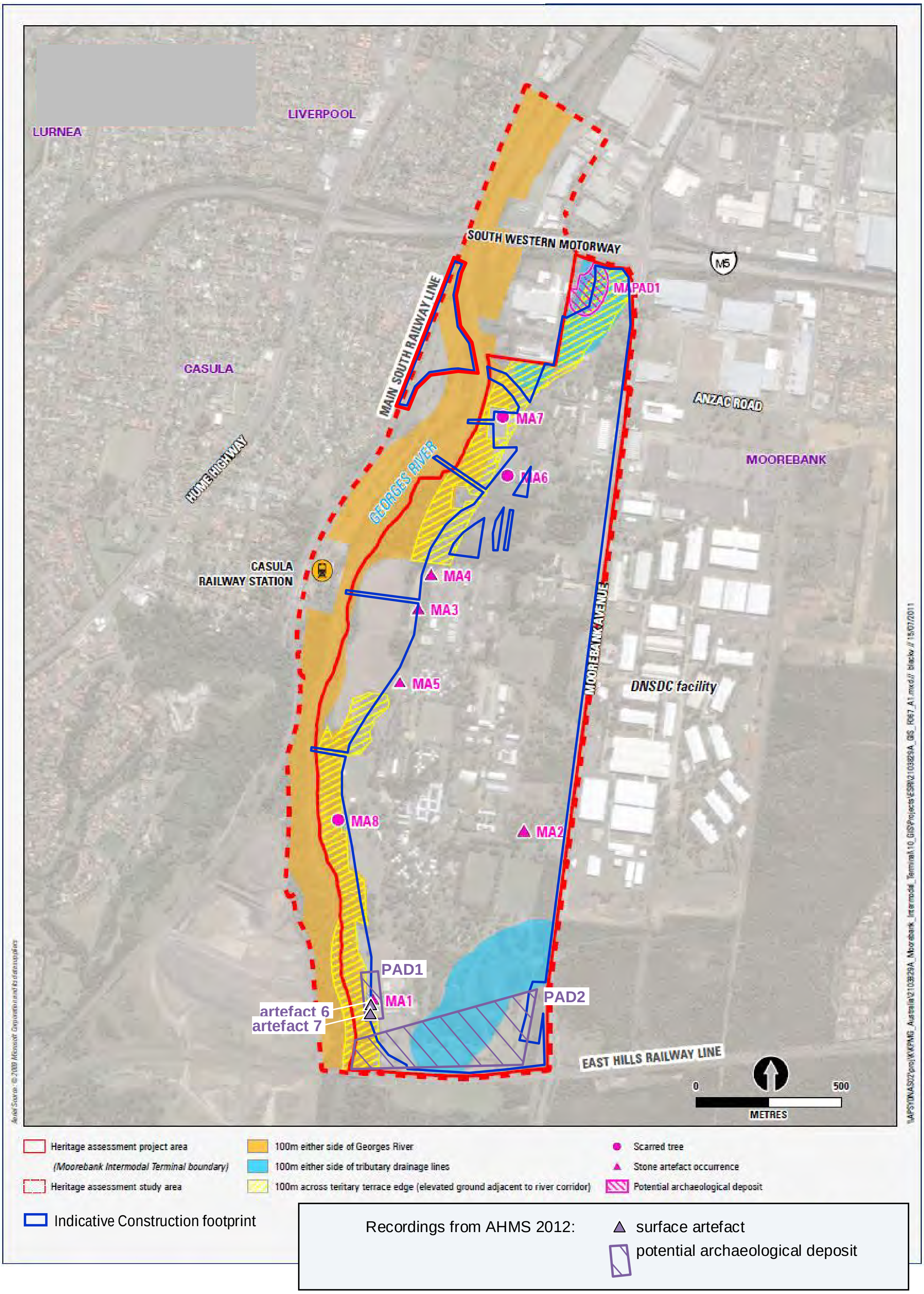


Figure 1 Location of all Aboriginal heritage recordings (pink and purple) and areas of archaeological sensitivity (yellow hatch, orange and blue shading) within the project area (red outline), relative to indicative construction footprint of the development (blue outline) (after Figure 4.1 in CDFD Aug 2011, p29). Note that the areas of archaeological sensitivity do not include areas of major land surface disturbance, as indicated by past or present vegetation clearance and building development (refer also Figure 18).

Heritage Recordings and those Selected for Test Excavation

Eight Aboriginal archaeological sites have been recorded in the Moorebank IMT project area. These consist of five artefact occurrences, and three scarred trees of possible Aboriginal origin. Of the five artefact occurrences, three occur in highly disturbed contexts and do not provide effective contexts for a test excavation program (MA2, 3, & 4). The remaining two sites (MA1 and MA5) have been selected for test excavation. In addition, all identified potential archaeological deposits (PADs) will be subject to testing (MAPAD1, PAD1 and PAD2), and the predicted archaeological sensitivity of the differing landforms across the project area will be tested in three representative sample areas. This section provides a description of all the artefact occurrences, the PADs and the sensitive landform categories.

The location of all recordings, relative to the indicative construction footprint of the Moorebank IMT development is shown in Figure 1.

Site MA1 (including 'Artefact 5' and 'Artefact 6' (AHMS 2012))

Map Grid Reference: 307309.624002 (GDA)

This recording consists of three surface artefacts recorded on or adjacent to an approximately 90m interval of roadway. The roadway runs parallel to the edge of an elevated terrace formation. One artefact was recorded in 2010 (NOHC 2011) and two further artefacts were recorded in 2011 (AHMS 2012).

The first recording was a single surface artefact in 2010, exposed on the shoulder of a road and situated on the edge of an elevated terrace (around 3-5m high), adjacent to the entrance to the Initial Employment Training Squadron building. The area was noted to be extensively disturbed by earth works, importation of fill and gravel, and the installation of underground services. The incidence of ground surface exposures was around 5%, with visibility in the exposures around 40%.

The artefact was a microblade core and displayed an area of adhering cement to its surface. It was considered possible that the item had been imported to its current location within building materials or fill.

1. Banded grey-brown fine grained metamorphic sedimentary rock, microblade core, 21 x 19 x 12 mm

Figure 2 MA1 looking north, in 2010 (artefact by foreground bag)

Two further artefacts were recorded in this location by AHMS in 2011 (AHMS 2012:87):

Artefact 5. Consisted of a red silcrete possible flaked piece, found on a sandy exposure, west of the road in survey Transect 3;

Artefact 6. Consisted of a poor quality grey chert/silcrete possible medial flake, fond on a sandy exposure, west of the road in survey Transect 3.

Transect 3 of the AHMS survey consisted of an area of 1.4 hectares, with 98 to 10% exposure visibility and an effective coverage of 10% (AHMS 2012:84). Based on the artefact finds and the landform type, AHMS identified a potential archaeological deposit on the terrace surface in the area of the finds (PAD1). This PAD recording corresponds to the Tertiary terrace archaeologically sensitive landform identified in NOHC (2011).

MA2

Map Grid Reference: 307826.6240593 (GDA)

This recording consists of a single artefact situated in a shallow scald within mown grass north of entry gates and inspection post in SME. The area has been previously subject to vegetation clearance, agricultural development, grading, soil removal and construction of surface drainage.

The incidence of ground surface exposures was around 20%, with visibility in the exposures around 25%

This is a possible artefact (use fragment), with most surfaces displaying natural fractures, with the exception of one possible platform edge with bifacial flaking.

1. Banded grey fine grained metamorphic sedimentary rock, possible artefact, 31 x 32 x 13mm

Figure 3 MA2 looking south-east

Figure 4 Possible artefact at MA2 (side view)

Figure 5 Possible artefact at MA2 (other side view)

Figure 6 Possible artefact at MA2 (edge view)

MA3

Map Grid Reference: 307456.6241375 (GDA)

This recording consist of a lone artefact located at the base of the cut and graded tertiary terrace edge and is approximately 300m south of MA 4. The area has been extensively disturbed from Defence related earthworks and excavations.

The incidence of ground surface exposures was around 95%, with visibility in the exposures around 85%

Many introduced gravels are present in the vicinity of the artefact, above and upslope of which lies a narrow vegetated margin of original soil with archaeological potential.

1. Banded grey-grey green rhyolite multi-platform core, at least 4 platforms, 5% cortex, 40 x 28 x 13mm

Figure 7 MA3 looking south-east

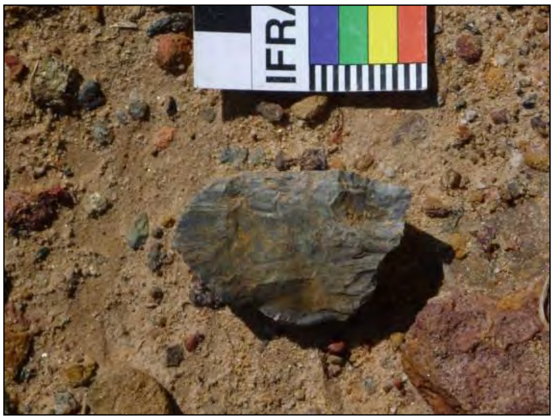


Figure 8 Artefact at MA3 (side view)

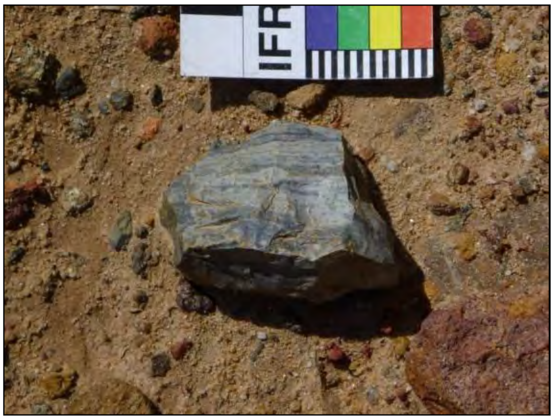


Figure 9 Artefact at MA3 (other side view)

MA4

Map Grid Reference: 307489.6241489 (GDA)

This recording is a low density artefact scatter of three artefacts exposed on the edge of a tertiary terrace and situated on a gravelled dirt track sloping down onto river flats ("dirt pans") below. The edge of the terrace is highly disturbed due to excavation and landscaping to form a uniform slope and straightened edge.

The incidence of ground surface exposures was around 80%, with visibility in the (track) exposures around 75%.

1. Red silcrete multi-platform core with at least 3 platforms, 39 x 35 x 30mm
2. Red to light red quartzite bipolar flake, 45% alluvial pebble cortex, 44 x 30 x 14mm
3. Light yellow patinated fine grained tuff steep edge concave scraper, secondary retouch along 75% of margin, remnant platform edge evident, 23 x 31 x 10mm

Figure 10 MA4 looking east, note elevated terrace and modified embankment.

Figure 11 Artefacts at MA4 (side view)

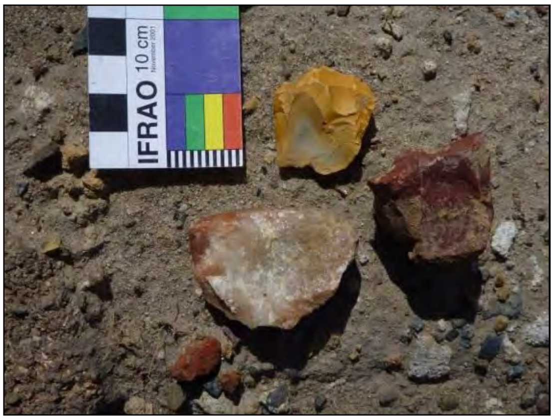


Figure 12 Artefacts at MA4 (other side view)

MA5

Map Grid Reference: 307396.6241118 (GDA)

This recording consists of 3 artefacts situated on the high side of an artificially benched slope atop the tertiary terrace, and is adjacent to the lower lying dirt pan. The three artefacts were found in area measuring 25 x 5m.

The incidence of ground surface exposures was around 15%, with visibility in the exposures around 85%

1. Yellow-brown broken flake, approximately 40% cortex, proximal end missing, 30 x 16 x 5mm.
2. Yellow-brown silcrete flake, focal platform, 18 x 12 x 3mm
3. Light brown fine grained metamorphic rock (tuff?), some modern edge damage, 10 x 7 x 1mm.

Figure 13 MA5 looking south along edge of terrace

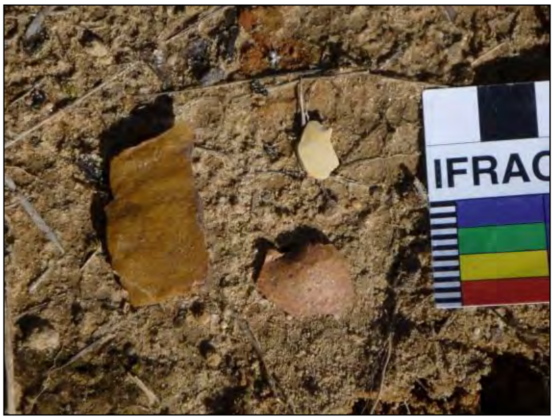


Figure 14 Artefacts at MA5 (side view)

Figure 15 Artefacts at MA5 (other side view)

MAPAD1

Map Grid References (GDA): Approximate perimeter points	*308063.6242558*
	308116.6242453
	308029.6242336
	307958.6242360
	307965.6242432
	307995.6242430
	308009.6242506

This recording consists of the banks and a fringing 50m radius around a natural lake basin situated in the far northern portion of the project area. The lake basin is situated in the upper reaches of an unnamed first order tributary which drains to the northeast. The proximity of this freshwater lake to the riparian corridor of the Georges River (350m to the west), which may have been estuarine at this point in prehistory, provides a strong basis for predicting evidence of past Aboriginal occupation along its original banks and surrounds.

The banks of the lake are now steep sided and are suggestive of the dumping and encroachment of landfill. This may have occurred as a result of successive Defence related development of the land to the east and south of the basin, and more recent commercial development on the lake's western side (Figure 16).

Figure 17 presents a comparison of aerial photography of the MAPAD1 area and associated drainage system from 1943 and 2008 (from www.six.nsw.gov.au). It is clear from the catchment comparison that the subject lake is now the last remaining relatively unmodified basin from the local Georges River flood plain, which originally included at least 6 lakes or anabranches.

2008
(from www.six.nsw.gov.au)

1958
(1958 topographic map, Moorebank Holsworthy Area CEN938d 1/9/57, Amended 22/4/58 (Aust War Mem'l 123, Item 493))

1943
(from www.six.nsw.gov.au)

Figure 16 A comparison of aerial photography and mapping across the MAPAD1 area, from 1943, 1958 and 2008, showing the remnant nature of the PAD and the boundary (red) relative to past ground disturbance.

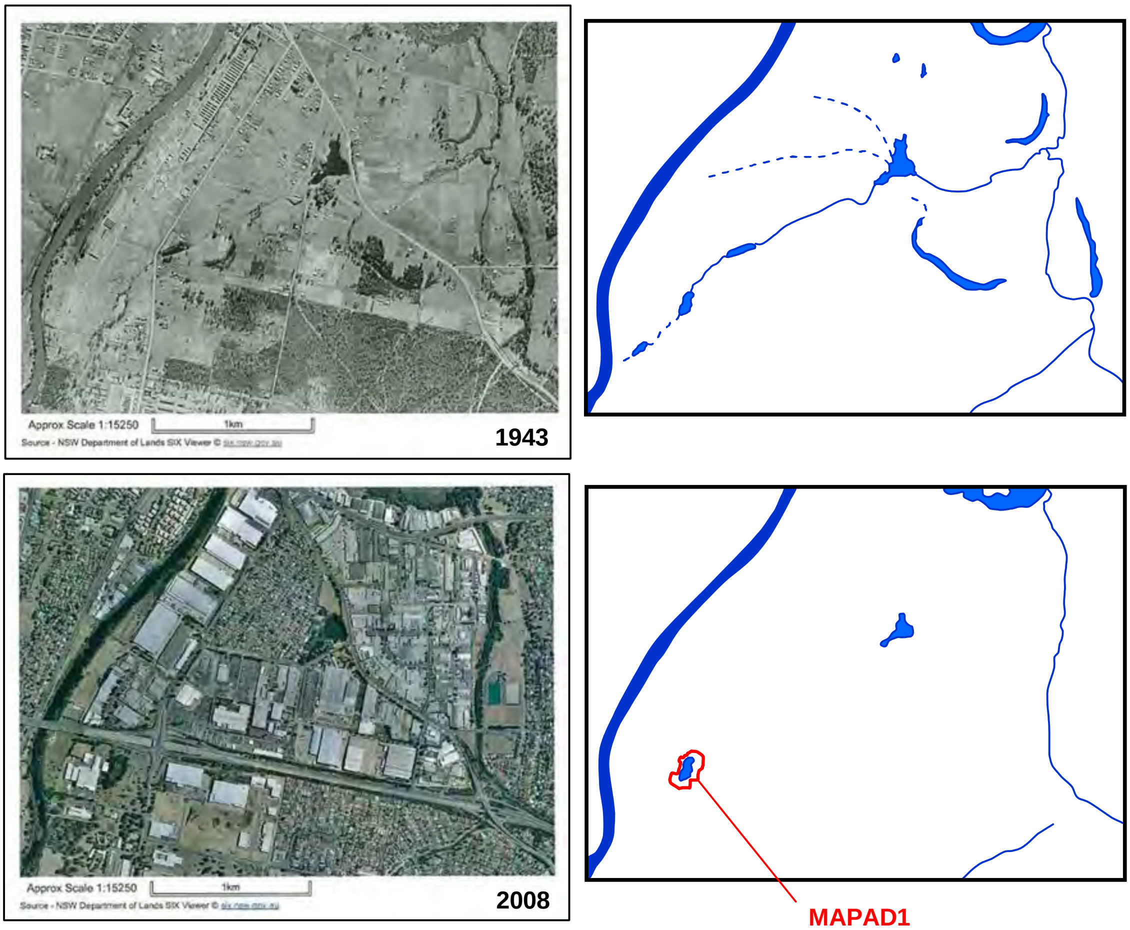


Figure 17 A comparison of aerial photography and mapping across the MAPAD1 area, from 1943 and 2008 showing the location of MAPAD1 relative to the pre-urban and contemporary surface drainage network.

PAD1

Map Grid References (GDA): Approximate perimeter points	*307319.6239944* *307276.6239941* *307255.6240103* *307309.6240111*

This potential archaeological deposit was defined by AHMS (2012), based on the landform, the presence of intact soil profile and the presence of artefacts 5 and 6 (AHMS 2012:76). It is described as a:

> River terrace running along the eastern side of the Georges River; largely undisturbed; vegetation cleared; eroding; grassy with exposures; 10% ground surface visibility. (AHMS 2012:87).

As such, this recording forms part of the archaeologically sensitive Tertiary terrace landform identified by NOHC (2011). An assessment of an isolated surface artefact by NOHC in 2011 indicated extensive ground disturbance in the area of the find from road works, importation of fill and underground services.

PAD2

Map Grid References (GDA): Approximate perimeter points *307864.6240004*
307824.6239767
307213.6239765
307235.6239858

This potential archaeological deposit was defined by AHMS (2012), based on the areas elevation above the terrace, the relatively low level of disturbance (despite its context within a golf course), and the presence of an intact soil profile. It was considered to have moderate archaeological potential (AHMS 2012:77).

It is defined as:

> 'Golf course between Anzac Creek and East Hills Rail Line; grassy but possibly some original soil profile, scattered large Eucalypts; 15% ground surface visibility; no artefacts identified on surface' (AHMS 2012:87).

This recording primarily includes three archaeologically sensitive landforms identified by NOHC (2011): the Georges River riparian corridor, the adjacent Tertiary terrace, and the riparian zone surrounding Anzac Creek, a first order tributary.

Archaeologically Sensitive Landforms

Following a review of previous local archaeological assessments, site location models (Boot 1990 & 1992, Dallas & Steele 2004, Dames and Moore 1996, NOHC 1997), geomorphological, and land use characteristics, the NOHC preliminary assessments identified three archaeologically sensitive landforms. These are described below and illustrated in Figure 2 and Attachment C. The identification of these zones represents a refinement of previous work conducted by Dallas and Steele (2004). The sensitive areas were defined by plotting predicted archaeological potential based on landform variables, and then excluding grossly or substantially disturbed land surfaces (Figure 18, refer also Attachment C).

The three archaeologically sensitive landforms are defined as:

- The Georges River Riparian Corridor – 100 m either side of the Georges River (inclusive of the 1890s eastern riverbank configuration);
- Minor Tributary Riparian Zones – 100 m either side of tributary drainage lines (inclusive of the pre-European drainage alignment, as best determined from historical mapping and 1943 aerial photography); and
- The elevated slopes and riverside margin of a locally elevated Tertiary alluvial terrace edge situated adjacent to the Georges River – zone 100 m wide. (NOHC 2011:14)

The predicted sensitivity of these landforms is based on a generalised site location model which postulates that the majority of sites occur on locally elevated, well-drained and low gradient ground, located in relative proximity to a fresh or estuarine water source (and that a majority of sites, and most larger sites, occur within 100 m of a fresh or estuarine water source).

The likely incidence of Aboriginal sites along the Georges River riparian corridor could be expected to be relatively high given its value in prehistory as a source of food, camping locations, raw materials and fresh water (the tidal limit is now situated at the Liverpool Weir, 1.3 km downstream). This expectation should, however, be moderated by factors which are known to obscure or destroy sites along fluvial corridors, notably, the scouring of archaeological deposits during flood events and their concealment by the deposition of flood born sediments.

Given the upper catchment context, and therefore low stream order of the tributary streamlines in the study area (both drain to the northeast and away from the river), the intermittent nature of these water sources limits the potential occurrence of adjacent sites to small and transient campsites with corresponding low incidences of artefact discard. This expectation can be qualified by an appreciation that:

- natural swamp or lake basins (some of which are shown on these tributaries in historical mapping and 1943 aerial photography (Figure 17)); may have afforded greater water permanence, and

- such streams may have represented the only fresh water near the river prior to the construction of the Liverpool Weir, when the tidal limit in the Georges River may have extended into or upstream of the study area.

The two classifications, being PAD and archaeologically sensitive landform, relate to different scales of predicted potential for archaeological deposits. Archaeologically Sensitive Landforms use a broad scale of identification, typically covering many hectares or square kilometres and are based on the predictive analysis of landform traits, such as geomorphological origin, local elevation and distance to water. The boundaries of a landform classification may be approximate or indicative. The landform classification may not take into consideration micro-topographic variations, or localised areas of low potential (due to disturbance or natural topographic variation). For this reason, it would be inaccurate to classify a sensitive landform as a PAD. A variable proportion of any identified sensitive landform may not have appreciable archaeological potential.

A deposit classification (i.e. a PAD) is a small scale identification, typically covering areas less than a hectare. Its identification will include reference to the characteristics of a specific location (rather than only generalised landform characteristics), and is likely to reflect micro-topographic traits and avoid areas of low potential due to disturbance. The boundaries of a PAD are likely to be definable at a small scale, and be specific to localise traits and reflect localised land use impacts.

The two potential archaeological deposits identified by AHMS are encompassed by the archaeologically sensitive landforms identified in the current assessment.

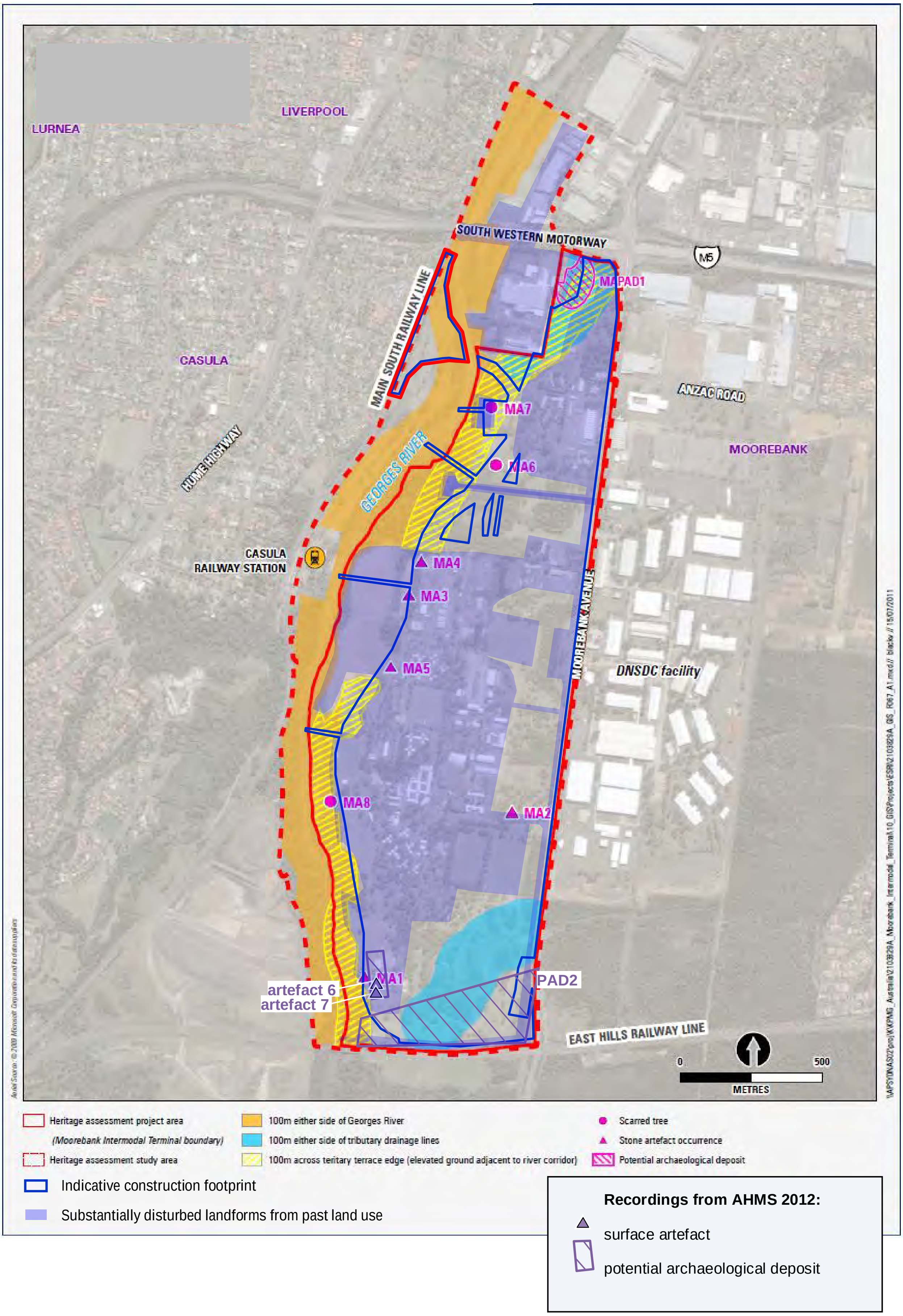


Figure 18 Substantially Disturbed Landforms from past land use
(following on from Dallas & Steele 2004 and NOHC 1997, 2010)

Objectives and Research Questions

The primary objectives of the proposed test excavation program are to:

- Conduct an investigation of sufficient scope, to gain a representative sample of the likely archaeological resource present at the test locations;
- Determine the nature and significance of any Aboriginal archaeological evidence within the test locations;
- Where necessary, determine appropriate strategies for the management of cultural heritage values related to any confirmed archaeological evidence, relative to the proposed Moorebank IMT development.

The test excavation program will be directed at the following research questions:

- How can the anticipated development impact of the Moorebank IMT project on any significant Aboriginal heritage values be effectively avoided or mitigated?
- What do the test results indicate about the past Aboriginal occupation of the project area and the Sydney region?
- How do the test results compare with other local and regional archaeological results and models?
- Does the subsurface archaeological resource accurately reflect the predictions on which the sensitive landform mapping is based?
- Based on the test excavation results, how can the local predictive model be refined or corrected?

Excavation Methodology

Two excavation methodologies are proposed:

- Mechanical test pit excavation using backhoe/excavator; and
- By-hand test pit excavation.

It is proposed to employ the mechanical test pit methodology in all test locations where the predicted archaeological potential is no greater than low (MA1 & PAD1, MA5 and representative sample location 3). This may be a site-specific assessment based primarily on disturbance levels and may run contrary to the relevant landform sensitivity rating.

The mechanical method will be suspended and a by-hand excavation methodology adopted if and when circumstances are encountered that warrant more controlled excavation. In the event that one or more of the following Aboriginal cultural features is potentially indicated by visible evidence on the land surface or during machine excavation, then the machine methodology will be suspended and a by-hand excavation methodology will be conducted in the area of the find:

- *In situ* bone material relating to Aboriginal occupation;
- The remains of a hearth in a relatively undisturbed condition;
- A lithic flaking floor in a relatively undisturbed condition;
- An arrangement of stones (showing evidence of deliberate placement by a human agency) in a relatively undisturbed condition;
- A disposal pit or post hole in a relatively undisturbed condition;

- A dense layer or lens of cultural material which could be potentially damaged/fragmented by a mechanical excavation method; or
- A deposit containing artefacts which displays well preserved fine scale stratigraphy which probably relates to cultural episodes or phases.

The term *undisturbed condition* in this context is defined as:

Archaeological material evidence which can be reliably interpreted to be in a context, arrangement or position, which is substantially unchanged since the human behaviour that resulted in its current context, arrangement or position.

It is proposed to employ the by-hand excavation methodology for all test pits in areas of predicted moderate to high archaeological sensitivity (MAPAD1, PAD2 & minor tributary Riparian zone, and representative sample locations 1 and 2). At MAPAD1, where there is evidence to indicate that there may be a substantial amount of fill overlying suspected archaeological deposits, machinery will be used to remove any fill and establish a safe surface for hand excavation of intact deposits. Machinery will also be used in vegetated test locations to clear the area prior to excavation and in instances where archaeological deposits, or suspected deposits, continue at depths in excess of 1.5 m (i.e. where OH&S concerns preclude further excavation by hand). In the latter case, if any of the triggers for cessation of machine excavation (outlined above) were encountered below 1.5 m, then further excavation in that pit would be suspended or the pit walls modified to allow safe by-hand excavation.

Excavation by Backhoe/Excavator

The following excavation methodology will be followed. This methodology may be subject to change depending on factors encountered in the field that have not been anticipated.

1. Mark out and record the required location of mechanical excavation pits.

2. Excavate pit.

Pits will be excavated by backhoe or excavator using, as a preferred set-up, a straight-edged toothless bucket 1000 mm in width. In the event that a straight edged bucket becomes unusable in compact or gravelly sediments, a toothed bucket will be employed, of similar or smaller width than the bucket used for the above spits. The intended depth interval for each spit will normally be 10 cm, but this may vary depending on the nature of the deposit and intended total depth of the pit. The actual depth interval achieved for each spit is dependent on the skill of the operator and the consistency and type of sediments encountered. As a consequence, spit intervals and the consistency across a spit excavation will tend to vary. Pits will have a potential final length of around 2 m to 4 m, depending on the final depth achieved, and the nature of the deposits.

The following excavation sequence will be followed (refer Figure 18):

- Excavation of spit one along an interval averaging 1.5 to 2.0 m in length
- Following the removal of spoil from each spit, a 5-10 cm strip may be removed from one side of the pit. This would be done where there is a potential risk of significant contamination from material dropping from previous and upper spit levels. The strip would be removed to ensure that the backhoe bucket does not contact the pit sides during the next spit excavation, therefore minimising potential contamination from upper levels.
- Following the removal of spoil from each spit, loose surface material or other unwanted sediment may be removed prior to the commencement of the following spit excavation.
- Excavation of spit 2 (and all subsequent spits), beginning approximately 50-150 mm from the far end of the previous spit, and ending before the near end of the pit is encountered. This is done in order to create a 'clean' end-wall and to prevent contamination from loose sediments at the ends of the pit.

- Following spit 2 (and after all subsequent spits), the near end of the pit will be extended by up to 300 mm in order to remove any fallen sediment from upper levels and to provide a 'clean' end point for the backhoe bucket.

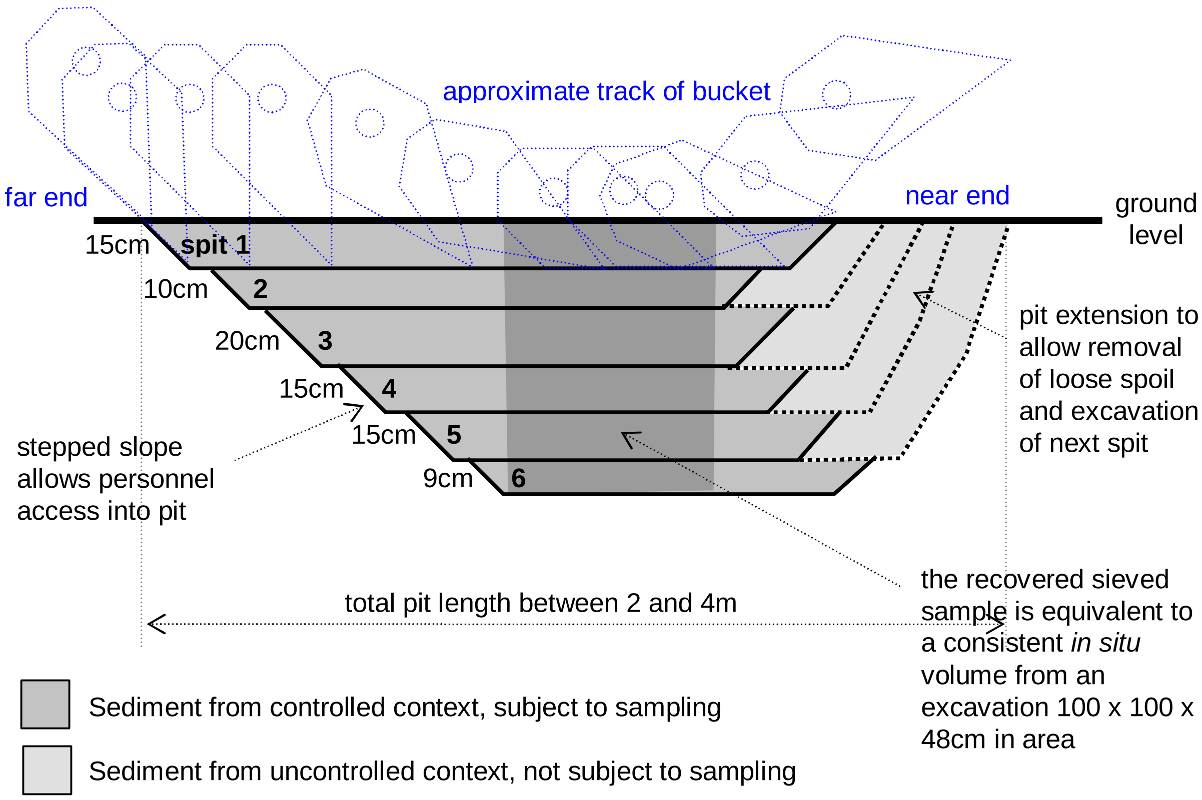


Figure 18 Indicative pit profile (not to scale) showing sampling methodology and sequence for mechanical pit excavation

- Following each spit excavation, a consistent sample of the excavated sediment will be recovered for sieving. The size of the recovered sample will vary according to the depth of the spit so that the volume is equivalent to the *in situ* deposit which would be recovered from an excavation area of 100 x 48 cm[14]. These varying sample sizes are shown in the Table 1 below. In the case of a spit with the preferred depth interval of 15 cm, the sample size would be 8 x 10 litre buckets.

Table 1 sample size of sediment recovered from each spit relative to spit depth

average depth interval across spit	no. of 10 lt buckets*	loose volume (litres)	equivalent *in situ* volume (litres)
2.5cm	1.3	13.3	12
5cm	2.7	26.7	24
7.5cm	4.0	40.0	36

average depth interval across spit	no. of 10 lt buckets*	loose volume (litres)	equivalent *in situ* volume (litres)
10cm	5.3	53.3	48
12.5cm	6.6	66.6	60
15cm	8.0	80.0	72
17.5cm	9.3	93.3	84
20cm	10.7	106.6	96
22.5cm	12	120.0	108
25cm	13.3	133.3	120

**Multiply spit depth (cm) by 0.535 to get no. of required 10 lt buckets*

- The material for sieving will preferentially be taken from the middle of the backhoe/excavator bucket, prior to the emptying of the bucket. This minimises the potential for contamination from sediments falling to lower levels from the pit sides. All material remaining in the bucket after recovery of the sample for sieving (if any) will be set aside in a separate pile.
- A larger sample for sieving may be recovered from this separate pile, if an in-field assessment of results indicates that a larger sample would be beneficial.
- Excavation of each test pit will cease according to an on-site appreciation of testing requirements. In most cases, excavation will cease when dense clay, or bed rock is encountered.

All sieving will be conducted with the aid of pressurised water from a water truck or an appropriate environmental source. All material will be sieved through 4 x 4 mm mesh, with the use of a top 10 x 10 mm mesh when required by the presence of large gravels.

All identified or suspected cultural material recovered from sieving will be retained, bagged and labelled. Materials which offer the potential for radiometric or other forms of dating may also be sampled, bagged and removed, where these relate to cultural or key stratigraphic features. In addition, samples of sediment may be taken for the purposes of palaeo-environmental analysis. A reference collection of natural gravels may be collected to aid in lithic interpretation, where appropriate.

3. Representative pits (i.e. one or two pits) at each test location may also be excavated beyond the top of the clay horizon in order to check the nature of deposits below. Excavation beyond clay may necessitate stepping out or battering the sides of the pit, given that this would mean disturbance to a broader area, this type of excavation would only be undertaken at pits where the recovered artefact incidence is between 0-5 per metre square. Excavation beyond clay would be done primarily to inspect the soil profile at depth. Depending upon the nature of these deposits, a decision would be made in the field regarding the merits of sieving such deposits (e.g. dense clay with no evidence to suggest the presence of archaeological evidence would not be sieved, deposits suspected to be palaeosols would be sieved).

4. Following cessation of excavation, the soil profile and characteristics will be described and checked with the separately documented incremental spit descriptions. PH measurements may be taken from representative pits at various locations in the profile.

5. All pits will be backfilled with the remaining excavated and sieved spoil. Where necessary, clean material will be sourced separately to allow backfilling of pits.

At MAPAD1, there is evidence of a possible cap of fill over the predicted archaeological deposit. In order to avoid unnecessary by-hand excavation through disturbed materials, the following procedure will be followed:

A mechanical or hand powered auger (drill diameter <300mm) will be used to test the depth of suspected fill at appropriate locations along the test transect(s). Auger locations will be selected according to an on-ground assessment of the micro-topography. Based on the auger results, any substantial fill layer at test pit locations will be excavated using mechanical excavation. This excavation will be monitored by the on-site archaeologist and will cease when the change from fill to natural deposits is observed. Fill excavation will be undertaken in 10 cm spits so that the detection of this soil transition can be carefully monitored. The fill material may not be subject to sieving

A mechanical excavator or bob cat will also be used to clear vegetation at test pit locations that are heavily overgrown such as by Lantana and similar plants. A whipper snipper/slasher may also be used for this purpose.

Excavation by hand

The following excavation methodology will be followed for hand excavated pits (This methodology may be subject to change.

1. Mark out and record pit locations.

2. Excavate hand-dug pit.

   Half metre (50 cm x 100 cm) pits will be excavated using standard by-hand archaeological methodologies including vertical and horizontal recording of spit levels and sedimentary, cultural and stratigraphic features.

   We anticipate that pits will have a maximum depth of one metre.

   Indicative pit intervals will be 10 cm, but will be reduced to 5 cm or less where intact stratigraphy is encountered or suspected.

   Excavation will cease according to an on-site appreciation of the vertical extent of the archaeological deposit.

   All unattended open pits will be fenced, and warning signs posted at all active works sites to advise pedestrians of hazards

3. All excavated archaeological deposit will be sieved with the aid of pressurised water from a water truck. All material will be sieved through 4 x 4 mm mesh, with use of a top 10 x 10 mm mesh where appropriate. All identified or suspected cultural material recovered from sieving will be retained, bagged and labelled.

4. All pits will be backfilled with the remaining excavated and sieved spoil.

In the event that hand excavation pits indicate substantial evidence of a deposit of low or nil archaeological potential (such as from disturbance), mechanical excavation will be employed for the remainder of test pits along that transect, subject to the triggers for hand excavation already outlined.

Figure 19 Example of excavation conducted by an excavator

Figure 20 Selection and transporting of excavated deposit

Figure 21 Wet sieving of excavated deposit at a sieve station

Figure 22 Example of mechanically excavated pit, note ramped and safe pit access and good section exposure

Location and Scope of Test Excavation Pits

Archaeological test excavation is proposed within the following landscape categories and combinations, where direct impact from the Moorebank IMT development is anticipated (Table 2):

- Tertiary terrace edge: MA5;
- Tertiary terrace edge and Georges River riparian zone: MA1 & PAD1, representative sample locations 1 and 2;
- Natural lake basin within a minor tributary riparian zone (adjacent to tertiary terrace edge): MAPAD1;
- Minor tributary riparian zone: PAD2;
- Tertiary terrace away from (riverside) edge (i.e. an area of predicted no archaeological sensitivity): representative sample location 3.

Three areas have been selected for archaeological subsurface testing outside of known sites and PADs. These areas provide a sample of the archaeological sensitivity categories (including the nul hypothesis) and have been selected to test the model within areas of lesser disturbance. These areas are described as representative sample areas 1-3:

- Representative sample area 1 is on the edge of the tertiary terrace and the Georges River basin and is located in a relatively undisturbed context.
- Representative sample area 2 is on the tertiary terrace edge and in a relatively undisturbed context.
- Representative sample area 3 is on the tertiary terrace away from its edge and any riparian zones. The area represents an area of predicted low archaeological potential in an area of minimal disturbance.

Wherever possible, test pits will be arranged in straight line transects and situated within the anticipated development footprint (the area subject to direct construction impact). The distance between test pits on transects will normally be 25 m (or 50 m across PAD2), except in the following circumstances:

- Where the avoidance of an erosional or other disturbance feature requires a one-off larger or smaller interval;
- An on-site appreciation of landform and archaeological potential indicates that a larger or smaller interval is necessary; or
- An in-field assessment of initial test pit results supports the conduct of additional (contingency) test pits at closer intervals or outside of a formal transect configuration.

It should be noted that transect placement and alignment has been guided not only by initial field assessments of archaeological potential, but also subsequent information from Defence regarding land use. For instance at MA1, the transect of proposed test pits curves to the west in order to avoid an area of recent disturbance (Figure 24). At representative sample location 1, testing will not be conducted at the far western end (Figure 26), immediately adjacent the river, as this area corresponds to where known chlorinated solvent impacts (TCE) are present in groundwater (gauged at approximately 5.2 m BGL), making the area potentially unsafe for excavation activities at this time.

The placement and alignment of test transect across PAD2 (Figure 25 - area currently used as a golf course) have also been modified in order to target areas of minimal disturbance and to minimise safety concerns and/or interruptions for golf course users.

Indicative locations of test pits are shown in Figures 18 – 28. Table 2 summarises the indicative number of test pits proposed at each test location

Where a proposed test pit falls within an area of:

- large stone cobbles or tors (with maximum linear dimensions greater than 300 mm);
- outcropping bedrock;
- highly disturbed or eroded ground; and/or
- substantial vegetation (with stem diameter of 500 mm or greater); and/or
- Ecologically Endangered Communities,

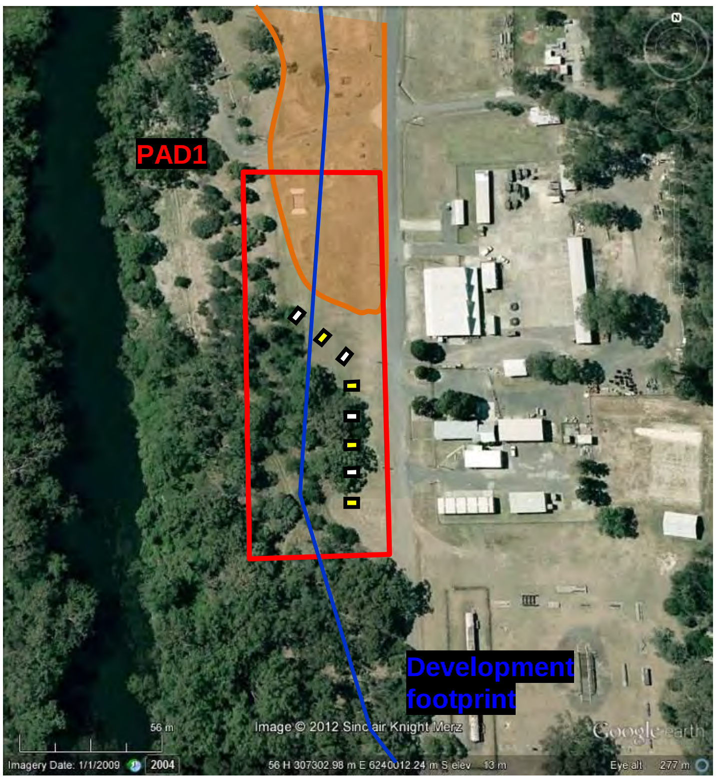
then the location of the test pit will be amended to the nearest location which avoids the constraint/s listed above.

Excavation and or spoil processing, may cease, or not be attempted, in any particular area where qualified advice indicates there may be a potential health risk or hazard to field workers. Examples include contaminated ground (such as from asbestos or hydrocarbons) and unexploded ordnance. As a health precaution, no excavation will be conducted in test pits once the water table, or other substantial ground water source, is encountered.

Table 2 Predicted Archaeological Potential and Indicative Number of Test Pits for Each Location

Site Name	Landform	Within archaeologically sensitive landform (y/n)	Degree of disturbance	Consequential rating of predicted archaeological potential	Proposed Subsurface testing Methodology	No. Test pits	Contingency No. Test pits
MA1 & PAD1	edge of tertiary terrace	Y	at least moderately disturbed	low	machine, or by hand where and if warranted	4	4
MA2	landform not identified as archaeologically sensitive	N	at least moderately disturbed	low	N/A	-	-
MA3 & 4	tertiary terrace	Y	highly disturbed	low	N/A	-	-
MA5	tertiary terrace	Y	at least moderately disturbed	low	machine, or by hand where and if warranted	7	6
MAPAD1	tertiary terrace and natural lake basin	Y	Potential for low degree of disturbance under fill	moderate-high	machine for excavation of fill, then by-hand unless otherwise warranted	8	11
PAD2 & minor trib. Riparian zone	minor tributary riparian zone	Y	at least low degree of disturbance outside of golf course developed areas such as fairways and landscaping	moderate	by-hand initially, then by machine or hand as determined from results	22	17

Site Name	Landform	Within archaeologically sensitive landform (y/n)	Degree of disturbance	Consequential rating of predicted archaeological potential	Proposed Subsurface testing Methodology	No. Test pits	Contingency No. Test pits
Representative Sample Location 1	tertiary terrace and Georges River riparian zone	Y	relatively undisturbed but some areas with fill and industrial contamination	moderate	by-hand initially, then by machine or hand as determined from results	5	4
Representative Sample Location 2	tertiary terrace	Y	relatively undisturbed but some areas impacted by former sewerage treatment works	moderate	by-hand initially, then by machine or hand as determined from results	7	6
Representative Sample Location 3	tertiary terrace, away from edge and riparian zone	N	relatively undisturbed some areas impacted by defence training works	nil	Machine, or by hand where and if warranted	7	6
Total						60	54

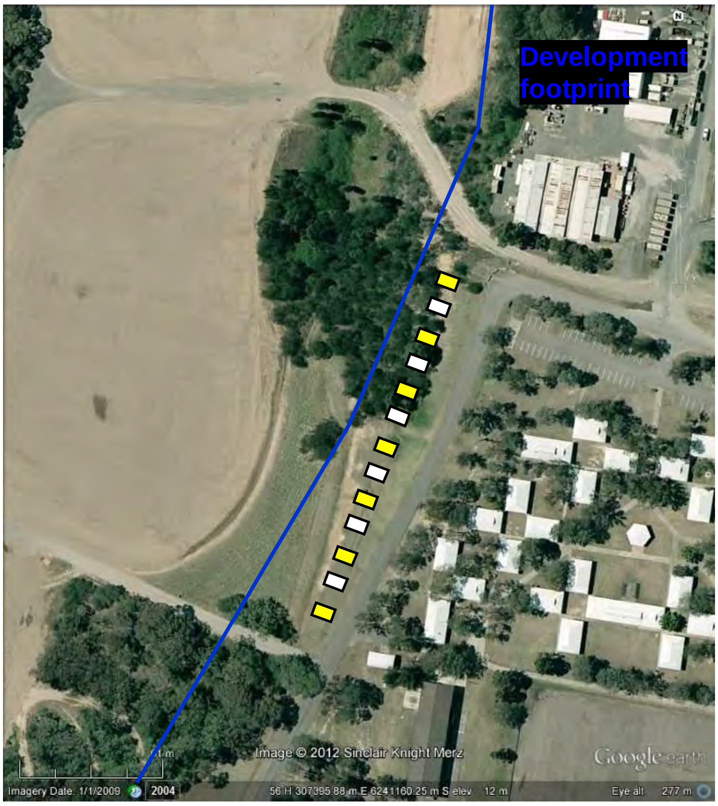


MA1 & PAD1

4 pits (yellow), 25 m apart – contingency for 4 additional pits (white)

(2009 image: Google Earth Pro)

Traverse modified to avoid recent disturbance and development in area:

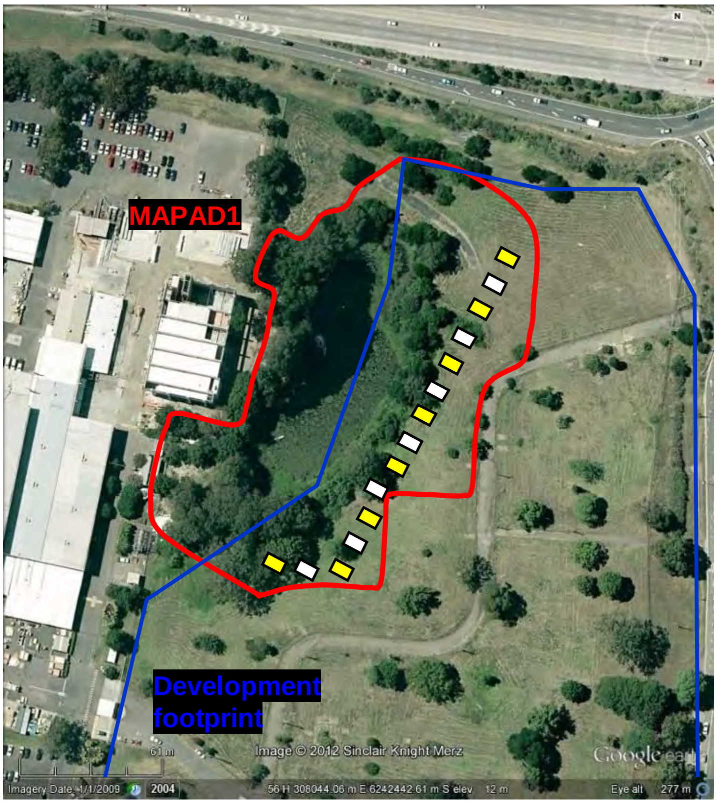


MA5

(occurs within terrace landform) 7 pits (yellow), 25m apart – contingency for 6 additional pits (white)

(2009 image: Google Earth Pro)

Figure 24 Indicative location of test pits at sites MA1 & PAD1 and MA5

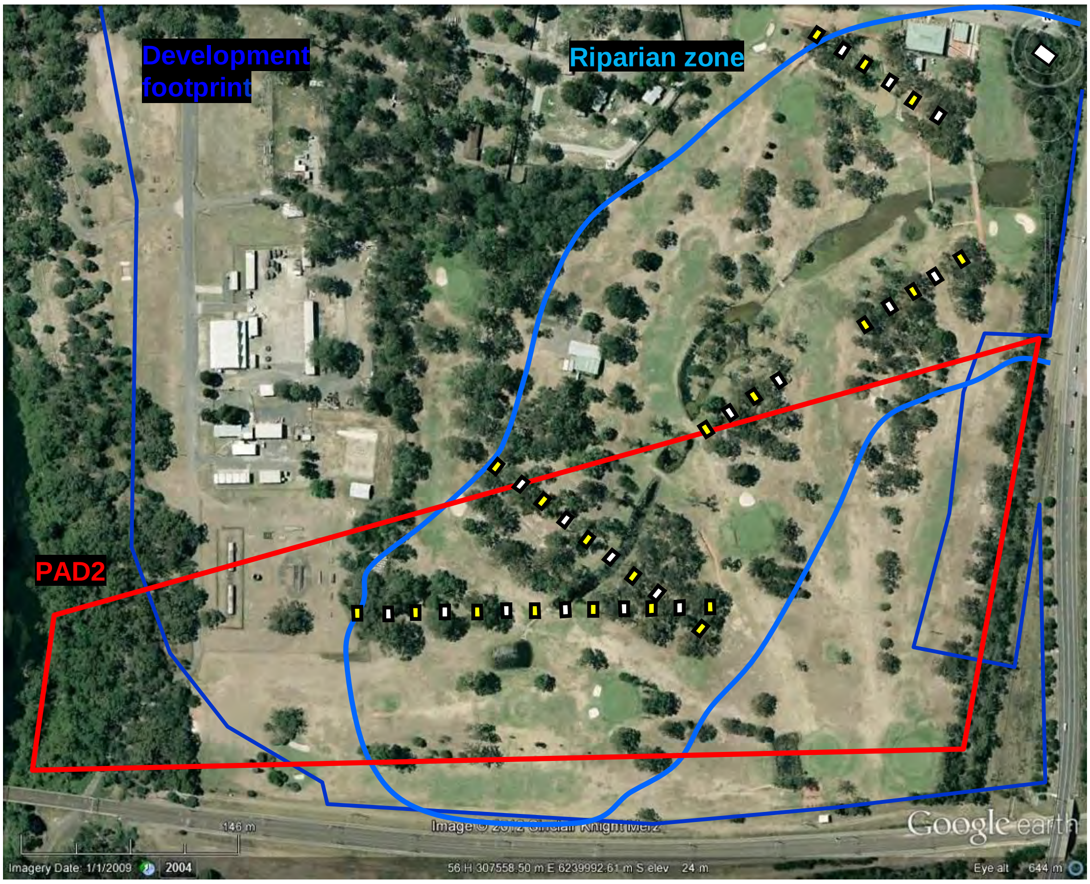


MAPAD1

(occurs within terrace landform)

8 pits (yellow), 25m apart with contingency for an additional 11 (7 at closer intervals and 4 pits at selected locations), depending on results

(2009 image: Google Earth Pro)



PAD2 & minor tributary riparian zone

22 pits (yellow) at 25 m intervals on 5 transects - contingency for an additional 17 pits (white).

(2009 image: Google Earth Pro)

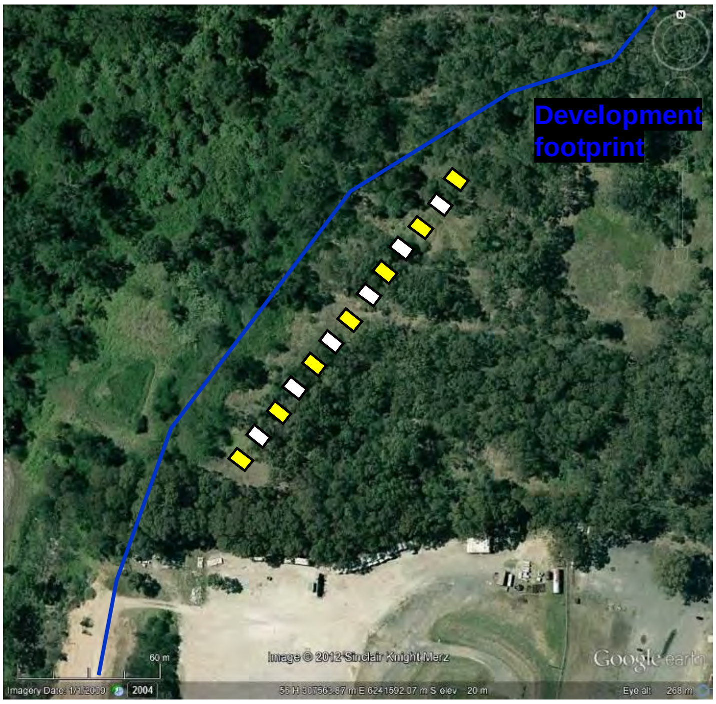
Figure 25 Indicative location of test pits at MAPAD1 and PAD2

Representative sample area 1

5 pits (yellow), 25m apart – contingency for an additional 4 pits (white)

Note avoidance of contaminated ground but remaining within area of proposed impacts

(2009 image: Google Earth Pro)

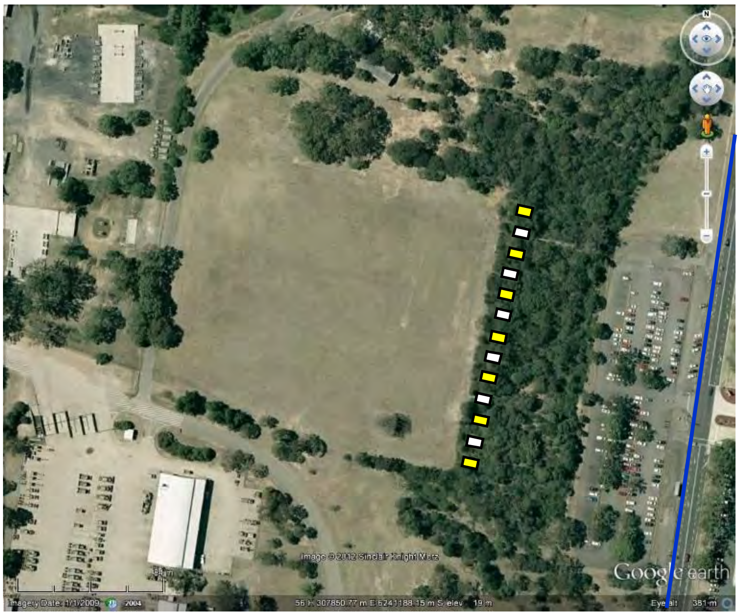


Representative sample area 2

7 pits (yellow), 25m apart – contingency for an additional 6 pits (white)

(2009 image: Google Earth Pro)

Figure 26 Indicative location of test pits at representative sample areas 1 and 2



Representative sample area 3

7 pits (yellow), 25m apart – contingency for an additional 7 pits (white)

(2009 image: Google Earth Pro)

Figure 27 Indicative location of test pits at representative sample areas 3

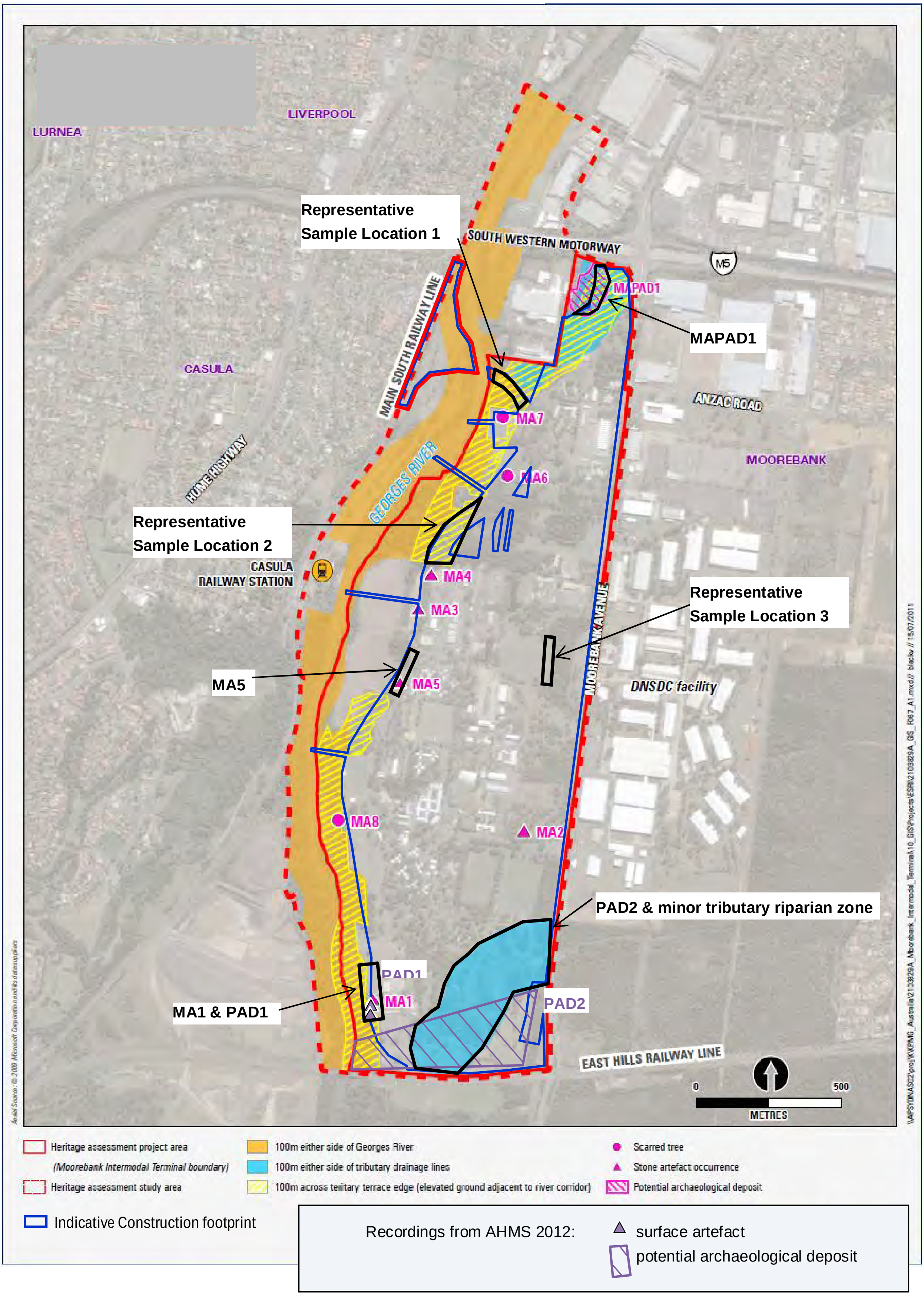


Figure 28 Location of all subsurface testing areas

Justification for the use of Mechanical Excavation

The proposed test excavation methodology for the program for the Moorebank project includes a mechanical excavation methodology that uses an excavator or backhoe to undertake the excavation work.

This methodology is proposed as it provides the best fit approach to the archaeological testing within areas of low archaeological potential. The aims of the test excavation program are to assess the presence or absence of Archaeological deposits in the study area and to determine what strategies, if any, are needed to mitigate the impact of the proposal on those deposits.

Mechanical excavation is by far the most effective means for testing large scale areas and addressing landscape based theory and predictive modelling as it can excavate and process ground quickly, thus allowing a maximum number and the greatest spread of samples within a limited period of time.

The mechanical excavation methodology provides a compromise sampling method that allows for speed and a maximum number, and spread, of samples, at the cost of lesser vertical control (compared to a hand excavation methodology), some potential for contamination, and the sacrifice of some excavated material which is mixed and remains untested.

The negative elements of this compromise are considered to be justifiable when considered as part of an overall risk/benefit assessment:

- Most deposits subject to mechanical testing are in open contexts and the artefacts encountered typically occur in low or moderate incidences and found to have little or no vertical integrity. In these contexts, the lesser vertical control and the untested excavated material associated with mechanical methodologies amounts to a minimal loss of information.
- Most tested deposits are defined according to varying scales of landform unit (such as spur crests, creek and river banks, dunes, terrace margins etc.) and typically extend across hectares. The proportion of these deposits subject to archaeological testing is typically less than 0.01%. In this context the information losses inherent in the methodology remain minimal.

The subsurface testing program at Moorebank will be concerned within broad landscape features and low-density artefact occurrences, both of which can be effectively tested using the mechanical excavation approach. The hand excavation provision will allow for the investigation of more significant features in a more controlled manner.

Registered Aboriginal Party Participation in Field Work

The proponent is committed to providing an opportunity to the representatives of registered Aboriginal parties to participate in the conduct of the test excavation program.

It is proposed that each registered Aboriginal party which seeks to participate in the field program, submit an application, demonstrating experience and field qualifications. The selection of field participants would be made by the proponent. Representation would be limited to one person per successful registered party application.

Protocol to be followed in the Event that Suspected Human Remains are Encountered

In the event that suspected human remains are encountered during any of the test excavation methodologies proposed, the protocol presented in Attachment B will be followed.

Environmental Safeguards

Minimal vegetation will be removed to facilitate the testing program.

All pits will be backfilled after completion of excavations at each location.

Sediment barriers will be set up around sieve stations to contain the spread and deposition of water-borne sediment. Sieve stations will be established in locations and managed so that surface run-off water does not reach the open water of creeks, rivers, lakes or swamps. A kit suitable for the containment of spillage of fuel for the water pump will be kept on site during the operations.

Analysis of Artefacts

All lithic items will be examined in detail by a lithic specialist Dr Chris Clarkson (or other qualified lithic specialist, depending on availability), using a low-power binocular microscope and incident illumination and/or hand lens. Descriptive recording of collected material will be to a level concomitant with the stated aims of the investigation, and the number of artefacts/type of material recovered.

The primary aim of the analysis of the lithic items retrieved from the test locations will be to assist in the assessment of the significance of the sites/deposits and to identify appropriate management strategies.

Raw material type will be recorded for each stone artefact. Attributes for each artefact in the assemblage will be entered into a relational database and digital photographs may be taken of selected artefacts, where appropriate. Information for each specimen recorded in the analysis will be provided in a final report Appendix.

Four basic variables will be recorded for each lithic item:

- size class, in one centimetre units;
- weight, as measured with an ISCO balance (precision of ±0.005 grams). Lithic item weights of less than 0.01 grams are accorded this nominal value;
- stone material type or category. To the extent possible, specific stone types will be identified, including colour and fabric characteristics. Some stone materials cannot be identified with confidence, even when magnified and viewed under reflected light. Such materials will be described as 'unidentified stone type';
- lithic item type or category (with further details entered into the comments section of the database);

Observations about notable technological attributes and other pertinent data such as specific characteristics of the stone material, any evidence of use-wear and potential tool-use residues, will also be recorded.

Report Preparation

The conduct and findings of the test excavation program will be documented in a cultural heritage assessment report which will form part of the EIS. The report will detail the methodology, background research, artefact analysis, results, assessment of significance, procedures for the management of sites and details of further archaeological investigations and /or salvage measures. Information received from registered Aboriginal parties will also be documented in the report except where identified as restricted or unsuitable for publication.

When completed, a draft of the cultural heritage assessment report will be provided to registered Aboriginal parties for comment. These comments, and any registered Aboriginal party heritage assessments, will then be addressed and incorporated into the final report.

The report will be consistent with reporting standards and guidelines as specified by the NSW Office of Environment and Heritage.

Care and Management of Recovered Artefacts

After examination and measurement, all recovered artefacts will be stored individually in standard resealable plastic bags. These containers would be labelled in permanent black pen with the item's unique identification number (where generated and appropriate), and/or details of its provenance within the excavation (as appropriate).

Following completion of the analysis of the recovered artefacts, it is proposed that all Aboriginal objects be repositioned back into the landscape ('returned to country') within reserved open space, in as close a position (as is feasible and safe) to their original find locations. The manner, format and containment of the artefact repositioning would be subject to agreement by the registered Aboriginal parties.

All locations of repositioned artefacts would be recorded on appropriate OEH forms and lodged with the AHIMS, administered by OEH.

In the event that the registered Aboriginal parties resolve to retain some (or all of the artefacts) in the care and custody of one or more individuals or organisations, then this would be subject to the approval of a Care Agreement by the OEH.

In the event that there is no agreement or consensus by the registered Aboriginal parties regarding the long term management of the recovered artefacts, then an application will be made to the Australian Museum (Sydney) for lodgement of the collection. If this application is rejected, then a management solution will be finalised through negotiation between the Moorebank Project Office, Department of Defence, OEH and the registered Aboriginal parties.

Aboriginal Consultation Process Regarding this Methodology

A draft version of this methodology was sent to all registered Aboriginal parties (RAPs) on the 13th September 2012 with a 28 day period for comment ending on 11th October 2012.

A site visit was held with the RAPs on the 26th September 2012. The site visit included a presentation on the project and proposed methodology and a tour of sites and areas that are proposed to be tested. All registered parties were represented at the site visit except for the Banyadjaminga organisation.

See Attachment A for a full description of the consultation process to date.

Comments on the methodology have been received from:

- Cubbitch Barta Native Title Claimants Aboriginal Corporation (CBNTCAC);
- Darug Aboriginal Landcare Incorporated (DALI);
- Darug Custodian Aboriginal Corporation (DCAC); and
- Darug Aboriginal Cultural Heritage Assessments (DACHA).

DALI, DCAC and DACHA all are in of support of the methodology (see Attachment A). CBNTCAC raised several matters regarding the methodology, however, these matters were all addressed in the course of the site visit and a subsequent telephone conversation with Nicola Hayes (NOHC) on the 27th September 2012. CBNTCAC supports the methodology as presented.

No requests for changes to the test excavation methodology have been received from any of the Registered Aboriginal Parties.

References

Archaeological & Heritage Management Solutions Pty Ltd (AHMS) 2012 Aboriginal Cultural Heritage Assessment [Final]. Appendix U In, *SIMTA Sydney Intermodal Terminal Alliance Part 3A Concept Application,* Hyder Consulting Pty Ltd.

Boot, P. 1990 *Archaeological Survey of Proposed Defence Housing Authority Subdivision at Holsworthy, NSW*. Report prepared for Kinhill Engineers Pty Ltd, Report by South-East Archaeology.

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Dallas, M. and D. Steele, 2004 *Aboriginal Archaeological Survey of Department of Defence Lands at Moorebank*. Report to GHD Pty Ltd on behalf of the Department of Defence.

Dames and Moore, 1996 *Environmental Management Plan for Liverpool Base Administrative Support Centre and School of Military Engineering.*

Department of Environment and Conservation (DEC) 2005 *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*. NSW Department of Environment and Conservation, Sydney.

Department of Environment, Climate Change & Water (DECCW) 2010 *Aboriginal cultural heritage consultation requirements for proponents 2010, Part 6 National Parks and Wildlife Act 1974.* NWS Department of Environment, Climate Change & Water, Sydney.

Graham Brooks and Associates Pty Ltd (GBA) 2004 Moorebank Defence Site, Moorebank. Heritage Assessment. Report to Department of Defence Property Disposals Task Force.

Navin Officer Heritage Consultants (NOHC) 1997 Aboriginal Cultural Heritage, *Technical Paper 11, Proposal for a Second Sydney Airport at Badgerys Creek or Holsworthy Military Area.* Report prepared for PPK Environment and Infrastructure, on behalf of the Commonwealth Department of Transport and Regional Development.

Navin Officer Heritage Consultants (NOHC) 2011 Moorebank Intermodal Freight Terminal Scoping Study, Cultural Heritage Desktop Review, Summary compilation of known and potential constraints. An interim report to Parsons Brinckerhoff, Sydney.

Attachment A

Outline of Aboriginal participation and consultation to date

Section removed, detailed in main report above.

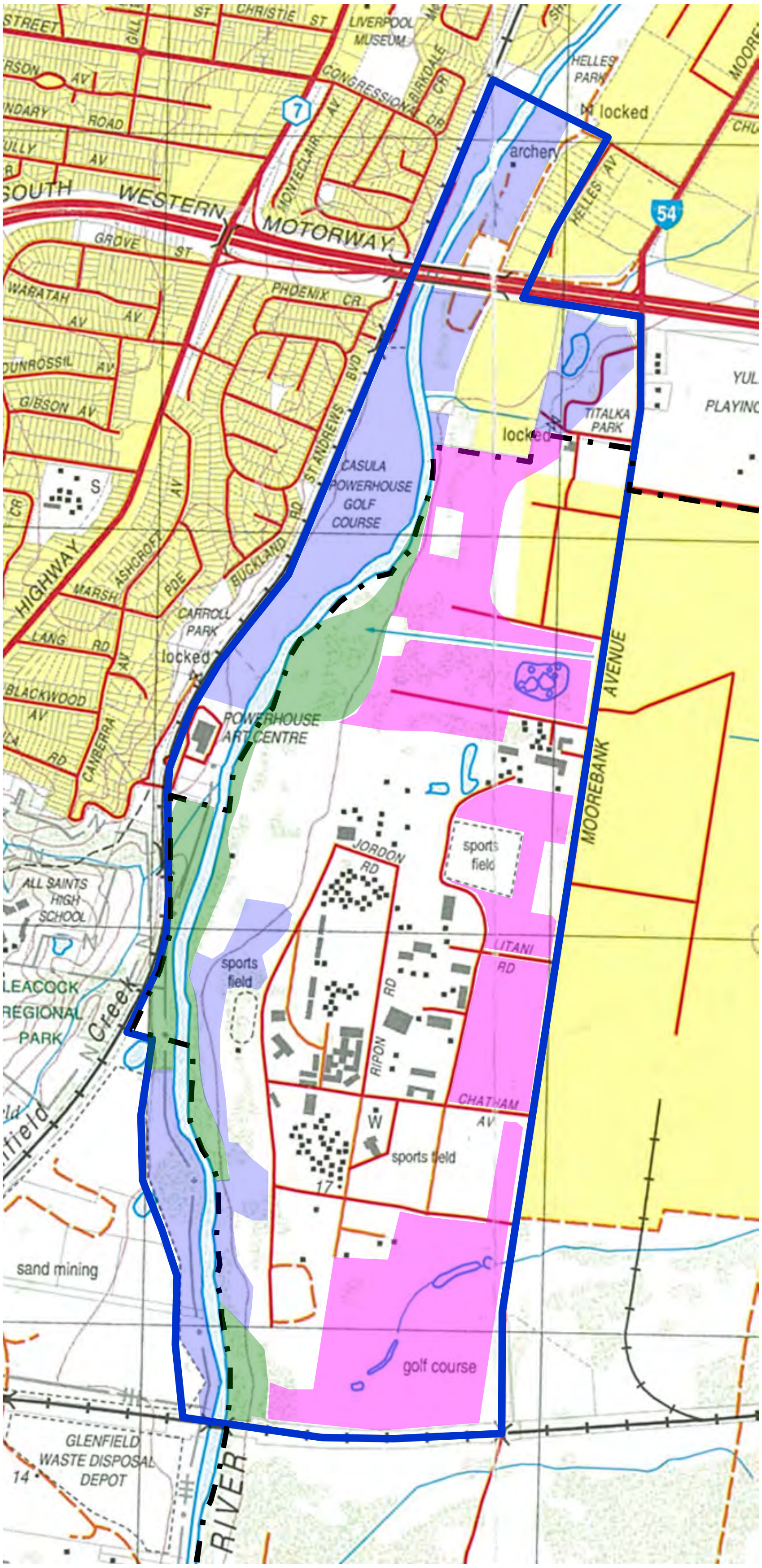
Attachment B

Protocol to be followed in the event of that suspected human remains are encountered

Section removed, replaced by Appendix 9.

Attachment C

Additional Mapping



Aboriginal archaeological sensitivity

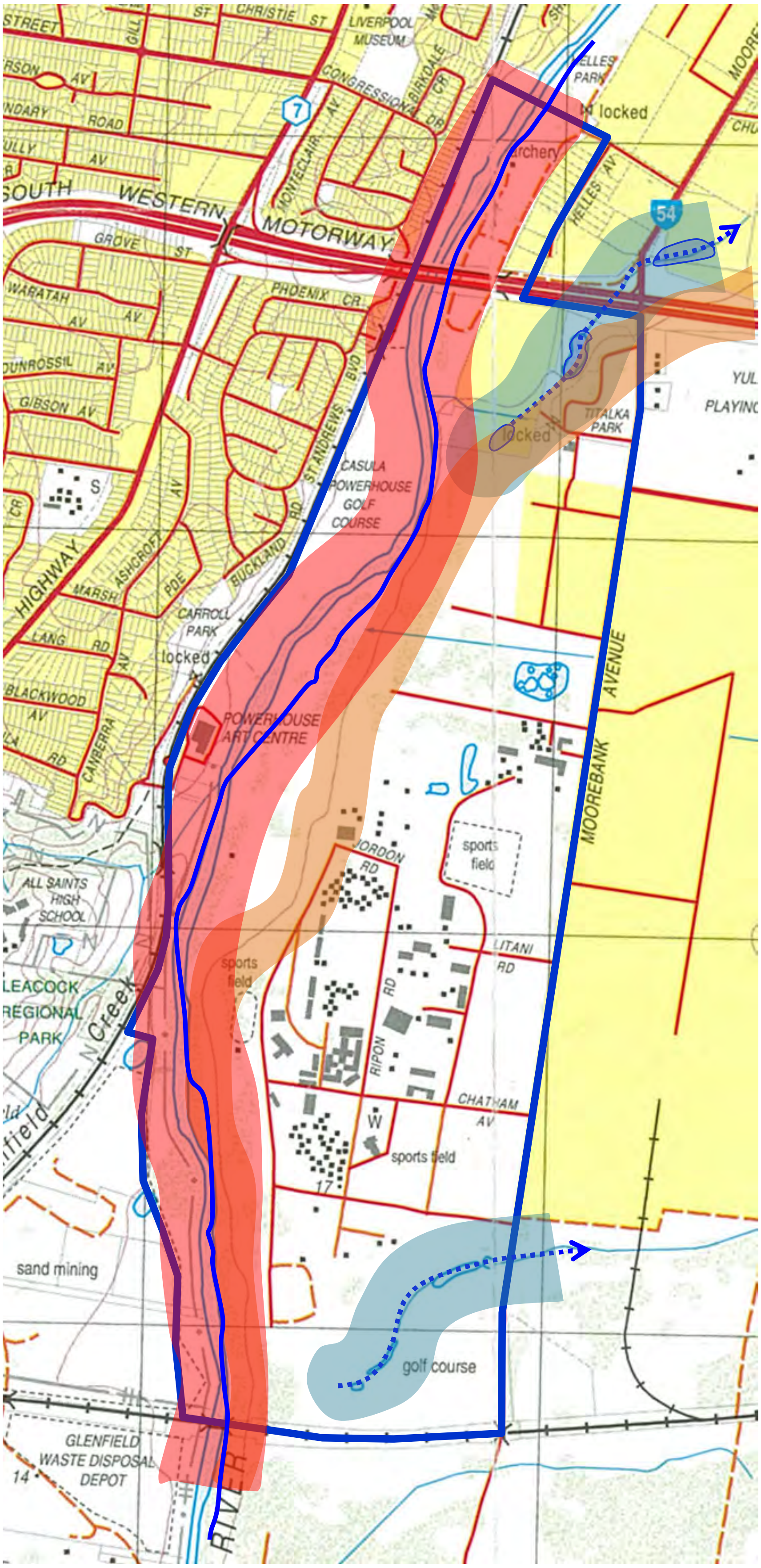
Archaeological Management Plan in (Dallas and Steele 2004)

- Low sensitivity – archaeological monitoring
- Unknown – further site inspection and assessment
- No sensitivity – no further assessment
- Dallas & Steele study area

Remaining study area

- Areas of lesser disturbance requiring survey and assessment

Figure C1 Aboriginal archaeological sensitivity as determined by Dallas and Steele in 2004 prior to the conduct of the Moorebank IMT project assessment (note: this graphic is from a draft interim report).



Predicted Aboriginal archaeologically sensitive landforms

(ignoring European landuse impacts)

- 100m either side of Georges River
- 100m either side of tributary drainage lines
- 100m across Tertiary terrace edge (elevated ground adjacent to river corridor)
- Riverbank indicated on c.1890 subdivision plan

Figure C2 Aboriginal archaeological sensitive landforms based on predictive modelling and ignoring the impact of subsequent European landuse. (note: this graphic is from a draft interim report).

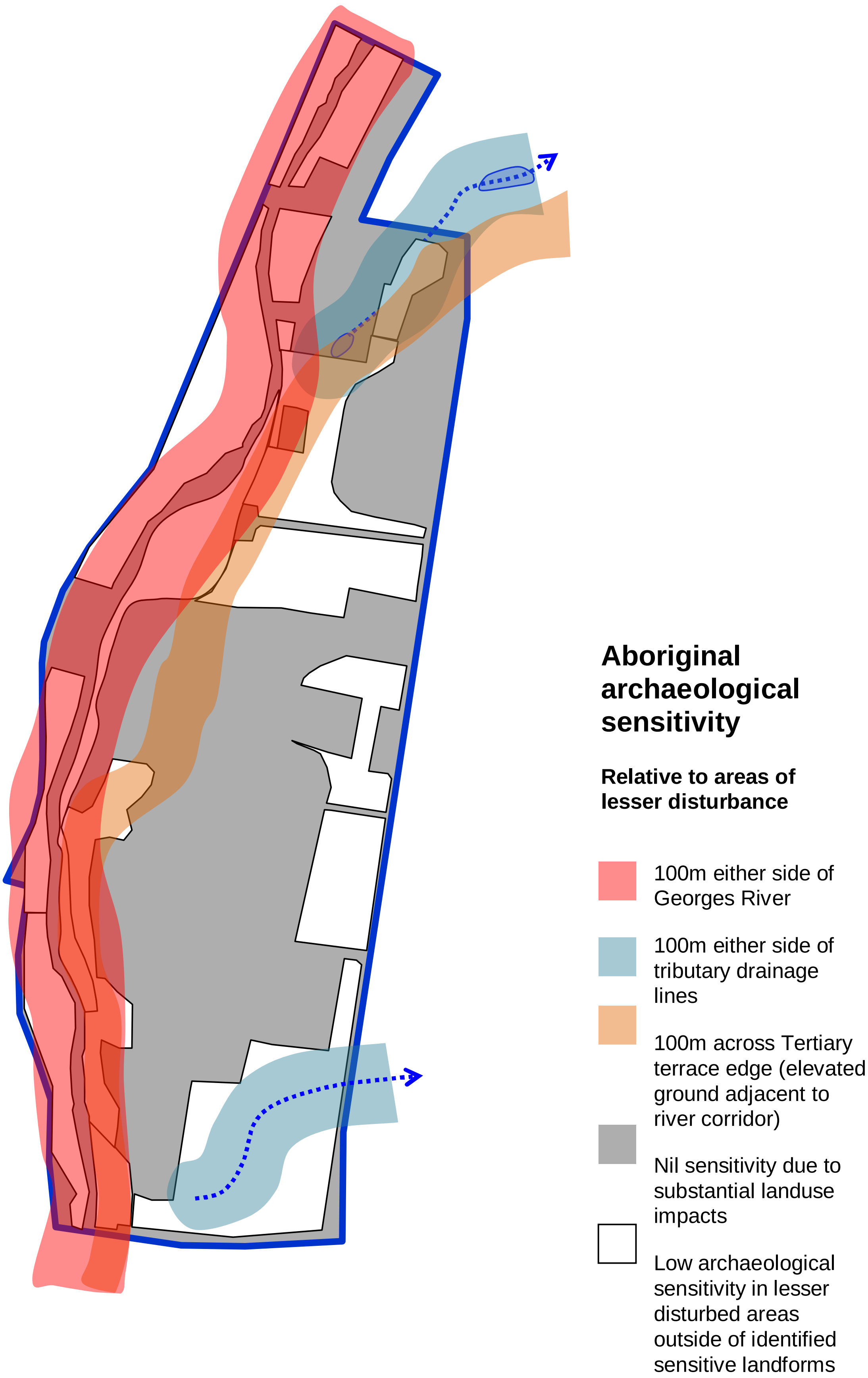


Figure C3 Aboriginal archaeological sensitive landforms compared with areas of substantial and lesser landuse disturbance. This figure illustrates the derivation of the zones shown in Figures 1 and 2. (note: this graphic is from a draft interim report).

APPENDIX 3

LITHICS ANALYSIS

Number	Pit	Spit	Fill Sample yn	Technological type	Retouched yn	Retouched type	Material	Colour	Completeness	Initiation	Platform type	Termination
1	1	2	No	Flaked piece	No		FGS	Grey	Complete			
2	1	4	No	Flake	No		FGS	Dark grey	Complete	Hertzian	Shattered	None
3	1	4	No	Flake	No		FGS	Dark grey	LCS left	Hertzian	Cortical	Shattered
4	5	3	No	Non-artefactual shatter			Glass	Brown				
5	5	3	No	Non-artefactual shatter			China	White				
6	5	3	No	Flake	No		Silcrete	Red	Complete	Hertzian	Single	Feather
7	5	3	No	Flaked piece	No		FGS	White	Complete			
8	5	3	No	Core	No		FGS	White	Broken			
9	6	8	No	Non-artefactual shatter	No		Milky quartz	White				
10	9	12	No	Flake	No		Silcrete	Red	Distal	None	None	Feather
11	10	7	No	Flake	No		Milky quartz	White	Complete	Bending	Cortical	Feather
12	10	12	No	Flake	No		Silcrete	Red	Distal	None	None	Feather
13	12	1	No	Flake	No		Silcrete	Red	Proximal	Hertzian	Facetted	None
14	13	1	No	Flake	No		Silcrete	Dark grey	Marginal	Hertzian	None	Shattered
15	13	1	No	Non-artefactual shatter	No		FGS	White				
16	14	6	No	Flake	No		Silcrete	Red	Margin missing	Hertzian	Shattered	Step
17	18	8	No	Non-artefactual shatter	No		Glass	Green				
18	18	12	No	Non-artefactual shatter			Milky quartz	White				
19	19	11	No	Non-artefactual shatter			Shale or decaying wood					
20	42	16	No	Non-artefactual shatter			FGS	Orange				
21	42	9	No	Flake	No		Silcrete	Orange with red mottles	Medial	None	None	None
22	34	1	Yes	Non-artefactual shatter	No		Silcrete	white				
23	34	2	Yes	Non-artefactual shatter	No		Brick	Red				
24	34	2	Yes	Non-artefactual shatter	No		Brick	Red				
25	34	2	Yes	Non-artefactual shatter	No		Brick	Red				
26	34	2	Yes	Non-artefactual shatter	No		Brick	Red				
27	34	2	Yes	Non-artefactual shatter	No		Brick	Red				
28	34	2	Yes	Non-artefactual shatter	No		Brick	Red				
29	34	2	Yes	Non-artefactual shatter	No		Brick	Red				
30	34	2	Yes	Non-artefactual shatter			Silcrete	Yellow				
31	34	2	Yes	Non-artefactual shatter			Silcrete	Dark grey				
32	34	2	Yes	Non-artefactual shatter			Brick	White				
33	34	2	Yes	Non-artefactual shatter			Brick	Orange				
34	34	2	Yes	Non-artefactual shatter			Brick	Cream				
35	34	2	Yes	Non-artefactual shatter			Silcrete	Yellow				
36	34	2	Yes	Non-artefactual shatter			Silcrete	Grey				
37	34	2	Yes	Non-artefactual shatter			Silcrete	Grey				
38	34	2	Yes	Non-artefactual shatter			Silcrete	Dark grey				
39	34	2	Yes	Non-artefactual shatter			Silcrete	Dark grey				
40	34	2	Yes	Non-artefactual shatter			Brick	Orange				
41	34	2	Yes	Non-artefactual shatter			Silcrete	Dark grey				
42	34	2	Yes	Non-artefactual shatter			Silcrete	Dark grey				
43	34	3	Yes	Non-artefactual shatter			Brick	Orange				
44	34	3	Yes	Non-artefactual shatter			Brick	Orange				
45	34	3	Yes	Non-artefactual shatter			Brick	Orange				
46	34	3	Yes	Non-artefactual shatter			Brick	Orange				

Number	Pit	Spit	Fill Sample yn	Technological type	Retouched yn	Retouched type	Material	Colour	Completeness	Initiation	Platform type	Termination
47	34	3	Yes	Non-artefactual shatter			Brick	Orange				
48	34	3	Yes	Non-artefactual shatter			Brick	Orange				
49	34	3	Yes	Non-artefactual shatter			Ceramic	White				
50	34	3	Yes	Non-artefactual shatter			Silcrete	White				
51	34	3	Yes	Non-artefactual shatter			Silcrete	Dark grey				
52	34	3	Yes	Non-artefactual shatter			Silcrete	Dark grey				
53	34	6	Yes	Non-artefactual shatter			Silcrete	white				
54	34	9	Yes	Flake	No		Silcrete	White	Complete	Hertzian	Single	Feather
55	35	1	Yes	Non-artefactual			Plastic, steel	Yellow				

Number	Dorsal cortex distribution	Dorsal cortex %	No. Dorsal scars	Dorsal scar orientation	Heat damage yn	Overhang removal yn	Facetting yn	Relic Platform	Weight	Length	Width	Thickness
1									1.9			
2	Primary	100	0						3.7	15.6	25.1	6.9
3	Patch left	20	1	Same					4.7	18.4	20.4	7.6
4									1.4			
5									0.3			
6	Tertiary	0	2	Same					0.3	14.1	11.9	1.7
7									0.8			
8									5.9	19	20.9	10
9									0.2			
10	Tertiary	0	2	Same					0.1	6.1	7.5	1.1
11	Tertiary	0	1	Same					0.2	5.8	9.2	2.2
12	Tertiary	0	2	Same					0.1	5.9	5.6	0.7
13	Tertiary	0	4	Oblique			Yes	Yes	0.2	15.4	5.8	2.1
14	Tertiary	0	2	Opposite					0.2			
15									0.1			
16	Tertiary	0	1	Same					0.1	5	4.3	0.8
17									8.2			
18									0.7			
19									0.5			
20									0.1			
21	Tertiary	0	3	Same					0.3	7.6	12.2	1.4
22									0.1			
23									0.2			
24									0.1			
25									0.1			
26									0.1			
27									0.1			
28									0.1			
29									0.1			
30									0.1			
31									0.1			
32									0.1			
33									0.1			
34									0.1			
35									0.1			
36									0.1			
37									0.1			
38									0.1			
39									0.1			
40									0.1			
41									0.1			
42									0.1			
43									0.2			
44									0.1			
45									0.1			
46									0.1			

Number	Dorsal cortex distribution	Dorsal cortex %	No. Dorsal scars	Dorsal scar orientation	Heat damage yn	Overhang removal yn	Facetting yn	Relic Platform	Weight	Length	Width	Thickness
47									0.1			
48									0.1			
49									0.2			
50									0.2			
51									0.1			
52									0.1			
53									0.1			
54	Tertiary	0	1	Indeterminate					0.1	4.6	6.4	0.6
55									0.9			

Number	Platform width	Platform thickness	Quarter width	Max width	Max percussion length	Max dimension	Orthogonal width	Orthogonal thickness	
1						22.1	10.1	6.6	
2	11.7		19.2	26.7	19.9	27.6	15.9	6.8	Edge damage on distal end.
3	19.8	4	19	20.8	22.6	25	22.3	6.4	shattering on distal end could indicate bipolar flake
4									Bottle glass fragment
5									White with glaze, curved rim. Chip.
6	6.2	2.2	9.1	12	14.8	15.3	11	1.5	
7						14.6	10.1	3.7	1 negative scar, and one potential ventral surface
8						27.5	19.8	11.4	2 scar directions (mfsp and mfs) on a thin tabular piece of stone
9									
10						8.8	6.7	1.1	
11	9.9	4	9.7	9.9	0	11.1	5	2.9	
12						6.9	5.3	0.8	
13	3.7	2.3	4.5	5	15.5	15.5	5	2.1	Relic Platform along left margin
14						11.9	4.5	2.5	
15									
16	3.3		4.5	4.8	7.8	9.3	3.9	0.6	
17									Several negative scars, but these are adjacent to a lateral break, and likely caused by the same application of force.
18									
19									Several pieces, almost certainly broken up in transit
20									
21						16.8	8.9	1.4	
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
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39									
40									
41									
42									
43									
44									
45									
46									

Number	Platform width	Platform thickness	Quarter width	Max width	Max percussion length	Max dimension	Orthogonal width	Orthogonal thickness	
47									
48									
49									
50									
51									
52									
53									
54	5.7	0.9	6	6.8	5.5	7.6	4.3	0.7	
55									European. Composite tube with steel core and plastic outer sleeve.

Number	AverageLengthWidth
1	16.1
2	21.75
3	23.65
4	
5	
6	13.15
7	12.35
8	23.65
9	
10	7.75
11	8.05
12	6.1
13	10.25
14	8.2
15	
16	6.6
17	
18	
19	
20	
21	12.85
22	
23	
24	
25	
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52	
53	
54	5.95
55	

APPENDIX 4

RECORD OF ABORIGINAL CULTURAL HERITAGE CONSULTATION

Consultation Log

Date of communication	Type	Persons involved	Key points discussed	Documentary Record
22/10/2010	letter	Tharawal LALC	letter inviting registration of interest in the project	Electronic copy
8/11/2010	letter	Tharawal LALC	Registration of interest in project	Hard copy of letter
5/12/2010	email	CBNTCAC	Registration of interest in project	Hard and electronic copy
10/1/2011	letter	Tharawal LALC, CBNTCAC, DCAC, DTAC, DACHA, DLO, DALI, Yarrawalk, Peter Faulk	Letter with methodology for 2011 field survey and inviting registration of interest in the project	Electronic Copies of letters
18/1/2011	letter	DLO, DCAC,	Registration of interest in project, agreed with methodology	Hard copy of letter
25/1/2011	Letter/fax	DACHA	Registration of interest in project, support the methodology	Hard copy of letter
27/1/2011	Letter/fax	DALI	Registration of interest in project, agreed with methodology	Hard copy of letter
29/1/2011	letter	CBNTCAC	Agreed with methodology but questions the use of the 2005 Interim guidelines	Hard copy of letter
25/6/2012	letter	Tharawal LALC, CBNTCAC, DCAC, DACHA, DLO, DALI, Frances Bodkin	Informing RAPs implementing the 2010 guidelines	Electronic Copies of letters
20/7/2012	letter	Norma Burrows, DTAC, Yarrawalk, GCHAC, Gandangara LALC,	inviting registration of interest in the project	Electronic Copies of letters
20/7/2012	letter	Tharawal LALC, CBNTCAC, DCAC, DACHA, DLO, DALI,	Informing RAPs of European excavation program commencement	Electronic Copies of letters

Date of communication	Type	Persons involved	Key points discussed	Documentary Record
		Frances Bodkin		
23/7/2012	letter	Tharawal LALC, CBNTCAC, DCAC, DACHA, DLO, DALI, Frances Bodkin	Informing RAPs of site inspection and subsurface investigation dates	Electronic Copies of letters
23/7/2012	email	Gandangara LALC	Registering an interest in the project	Electronic and hard Copies of letters
30/7/2012	Email	France Bodkin	Formal registration of interes	Hard copy
3/8/2012	letter	Tocomwall	Registering an interest in the project	Electronic and hard Copies of letters
7/8/2012	email	Tocomwall	Informing RAPs of site inspection and subsurface investigation dates	Electronic Copies of letters
7/8/2012	email	DLO, DCAC, Tharawal LALC, Gandangara LALC,	ID card applications and nomination of site workers	Electronic Copies of letters
9/8/2012	email	DALI	ID card	Electronic Copies of letters
10/8/2012	Email	DALI	ID card	Electronic Copies of letters
14/8/2012	email	Tocomwall, DALI, Gandangara LALC, Frances Bodkin, DCAC, DLO, Tharawal LALC	Postponement of site visit	Electronic Copies of letters
14/8/2012	Phone call	CBNTCAC, DACHA	Postponement of site visit	Phone call log
14/8/2012	email	Tocomwall	Postponement of site visit	Electronic Copies of letters
8/9/2012	letter	Tocomwall, DALI, Gandangara LALC, Frances Bodkin, DCAC, DLO, Tharawal LALC, CBNTCAC, DACHA	Draft subsurface testing methodology for comment and site visit invitation	Electronic Copies of letters

Date of communication	Type	Persons involved	Key points discussed	Documentary Record
14/9/2012	letter	Tocomwall, DALI, Gandangara LALC, Frances Bodkin, DLO, Tharawal LALC, CBNTCAC, DACHA	Change of date for site visit	Electronic and hard Copies of letters
18/9/2012	letter	CBNTCAC	Questions regarding methodology	Hard copy of letter
20/9/2012	fax	DACHA	Agreed with methodology	
21/9/2012	email	DCAC	Agrees with methodology	Hard and electronic copy
26/9/2012	Site visit	DLO, DALI, CBNTCAC, DACHA, DCAC, Gandangara LALC, Tharawal LALC	Site walkover, methodology and project discussion	
27/9/2012	phone	CBNTCAC	Methodology questions	Phone conversation note
27/9/2012	Fax/letter	DALI	Supports methodology	Hard copy
3/10/2012	email	DCAC	Concerns regarding pond and scarred tree and fitness of site workers	Hard and electronic copy
25/1/2013	letter	Tocomwall, DALI, Gandangara LALC, DLO, Tharawal LALC, CBNTCAC, DACHA	Draft report sent to RAPs for comment	Hard and electronic copy
4/2/2013	letter	Tocomwall, DALI, Gandangara LALC, DLO, Tharawal LALC, CBNTCAC, DACHA	Letter inviting to LCC survey	Hard and electronic copy
4/2/2013	email	Frances Bodkin	Letter inviting to LCC survey	electronic copy
6/2/2013	email	Tocomwall, DALI,	Change of survey day	electronic copy

Date of communication	Type	Persons involved	Key points discussed	Documentary Record
		Gandangara LALC, DLO, Tharawal LALC, CBNTCAC		
6/2/2013	Phone call	DACHA	Change of survey day	Phone log note
6/2/2013	Email	Frances Bodkin	Unable to make survey provided postal address	electronic copy
12/2/2013	email	Tocomwall, DALI, Gandangara LALC, DLO, Tharawal LALC, CBNTCC, Frances Bodkin	Site visit details	electronic copy
12/2/2013	Phone call	CBNTCAC, DACHA	Site visit details	Phone log note
12/2/2013	email	Frances Bodkin	Can provide details on plant use	Electronic copy
13/2/2013	fax	DACHA	Support recommendations in report, important cultural area	Hard copy
20/2/2013	Email/letter	Tocomwall, DALI, Gandangara LALC, DLO, Tharawal LALC, CBNTCAC, Frances Bodkin	Letter outlining result of LCC land survey and no change to draft report	Electronic copy
20/2/2013	fax	DACHA	Letter outlining result of LCC land survey and no change to draft report	Electronic copy
20/2/2013	email	Tocomwall	Supports recommendations in the report	Hard and electronic copy
22/2/2013	phone	DALI	Reiterates previous comments and accepts and support the recommendations in the report	Phone conversation log
25/2/2013	email	DCAC – Leanne Watson	Letter stating the high cultural significance of the study area and the	Hard and Electronic copy

Date of communication	Type	Persons involved	Key points discussed	Documentary Record
			DCAC stance that the scarred trees should be conserved.	
9/07/2013	post	All RAPS	inviting representatives to LCC land subsurface testing program	Electronic copy
16/07/2013	phone	DLO - Gordon Workman	has not received letter inviting representatives to LCC land subsurface testing program	consultation log
16/07/2013	email	DLO - Gordon Workman	sending letter inviting representatives to LCC land subsurface testing program	electronic copy
16/07/2013	phone	Tocomwall - Scott Franks	has not received letter inviting representatives to LCC land subsurface testing program - discussed the fact that we would be meeting Monday 22 July 2013 at 9am and advised him to get in touch if he does not receive his letter in the coming days.	consultation log
17/07/2013	phone	All RAPS	following up on letter and advising of time and meeting place	consultation log
17/07/2013	email	CBNTCAC, DLO, DALI, DCAC, Banyadjaminga, GLALC, Tocumwal	follow up to letter and phone calls with subsurface testing details	electronic copies
2/12/2013	post	All RAPs	Draft report for comment	electronic copy
11/12/13	fax	DACHA	Response to draft report	Hard/electronic copy
18/12/13	email	DCAC	Response to draft report	Hard/electronic copy
7/1/14	post	CBNTCAC	Response to draft report	Hard/electronic copy

LALC =	Local Aboriginal Land Council
CBNTCAC =	Cubbitch Barta Native Title Claimant Corporation
DCAC =	Darug Custodial Aboriginal Corporation
DTAC =	Darug Tribal Aboriginal Corporation
DACHA =	Darug Aboriginal Cultural Heritage Assessments
DLO =	Darug Land Observations
DALI =	Darug Aboriginal Landcare Incorporated
Yarrawalk =	Tocomwall
GCHAC =	Gunjeewong Cultural Heritage Aboriginal Corporation

Cubbitch Barta Native Title Claimants
Aboriginal Corporation
55 Nightingale Road,
PHEASANTS NEST. N.S.W. 2574.
10th December, 2013.

Navin Officer Heritage Consultants Pty Ltd.
Number 4 Kingston Warehouse,
71 Leichardt Street,
KINGSTON. ACT. 2604.

Dear Jo & Bec,

RE; MOOREBANK INTERMODAL
POWERHOUSE CASULA

Thank you for the opportunity of participating in the above proposed project, and for the opportunity of commenting on the DRAFT Subsurface Testing Report.

This is probably the most unusual report which I have been asked to comment on in the time I have been participating in such projects for over 20 years.

It is hard to put a significance to something that is as unknown as this appears to be. Excited that the possibilities of such deep deposits, that may or may not have Aboriginal cultural significance and also historical significance. Deposits that pre date the Liverpool weir being built in 1836, as having the potential to contain significant materials is important.

However I feel that it is highly unlikely that any kind of development will allow for excavations to the scope that you have described in the report. Yes there may be impacts to that lower level by the construction of the overbridge, but will it allow for testing the deposit prior to that works. It may prove your theory, but will it potentially ever be allowed to happen. At this point in time the testing that has recently been carried out shows no reason why the works cannot proceed. The few artefacts that were excavated appear to have come from some other source, than being in situ from use by Aboriginal people in the past.

I would recommend that those artefacts recovered be allowed to be reburied somewhere within the proposed development, where they will be recorded, and not be impacted by any future development.

Yours faithfully,

G. Chalker

Glenda Chalker
Hon. Chairperson
Phone/Fax 02 46841129 0427218425

Darug Aboriginal Cultural Heritage Assessments

ABN 51734106483

Gordon Morton

Mob: 0422 865 831
Fax: 45 677 421

Celestine Everingl n
90 Hermitage Rd.. urrajong Hills, 2758
Ph/Fax: 45677 421
Mob: 0432 528 89

11. 12 13

Attention

Jo Dibden
Navin Officer

re Moorebank Intermodal Terminal – Liverpool City Council Northern Powerhouse Land.

DACHA have reviewed your comprehensive report on your findings, management and mitigation strategies and recommendations and we are in full support of your aims and objectives for this important Darug area. We wish to be consulted at all times and be involved in any future fieldwork.

Yours Sincerely,
C. Everingham

Cultural Heritage – Building respect for the past and Conservatio or the future

DARUG CUSTODIAN
ABORIGINAL
CORPORATION

PO BOX 81 WINDSOR 2756
PHONE: 0245775181 FAX: 0245775098
MOBILE: 0415770163
EMAIL: mulgokiwi@bigpond.com

Attention: Jo Dibden.

Subject: Moorebank Intermodel Terminal Draft Aboriginal subsurface testing Report.

Dear Jo,

The Darug Custodian Aboriginal Corporation have received and reviewed the draft report for Moorebank Intermodel Terminal.

We support the research methodologies that were investigated during these works, the draft report has recorded the findings accurately and extensively for this project.

Our group finds all of our sites and objects significant and support the recommendations set out in this report.

The main aim of our group is to conserve and protect our sites, where this is not possible we strongly recommend interpretive strategies. Interpretive strategies that work well in development areas such as this is an information booklet that is given to visitors. Public art and interpretive signs are also important for areas such as this.

Please contact us with all further enquiries on the above contacts.

Regards

Leanne Watson

APPENDIX 5

AHIMS SITE SEARCH

AHIMS Web Services (AWS)
Search Result

Your Ref Number :
Client Service ID : 85420

Navin Officer Heritage Consultants Pty Ltd
4/71 Leichhardt Street
Kingston Australian Capital Territory 2604

Date: 15 November 2012

Attention: Rebecca Parkes

Email: rparkes@nohc.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 56, Eastings : 303000 - 312000, Northings : 6236000 - 6246000 with a Buffer of 50 meters, conducted by Rebecca Parkes on 15 November 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

80	Aboriginal sites are recorded in or near the above location.
1	Aboriginal places have been declared in or near the above location. *

ID	Aboriginal Place Name
0	Collingwood Precinct

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

PO BOX 1967 Hurstville NSW 2220
43 BridgeStreet HURSTVILLE NSW 2220
Tel: (02)9585 6345 (02)9585 6741 Fax: (02)9585 6094

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au

Collingwood Precinct

View map showing all Aboriginal Places

Why is it an Aboriginal Place?

Collingwood Precinct was a 'high ground' meeting place for Dharawal, *Gandangara* and *Dharug* Aboriginal people, and a vantage point from which to observe Country.

Why is it important to Aboriginal people?

Collingwood Precinct is a significant part of the landscape for Dharawal, *Gandangara* and *Dharug* people. The hill top and ridge line was a meeting place for Aboriginal groups and also a vantage point during the pre-contact era enabling Country to be observed and monitored. The lookout provided views across the landscape, which allowed for observations of weather patterns, movements, threats from fire and changes in seasonal vegetation. The 'vista' from the high ground provides a view corridor southeast to the Georges River. Gavin Andrews explains: 'The area was important because it's a high point and it was a place where different nations would meet, but also where people would look over the country...you could see everything in all directions from there...[and] it's right near the Georges River, which was the major method of transportation in the area.'

The Aboriginal Place is associated with early engagement, and at times conflict, between colonial settlers and Aboriginal people. The American whaler, Captain Eber Bunker, constructed a large house, Collingwood House, in this location in 1810.

Today, the Collingwood Precinct Aboriginal Place is important to Aboriginal people because the location and outlook provide a connection to Country and culture. The site also continues to be used as a meeting place for Aboriginal people.

What's on the ground?

There are no physical traces of past Aboriginal presence within the Collingwood Precinct Aboriginal Place, though a stone ground-edge hatchet (axe) has previously been recovered from the area. The value of the place lie in people's stories and knowledge of the location and in the relationships that Aboriginal people have with this landscape.

Nature of the environment

The Collingwood Precinct Aboriginal Place is surrounded by urban residential development. The high ground ridgeline, which retains views to the south east, is made up of open space parkland. Collingwood House colonial estate and the Liverpool Regional Museum lie adjacent to the Aboriginal Place.

What's the land used for?

Collingwood Precinct Aboriginal Place is located on land zoned as 'Community Open Space', which includes mixed-use parkland.

Land status

The Collingwood Precinct Aboriginal Place is located on public land owned and managed by the Liverpool City Council.

Quotes

Gavin Andrews 2009: 'I'm so proud to see this land recognised because it's a very significant site for the Aboriginal people in this area.' Aunty Norma Shelley 2009: In reference to future land use: 'But mostly we want nothing to be done with it at all, we want it to be left alone.'

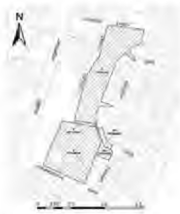
Further information

McDonald, A 2009, Collingwood Precinct Aboriginal Place, Parliament of NSW, Parliamentary Secretary, Legislative Assembly, Macquarie Fields. [www.parliament.nsw.gov.au/Prod/parlment/hansart.nsf/V3Key/LA20090901007]

Tarasov, A 2009, 'Place recognised as significant', *Liverpool City Champion, Local News*. [www.liverpoolchampion.com.au/news/local/news/general/place-recognised-as-significant/1460224.aspx]

View across parkland of Collingwood Precinct Aboriginal Place

Part of audience at Collingwood Precinct Aboriginal Place declaration celebration



Map of Collingwood Aboriginal Place (NSW Government Gazette, 2009)

About this place

Location:
Latitude:
-33.9332851845
Longitude:
150.918346069

Size (approx):
4.7 hectares

Date created:
6 March 2009
See gazettal notice p. 1338

Local Aboriginal land council:
Tharawal

Local government area:
Liverpool

Contact:
Community Operations Branch, Central Region: (02) 9995 5000

NSW Office of Environment & Heritage

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : MIMT

Client Service ID : 85420

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-5-2537	HPR-OS-1	AGD	56	303150	6243640	Open site	Valid	Artefact : -	Open Camp Site	98369,98370,98371,98443,98739
	Contact	**Recorders**	Robynne Mills					**Permits**	1431	
45-5-2538	HPR-ST-1	AGD	56	306810	6243650	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	98443
	Contact	**Recorders**	Robynne Mills					**Permits**		
45-5-2540	Liverpool Weir ocs1	AGD	56	308420	6244040	Open site	Valid	Artefact : -	Open Camp Site	98443
	Contact	**Recorders**	Jeff Thomas					**Permits**		
45-5-2534	BR_IF_1	AGD	56	303150	6243850	Open site	Valid	Artefact : -	Isolated Find	98369,98370,98371,98443,98739
	Contact	**Recorders**	Robynne Mills					**Permits**		
45-5-2495	MFH 2	AGD	56	304300	6238300	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	**Recorders**	Mary Dallas Consulting Archaeologists					**Permits**		
45-5-2479	IF 1 (isolated find)	AGD	56	303680	6241600	Open site	Valid	Artefact : -	Isolated Find	98369,98370,98371,98443,98739
	Contact	**Recorders**	Ms.Elizabeth White					**Permits**		
45-5-2481	Maxwells Creek 11 (MC11)	AGD	56	303720	6241600	Open site	Valid	Artefact : -	Open Camp Site	98369,98370,98371,98443,98739
	Contact	**Recorders**	Ms.Elizabeth White					**Permits**	1398	
45-5-2482	Maxwells Creek 10 (MC10)	AGD	56	303490	6241050	Open site	Valid	Artefact : -	Open Camp Site	98369,98370,98371,98443,98739
	Contact	**Recorders**	Ms.Elizabeth White					**Permits**	1564	
45-5-2483	Maxwells Creek 9 (MC9)	AGD	56	303050	6241080	Open site	Valid	Artefact : -	Open Camp Site	98369,98370,98371,98443,98739
	Contact	**Recorders**	Ms.Elizabeth White					**Permits**		
45-5-2469	IF1	AGD	56	303830	6241020	Open site	Valid	Artefact : -	Isolated Find	98369,98370,98371,98443
	Contact	**Recorders**	Helen Brayshaw					**Permits**	1398	
45-5-2470	IF2	AGD	56	303370	6242320	Open site	Valid	Artefact : -	Isolated Find	98369,98370,98371,98443,98739
	Contact	**Recorders**	Helen Brayshaw					**Permits**		
45-4-0936	Crossroad 1	AGD	56	303780	6240070	Open site	Valid	Artefact : -	Open Camp Site	98369,98370,98371,98443,98739
	Contact	**Recorders**	Kerry Navin,Mr.Kelvin Officer					**Permits**	987	
45-4-0937	Crossroad 2	AGD	56	303750	6240070	Open site	Valid	Artefact : -	Open Camp Site	98369,98370,98371,98443,98739

Report generated by AHIMS Web Service on 15/11/2012 for Rebecca Parkes for the following area at Datum :GDA, Zone : 56, Eastings : 303000 - 312000, Northings : 6236000 - 6246000 with a Buffer of 50 meters.Additional Info : Background information for cultural heritage assessment. Number of Aboriginal sites and Aboriginal objects found is 80

NSW GOVERNMENT | Office of Environment & Heritage

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : MIMT

Client Service ID : 85420

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
	Contact	Recorders	Kerry Navin,Mr.Kelvin Officer					Permits	986	
52-2-0086	Long Point;Matthews No.1 Shelter;	AGD	56	308300	6237700	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	Contact	Recorders	Margrit Koettig					Permits		
45-5-0890	WG3 (Wattle Grove)	AGD	56	309100	6240030	Open site	Valid	Artefact : -	Open Camp Site	2474
	Contact	Recorders	Philip Boot					Permits	465	
45-5-0891	WG2 (Wattle Grove)	AGD	56	309020	6239950	Open site	Valid	Artefact : -	Open Camp Site	2474
	Contact	Recorders	Philip Boot					Permits	465	
45-5-0892	WG1 (Wattle Grove)	AGD	56	309070	6239950	Open site	Valid	Artefact : -	Open Camp Site	2474
	Contact	Recorders	Philip Boot					Permits	465	
45-5-2301	P-CP1	AGD	56	303690	6241790	Open site	Valid	Artefact : -	Open Camp Site	98369,98370,98371,98443,98739
	Contact	Recorders	Helen Brayshaw					Permits		
45-5-2302	GP-CP2;	AGD	56	303750	6241950	Open site	Valid	Artefact : -	Open Camp Site	98369,98370,98371,98443
	Contact	Recorders	Helen Brayshaw					Permits	850	
45-5-2303	P-CP3	AGD	56	303400	6242200	Open site	Valid	Artefact : -	Open Camp Site	98369,98370,98371,98443,98739
	Contact	Recorders	Helen Brayshaw					Permits		
45-5-0337	Greenwood 1;Freeway No.5;	AGD	56	311800	6241530	Open site	Valid	Artefact : -	Open Camp Site	260,824,1018,2132
	Contact	Recorders	P Cain,Ms.Laila Haglund					Permits	285,337	
45-5-0971	WGO3-2	AGD	56	310430	6239900	Open site	Valid	Artefact : -	Open Camp Site	2826
	Contact	Recorders	Philip Boot					Permits		
45-5-0972	WGO3-1	AGD	56	310620	6239950	Open site	Valid	Artefact : -	Open Camp Site	2826
	Contact	Recorders	Philip Boot					Permits	702,905	
45-5-2344	Holsworthy IF 4;	AGD	56	311200	6240380	Open site	Valid	Artefact : -	Isolated Find	
	Contact	Recorders	Robynne Mills					Permits		
45-5-2345	Holsworthy IF 2,3;	AGD	56	311900	6240480	Open site	Valid	Artefact : -	Isolated Find	
	Contact	Recorders	Robynne Mills					Permits		
45-5-2346	Holsworthy IF 1;	AGD	56	311810	6240410	Open site	Valid	Artefact : -	Isolated Find	
	Contact	Recorders	Robynne Mills					Permits		
45-5-0844	Prestons 1;	AGD	56	303570	6243200	Open site	Valid	Artefact : -	Open Camp Site	2165,98369,98370,98371,98443,98739
	Contact	Recorders	Kerry Navin					Permits	311	

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AHIMS Web Services (AWS)

Extensive search - Site list report

Office of Environment & Heritage — NSW Government

Your Ref Number : MIMT
Client Service ID : 85420

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-6-2428	Glenfield S.T.	AGD	56	306200	6239600	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	
	Contact	Recorders	Anthony English					Permits		
45-5-0123	George's River:	AGD	56	307040	6236964	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	Contact	Recorders	R Etheridge					Permits		
45-5-0124	Harris Creek:	AGD	56	307040	6236964	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	Contact	Recorders	B Mclean					Permits		
45-5-2355	WGO 3-1; (duplicate copy 45-5-0972)	AGD	56	310620	6239950	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Philip Boot					Permits		
45-5-2369	WGO3-2;(REFER TO 45-5-0971)	AGD	56	310430	6239900	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Philip Boot					Permits		
45-5-2376	P-CP10	AGD	56	303640	6241560	Open site	Valid	Artefact : -	Open Camp Site	3726,98369,98370,98371,98443,98739
	Contact	Recorders	Helen Brayshaw,Elizabeth Rich					Permits	1564	
45-5-0720	Kiawaka 3	AGD	56	305980	6240600	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	1360
	Contact	Recorders	Mary Dallas Consulting Archaeologists					Permits	264	
45-5-0721	Kiawaka 4	AGD	56	306000	6240660	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	1360
	Contact	Recorders	Mary Dallas Consulting Archaeologists					Permits		
45-5-0722	Kiawaka 5	AGD	56	306300	6240340	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	1360
	Contact	Recorders	Mary Dallas Consulting Archaeologists					Permits	2521	
45-5-0723	Kiawaka 2	AGD	56	306250	6240150	Open site	Valid	Artefact : -	Open Camp Site	1360
	Contact	Recorders	Mary Dallas Consulting Archaeologists					Permits		
45-5-0724	Kiawaka 1	AGD	56	305950	6240270	Open site	Valid	Artefact : -	Open Camp Site	1360
	Contact	Recorders	Mary Dallas Consulting Archaeologists					Permits		
45-5-0837	Toll Plaza Site 1;TPS 1;	AGD	56	311900	6241580	Open site	Valid	Artefact : -	Open Camp Site	2132
	Contact	Recorders	F Cain					Permits		

Report generated by AHIMS Web Service on 15/11/2012 for Rebecca Parkes for the following area at Datum :GDA, Zone : 56, Eastings : 303000 - 312000, Northings : 6236000 - 6246000 with a Buffer of 50 meters.Additional Info : Background information for cultural heritage assessment. Number of Aboriginal sites and Aboriginal objects found is 80

Office of Environment & Heritage

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : MIMT
Client Service ID : 85420

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-5-0778	MC-1 (Maxwells Creek)	AGD	56	304040	6242410	Open site	Valid	Artefact : -	Open Camp Site	1727,97544
	Contact	Recorders	Alice Gorman,Laura-Jane Smith					Permits	1025	
45-5-0779	MC-2 (Maxwells Creek)	AGD	56	303870	6242530	Open site	Valid	Artefact : -	Open Camp Site	1727,98369,98370,98371,98443,98739
	Contact	Recorders	Alice Gorman,Laura-Jane Smith					Permits		
45-5-0780	MC-3 (Maxwells Creek)	AGD	56	303350	6239250	Open site	Valid	Artefact : -	Open Camp Site	1727,98369,98370,98371,98443,98739
	Contact	Recorders	Alice Gorman,Laura-Jane Smith					Permits		
45-5-0781	MC-4 (Maxwells Creek)	AGD	56	303400	6239350	Open site	Valid	Artefact : -	Open Camp Site	1727,98369,98370,98371,98443,98739
	Contact	Recorders	Alice Gorman,Laura-Jane Smith					Permits		
45-5-0782	MC-5 (Maxwells Creek)	AGD	56	303530	6239640	Open site	Valid	Artefact : -	Open Camp Site	1727,98369,98370,98371,98443,98739
	Contact	Recorders	Alice Gorman,Laura-Jane Smith					Permits		
45-5-0783	MC-6;	AGD	56	303400	6239550	Open site	Valid	Artefact : -	Open Camp Site	1727,98369,98370,98371,98443,98739
	Contact	Recorders	Alice Gorman,Laura-Jane Smith					Permits		
45-5-0784	MC-7;	AGD	56	302900	6239240	Open site	Valid	Artefact : -	Open Camp Site	1727,98369,98370,98371,98443,98739
	Contact	Recorders	Alice Gorman,Laura-Jane Smith					Permits		
45-5-0785	MC-8;	AGD	56	303710	6240550	Open site	Valid	Artefact : -	Open Camp Site	1727,98369,98370,98371,98443,98739
	Contact	Recorders	Alice Gorman,Laura-Jane Smith					Permits		
45-5-0001	Macquarie Fields;Three Hand Alcove;	AGD	56	306685	6236409	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	1976
	Contact	Recorders	ASRSYS					Permits		
45-5-2725	PAD-OS-1	AGD	56	303720	6241200	Open site	Valid	Artefact : -		98369,98370,98371,98443,98739
	Contact	Recorders	Robynne Mills					Permits	1396	
45-5-2744	MLE1	AGD	56	303500	6238550	Open site	Valid	Artefact : -		98739

Report generated by AHIMS Web Service on 15/11/2012 for Rebecca Parkes for the following area at Datum :GDA, Zone : 56, Eastings : 303000 - 312000, Northings : 6236000 - 6246000 with a Buffer of 50 meters.Additional Info : Background information for cultural heritage assessment. Number of Aboriginal sites and Aboriginal objects found is 80

AHIMS Web Services (AWS)

Extensive search - Site list report

Office of Environment & Heritage — NSW Government

Your Ref Number : MIMT
Client Service ID : 85420

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
	Contact	Recorders	Dominic Steele Archaeological Consulting					Permits	1999	
45-5-2800	MC9	AGD	56	303760	6241880	Open site	Valid	Art (Pigment or Engraved) : -		98369,98370,98371,98443,98739
	Contact	Recorders	Mr.Neville Baker					Permits		
45-5-2709	P-CP16	AGD	56	303900	6241890	Open site	Valid	Artefact : -		3726,98369,98370,98371,98443,98739
	Contact	Recorders	Helen Brayshaw,Ms.Elizabeth White					Permits	1637	
45-5-2761	P-CP15	AGD	56	303750	6241690	Open site	Valid	Artefact : -		3726,98369,98370,98371,98443,98739
	Contact	Recorders	Helen Brayshaw,Ms.Elizabeth White					Permits	1398	
45-5-2853	PAD 6 WSO	AGD	56	303510	6240920	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders	Helen Brayshaw					Permits	1638	
45-5-2883	MB.1	AGD	56	308700	6241700	Open site	Valid	Artefact : -		
	Contact	Recorders	Mary Dallas Consulting Archaeologists					Permits		
45-5-2912	Brickmakers Creek	AGD	56	307950	6245250	Open site	Destroyed	Artefact : 8		
	Contact	Recorders	Michael Guider					Permits		
45-5-2875	PAD 6 Open Campsite	AGD	56	303610	6240840	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders	Central West Archaeological and Heritage Services Pty Ltd					Permits	1737	
45-5-2919	H667	AGD	56	306990	6237370	Open site	Valid	Artefact : -		
	Contact	Recorders						Permits		
45-5-2934	H414	AGD	56	307600	6237325	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders	Navin Officer Heritage Consultants Pty Ltd					Permits		
45-5-2935	H413	AGD	56	308500	6235975	Open site	Valid	Grinding Groove : -		
	Contact	Recorders	Navin Officer Heritage Consultants Pty Ltd					Permits		
52-2-2324	H304	AGD	56	307050	6235850	Open site	Valid	Art (Pigment or Engraved) : -, Artefact : -		
	Contact	Recorders	Navin Officer Heritage Consultants Pty Ltd					Permits		

Report generated by AHIMS Web Service on 15/11/2012 for Rebecca Parkes for the following area at Datum :GDA, Zone : 56, Eastings : 303000 - 312000, Northings : 6236000 - 6246000 with a Buffer of 50 meters.Additional Info : Background information for cultural heritage assessment. Number of Aboriginal sites and Aboriginal objects found is 80

AHIMS Web Services (AWS)

Extensive search - Site list report

Office of Environment & Heritage, NSW

Your Ref Number : MIMT

Client Service ID : 85420

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-5-2931	H581	AGD	56	306850	6237490	Open site	Valid	Artefact : -		
	Contact	Recorders	Navin Officer Heritage Consultants Pty Ltd					Permits		
45-5-2957	799	AGD	56	308500	6236240	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders						Permits		
45-5-2963	Site H928	AGD	56	306840	6237510	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Bobbie Oakley					Permits		
45-5-2968	Site H1025	AGD	56	307280	6237500	Open site	Valid	Artefact : -		
	Contact	Recorders	Navin Officer Heritage Consultants Pty Ltd					Permits		
45-5-2946	H363	AGD	56	307050	6237560	Open site	Valid	Artefact : -		
	Contact	Recorders						Permits		
45-5-2947	H362	AGD	56	307130	6238300	Open site	Valid	Artefact : -		
	Contact	Recorders						Permits		
45-5-2915	H684	AGD	56	311600	6236050	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders	Navin Officer Heritage Consultants Pty Ltd					Permits		
45-5-2916	H683	AGD	56	311650	6236820	Open site	Valid	Potential Archaeological Deposit (PAD) : -, Grinding Groove : -		
	Contact	Recorders	Navin Officer Heritage Consultants Pty Ltd					Permits		
45-5-2914	H820	AGD	56	308510	6236650	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Kelvin Officer,Navin Officer Heritage Consultants Pty Ltd					Permits		
45-5-2964	Site H970	AGD	56	307130	6236550	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders	Bobbie Oakley					Permits		
45-5-2969	Site H1029	AGD	56	308200	6236700	Open site	Valid	Grinding Groove : -		
	Contact	Recorders	Navin Officer Heritage Consultants Pty Ltd					Permits		
45-5-2480	Maxwells Creek 12 (MC12)	AGD	56	303700	6241700	Open site	Valid	Artefact : -	Open Camp Site	98369,98370,98371,98443,98739
	Contact	Recorders	Ms.Elizabeth White					Permits		

Report generated by AHIMS Web Service on 15/11/2012 for Rebecca Parkes for the following area at Datum :GDA, Zone : 56, Eastings : 303000 - 312000, Northings : 6236000 - 6246000 with a Buffer of 50 meters.Additional Info : Background information for cultural heritage assessment. Number of Aboriginal sites and Aboriginal objects found is 80

Office of Environment & Heritage

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : MIMT
Client Service ID : 85420

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-5-0889	WG 4 (Wattle Grove)	AGD	56	309130	6240170	Open site	Valid	Artefact : -	Open Camp Site	2474
	Contact	**Recorders**	Philip Boot					**Permits**	465	
45-5-0794	Holsworthy (H) 2;	AGD	56	309550	6240200	Open site	Valid	Artefact : -	Open Camp Site	1934
	Contact	**Recorders**	Philip Boot					**Permits**	456	
45-5-3531	Glenfield 1	GDA	56	306252	6239702	Open site	Valid	Artefact : 1		
	Contact	**Recorders**	Australian Museum Business Services (AMBS)					**Permits**		
45-5-0795	Holsworthy (H) 1;	AGD	56	309300	6240120	Open site	Valid	Artefact : -	Open Camp Site	1934
	Contact	**Recorders**	Philip Boot					**Permits**	456	
45-5-3639	BC1 (Liverpool)	GDA	56	305214	6237770	Open site	Valid	Artefact : 1		101368
	Contact	**Recorders**	Mr.Oliver Brown					**Permits**		
45-5-3629	Collingwood Park (CW 1)	GDA	56	307600	6243160	Open site	Valid	Artefact : -, Potential Archaeological Deposit (PAD) : -		101316
	Contact	**Recorders**	Mr.Oliver Brown					**Permits**	3184	
45-5-0257	Liverpool Chipping Norton	AGD	56	310540	6245081	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	260,1018
	Contact	**Recorders**	David Bell					**Permits**		

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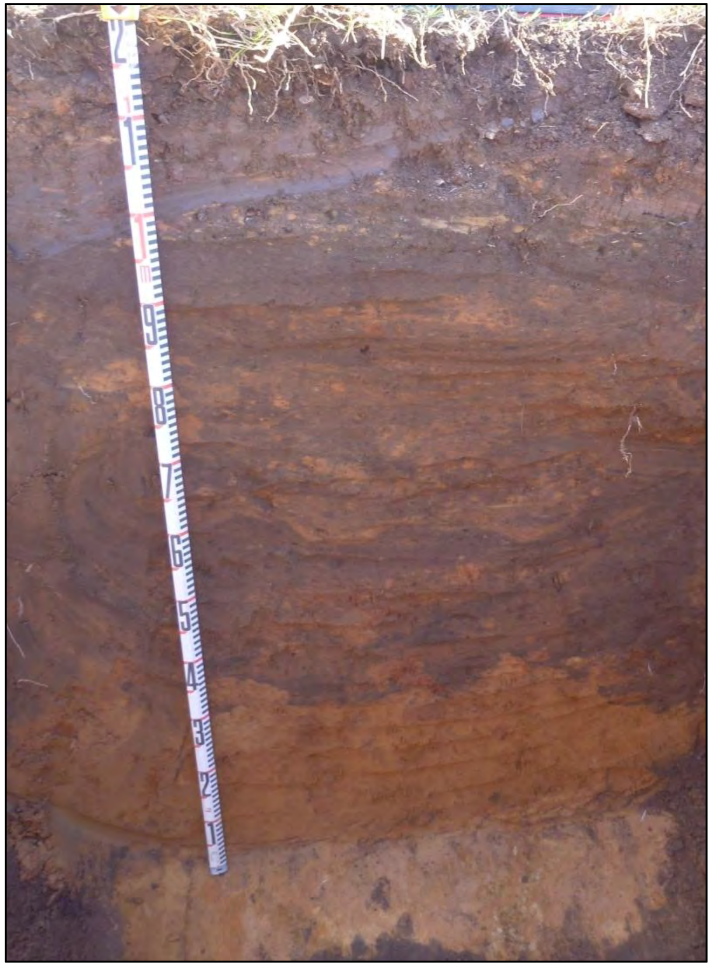
APPENDIX 6

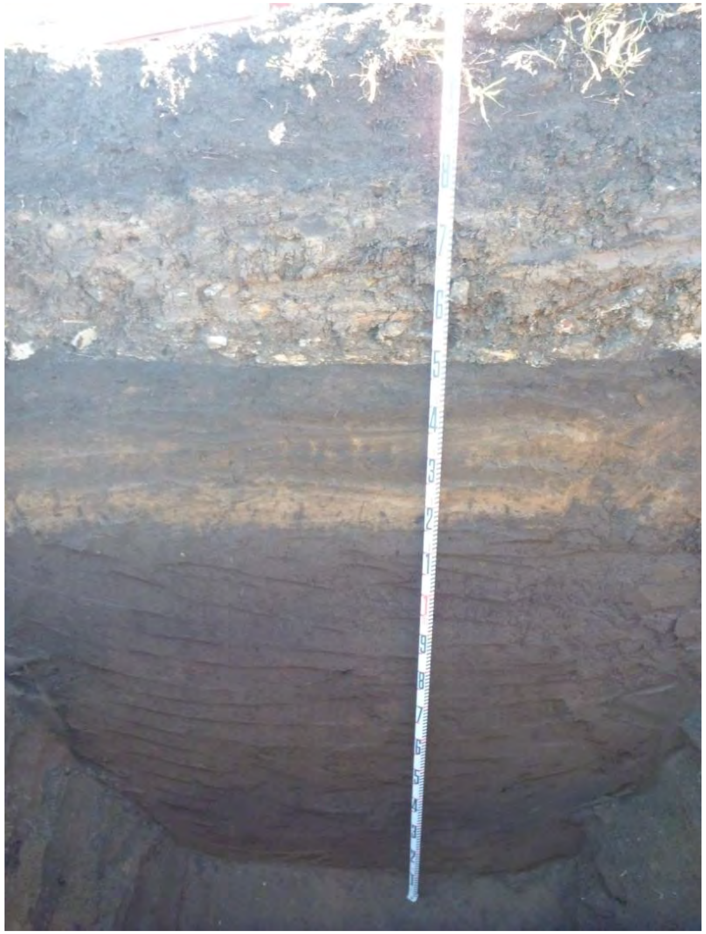
PIT DESCRIPTIONS

Test Pit 1: GDA Zone 56 – 307222 E 6241626 N	Spit	Depth (cm)	Description
	1	6	Brown clayey loam with grass rootlets
	2	8	Compacted orange brown clay fill with large angular gravels
	3	18	Continuation of compacted orange brown clay fill with large angular gravels and brown loam intermixed
	4	31	Continuation of fill down, sharp transition to soft dark brown sand at 28 cm, some modern rubbish visible in southeast corner.
	5	42	Mottled brown and orange brown sand.
	6	54	As above.
	7	64	Soft orange sand, mottled with brown, occasional orange concretions and charcoal pieces.
	8	73	Grading to orange clayey sand with dark brown sand mottles, increasing orange clayey concretions
	9	84	As above with increasing clay content
	10	95	As above
	11	105	Grades to orange yellow clayey sand with broad mottling of dark brown sand
	12	117	Grades to orange sandy clay in west, but pocket of introduced ballast/road base across eastern half of pit. Disturbed location
West wall of Test Pit 1 following excavation of Spit 12			

Test Pit 2: GDA Zone 56 – 307235 E 6241643 N	Spit	Depth (cm)	Description
	1	10	black brown clay loam with fill - large angular gravels
	2	21	compacted clayey fill with sandstone gravels
	3	35	as above
	4	50	sharp transition to dark brown sand with mixed gravels and occasional clay nodules - fill?
	5	60	continuation of orange brown sand with gravels and clay nodules, appears to still be fill
	6	71	sharp transition at 62-65cm to clean orange sand - natural?
	7	85	continuation of clean coarse orange brown sand
	8	95	as above
	9	105	as above
	10	115	as above
	11	127	as above
	12	140	grades to dark brown stained sand
	13	155	continuation of grey brown sand
	14	166	as above
	15	185	continuation of same - limit of safe excavation without extensive benching - end of pit
Montage of east wall of Test Pit 2: Spits 1-15			

Test Pit 3: GDA Zone 56 – 307259 E 6241665 N	Spit	Depth (cm)	Description
	1	10	dark brown loam with orange sand and clay mixed through - fill
	2	20	mixed brown sand and loam fill with clay and sandstone nodules
	3	30	as above
	4	40	60cm diameter pocket of clay fill extends across west half, starts about 25cm down
	-	-	clay fill and building rubble continuing beyond 100cm - too disturbed, abandoned

Test Pit 4: GDA Zone 56 – 307262 E 6241688 N	Spit	Depth (cm)	Description
	1	10	dark brown loam with cream sand and clay mixed through - fill
	2	20	mixed brown sand and loam fill with clay and sandstone nodules
	3	30	as above
	4	40	as above with clear transition to yellow brown sand at base
	5	50	mixed fill, black brown silty loam coming through at base - old ground surface ?
	6	60	black brown silty loam with organic material - grass - old A horizon?
	7	70	continuation of dark brown silty sand with orange brown mottling from bioturbation
	8	80	continuation of yellow brown sand, grades back to dark brown silty sand at 75cm
	9	90	continuation of dark brown sandy silt
	10	100	grades to clean yellow brown sand
	11	120	clean yellow brown sand
	12	130	as above
	13	135	grades to dark grey brown clayey sand
	14	150	yellow brown sand grading quickly back to grey brown at base
	15	160	dark grey brown sand grades to dark brown clayey sand
	16	170	continuation of dark brown clayey sandy silt, increasing clay with depth - end of pit - limits of safe works
East wall of Test Pit 4 following excavation of Spit 16			

Test Pit 5: GDA Zone 56 – 307273 E 6241708 N	Spit	Depth (cm)	Description
	1	10	brown clayey loam
	2	20	as above with some clay fill intermixed
	3	30	mixed clay fill
	4	40	sharp transition to black brown silty loam at 32cm
	5	50	continuation of black brown silty loam
	6	60	dark brown silty sand grading to orange brown sand
	7	70	continuation of yellow/orange brown sand with dark brown mottling
	8	80	grades to dark brown sandy silt with occasional charcoal pieces
	9	90	continuation of dark brown sandy silt
	10	100	as above with occasional charcoal pieces and clay nodules
	11	110	as above with pocket of charcoal in centre, 10cm diameter - burnt tree/branch?
	12	120	as above, charcoal more diffuse, yellow brown sand coming through at base - end of pit - limit of machine and safe works
	13	130	grades to brown silty sand with occasional yellow brown mottling and occasional charcoal
	14	140	continuation of brown silty sand with occasional yellow brown mottling and occasional charcoal
	15	155	as above
	16	165	as above
	17	175	as above - becoming paler with depth - end of pit - at limit of safe works
East wall of Test Pit 5 following excavation of Spit 17			

Test Pit 6: GDA Zone 56 – 307289 E 6241735 N	Spit	Depth (cm)	Description
	1	135	dark brown silty sand with numerous tree roots, <50mm in diameter
	2	145	continuation of dark brown silty sand, decreasing tree roots
	3	156	as above, no tree roots
	4	165	as above with occasional charcoal
	5	175	as above with occasional rootlets
	6	185	continuation of fine brown silty sand
	7	195	as above
	8	205	as above
	9	215	Grades to dark brown silty sand
	10	225	continuation of dark brown silty sand
	11	235	as above
	12	245	as above with increasing compaction - end of pit - limit of machine and safe works
East wall of Test Pit 6 following excavation of Spit 12			

cut down 10cm to natural, below mixed clay fill. all measurements are from start of natural

Test Pit 7: GDA Zone 56 – 307303 E 6241752 N	**Spit**	**Depth (cm)**	**Description**
	1	10	grey brown silty sand
	2	20	grey brown silty sand with slight mottling of dark brown at base
	3	30	Dark brown silty sand
	4	40	grades to yellow brown sand
	5	50	mottled brown and black brown silty sand
	6	60	grading to yellow brown sand
	7	70	clean yellow brown sand, coarse
	8	80	as above
	9	90	as above, becoming paler with depth, mottling of dark brown at base
	10	100	coarse brown sand - clean
	11	110	clean brown sand
	12	120	dark brown sand
	13	130	dark brown silty sand with rootlets, grading to black brown clayey sand - end of pit - limit of safe works
West wall of Test Pit 7 following excavation of Spit 13			

Cut down 100cm through fill – Spit 1 begins at 100cm

Test Pit 8: GDA Zone 56 – 307311 E 6241776 N	Spit	Depth (cm)	Description
	1	110	coarse brown sand grading to black brown silty sand with charcoal at base
	2	120	black brown silty sand with occasional charcoal
	3	130	as above with occasional tree roots, <50mm diameter
	4	140	compacted black brown silt
	5	150	increasingly compact brown silt with numerous charcoal flecks
	6	165	compacted fine brown silt with occasional charcoal
	7	175	as above, tree roots coming through at base
	8	180	fine brown silt with occasional charcoal, decreasing compaction
	9	190	as above
	10	200	as above with increasing charcoal flecks
	11	210	as above
	12	220	as above - end of pit - limit of machine and safe works
East wall of Test Pit 8 following excavation of Spit 12			

Test Pit 9: GDA Zone 56 – 307329 E 6241796 N	Spit	Depth (cm)	Description
	1	10	brown silty sandy loam
	2	20	as above
	3	30	grading to dark brown
	4	40	fine black brown silty sand
	5	50	mottled brown and black brown silty sand
	6	60	as above
	7	70	mottled yellow brown and black brown sand
	8	80	as above
	9	90	coarse yellow brown sand with sharp transition to brown sand at base
	10	100	coarse brown sand
	11	110	coarse brown sand
	12	120	coarse brown sand
East wall of Test Pit 9 following excavation of Spit 12			

machine removed 10cm of clay fill - pit measurements from beginning of natural

Test Pit 10: GDA Zone 56 – 307340 E 6241814 N	**Spit**	**Depth (cm)**	**Description**
	1	10	black brown silty sandy loam with grass rootlets, mottled yellow brown sand coming through at base
	2	20	mottled yellow brown and brown sand with charcoal flecks
	3	30	as above
	4	40	as above
	5	50	dark brown silty sand mottled with yellow brown sand, grading to yellow brown sand
	6	60	mottled yellow brown and brown sand
	7	70	grading to dark brown silty sand, *3cm band of large gravels at 65cm*
	8	80	coarse yellow brown sand
	9	90	as above, grading to dark brown silty sand
	10	100	grading back to yellow brown sand
	11	110	grading to dark brown silty sand
	12	120	continuation of dark brown silty sand
West wall of Test Pit 10 following excavation of Spit 12			

machine cut down 20cm through clay fill cap - all spit measurements from beginning of natural

Test Pit 11: GDA Zone 56 – 307354 E 6241839 N	**Spit**	**Depth (cm)**	**Description**
	1	10	dark grey brown silty sandy loam
	2	20	grades to brown silty sand
	3	30	grading to yellow brown sand mottled with dark brown silty sand
	4	40	mottled yellow brown and dark brown silty sand, tending to yellow brown sand - occasional charcoal flecks; few fragments of red sand stock bricks
	5	50	grading to yellow brown sand with charcoal staining
	6	60	grading to paler yellow brown sand with some brown mottling and charcoal staining
	7	70	mottled yellow brown sand, grades to dark brown silty sand mottled with yellow brown, charcoal throughout – **Early 20th C brass bullet shell**
	8	80	grades to pale yellow brown sand, decreasing charcoal
	9	90	dark brown silty sand
	10	100	grading to dark brown sand
	11	110	yellow brown sand
	12	120	coarse yellow brown sand with occasional *subangular to subrounded gravels*
West wall of Test Pit 11 following excavation of Spit 12			

Test Pit 12: GDA Zone 56 – 307367 E 6241851 N	Spit	Depth (cm)	Description
	1	10	stripped back 1cm of grass and started excavation, dark grey brown silty sandy loam, mottled yellow brown and brown sand coming through at base
	2	20	grades to yellow brown silty sand
	3	30	clean brown to yellow brown sand, tending to yellow brown at base
	4	40	as above
	5	50	yellow brown sand with patches of darker brown sand coming through at base
	6	60	yellow brown sand, darker brown staining and charcoal coming through at base
	7	70	yellow brown sand
	8	80	grading to darker brown sand
	9	90	continuation of dark brown sand
	10	100	as above
	11	110	as above
	12	120	as above limit of safe works
West wall of Test Pit 12 following excavation of Spit 12			

Test Pit 13: GDA Zone 56 – 307384 E 6241878 N	Spit	Depth (cm)	Description
	1	10	stripped back turf - 1cm - natural soil at surface - dark grey brown silty sandy loam, mottling of yellow brown sand coming through at base
	2	20	yellow brown sand mottled with dark brown silty sand
	3	30	grades to yellow brown sand
	4	40	yellow brown sand, dark grey brown silty sand and charcoal starting to come through at base
	5	50	Mottled brown and yellow brown sand
	6	60	brown silty sand, clear transition to yellow brown sand at base, occasional charcoal pieces in the yellow brown sand
	7	70	yellow brown sand, occasional rounded and sub-rounded gravels and charcoal staining
	8	80	dark brown sand
	9	90	grading to yellow brown sand
	10	100	continuation of yellow brown sand
	11	110	grades to uniform brown sand
	12	120	continuation of brown sand limit of safe works
West wall of Test Pit 13 following excavation of Spit 12			

Test Pit 14: GDA Zone 56 – 307410 E 6241896 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back - dark grey brown silty sandy loam, mottling of yellow brown sand coming through at base
	2	20	grades to yellow brown sand
	3	30	continuation of brown to yellow brown sand – **glass fragment: Second half of 19th C**
	4	40	as above
	5	50	as above
	6	60	as above
	7	70	as above
	8	80	continuation of clean brown sand
	9	90	as above
	10	100	as above
	11	110	as above
	12	120	as above end of pit - limit of safe works
West wall of Test Pit 14 following excavation of Spit 12			

Test Pit 15: GDA Zone 56 – 307416 E 6241913 N	Spit	Depth (cm)	Description
	1	10	2cm of grass stripped back - dark grey brown silty sandy loam, mottling of yellow brown sand coming through at base
	2	20	grades to yellow brown sand
	3	30	Thin and somewhat indistinct band of brown silty sand from 21-24cm, then continuation of clean yellow brown sand
	4	40	clean yellow brown sand
	5	50	above with distinct mottling of black and dark brown coming through at base
	6	60	black brown silty sand, grades quickly to yellow brown sand at about 54cm, mottling of dark brown silty sand coming through again at base
	7	70	yellow brown sand
	8	80	continuation of clean yellow brown sand
	9	90	as above
	10	100	coarse yellow brown to brown sand, tends to brown sand
	11	110	continuation of same coarse brown sand
	12	120	as above end of pit - limit of safe works
West wall of Test Pit 15 following excavation of Spit 12			

Test Pit 16: GDA Zone 56 – 307445 E 6241943 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back to natural soil at surface, dark grey brown silty sandy loam, clear transition to yellow brown sand at 5-6cm
	2	20	continuation of yellow brown sand with intermittent mottling/staining of dark brown
	3	30	continuation of yellow brown sand, clear transition to dark grey brown silty sand at 25-28cm
	4	40	clear transition back to yellow brown sand at approximately 31-33cm, darker brown silty sand mottling coming through second half of spit
	5	50	grades quickly to brown sand at 43-46cm
	6	60	quickly grades back to yellow brown sand at 51-54cm
	7	70	continuation of yellow brown sand, broad mottling of brown at base
	8	80	continuation of coarse clean yellow brown sand
	9	90	continuation of yellow brown sand
	10	100	coarse yellow brown to brown sand
	11	110	as above
	12	120	as above end of pit - limit of safe works
West wall of Test Pit 16 following excavation of Spit 12			

Test Pit 17: GDA Zone 56 – 307441 E 6241954 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back to natural soil at surface, dark brown silty sandy loam with grass rootlets, grading to yellow brown at base
	2	20	dark yellow brown silty sand with mottling of yellow brown sand and intermittent charcoal, mottling of yellow brown and brown sand at base
	3	30	grades quickly to dark brown silty sand
	4	40	continuation of dark brown silty sand, mottling of yellow brown at base
	5	50	Yellow brown sand
	6	60	as above
	7	70	as above
	8	80	clear transition to dark brown silty sand at 72cm, yellow brown sand starting to come through at base
	9	90	dark brown silty sand with mottling of yellow brown sand and intermittent charcoal - **piece of glazed stoneware: mid 19th C**
	10	100	dark brown sandy silt-silty sand
	11	110	compacted black brown sandy silt with increasing compaction, black brown clayey sand coming through at base
	12	120	fine black brown clayey silt, variable compaction end of pit - limit of safe works
West wall of Test Pit 17 following excavation of Spit 12			

Test Pit 18: GDA Zone 56 – 307460 E 6241964 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back to natural soil at surface, dark brown silty sandy loam with grass rootlets, grading to yellow brown at base, increasing sand content with depth
	2	20	yellow brown sand mottled with dark brown silty sand, grades quickly to dark brown silty sand
	3	30	dark brown silty sand to about 22-23cm, grades quickly to yellow brown sand then back to dark brown silty sand at base
	4	40	yellow brown sand
	5	50	continuation of coarse yellow brown sand
	6	60	as above, grading to brown sand at 55cm
	7	70	dark brown silty sand/sandy silt
	8	80	compacted black brown sandy silt with increasing compaction, occasional tree roots piece of flaked black glass
	9	90	continuation of black brown silt, tree roots continue at southern end
	10	100	as above
	11	110	as above
	12	120	as above end of pit - limit of safe works
West wall of Test Pit 18 following excavation of Spit 12			

irrigation pipe in west end in Spit 2, shifted pit 60cm east - Silt at <7.4 AHD

Test Pit 19: GDA Zone 56 – 307477 E 6241987 N	**Spit**	**Depth (cm)**	**Description**
	1	10	2cm of grass stripped back to natural soil at surface -,dark brown silty sandy loam with grass rootlets, grading to yellow brown at base, increasing sand content with depth, faint mottling of yellow brown at base
	2	20	yellow brown sand mottled with dark brown silty sand, grades quickly to dark brown silty sand at base
	3	30	yellow brown sand
	4	40	yellow brown sand with distinct band of black brown silty sand from c.35-38m across eastern half
	5	50	coarse yellow brown sand
	6	60	as above with clear transition to dark brown silty sand at base
	7	70	compacted black brown silty sand, clear transition to yellow brown sand with occasional brown mottling at about 67-68cm
	8	80	clean coarse yellow brown sand
	9	90	as above
	10	100	as above
	11	110	as above
	12	120	as above end of pit - limit of safe works
North wall of Test Pit 19 following excavation of Spit 12			

shifted pit 20cm south due to presence of water pipe in northwest corner at spit 2

Test Pit 20: GDA Zone 56 – 307499 E 6241990 N	**Spit**	**Depth (cm)**	**Description**
	1	10	2cm of grass stripped back to natural soil at surface, dark brown silty sandy loam with grass rootlets, piece of brick in centre continues into spit 2 – **glass fragment: Second half of 19th C**
	2	20	dark brown silty sand, poly pipe in northwest corner, shifted pit 20cm south
	3	30	as above with numerous fragments of red brick, below the bricks (25cm) grades quickly to yellow brown sand
	4	40	continuation of yellow brown sand
	5	50	coarse yellow brown sand
	6	60	mottled yellow brown sand and brown silty sand - insect bioturbation?
	7	70	10cm band of dark brown silty sand
	8	80	yellow brown sand
	9	90	at 85cm clear transition to dark brown silty sand with numerous charcoal pieces
	10	100	continuation of black brown sandy silt
	11	110	as above, intermittent charcoal
	12	120	continuation of same, tending to black brown clayey silt at base end of pit - limit of safe works
West wall of Test Pit 20 following excavation of Spit 12			

Test Pit 21: GDA Zone 56 – 307506 E 6241963 N	Spit	Depth (cm)	Description
	1	10	2cm of grass stripped back to natural soil at surface, dark brown silty sandy loam
	2	20	dark brown silty sand, numerous charcoal pieces and charcoal staining at base
	3	30	dark brown silty sand, mottling of yellow brown at base – **wire nail, handmade brick: Second half of 19th C**
	4	40	grades back to yellow brown sand
	5	50	continuation of yellow brown sand, mottling of dark brown silty sand at base
	6	60	black brown sandy silt
	7	70	continuation of black brown sandy silt – **glass fragment: Second half of 19th C**
	8	80	black brown sandy silt
	9	90	as above with occasional tree roots at base, <50mm in diameter
	10	100	black brown sandy silt
	11	110	as above
	12	120	as above, increasing compaction end of pit - limit of safe works
North wall of Test Pit 21 following excavation of Spit 12			

Test Pit 22: GDA Zone 56 – 307465 E 6242012 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back to natural soil at surface, dark brown silty sandy loam with mottling of yellow brown sand at eastern end of pit
	2	20	grades quickly to yellow brown sand at 9-12cm
	3	30	continuation of yellow brown sand with mottling of dark brown from insect burrows
	4	40	continuation of yellow brown sand
	5	50	as above
	6	60	as above, mottling of dark brown silty sand begins at 57-58cm tree root across eastern end of pit at base of spit
	7	70	grades to dark brown silty sand with numerous charcoal pieces
	8	80	black brown sandy silt with clear transition to yellow brown sand at base with intermittent brown mottling - insect bioturbation?
	9	90	coarse yellow brown sand, faint mottling of darker brown coming through at base
	10	100	continuation of yellow brown sand
	11	110	as above
	12	120	as above with intermittent charcoal pieces end of pit - limit of safe works
North wall of Test Pit 22 following excavation of Spit 12			

Test Pit 23: GDA Zone 56 – 307516 E 6242035 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back to natural soil at surface, dark brown silty sandy loam with mottling of yellow brown sand at eastern end of pit
	2	20	grades quickly to yellow brown sand at 9-12cm
	3	30	continuation of yellow brown sand with mottling of dark brown from insect burrows
	4	40	dark brown silty sand grades quickly to yellow brown sand at 35 cm
	5	50	coarse yellow brown sand
	6	60	as above
	7	70	as above
	8	80	as above, faint mottling of brown sand at base
	9	90	coarse clean yellow brown sand, becoming slightly paler with depth
	10	100	as above
	11	110	as above - loose coarse clean yellow brown sand
	12	120	as above with intermittent charcoal pieces end of pit - limit of safe works
West wall of Test Pit 23 following excavation of Spit 12			

Test Pit 24: GDA Zone 56 – 307535 E 6242054 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back to natural soil at surface, dark brown silty sandy loam with grass rootlets
	2	20	dark brown silty sandy loam with occasional mottling of yellow brown sand, mottling of yellow brown and dark brown silty sand at base
	3	30	grades to mottled yellow brown sand, mottling decreasing with depth
	4	40	continuation of yellow brown sand
	5	50	as above
	6	60	continuation of coarse yellow brown sand
	7	70	as above
	8	80	coarse brown sand
	9	90	as above, mottling of dark brown silty sand at base
	10	100	grades quickly to black brown silty sand
	11	110	black brown sandy silt, mottling of yellow brown sand
	12	120	yellow brown sand end of pit - limit of safe works
West wall of Test Pit 24 following excavation of Spit 12			

Test Pit 25: GDA Zone 56 – 307550 E 6242068 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back to natural soil at surface, dark grey brown silty sandy loam with grass rootlets – **Porcelain insulator: mid 20th C**
	2	20	grades to brown sand, decreasing roots
	3	30	continuation of brown sand
	4	40	as above
	5	50	as above, slight mottling of yellow brown at base
	6	60	mottled yellow brown sand and dark brown sand, linear feature (10cm wide) across northwest corner at base of spit
	7	70	mottled yellow brown sand and dark brown sand
	8	80	as above with dark brown silty sand coming through at base in northeast corner
	9	90	clear transition to black brown sandy silt at or just below 90cm, mottling of brown sand at base
	10	100	coarse brown sand
	11	110	as above
	12	120	as above with increasing fine charcoal pieces end of pit - limit of safe works
West wall of Test Pit 25 following excavation of Spit 12			

Test Pit 26: GDA Zone 56 – 307570 E 6242090 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back to natural soil at surface, dark grey brown silty sandy loam with grass rootlets
	2	20	grades to brown sand, decreasing roots
	3	30	coarse brown sand
	4	40	as above
	5	50	grades to brown sand with dark brown silty sand mottling
	6	60	black brown sandy silt, mottling of brown sand coming through at base
	7	70	coarse brown sand
	8	80	as above
	9	90	as above with clear transition to dark brown sandy silt at 88-90cm
	10	100	grades quickly to brown sand at base
	11	110	coarse brown sand
	12	120	as above end of pit - limit of safe works
West wall of Test Pit 26 following excavation of Spit 12			

Test Pit 27: GDA Zone 56 – 307587 E 6242111 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back to natural soil at surface, dark grey brown silty sandy loam with grass rootlets
	2	20	grades quickly to brown sand, decreasing roots
	3	30	continuation of coarse brown sand
	4	40	as above, mottling of dark brown at base
	5	50	grades quickly to black brown silty sand mottled with yellow brown, intermittent charcoal throughout piece of slate - nineteenth century roofing or writing piece?
	6	60	grades quickly to black brown sandy silt
	7	70	black brown sandy silt mottled with brown sand, mottling of yellow brown sand coming through at base
	8	80	coarse brown to yellow brown sand
	9	90	continuation of coarse brown sand
	10	100	as above
	11	110	coarse brown sand, becoming slightly paler and coarser
	12	120	continuation of coarse brown sand end of pit - limit of safe works
West wall of Test Pit 27 following excavation of Spit 12			

40cm of clay fill removed by machine - all measurements taken from beginning of natural

Test Pit 28: GDA Zone 56 – 307606 E 6242098 N	Spit	Depth (cm)	Description
	1	10	dark brown silty sand, mottled with yellow brown sand
	2	20	continuation of brown sand
	3	30	as above with increasing charcoal pieces and staining
	4	40	grades to black brown sandy silt with increasing compaction
	5	50	continuation of black brown sandy silt, mottling of yellow brown sand coming through at base
	6	60	continuation of yellow brown sand, mottled with dark brown
	7	70	as above
	8	80	yellow brown sand with intermittent charcoal staining
	9	90	coarse brown sand, becoming slightly paler with depth, increasing charcoal
	10	100	90-95cm= dark brown sand with numerous charcoal pieces, at 94-96cm, grades back rapidly to paler brown sand
	11	110	continuation of coarse brown sand, clear transition to black brown sandy silt at 109/110cm
	12	120	black brown sandy silt end of pit - limit of safe works
North wall of Test Pit 28 following excavation of Spit 12			

Test Pit 29: GDA Zone 56 – 307564 E 6242123 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back to natural soil at surface, dark grey brown silty sandy loam
	2	20	grades to brown sand with intermittent charcoal staining
	3	30	20-25cm = black brown sandy silt, clear irregular transition to yellow brown sand at 25-28cm, intermittent charcoal pieces and staining at base
	4	40	yellow brown sand continues to about 33-34cm, clear transition back to compacted black brown sandy silt, clear transition to yellow brown sand at 38-39cm
	5	50	coarse yellow brown sand
	6	60	as above
	7	70	as above
	8	80	as above
	9	90	continuation of coarse brown sand, mottling of darker brown coming through at base – **corroded nail:**
	10	100	dark brown silty sand to about 92-93cm, clear transition back to coarse brown/yellow brown sand, then clear transition back to black brown sandy silt at about 96-98cm
	11	110	102-103cm, clear transition to yellow brown sand
	12	120	continuation of yellow brown sand with clear transition to compacted black brown sandy silt at 119/120cm end of pit - limit of safe works
North wall of Test Pit 29 following excavation of Spit 12			

65cm of clay fill removed by machine - spit 1 begins at 65cm, where natural begins – all measurements taken from beginning of natural

Test Pit 30: GDA Zone 56 – 307545 E 6242133 N	**Spit**	**Depth (cm)**	**Description**
	1	10	yellow brown sand - clear transition to compacted black brown sandy silt at 5cm
	2	20	compacted black brown clayey sandy silt
	3	30	as above, increasing compaction and increasing clay increasing compaction, very difficult to dig, no artefacts, reverted to mechanical excavation
	-	-	mud bucket on excavator refused, changed to toothed bucket to explore lower deposits – abandoned sampling due to use of toothed bucket and apparently sterile clayey deposit - continuation of black brown clayey silt to around 2 m, where it starts to grade back to brown sand pit abandoned, pending inspection by geomorphologist

Test Pit 31: GDA Zone 56 – 307523 E 6242145 N	Spit	Depth (cm)	Description
	1	10	2cm of grass stripped back to natural soil at surface, brown sandy loam with numerous grass roots
	2	20	grades to brown sand
	3	30	coarse brown silty sand
	4	40	as above, becoming sandier, mottling of dark brown and intermittent charcoal staining at base
	5	50	mottled yellow brown and brown sand
	6	60	continuation of yellow brown sand, mottled with dark brown
	7	70	as above
	8	80	as above
	9	90	yellow brown sand with black brown coming through at base in east end
	10	100	clear transition to black brown sandy silt at 90-100cm, deeper in west
	11	110	black brown sandy silt
	12	120	compacted black brown sandy silt end of pit - limit of safe works
North wall of Test Pit 31 following excavation of Spit 12			

Test Pit 32: GDA Zone 56 – 307592 E 6242137 N	Spit	Depth (cm)	Description
	1	10	dark brown silty sandy loam
	2	20	brown sand mottled with black brown sandy silt and charcoal staining, darker brown coming through at base
	3	30	at 25cm grades to mottled yellow brown sand and black brown sandy silt
	4	40	yellow brown sand with black brown mottling, black brown sandy silt dominant at base
	5	50	grades back to yellow brown sand, then black brown sandy silt coming through at base
	6	60	continuation of yellow brown sand, mottled with dark brown mottled yellow brown and black brown silty sand - fine bands/strata of both, black brown with intermittent mottling of yellow brown at base
	7	70	quickly grades back to yellow brown sand , then back to black brown sandy silt at base
	8	80	yellow brown sand with intermittent charcoal staining
	9	90	at 85-87cm there is a clear transition to dark brown silty sand
	10	100	continuation of dark brown silty sand
	11	110	as above
	12	120	as above with a tree root across the base, clear transition to black brown sandy silt at 118-120cm end of pit - limit of safe works
West wall of Test Pit 32 following excavation of Spit 12			

Test Pit 33: GDA Zone 56 – 307598 E 6242159 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back to natural soil at surface, dark brown silty sandy loam – **1982 one cent piece**
	2	20	grades to brown sand with intermittent charcoal staining
	3	30	grades quickly to black brown sandy silt
	4	40	continuation of black brown sandy silt, faint mottling of yellow brown at base
	5	50	grades to coarse yellow brown sand with occasional charcoal
	6	60	continuation of yellow brown sand
	7	70	as above
	8	80	yellow brown sand with intermittent dark brown mottling/laminates
	9	90	as above
	10	100	as above
	11	110	clear transition at 102-105cm to black brown sandy silt, yellow brown sand coming through again at base
	12	120	grades quickly to compacted black brown sandy silt end of pit - limit of safe works
West wall of Test Pit 33 following excavation of Spit 12			

<table>
<tr><th>Test Pit 34: GDA Zone 56 – 307602 E 6242186 N</th><th>Spit</th><th>Depth (cm)</th><th>Description</th></tr>
<tr><td rowspan="12"></td><td>1</td><td>10</td><td>2cm of grass stripped back to natural soil at surface, dark brown silty sandy loam with grass rootlets</td></tr>
<tr><td>2</td><td>20</td><td>mottling of yellow brown sand coming through from about 11cm</td></tr>
<tr><td>3</td><td>30</td><td>increasing yellow brown sand, intermittent charcoal flecks</td></tr>
<tr><td>4</td><td>40</td><td>grades to yellow brown sand with intermittent charcoal staining and mottling of dark brown, 20 cm wide pocket of charcoal at southern end</td></tr>
<tr><td>5</td><td>50</td><td>as above, increasing brown mottling and charcoal pieces, particularly across southern half</td></tr>
<tr><td>6</td><td>60</td><td>increasing yellow brown sand</td></tr>
<tr><td>7</td><td>70</td><td>band of dark brown sandy silt from 62-68cm, clear transition to yellow brown sand either side</td></tr>
<tr><td>8</td><td>80</td><td>yellow brown sand with clear transition to black brown sandy silt at 76-78cm</td></tr>
<tr><td>9</td><td>90</td><td>black brown sandy silt - silty sand with occasional tree roots - < 20mm</td></tr>
<tr><td>10</td><td>100</td><td>as above</td></tr>
<tr><td>11</td><td>110</td><td>as above, occasional charcoal pieces in northern end</td></tr>
<tr><td>12</td><td>120</td><td>as above, traces of brown sand coming through at base end of pit limit - limit of safe works</td></tr>
<tr><td>West wall of Test Pit 34 following excavation of Spit 12</td><td></td><td></td><td></td></tr>
</table>

Test Pit 35: GDA Zone 56 – 307611 E 6242208 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back to natural soil at surface, dark brown silty sandy loam with grass rootlets
	2	20	continuation of dark brown sandy silt with faint mottling of yellow brown sand, increasing with depth, occasional charcoal pieces
	3	30	as above
	4	40	mottled yellow brown and brown sand, increasing yellow brown sand
	5	50	yellow brown sand with mottling of dark brown silty sand and intermittent charcoal staining
	6	60	continuation of yellow brown sand
	7	70	yellow brown sand with clear transition to black brown sandy silt at 62-64cm
	8	80	black brown sandy silt
	9	90	dark brown silty sand grades to black brown sandy silt at 85-87cm
	10	100	dark brown sand
	11	110	grades to dark brown silty sand
	12	120	grades to black brown sandy silt, yellow brown sand coming through at southern end from 115-120cm end of pit - limit of safe works
West wall of Test Pit 35 following excavation of Spit 12			

Test Pit 36: GDA Zone 56 – 307611 E 6242232 N	**Spit**	**Depth (cm)**	**Description**
	1	10	1cm of grass stripped back to natural soil at surface, dark brown silty sandy loam with grass rootlets
	2	20	continuation of dark brown sandy silt with faint mottling of yellow brown sand, increasing with depth, occasional charcoal pieces
	3	30	grades to yellow brown sand at about 25cm, charcoal pieces continuing
	4	40	mottled yellow brown and brown sand, increasing yellow brown sand, dark brown silty sand coming through across northern half
	5	50	dark brown silty sand with mottling of yellow brown sand
	6	60	brown to yellow brown sand with decreasing mottling of dark brown silty sand
	7	70	grades to clean coarse yellow brown sand
	8	80	yellow brown sand
	9	90	grades to dark brown at base
	10	100	dark brown silty sand grades back to coarse yellow brown sand at about 95cm
	11	110	yellow brown sand with numerous small charcoal pieces, clear transition to black brown silty sand at 108-110cm
	12	120	dark brown silty sand across southern half, yellow brown sand continues across northern half to depth of 120cm, linear dark brown feature, 10-15cm wide, runs east-west across northern half end of pit - limit of safe works
North wall of Test Pit 36 following excavation of Spit 12			

Test Pit 37: GDA Zone 56 – 307616 E 6242255 N	**Spit**	**Depth (cm)**	**Description**
	1	10	2cm of grass stripped back to natural soil at surface, dark brown silty sandy loam with grass rootlets and tree roots - <30mm
	2	20	continuation of dark brown sandy silt with faint mottling of yellow brown sand, increasing with depth, occasional charcoal pieces
	3	30	continuation of dark brown sandy silt with numerous tree roots, yellow brown sand coming through at base
	4	40	mottled yellow brown and brown sand, increasing yellow brown sand
	5	50	dark brown silty sand with mottling of yellow brown sand
	6	60	brown to yellow brown sand with decreasing mottling of dark brown silty sand
	7	70	yellow brown sand mottled with dark brown silty sand
	8	80	as above, black brown silty sand coming through at base across southern third
	9	90	clear transition to black brown silty sand at 80cm in south, sloping down to 88-90cm in north
	10	100	black brown silty sand with intermittent charcoal
	11	110	dark brown silty sand with numerous charcoal flecks
	12	120	as above end of pit - limit of safe works
West wall of Test Pit 37 following excavation of Spit 12			

pit on slope, leading downward to west, all measurements taken from higher eastern side

Test Pit 38: GDA Zone 56 – 307612 E 6242272 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back - dark brown silty sandy loam with grass rootlets, occasional pieces of clay
	2	20	continuation of dark brown sandy silt with faint mottling of yellow brown sand, increasing with depth, occasional pieces of rubble
	3	30	continuation of dark brown sandy silt with numerous pieces of rubble and clay - clear transition to brown sand across southern half at about 28cm, black brown silty sand and rubble fill continues across northern half
	4	40	brown sand across southern half, clear transition to black brown silty sand at 31-32cm
	5	50	black brown silty sand
	6	60	black brown silty sand, grades quickly to brown sand by 53cm, numerous charcoal pieces throughout
	7	70	continuation of brown sand with intermittent charcoal
	8	80	as above, clear transition to black brown silty sand at about 74-79cm, deeper in north
	9	90	black brown silty sand
	10	100	grades to brown to yellow brown sand
	11	110	coarse brown sand with intermittent charcoal
	12	120	grades to yellow brown sand mottled with dark brown and intermittent charcoal staining end of pit -limit of safe works
North wall of Test Pit 38 following excavation of Spit 12			

30cm of clay fill removed by machine - all measurements taken from start of natural

Test Pit 39: GDA Zone 56 – 307607 E 6242306 N	**Spit**	**Depth (cm)**	**Description**
	1	10	mottled brown and yellow brown sand
	2	20	brown and yellow brown mottled sand with intermittent charcoal staining
	3	30	brown sand with intermittent charcoal staining, dark brown silty sand begins at 28cm
	4	40	compacted black brown sandy silt
	5	50	continuation of black brown sandy silt, grades to yellow brown sand at base
	6	60	as above - grades to brown sand
	7	70	continuation of coarse brown sand
	8	80	as above with clear transition to black brown silty sand at 79-80cm
	9	90	grades back to yellow brown sand
	10	100	brown sand with intermittent mottling of yellow brown
	11	110	dark brown silty sand with clear transition to brown sand at 102-105cm
	12	120	continuation of black brown sandy silt - silty sand end of pit limit of safe works
North wall of Test Pit 39 following excavation of Spit 12			

25cm of fill removed by machine - all measurements taken from start of natural

Test Pit 40: GDA Zone 56 – 307610 E 6242327 N	**Spit**	**Depth (cm)**	**Description**
	1	10	friable brown sandy loam with grass roots and clumps of orange-red clay
	2	20	brown and yellow brown mottled sand with intermittent charcoal staining, pocket of friable sandy loam with organic matter at southern end of pit
	3	30	as above, plastic golf tee came out of disturbed pocket at southern end
	4	40	clear transition to black brown sandy silt at 30-31cm - pocket of loose fill continues at southern end
	5	50	black brown sandy silt - pocket continues in south
	6	60	brown sand- pocket continues in south
	7	70	continuation of coarse brown sand not excavating the fill that continues at the southern end
	8	80	as above with intermittent charcoal pieces and staining coming through at base
	9	90	as above
	10	100	coarse brown sand
	11	110	as above
	12	120	as above with clear transition to black brown silty sand at 116cm end of pit limit of safe works
North wall of Test Pit 40 following excavation of Spit 12			

pit cut down to 60cm by machine, top 60cm were sterile in adjacent pit, excavation begins at Spit 7

Test Pit 41: GDA Zone 56 – 307336 E 6241807 N	**Spit**	**Depth (cm)**	**Description**
	7	70	coarse brown sand with mottling of yellow brown at base
	8	80	yellow brown sand with dark brown mottling
	9	90	yellow brown sand with dense mottling of dark brown from bioturbation
	10	100	grades to loose coarse yellow sand
	11	110	continuation of loose coarse yellow sand
	12	120	continuation of coarse yellow brown - yellow sand
	13	130	as above
	14	140	as above
	15	150	as above
	16	160	as above - darker brown sand coming through at base
	17	170	black brown silty sand to 165cm, clear transition to yellow sand – **handmade brick: 19th C**
	18	180	pale yellow sand with clear transition to black brown silty sand at 173-178cm, deepest in east end of pit limit of safe works
South wall of Test Pit 41: Spits 7-18			

machine cut down first 60cm through sterile alluvial deposits, excavation begins at Spit 7

Test Pit 42: GDA Zone 56 – 307348 E 6241822 N	**Spit**	**Depth (cm)**	**Description**
	7	70	yellow brown sand with numerous charcoal pieces throughout
	8	80	yellow brown sand with decreasing dark brown mottling
	9	90	clear transition to dark brown silty sand at 82cm – **glass fragment: Second half of 19th C**
	10	100	grades to yellow brown sand with dark brown mottling– **Earthenware with blue transfer: Post 1830; Ewbank Nail: 1840s-1860s; Bone china hollowware post: 1850s/60s**
	11	110	brown sand with black brown mottling
	12	120	brown sand with dark brown mottling and charcoal staining
	13	130	as above
	14	140	grades to brown sand with numerous small charcoal pieces and charcoal staining across northern half at base
	15	150	dark brown mottled sand grades to yellow brown sand with dark brown mottling - bioturbation boundary, dark brown silty sand coming through at base across northern 20cm
	16	160	mottled brown and yellow brown sand
	17	170	as above, clear transition to black brown silty sand at base - southern end
	18	180	compacted black brown silty sand extends across southern 2/3 with yellow brown sand continuing in north end of pit limit of safe works
West wall of Test Pit 42: Spits 7-18			

Test Pit 43: GDA Zone 56 – 307379 E 6241869 N	Spit	Depth (cm)	Description
	1	10	1cm of grass stripped back, brown sandy loam
	2	20	grades to black brown silty sand
	3	30	grades to brown sand
	4	40	brown sand, becoming darker with depth
	5	50	yellow brown sand with mottling of dark brown silty sand and numerous small charcoal pieces
	6	60	dark brown sand with decreasing mottling of yellow brown
	7	70	dark brown sand with broad mottling of brown sand
	8	80	coarse brown sand
	9	90	coarse brown sand
	10	100	as above with intermittent charcoal
	11	110	as above
	12	120	as above, tends to slightly darker brown with depth, end of pit - limit of safe works
North wall of Test Pit 43 following excavation of Spit 12			

Test Pit 44: GDA Zone 56 – 307395 E 6241888 N	**Spit**	**Depth (cm)**	**Description**
	1	10	1cm of grass stripped back, dark brown sandy loam, brown sand coming through at base
	2	20	brown sand
	3	30	grades to dark brown silty sand, mottling of brown sand coming through from 25cm, brown sand dominates at base
	4	40	brown sand, grades to darker brown
	5	50	grades quickly to pale brown sand with dark brown mottling at 41-43cm
	6	60	continuation of dark brown and yellow brown mottled sand
	7	70	continuation of mottled sands, black brown silty sand increasing with depth
	8	80	grades to coarse brown sand
	9	90	coarse brown sand with increasing mixed gravels and large (150mm) pieces of rounded shale
	10	100	as above with increasing rock
	11	110	as above, increasing rock
	12	120	as above end of pit - limit of safe works
North wall of Test Pit 44 following excavation of Spit 12			

Used machine to cut down through recent sterile sands to black brown silty sand at 80cm

Test Pit 45: GDA Zone 56 – 307459 E 6241958 N	**Spit**	**Depth (cm)**	**Description**
	1 (8)	85	black brown silty sand - sandy clayey silt
	2 (9)	91	compacted black brown clayey silt, with occasional charcoal and red concretions mud bucket refusing against compacted deposit, changing to toothed bucket for one spit
	3 (10)	98	black brown clayey silt, with occasional charcoal and red concretions, decreasing compaction
	4 (11)	110	as above fine tree roots continuing
	5 (12)	120	grades to dark brown clayey sandy silt
	6 (13)	130	grades to dark brown silty sand
	7 (14)	145	dark brown silty sand with intermittent charcoal and small pockets of paler brown sand
	8 (16)	157	as above with increasing fine charcoal pieces end of pit
West wall of Test Pit 45: Spits 1-8 (8-16)			

APPENDIX 7

DETAILED SIGNIFICANCE ASSESSMENT

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

i) A class of Australia's natural or cultural places, or

ii) A class of Australia's natural or cultural environments.

This item is assessed as not having significance against this criterion.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

This item has been disturbed by subsequent land use that has affected the vertical integrity of archaeological material. The loss of site integrity also impacts on the potential research value of the items and consequent changes in significance that may have come from intactness. The item comprises artefacts of unknown provenance in a disturbed context. There is low archaeological significance at a local level.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site does not meet the threshold for listing on the Commonwealth Heritage List.

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as having significance against this criterion. The item contributes to the significance of the Unit 1 and Unit 2 deposits at MAPAD2.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having significance against this criterion. The item contributes to the significance of the Unit 1 and Unit 2 deposits at MAPAD2.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

iii) A class of Australia's natural or cultural places, or

iv) A class of Australia's natural or cultural environments.

This item is assessed as having significance against this criterion. The item is representative of Aboriginal land use along the Georges River and the environment that existed prior to European settlement.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

This item displays high stratigraphic integrity however the artefacts are interpreted to be present in these deposits as the result of fluvial reworking of sediments during flood events of the nineteenth/twentieth centuries. There is low archaeological significance at a local level.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site meets the threshold for listing on the Commonwealth Heritage List under criteria b, c, d, g and i.

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as not having significance against this criterion.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as having significance against this criterion. The item contributes to the significance of the Unit 1 and Unit 2 deposits at MAPAD2.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having significance against this criterion. The item contributes to the significance of the Unit 1 and Unit 2 deposits at MAPAD2.

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

v) A class of Australia's natural or cultural places, or

vi) A class of Australia's natural or cultural environments.

This item is assessed as having significance against this criterion. The item is representative of Aboriginal land use along the Georges River and the environment that existed prior to European settlement.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion as it displays a connection for the Aboriginal community to past cultural events.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion for the connection it provides between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

This item displays high stratigraphic integrity. A single small artefact was recovered from the upper portion of the Unit 1 deposits at MAPAD2. However, given that the age and nature of the Unit 1 deposits is yet to be determined, the circumstances surrounding the deposition of the recovered artefact cannot be accurately inferred. There is low to moderate archaeological significance at a local level.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

This site meets the threshold for listing on the Commonwealth Heritage List under criteria b, c, d, g and i.

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as having heritage value against this criterion in terms of its association with the course of Australia's natural and cultural history, in particular its connection to environmental conditions prior to and subsequent to European settlement.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as having heritage value against this criterion due to the fact that it appears to comprise a hitherto unrecorded example of changes in flood regime that appear to archive:

- regional properties in the catchment sediment record; and
- a record of recent sand aggradation and vertical accretion superimposed on the earlier floodplain surface caused by the construction of the Liverpool Weir in 1836.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having heritage value against this criterion due to its potential to:

- yield information on the nature of the hydrological adjustment of the river – an ongoing process – where better understanding of the trajectory of change in the last 180 years provides baselines and context for present riparian ecological issues and management;
- yield information on the types of floodplain vegetation present in the period 1790-1830 that may be well preserved in Unit 1 sealed by the Unit 2 sands; and
- contain evidence of the prior condition of the floodplain preserved in the sequence (e.g. as microfossil inclusions such as pollen, diatoms) or as larger features (tree burn outs, flood event layers).

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

vii) A class of Australia's natural or cultural places, or

viii) A class of Australia's natural or cultural environments.

This item is assessed as having significance against this criterion. The item appears to demonstrate the principal characteristics of a pre-European/early contact floodplain that has been capped by overflow sands as the result of floodplain adjustments in response to the construction of the Liverpool Weir.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as not having significance against this criterion.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion. The item is likely to be of importance to both the Aboriginal community and the local Liverpool community in terms of the record they appear to archive of ecological change, flooding patterns and potential information regarding the pre-European landscape.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as not having significance against this criterion.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as having significance against this criterion. The item has the potential to contain archaeological and paleo-environmental evidence that would be of importance in terms of understanding Indigenous traditions and life-ways. Such evidence would be of importance as a connection between the present Aboriginal community and Indigenous tradition.

Statement of heritage significance:

This item displays high stratigraphic integrity, however it should be noted that the majority of stratigraphic units investigated during the subsurface testing program appear to relate to sedimentation processes during the past 200 years. There potentially high scientific, educational, natural, representative and Aboriginal cultural value at local, State and National levels.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

The item requires further investigation to fully determine significance.

This site meets the threshold for listing on the Commonwealth Heritage List under criteria a, b, c, d, g, h and i.

Analysis against Commonwealth Heritage significance criteria

Criterion (a): *The place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history*

This item is assessed as having heritage value against this criterion in terms of its association with the course of Australia's natural and cultural history, in particular its connection to environmental conditions prior to and subsequent to European settlement.

Criterion (b): *The place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history*

This item is assessed as having heritage value against this criterion due to the fact that it appears to comprise a hitherto unrecorded example of changes in flood regime that appear to archive:

- regional properties in the catchment sediment record; and
- a record of recent sand aggradation and vertical accretion superimposed on the earlier floodplain surface caused by the construction of the Liverpool Weir in 1836.

Criterion (c): *The place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

This item is assessed as having heritage value against this criterion due to its potential to:

- yield information on the nature of the hydrological adjustment of the river – an ongoing process – where better understanding of the trajectory of change in the last 180 years provides baselines and context for present riparian ecological issues and management;
- yield information on the types of floodplain vegetation present in the period 1790-1830 that may be well preserved in Unit 1 sealed by the Unit 2 sands; and
- contain evidence of the prior condition of the floodplain preserved in the sequence (e.g. as microfossil inclusions such as pollen, diatoms) or as larger features (tree burn outs, flood event layers).

Criterion (d): *The place has a significant heritage value because of the place's importance in demonstrating the principal characteristics of:*

ix) A class of Australia's natural or cultural places, or

x) A class of Australia's natural or cultural environments.

This item is assessed as having significance against this criterion. The item appears to demonstrate the principal characteristics of a pre-European/early contact floodplain that has been capped by overflow sands as the result of floodplain adjustments in response to the construction of the Liverpool Weir.

Criterion (e): *The place has a significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.*

This item is assessed as not having significance against this criterion.

Criterion (f): *The place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.*

This item is assessed as having significance against this criterion. It appears to be the direct result of early nineteenth century innovation and technical achievement with regard to modification of a river system in order to secure a fresh water supply for Liverpool. As such, these deposits are potentially of importance as an indirect demonstration of that early nineteenth century technical achievement.

Criterion (g): *The place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

This item is assessed as having significance against this criterion. The item is likely to be of importance to both the Aboriginal community and the local Liverpool community in terms of the record they appear to archive of ecological change, flooding patterns and potential information regarding the pre-European landscape.

Criterion (h): *The place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.*

This item is assessed as having significance against this criterion. This item appears appear to be the direct result of construction of the Liverpool Weir, which was designed by David Lennox, an engineer who was also important within NSW and Victoria due to his involvement in bridge design and construction. The life and works of David Lennox are thus important in the context of local history, as well as the history of infrastructure within NSW and Australia as a whole. As such, these deposits are potentially of importance as direct evidence of the effect of the works of David Lennox.

Criterion (i): *The place has significant heritage value because of the place's importance as part of Indigenous tradition.*

This item is assessed as not having significance against this criterion.

Statement of heritage significance:

This item displays high stratigraphic integrity, however it should be noted that the majority of stratigraphic units investigated during the subsurface testing program appear to relate to sedimentation processes during the past 200 years. There potentially high scientific, educational, natural, representative and Aboriginal cultural value at local, State and National levels.

The item has significance to the Aboriginal community as a tangible connection to country and an example of past lifeways.

The item requires further investigation to fully determine significance.

This site meets the threshold for listing on the Commonwealth Heritage List under criteria a, b, c, d, f, g and h.

APPENDIX 8

GLOSSARY

alluvial - pertaining to alluvium and fluvial processes.

alluvium - unconsolidated deposit of gravel, sand, mud etc., formed by water flowing in identifiable channels. Commonly well-sorted and stratified.

archaeological site - A site is defined as any material evidence of past Aboriginal activity which remains within a context or place which can be reliably related to that activity. Usually a site classification requires a minimum of two detected artefacts.

artefact - an object, normally portable, made or modified by human hand (see 'stone artefact').

assemblage - see lithic assemblage.

background discard - There is no single concept for background discard or 'scatter', and therefore no agreed definition. The definitions in current use are based on the postulated nature of prehistoric activity, and often they are phrased in general terms and do not include quantitative criteria. Commonly agreed is that background discard occurs in the absence of 'focused' activity involving the production or discard of stone artefacts in a particular location. An example of unfocussed activity is occasional isolated discard of artefacts during travel along a route or pathway. Examples of 'focussed activity' are camping, knapping and heat-treating stone, cooking in a hearth, and processing food with stone tools.

In practical terms, over a period of thousands of years an accumulation of 'unfocussed' discard may result in an archaeological concentration that may be identified as a 'site'. Definitions of background discard comprising only qualitative criteria do not specify the numbers (numerical flux) or 'density' of artefacts required to discriminate site areas from background discard.

background lithic material - natural stone (in the form of pebbles and/or fragments) of types used by Aborigines to make artefacts (such as quartz, tuff, silcrete, chalcedony and quartzite) and occurring in or near a prehistoric archaeological site.

background scatter - can be generally defined as manuport and artefactual material which is *insufficient either in number or in association* with other material to suggest focused activity in a particular location. However, a specific definition of 'background scatter' is inappropriate because it may imply more than simply a pattern of dispersed isolated finds.

backing (retouch) - abruptly angled flaking (retouch) which has shaped a thick back part to an implement such as an elouera or microlith. The process of flaking varies from bipolar impact (on some eloueras) to delicate application of pressure with a small stone ('chimbling' used to make microliths).

bending initiation - the commencement of a fracture by the application of a bending load or force, as in breaking a bar of chocolate, where the load is applied away from the point at which the object breaks. Bending initiation is common in the fracture of a tool's cutting edge during its use, and is commonly caused by human treadage at a site. It normally occurs on thin edges (see also 'snap fractures or flakes').

bioturbation - the process of mixing soil materials or sediments by living organisms.

bipolar core - A core (nucleus) that is supported on a stone anvil surface and struck repeatedly with a hammerstone from above. Diagnostic attributes of bipolar fracture damage are point or sinuous ridge type initiation platforms, crushing, cracks, and concentrated overlapping step fractures emanating from areas of hammer impact.

bipolar flake - (and broken bipolar flake) -a flake retaining evidence of bipolar fracture damage on at least one end. Some of these are 'compression flakes' formed by substantial compressive force. A broken bipolar flake has a transversely oriented breakage.

bipolar flaking - a method of making flakes or retouched flake tools by smashing a piece of stone, often a quartz pebble, rested on a stone surface and repeatedly striking the core from above with a stone hammer.

broken bipolar flake - Transversely broken flake from a bipolar core.

broken flake - A flake with two or more breakages but retaining its area of flake initiation.

chalcedony - a compact variety of silica, formed of quartz crystallites, often fibrous in form and with sub-microscopic pores which contain water (about 1% of weight). Coloured varieties include carnelian (yellow brown), sard (brown), agate (varicoloured) and jasper (red). Chalcedony can form veins or can occur as pseudomorphs, resulting from silica-charged solution infiltrating voids or cavities in rock, sometimes by gradually replacing decaying organic matter. Chalcedony, like fine quality chert, was a valued stone tool material. Mohs hardness always registers within half a point of 7. Chalcedony appears very fine-grained to the naked eye and can be translucent, banded and include a wide variety of colours. This rock type breaks by the process of conchoidal (shell-like) fracture and provides flakes that have sharp durable edges.

chert - a highly siliceous rock type formed biogenically from the compaction and precipitation of the silica skeletons of diatoms. Normally there is a high percentage of cryptocrystalline quartz. This rock type breaks by the process of conchoidal (shell-like) fracture and provides flakes that have sharp durable edges.

clast - a grain or crystal with a finer grained matrix (usual in silcrete).

colluvium - an unconsolidated deposit of gravel, sand, mud etc., formed by water flowing across a hillslope surface (slopewash, sheetwash, rainwash) and/or by mass movement. Commonly poorly sorted and stratified.

cobble - waterworn stones of diameter greater than 64 mm (about the size of a tennis ball) and less than 256 mm (about the size of a basketball). Archaeologists often refer to cobbles as pebbles (see also 'pebble').

conchoidal flake - a flake created by Hertzian initiation (a cone crack). This is the most common type of flake produced by tool making, but occasionally also occurs in nature. It is distinguished by a partial or complete cone crack and a bulb of force; other fracture surface features are éraillure scar, lances and undulations (see these other glossary entries, and Cotterell and Kamminga 1987, 1992). The inside fracture surface of a well-formed conchoidal flake is similar to that of a bivalve shell, hence the term 'conchoidal'. 'Conchoidal fracture' refers to the process of this flake formation.

concretion and nodules - a mineral forming in isolated aggregates, sometimes as spherical or ellipsoidal forms. Concretions display a concentric zonation of matrix components, whereas nodules display an undifferentiated internal fabric.

cone crack initiation - a Hertzian cone initiation which leads to the formation of a conchoidal flake. A Hertzian cone is similar in shape to the neck of a milk bottle with the top of this cone being the initiation of the circular fracture. On a flake surface the cone is not fully formed and is represented by one side, because the fracture-initiating force was applied from above at an angle of about forty five degrees, not ninety degrees. Other terms in current usage are 'focussed initiation' and 'split cone'.

conjoin analysis - piecing together or 'conjoining' artefacts helps in reconstructing prehistoric 'events' (such as tool manufacture, tool use activities and cutting-edge rejuvenation), determining chronology and assessing site integrity.

core (synonymous with nucleus) - a piece of stone, often a pebble or cobble but also quarried stone, from which flakes have been struck for the purpose of making stone tools. (see also 'tabular nucleus'). The core (or core fragment) is generally amorphous in shape. Flakes removed from a core are called 'primary flakes' and may be further shaped by finer flaking, called 'retouch'. The term 'nucleus' refers to cores and flakes or cores that have been retouched.

core rotation - rotation of a core so that another surface is presented from which to initiate fractures that create flakes or blades. Usually this occurs when the previously flaked part of the core because unsuitable for further flake removals. Core rotation may be in any direction. The process may be opportunistic or planned, and is aimed at maximising the number of suitable flakes detached from the core.

cortex - cortex is the weathered exterior of rocks formed by long periods of exposure to chemical and physical weathering. The percentage of cortex remaining on either the dorsal (if limited to the dorsal), the platform (if limited to the platform) or both dorsal and platform (if occurring on both) is recorded in 10% increments. On flaked pieces, cortex is recorded as an estimation of the total surface area covered

cortex type - cortex type varies according to the environment in which it formed and the subsequent processes by which it came to be transported to its current position. Three types of cortex are recorded for all artefacts preserving a cortical remnant. These are angular, rounded and irregular.

debitage - commonly used French word for the stone refuse from flaking activity. Usually there is a large quantity of flaking debitage for every finished stone implement.

discard - when referring to lithic scatters the term discard means the incidental, intended and unintended scatter of artefacts on the ground surface or directly into a sediment.

distal portion or end - the end of a flake or microblade (the opposite end to the that of the point of fracture origin on the ventral (or inside) surface. Tabular cortex is the weathered surface of a tabular shaped nucleus (core).

dorsal face/facet - the outside surface(s) of a flake, the inside surface of the flake being one side of the fracture created during the formation of the flake. The speed at which these fracture formed ranges from about 200 m to over one kilometres a second (see also 'ventral face').

edge-ground axe - Implement shaped on at least one margin by grinding against another surface. Such implements are often shaped by flaking, pecking, flaking and pecking or grinding and/or burnishing around much of their exterior.

end scraper - A flake with a flat ventral surface and steeply retouched distal end.

Éraillure flake - a secondary flake, always very thin in cross-section, that usually remains attached by a fine bridge of stone to the bulbar surface of a conchoidal negative flake scar. The fine attachment is easily removed by applying a very small force. A negative éraillure scar is left on one side of the bulb of force, which is in the upper part of the ventral surface of the primary flake from which it was detached, and is often referred to as 'bulbar scar'. This flake type has no initiation platform, is round or ovoid in plan view, and is always very thin. This flake type is not significant for the purposes of analysis other than to indicate conchoidal flaking.

flake - (General) a piece of stone detached from a nucleus such as a core. A complete or substantially complete flake of lithic material usually with evidence of hard indenter initiation, or occasionally bending initiation. A general category for substantially complete conchoidal flakes, and rarely bending-initiated flakes.

The most common type of flake is called 'conchoidal flake'. In certain circumstances flakes (especially conchoidal flakes) may be the result of natural fracture of stone. The flake's primary fracture surface (the ventral or inside surface) exhibits features such as fracture initiation, bulb of force, and undulations and lances that indicate the direction of the fracture front. Very occasionally a conchoidal flake comprises only a bulb of force (see also 'core', 'fracture initiation', 'bulb or force', 'lances' and 'undulations', and specific flake types).

flake portion - multiple breaks/proximal, distal/longitudinal, indicting the portion of the original flake. Multiple breakages indicates a fragment of a flake exhibiting more than one breakage but still retaining at least some of its initiation area. Proximal portion of a flake is synonymous with 'step-terminated flake'. This variety of flake sustains a breakage at its distal end either because it was detached from the nucleus by a bending force that created a second, transverse break or was broken transversely by a bending force after it was detached (such as when it struck the ground during knapping or subsequently by treadage at the site).

flake fragment - A category comprising flake fragments without areas of fracture initiation but which display sufficient fracture surface attributes (normally conchoidal markings) for identification as a lithic artefact fragment.

flake rotation contact damage - the fine flake scars damage on the distal end of a flake (such as a microlith backing flake) a fraction of a second after it has been created and before it separates fully from the nucleus. This fracturing is caused by the continued application of load or force to the flake as its upper part moves outwards and away from the nucleus.

flaked piece - A flaked piece is defined as any piece of rock clearly derived from the process of conchoidal fracture, but for which no attributes exist to identify it as a core, a flake or any other identifiable technological category.

flake from bipolar core - A flake retaining evidence of bipolar fracture damage on at least one end. Some of these are 'compression flakes' formed by substantial compressive force.

flake portion - a proximal portion retains the area of flake initiation, a distal portion exhibits a flake termination. Longitudinally broken flakes and ones with an oblique break are also recognised.

flat - a landform element which is planar or near horizontal; creek flat - flat adjacent to a creek usually a floodplain.

floodplain - valley floor flat adjacent to a stream which is flooded by the 'annual' flood (often considered to be the flood with a recurrence interval of about 1.6 years).

fluvial - pertaining to a stream or river.

fracture or flake initiation - the point or area defining the beginning of a flake-forming fracture (always found at the top of the top of the flake scar or ventral (inside) surface of the flake (see also 'initiation surface').

fresh breakage or fracture - fracturing of a lithic item during archaeological excavation or sieving. Such fracture, which has no adhering sediment or sediment stain, may be caused by trowel, pick, shovel or earth moving machinery.

heat fracture - fractures cause by heating the stone, either from natural causes, a campfire, or intentional heat treatment. Generally, these are undesirable effects though larger pieces of stone fractured by heat sometimes are used as cores or made into implements because of their convenient shape or size. Attributes indicating heat fracture include colour change, cracking, crazing, potlidding and creation of highly irregular fracture surface topography (often referred to as 'crenation' or 'crenulation'.

hammerstone /anvil - A piece of stone with such evidence of use in the form of diagnostic abrasion and other fracture damage.

heat treatment - the intentional slow heating of stone, such as silcrete, above 300°C to improve its flaking properties.

hinge termination - when the end of the flake or fracture continuously turns at ninety degrees to the surface of the nucleus or outside surface of the flake (see also 'retroflexed hinge termination').

indeterminate retouched piece in artefact or piece of an artefact with retouch along at least one margin. The purpose of this retouch cannot be determined, though some items are probably fragments of microlithic items, scrapers or utilised flakes listed above

implement (of stone) - synonym for a stone tool, usually denoting a tool that has been shaped by flaking (retouch).

initiation - see 'fracture or flake initiation'.

initiation platform - see 'initiation surface'.

initiation surface - the surface of a stone (sometimes called a platform) that is struck with a hammerstone at low angle for the purpose of detaching a flake. This surface is where a flake-forming crack commences; commonly part of it is retained on the flake. The load applied to this surface may be delivered by a hammerstone or by continuous increasing pressure with a length of dense wood or bone (a pressor or pressure flaking tool).

isolated find - a single stone artefact, not located within a rock shelter, and which occurs without any associated evidence of Aboriginal occupation within a specified radius, such as 60 metres (depending on which archaeological convention is used). This term is normally useful only in the context of surface archaeological survey results and subsurface testing results. Isolated finds may be constituent components of background discard, or indicative of obscured, remnant and disturbed sites.

knapping episode - a series of flaking events (see also 'knapping event')

knapping event - a single act of flaking a piece of stone resulting in the *in-situ* deposition of stone flaking debris. Such an event may occur as part of a series of events

lamination - a fine layer within the matrix of a lithic material. This layer is less than 2 mm thick.

lateral margin (of a flake) - the edge along the side of a flake, running from the flake's initiation surface to its termination.

lithic - in an archaeological context, items of a hard, usually siliceous, stone of a type selected by Aborigines for tool making. These items are often nondescript fragments but some also finely shaped implements.

lithic assemblage (of stone) - a collection of whole and fragmentary stone artefacts and manuports obtained from an archaeological site, either by collecting items scattered on the present ground surface (see lithic scatter) or by controlled excavation (see also 'stone artefact').

lithic fragment - a nondescript lithic item that does not have sufficient morphological attributes to identify it as a complete artefact or a portion of an artefact. The lithic fragment category comprises items which are identified only to the level of manuport fragments, even though it contains nondescript flaking shatter and fragments of flakes not individually identifiable as such. Some fragments exhibit attributes characteristic of heat stress, such as occurs during bushfire, hearth fire or intentional heat treatment. Evidence of heat fracture on lithic fragments (and identifiable artefacts) has been recorded in the comments for each entry. Depending on the nature of the cultural sediment and non-Aboriginal land-use practices this group may also contain a small number of non-artefactual fragments exhibiting fresh fracture surfaces.

lithic item - a piece of stone exhibiting fracture surfaces and not identified as a natural piece of stone.

manuport - an object or fragment of an object (called item in this report) carried by human agency to the locality in which it is found.

margin - the surface immediately adjacent to an edge, the letter being the intersection of two margins.

microdebitage - flaking waste or debris (debitage) up to 10 mm in maximum size. There is no uniform metrical definition of micro-debitage and some archaeologists specify a maximum size of 5 mm.

microlith (synonym 'backed blade') - a variety of small, delicately retouched implements of various shapes such as asymmetric (bondi) point, segment, crescent, triangle, trapeze, rectangle and oblique ended. These implements are commonly thought to have been spear barbs.

microlith preform - a microblade with some degree of initial backing retouch, often along the distal end. Recognised portions are proximal, distal and fragment.

mottles (on stone surface) - masses or blotches of subdominant colours in an area of stone surface.

mottles (in soil/sediment) - masses or blotches of subdominant colours within a soil mass. Often evidence of poor drainage or extensive bioturbation.

nondescript core or core fragment A core (or core fragment) of generally amorphous shape.

nucleus see 'core', 'polyhedral core', 'tabular nucleus'.

outrépasse termination - a flake ending that turns inwards within the nucleus taking off part of its base. This occurs when the fracture front approaches the bottom of a nucleus and must turn in one direction or the other, as the stresses on either side of the fracture front cannot be equal. If the fracture front turns sharply towards in the other direction the flake will terminate in a hinge. A modest to pronounced outrépasse termination is common on microlith backing flakes and occasionally is seen on microblades.

pebble - by geological definition, a waterworn stone less than 64 mm in diameter (about the size of a tennis ball). Archaeologists often refer to waterworn stones larger than this as pebbles though technically they are cobbles.

pH - acidity or alkalinity of soil or water. Expressed in logarithmic units either side of 7 which is neutral, <7 = acid, >7 = alkaline.

pit - a below ground level ('subsurface') testing location, either excavated by hand and sometimes referred to as a *spade pit* or *shovel pit*, or excavated by machine, such as with a backhoe or machine auger and sometimes referred to as a *trench*.

porphyry - An igneous rock rich in phenocrysts. The term 'porphyritic' refers to ones in which relatively large crystals are set in a fine-grained or glassy groundmass.

potlid - A piece of lithic material that has a generally convex or dome-shaped ventral surface, often with evidence of fracture initiation from a location within the surface and not from the edge.

preform - a flake or blade selected for shaping by retouch into an implement. For inclusion in this category an artefact must have some degree of retouch (see also 'retouch' and 'blank').

primary fracture surface One of the two conjoining fracture surfaces created on a nucleus and flake after the flake has detached. The primary fracture surface on the flake is called the ventral surface.

proximal - the top part of a flake beginning with the initiation surface or ridge. It is the same for an implement (or tool). The opposite end of flake is called the distal end.

quarry - a site where stone was obtained by excavation from bedrock with extraction tools of simple design (see also Stone procurement site or place).

quartz - a mineral composed of crystalline silica SiO^2. Quartz is a very stable mineral that does not alter chemically during weathering or metamorphism. It is hard, usually colourless or white ('milky'). In its massive form quartz occurs as geodes or veins, from which pebbles are formed by weathering. Despite the often unpredictable nature of fracture in quartz the flakes often have sharp cutting edges. Quartz is common and abundant, and the Aborigines used it throughout Australia to make convenient light-duty cutting tools.

quartzite - A hard, silica rich stone formed from a sandstone that has been recrystallised by heat (meta-quartzite) or strengthened by slow infilling of silica in the voids between sand grains (orthoquartzite). The essential difference between sandstone and quartzite is that major fracture will propagate around the larger grains in sandstone and through the grains in quartzite.

Quaternary - The most recent geological time period. Divided into the Holocene and the Pleistocene. Began 1.8 million years ago (see also 'stone procurement site').

reduction process - the process of removing flakes from a core, or of manufacturing an implement by flaking and/or grinding, or progressively rejuvenating a tool's working edge.

reduction strategy - strategy of flaking and/or grinding a piece of stone in predetermined stages to produce an implement.

residues on stone tools - residue analysis concerns the identification of tool use activities from preserved organic and inorganic residues of worked materials. These residues may be compacted into small flake scars on the edges of utilised artefacts or adhere strongly to their surfaces. Routine examination of residues is aided by low-magnification microscopy.

retouch or retouching - an area of flake scars on an artefact resulting from intentional shaping, resharpening, or rejuvenation after wear or breakage. In resharpening a cutting edge the retouch is invariably found only on one side (see also 'indeterminate retouched piece', retouch flake' etc.).

sandstone - a cemented or compacted rock consisting of detrital grains which range in size from 2 mm. Because of its chemical stability quartz often comprises the majority of the grains. The nature of the cement is denoted by terms such as argillaceous (clayey), calcareous, ferruginous and tuffaceous sandstone.

sieve damage - fracture damage on lithic items caused by abrasive contact with the sieve mesh during the process of sieving. This occurs more commonly with wet sieving of clayey sediment.

silcrete - (also known as 'porcellanite' and 'grey billy') A hard, fine grained siliceous stone flaking properties similar to quartzite and chert. It is formed by the cementation and/or replacement of bedrock, weathering deposits, unconsolidated sediments, soil or other material by a low temperature physico-chemical process.

Silcrete is essentially composed of quartz grains cemented by microcrystalline silica (SiO^2). Mineral composition is highly variable, but it comprises more than 85% silica, and includes aluminium, iron and titanium in small but significant amounts. The bonding matrix is often composed of microcrystalline quartz or chalcedony. Clasts are most often quartz grains but may also include chert or chalcedony or some other hard mineral particle. Mechanical properties and texture are equivalent to the range exhibited by chert at the fine-grained end of the scale to silcrete at the coarse-grained end. Silcrete is used by Aborigines for stone tool manufacture throughout most of Australia.

site designation - name or identification given to a site identified as a result of subsurface testing.

site integrity - the degree of post-depositional disturbance to a site.*

spit - an arbitrary interval of excavated depth in an archaeological excavation, such as in: spit 2 was the layer of deposit excavated between 10 and 20cm below ground level.

stone artefact - a piece or fragment of stone showing evidence of intentional human creation or modification.

stone layer - a sheet or layer of gravel sized materials found within a body of soil material. Commonly formed at the lower limit of bioturbation and often contains a concentration of artefacts.

stone material - (synonymous with 'lithic material', 'stone type' and 'raw material' which is a less specific but commonly used term).

stone procurement place (or site) - a place where stone is obtained for making into artefacts. As a prehistoric site type in Australia, stone procurement places range on a continuum, from pebble beds in watercourses (where there may be little or no archaeological evidence of human activity) to extensively quarried outcrops of bedrock where there is clear evidence of procurement activity, such as quarry pits, discarded hammerstones and large consolidated cultural deposits of primary flaking debris. (See also quarry)

stone tool - a piece of flaked or ground stone used in an activity or fashioned for use as a tool. A synonym of stone tool is implement, which is more often used by archaeologists to describe a flake tool fashioned by more delicate flaking (retouch).

technological attributes analysis - methods of reconstructing reduction sequences in stone technology (see reduction sequence). Discrete and metrical attributes of artefacts are identified, recorded and examined mathematically.

termination (of a flake) - the distal end

use fractures - breakages on the edges of stone tools resulting from tool use (see also 'use-wear').

use-wear - microscopic and macroscopic damage to the surfaces of stone implements resulting from its use. Routine examination for use-wear is aided by low-magnification microscopy. Major use-wear forms are edge fractures, use-polish and smoothing, abrasion, and edge rounding and bevelling.

ventral face - the inside surface of a flake created during the flake's formation. The speed of the fracture ranges from about 200 metres to over one kilometres per second (see also 'dorsal face').

volcanic stone - rock types formed by volcanic activity display a wide range of mechanical and flaking properties. Freshly fractured volcanic stone tends not to have fine, durable edges suitable for cutting. Only a few types are utilised for making stone tools, often ones that are shaped by grinding.

working edge - the edge of a tool in contact with the worked substance or material during its usage.

APPENDIX 9

UNANTICIPATED DISCOVERY PROTOCOLS

Protocol to be followed in the event that previously unrecorded Aboriginal object(s) are encountered

In the event that one or more Aboriginal objects are revealed during development works, the following protocol will be actioned:

1. The discoverer of the find(s) will notify machinery operators in the immediate vicinity of the Aboriginal object so that work can be halted in the area of the find(s).

2. The find will be reported to the site supervisor and the Principal/Project Manager.

3. Immediately notify the following authorities or personnel of the discovery:

    a. The Heritage Branch of the Department of Planning and Infrastructure;

    b. An archaeologist or Aboriginal Heritage Officer from the Office of the Environment and Heritage (OEH), Environment Protection and Regulation Group, Metropolitan Branch (02 9995 5000), or call the OEH Environment Line: 131555 (excluding mobiles); and

    c. Representative(s) from the RAPs (as appropriate).

4. The approximate extent, nature, associated archaeological potential and likely significance of the Aboriginal object(s) will be determined by an appropriately qualified person or persons such as the project archaeologist, in consultation with sites officer(s) and/or representatives nominated by the RAPs.

5. The appropriately qualified person(s) will determine if the find(s) belong to a previously recorded site or potential archaeological deposit. If the location of the finds is consistent with a previous recording, construction work can proceed provided that any required mitigative actions defined in an approved management Plan which addresses cultural heritage impacts have been completed.

6. If the find is a new recording then the Heritage Branch of the Department of Planning and Infrastructure and OEH will be notified of the find and an appropriately qualified person or persons (such as the project archaeologist), accompanied by, and in consultation with RAP representatives will record the finds, and assess the likely significance of the finds and any associated deposits.

7. The new recording will be documented on a OEH site card and lodged with OEH.

8. The recording and assessment results will be reported to the Proponent/Project Manager and an appropriate management strategy will be developed and instigated, in consultation with RAP representatives, the Heritage Branch of the Department of Planning and Infrastructure, , and where appropriate OEH. The management of the find(s) may involve:

    a. The conduct of an archaeological salvage excavation with the aim of recovering a sufficient sample of the deposit to allow an analysis which is commensurate with the assessed potential of the deposit, or

    b. Collection of surface artefacts and any other required samples; and

    c. The temporary storage of recovered Aboriginal objects by the project archaeologist pending the completion of analysis.

9. In the event of the collection of Aboriginal artefacts from the project area:

    a. The artefacts will be appropriately recorded and collected.

       The location of the recovered artefacts will be recorded using a hand-held GPS, (if available and where necessary), or alternatively, by noting road project chainage intervals;

b. The collected artefacts will be placed in a clear-plastic bag and placed in temporary secure storage at the site office

   Each bag should have the following information marked on it using a broad nib permanent spirit pen:

   – The site location;
   – The date (day/month/year);
   – The collector's name; and
   – Any other relevant information (such as a GPS reference or description of contents);
   – Where necessary, the Proponent is responsible for the temporary and secure storage of recovered Aboriginal objects prior to their long term management (refer step 10).

10. Following the completion of those construction works in which Aboriginal objects may potentially be revealed, the project archaeologist will analyse the data from collected artefacts, together with any data and finds from salvage excavations, (conduct any radiocarbon dating determinations, where appropriate) and prepare a report.

11. The post-analysis management of any recovered items will be the subject of discussion and a potential resolution(s) of the Aboriginal Focus Group, and liaison with and approval from OEH.

Protocol to be followed in the event that suspected human remains are encountered

1. All ground surface disturbance in the area of the finds should cease immediately the finds are uncovered.

    a. The discoverer of the find(s) will notify all field workers and machinery operators in the immediate vicinity of the find(s) so that work can be halted; and

    b. The excavation director, site supervisor and representatives of Parsons Brinckerhoff (PB) and the Moorebank Project Office (MPO) will be informed of the find(s).

2. If there is substantial doubt regarding a human origin for the remains, then consider if it is possible to gain a qualified opinion within a short period of time. If feasible, gain a qualified opinion (this can circumvent proceeding further along the protocol for remains which turn out to be non-human). If conducted, this opinion must be gained without further disturbance to any remaining skeletal material and its context (Be aware that the site may be considered a crime scene containing forensic information). If a quick opinion cannot be gained, or the identification is positive, then proceed to the next step.

3. Immediately notify the following people of the discovery:

    a) The local Police (this is required by law);

    b) Department of Planning and Infrastructure

    c) An archaeologist or Aboriginal Heritage Officer from the Office of the Environment and Heritage (OEH), Environment Protection and Regulation Group, Metropolitan Branch (02 9995 5000), or call the OEH Environment Line: 131555 (excluding mobiles);

    e) Representative(s) from the registered Aboriginal parties (as appropriate); and

    f) The project archaeologist (if not already present).

4. Facilitate the evaluation of the find(s) by the statutory authorities and comply with any stated requirements. Depending on the evaluation of the find(s), the management of the find(s) and their location may become a matter for the Police and/or Coroner.

5. Excavation works in the area of the find(s) may not resume until the proponent receives written approval from the relevant statutory authority: from the Police or Coroner in the event of an investigation, or from OEH in the case of Aboriginal or Non-Aboriginal remains outside of the jurisdiction of the Police or Coroner.

In the event that the proponent continues an active role in the evaluation and/or management of the find(s), via a direction or advice from the Police, Coroner and/or the OEH or Heritage Council, then all or some of the following steps *may* be conducted:

6. Facilitate, in co-operation with the appropriate authorities, the definitive identification of the skeletal material by a specialist (if not already completed). This must be done with as little further disturbance to any remaining skeletal material and its context as possible.

7. If the specialist identifies the remains as non-human then, where appropriate, the protocol for the discovery of Non-Aboriginal or Aboriginal artefacts should be followed.

8. If the specialist determines that the remains are human, then the proceeding course of action may be of three types:

a. The remains are of an Aboriginal or non-Aboriginal person who died less than 100 years ago. All further decisions and responsibilities regarding the remains and find location rest with the Police and/or the State Coroner.

b. The remains are of a non-Aboriginal person who died more than 100 years ago. In this case, and where the Police have indicated that they have no interest in the find(s), the following steps may be followed:

    i. Ascertain the requirements of the Heritage Branch (OEH), the proponent, the project archaeologist, and the views of any relevant community stakeholders;

    ii. Based on the above, determine and conduct an appropriate course of action. Possible strategies could include one or more of the following:

        1. Avoiding further disturbance to the find and conserving the remains in situ (this option may require relocating the development and this may not be possible in some contexts);
        2. Conducting (or continuing) archaeological salvage of the finds following receipt of any required statutory approvals;
        3. Scientific description (including excavation where necessary), and possibly also analysis of the remains prior to reburial;
        4. Recovering samples for dating and other analyses; and/or
        5. Subsequent reburial at another place and in an appropriate manner determined by the Heritage Council and in consultation with other relevant stakeholders.

c. The remains are of an Aboriginal person who died more than 100 years ago. In this case the following steps may be followed:

    i. Ascertain the requirements of the relevant registered Aboriginal parties, the OEH, the proponent, and the project archaeologist;

    ii. Based on the above, determine and conduct an appropriate course of action. Possible strategies could include one or more of the following:

        1. Avoiding further disturbance to the find and conserving the remains in situ, (this option may require relocating the development and this may not be possible in some contexts);
        2. Conducting (or continuing) archaeological salvage of the finds following receipt of any required statutory approvals (e.g. AHIP issued);
        3. Scientific description (including excavation where necessary and where an AHIP has been issued), and possibly also analysis of the remains prior to reburial;
        4. Recovering samples for dating and other analyses; and/or
        5. Subsequent reburial at another place and in an appropriate manner determined by the registered Aboriginal parties and the OEH.

    iii. No removal of human remains will take place unless an AHIP has been issued.

Reference/Sources:

Donlan, D., McIntyre-Tamwoy, S. and A. Thorne 2002 Aboriginal Skeletal Remains Manual. NSW National Parks and Wildlife Service, Hurstville.

Heritage Office, NSW 1998 *Skeletal Remains Guidelines for the Management of Human Skeletal Remains under the Heritage Act 1977*.

Protocol to be followed in the event that previously unrecorded (non Aboriginal) relics (historical artefacts) are encountered

In the event that historical sites/objects are revealed during construction works, the following protocol will be actioned:

1. The discoverer of the find(s) will notify machinery operators in the immediate vicinity of the find(s) so that work can be halted in the area of the find(s).

2. The find will be reported to the site supervisor and the Principal/Project Manager.

3. Immediately notify the following authorities or personnel of the discovery:

   a. The Heritage Branch of the Department of Planning and Infrastructure; and

   b. An archaeologist or appropriate staff member from the Heritage Branch, Office of the Environment and Heritage (OEH) (02 98738500).

4. The approximate extent, nature, associated archaeological potential and likely significance of the find(s) will be determined by an appropriately qualified person, such as the project archaeologist.

5. The appropriately qualified archaeologist will determine if the finds belong to a previously recorded site. If the location of the finds is consistent with a previous recording, construction work can proceed provided that any required mitigative actions defined in an approved management Plan which addresses cultural heritage impacts have been completed.

6. If the find is a new recording then the Heritage Branch of OEH will be notified of the find and an appropriately qualified person or persons (such as the project archaeologist), will record the find(s), and assess the likely significance of the finds and any associated deposits.

7. The recording and assessment results will be reported to Proponent/Project Manager and an appropriate management strategy will be developed and instigated, in consultation with the Heritage Branch. The management of the find(s) may involve

   a. No further action,

   b. Collection of surface artefacts and any other required samples; or

   c. The conduct of an archaeological salvage excavation with the aim of recovering a sufficient sample of the deposit to allow an analysis which is commensurate with the assessed potential of the deposit, and

   d. The temporary storage of recovered items by the project archaeologist pending the completion of analysis.

8. In the event of the collection of non-Aboriginal artefacts from the project area:

   a. The artefacts will be appropriately recorded and collected.

      The location of the recovered artefacts will be recorded using a hand-held GPS, (if available and where necessary), or alternatively, by noting road project chainage intervals;

   b. The collected artefacts will be placed in a clear-plastic bag and placed in temporary secure storage at the site office

      Each bag should have the following information marked on it using a broad nib permanent spirit pen:

- The site location;
- The date (day/month/year);
- The collector’s name; and
- Any other relevant information (such as a GPS reference or description of contents);
- Where necessary, the Proponent is responsible for the temporary and secure storage of recovered non-Aboriginal artefacts prior to their long term management (refer step 9).

9. Following the completion of those construction works, the project archaeologist will analyse the data from the collected artefacts, together with any data from the recorded sites and prepare a report as per standard NSW Heritage Branch reporting guidelines.

10. The management of any recovered items will be the subject of liaison with the Heritage Branch of OEH.