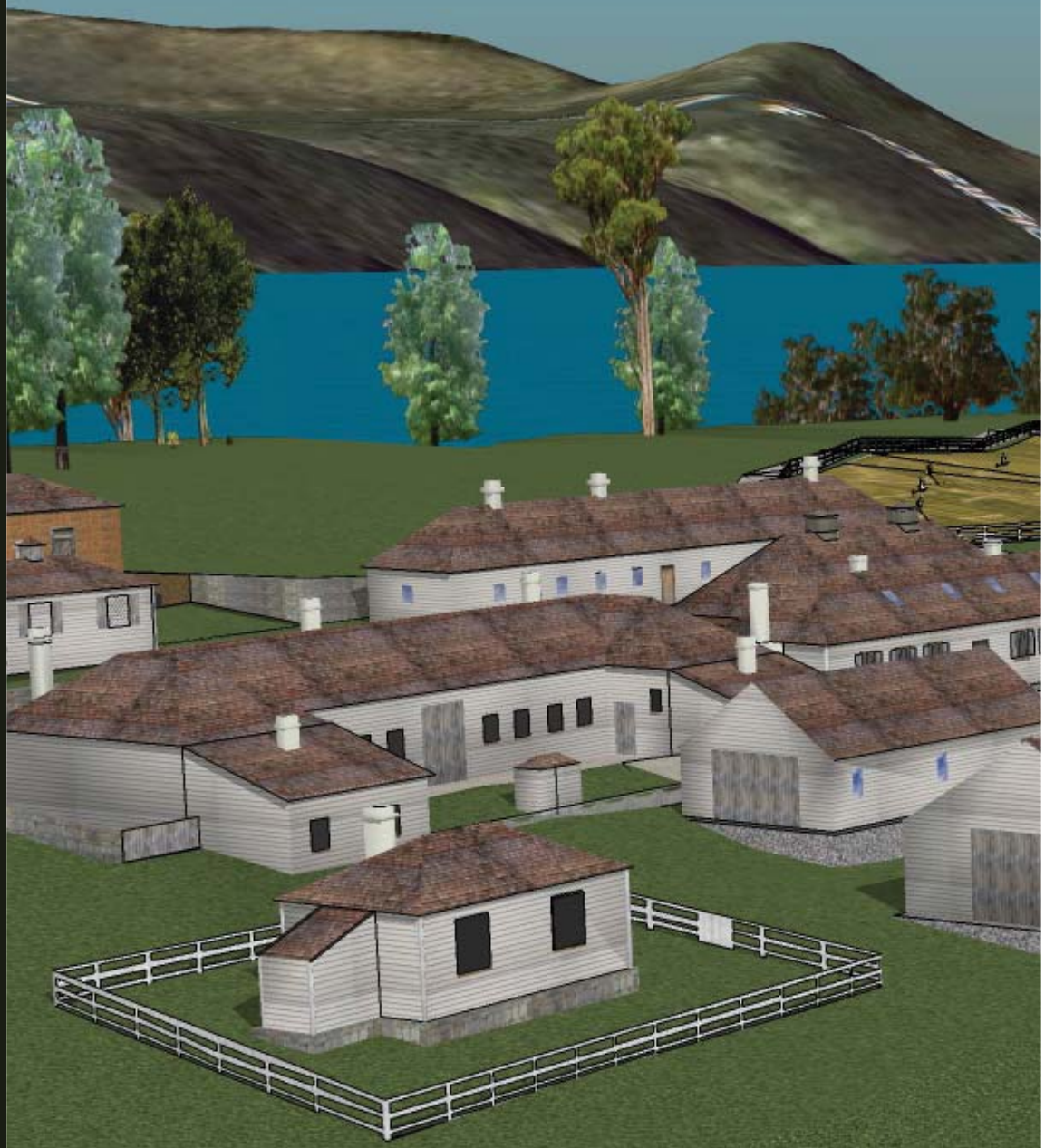
DigIt

Volume 2, Issue 2



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Email: dig.it@flindersarchsoc.org
Web: flindersarchsoc.org
Twitter: @FlindersArchSoc
Facebook: /archsocdigit
Join our free mailing list: archsoc@flinders.edu.au

DigIt

Editorial

Dig It is a community product. The total number of people involved in writing, editing, formatting, reviewing, layouting and printing this issue were 39 from 24 different institutions – and that does not even include the greater number of people who provide helpful comments and ideas along the way, or write and talk to us to let us know they appreciate our work – all of which are very important things to keep us going. Special thanks goes out to ArchSoc, who are always there in the background offering practical help at the most critical times.

Compared to the 2014-1 issue, this second issue of 2014 has a more local touch, but still includes reports about archaeological work being done in places as far away as Thailand, Italy, the UK, and South America. We are proud to have encouraged a number of undergraduate and Masters students to publish their thoughts and research. We want to particularly develop this part of the journal by encouraging fresh new authors to share their ideas. One step towards this goal was a book review Master Class, held in November together with Dr Alice Gorman, book review editor of *Australian Archaeology*, that encouraged 16 students to write reviews for *AA* and *Dig It* – two of which readers can find in this issue.

And since *Dig It* is a community product many editors and review panel members will stay on in 2015 when Jordan Ralph will take over editor-in-chief with new ideas and enthusiasm. During the last weeks, we have been preparing ideas for making *Dig It* even more successful in the future. The 2014 *Dig It* team would like to thank ArchSoc for giving us the opportunity to be part of a rewarding and creative experience. I personally would like to thank all authors, editors, and reviewers for the hard work and dedication that is needed to create one of only three peer-reviewed archaeology student journals in the world: *Dig It*!

Jana Rogasch
Editor, *Dig It: The Journal of the Flinders Archaeological Society*
<jana.rogasch@flinders.edu.au>

ArchSoc members during Total Station and GPS workshops (photographs by Dianne Riley, 2014)

President's Address

The second half of 2014 was a busy one for the Flinders Archaeological Society. During this period not only did the Society support University events such as O'week in late July and the Open Day in early August, it undertook a new direction. Under the guidance of a new look Executive Committee, ArchSoc organised a series of workshops in order to allow members the opportunity to further develop their professional skills. Participants came together in a relaxed atmosphere and in total three workshops have been held since July; two Total Station workshops (August and September), and a GPS workshop (October). Thanks is especially given to the two professionals, Rob Koch and Jordan Ralph, who gave their time pro bono to ArchSoc, and who also committed to undertaking further workshops in 2015. ArchSoc continued to support the Flinders University Department of Archaeology's Thursday Seminars in 2014 and looks forward to continuing to do so in 2015. In November, ArchSoc also supported the Book Review Master Class with Dr. Alice Gorman.

In October, ArchSoc was asked to take part in the Highercombe Museum Vintage Fair. This was a direct result of the involvement of ArchSoc members in the public archaeology event carried out during *About Time: South Australia's History Festival* in May. As a result of its connection with Highercombe, ArchSoc went on to present a brief overview of the value of potential relationships with branches of the National Trust, at the State Conference of the National Trust of South Australia on 19th November. This presentation was undertaken with a view to setting up future opportunities of field work and research for ArchSoc members.

Overall, however, membership was down for 2014 and this is something that needs to be addressed in 2015. Membership fees will, however, remain at $15, with no concessions, for the coming year. The ArchSoc 5-year-plan (a product of the Forum held in November) is exciting and offers future committees the benefit of an in-place strategy for the future direction of ArchSoc.

In review, 2014 has been an innovative and productive year. To ensure that the vision for the future direction of ArchSoc materialises, continued energy and commitment from all ArchSoc members will be needed in 2015.

Dianne Riley
President, Flinders Archaeological Society 2014
<rile0066@flinders.edu.au>

Dianne Riley, Adeena Fowke and Aletta Fowke at the ArchSoc stall, Flinders University O'week (photograph by Susan Arthure, July 2014)

Virtual Archaeology and New Possibilities for Historic Site Interpretation:

A case study from Point Puer, Tasmania

John Stephenson

Heritage Tasmania, <john.stephenson@dpipwe.tas.gov.au>

Abstract

The act of interpreting historic sites without compromising their integrity is an art which requires careful balancing. The use of digital technology to record, analyse and interpret historic sites has become widespread, although the Australian heritage sector is yet to fully embrace the opportunities. The Point Puer Boys' Prison at Port Arthur, Tasmania, has been used as a case study to test the relevance of digital technology to the field of archaeological interpretation. A complete 3D digital reconstruction of Point Puer was created, which has then been used as a basis to demonstrate possible interpretation and education techniques. This project was aimed to be a technology demonstration for the Australian heritage sector, illustrating how digital technology can be used as a management tool at historic sites using free software that is accessible to the general public.

Virtual archaeology

Virtual archaeology is a continuation of traditional cultural heritage research utilising modern digital techniques (Koller et al. 2009). Digital technology allows historic sites that are no longer visible or accessible to be recreated in a virtual environment (Ch'ng 2009). Visual representations are a powerful tool for disseminating scholarly information, and are regularly used by the heritage sector (Frischer 2008). The first virtual recreations of historic sites were created in the 1990s when expensive 3D Imaging Centres were first constructed (Stone and Ojika 2000). Today the same technology is available on a personal computer using software programs such as *Autodesk Maya* and *3D Studio Max* (Ch'ng 2009).

Digital recreations have the advantage over physical reconstructions as they can be created at a scale of 1:1 and can be easily changed or improved when additional information comes to light (Guidi et al. 2005). The digital nature of a recreation also means it can be easily shared with other scholars (Zara and Slavik 2003). This is important as a comprehensive digital recreation of a site requires an interdisciplinary approach. It requires input from historians, archaeologist, architects and digital artists (Wells et al. 2010).

Traditional surveying methods can be used to collect spatial data from extant buildings. Photogrammetric techniques are useful for recording buildings with simple shapes (planer polygons, cylinders, cones) while more complex shapes require laser scanning (Lerones et al. 2010). Where the object no longer exists it is essential to conduct extensive research into the location, size, form and materials used to construct the original feature so as to create an accurate representation that will stand up to scholarly debate (Styliadas et al. 2009).

Despite the best efforts of the researchers there will always be some features that cannot be confirmed or questions that cannot be answered. No recreation will ever be completely accurate. Winterbottom and Long (2006) believe it is important to acknowledge this uncertainty. Uncertainty in digital representations can be represented by different coloured buildings, semi-transparent buildings, or by identifying the level of confidence in supporting data (Dylla et al. 2010:62; Koller et al. 2009).

Virtual archaeology is a growing component of the archaeological sector, acting as a tool for archaeologists to present their findings and conclusions to a wider audience, often to people who are not professionals in the field (Van Dyke 2006). Three dimensional representations and fly-throughs are common ways to present this information, and are often found at information kiosks or as video displays at historic sites (Ch'ng 2009; Vlahakis et al. 2002). The technology allows archaeologists to educate, not just to entertain the public, distributing information over the internet and through popular media (Frischer 2008; Van Dyke 2006).

Augmented reality

Kiosk-type information booths with touch screens and fly-through video displays are common interpretation methods at historic sites (Vlahakis et al. 2002). The latest developments in the field have included location based Augmented Reality (AR), where information from a virtual world is combined with information from the real world (Ivanova and Ivanov 2011). This information can be displayed using smartphone applications, static Computer Augmented Virtual Environment (CAVE) displays or location-based Head Mounted Displays (HMD) which can create a fully immersive experience (Haydar et al. 2010; Nassar and Meawad 2010). The release of the *Google Glass* project, which has been referred to as 'wearable computing', represents the emergence of immersive augmented reality technology that is available to the general public (Olmedo and Jorge 2013:63). Augmented Reality makes it possible to compete in sporting events at the ancient Olympic Games, to take a guided tour of Notre Dame Cathedral by a medieval monk (Ch'ng 2009), or to search an underwater shipwreck for artefacts without getting wet (Haydar et al. 2010).

Many of the published examples have been developed as prototypes and technology demonstrations, and therefore do not always present practical setups that can be adopted by other heritage sites (Nassar and Meawad 2010). The immersive experience of HMD technology that allows a user to enter a virtual environment is impressive, however the few quantitative studies conducted in the field have found that users are more comfortable using smartphone or tablet devices compared to glasses or a full head set (Nassar and Meawad 2010; Olmedo and Augusto 2013).

Ivanova and Ivanov (2011) have demonstrated that augmented

This article was adapted from the report Digital Recreation of Point Puer Boys' Prison. *For further reading please consult:*

<http://www.flinders.edu.au/ehl/fms/archaeology_files/dig_library/directed_studies/ARCH8404_JStephenson_Report.pdf>

reality technology can be used in the classroom by students to gain an increased understanding of spatial concepts, and that it supports the students with their own self-guided investigations of a subject. Unfortunately there have been few quantitative studies to support that the same technology can help students or visitors to gain a similar understanding of spatial relationships at an historic site. Nassar and Meawad (2010) believe that more quantitative research is needed in this field.

Australian context

Despite the above international studies that demonstrate the effectiveness of this technology, there are limited examples of the Australian heritage sector embracing its potential. The following projects have gone some way to addressing this gap in the sector. The *AE2 Commander* project presents an educational history experience in a gaming environment. It recreates the experience of commanding the Australian submarine that sailed through the Dardenelles during the Gallipoli campaign in 1915 (Brogan and Masek 2011). Players are guided through the game by a historically accurate narrative which is based on information from diaries and reports from the National Archives Office of Australia and the Australian War Memorial (Brogan and Masek 2011).

SahulTime is an Australian project that combines spatial and temporal data presenting it in a geographic web browser. In effect it represents a satellite view of the changing landscape over epochs of time and is accessible over the internet (Coller 2009). *Critical Masses* is a pilot project investigating the potential of smart-phone based augmented reality interpretations for Australia's Cold War historic sites, including abandoned atomic test sites (Broderick et al. 2009).

The above examples demonstrate that the use of digital technology is creeping into the Australian heritage sector, but the industry still has some way to catch the rest of the world. It is perplexing that this has not been introduced more widely in Australia. Perhaps this is because of the lack of quantitative data to support the benefits (Ch'ng 2009), a fear of prohibitive costs created by early examples (Olmedo and Augusto 2013), or the technology appears too complex (Nassar and Meawad 2010). The following project aims to dispel some of these common misconceptions.

Figure 1: Surface remains at Point Puer, representing what is left of the Trades Area where hundreds of boys slept, ate, studied and were taught trades that would find them employment once released from prison (photograph by the author, October 2012)

Point Puer

The Point Puer Boys' Prison was the first dedicated juvenile detention centre in the British Empire, operating between 1834 and 1848, during which it housed over 3,000 boys aged 10-17 (Tuffin 2007). There are currently no standing buildings at the prison, therefore, like many archaeological sites it can be difficult to picture how the prison looked and operated. The location is now part of the World Heritage listed Port Arthur Historic Sites, in Tasmania, and managed by the Port Arthur Historic Sites Management Authority. Guided tours of the archaeological remains are conducted at the site, these are restricted to the location of the Boys' Barracks, Workshops and Administration buildings, which are referred to collectively as the Trades Area. Other parts of the Prison are now overgrown or simply too far to walk to in the allotted time for the tour.

Point Puer is an ideal location to test the effectiveness of digital archaeology. The present site consists of stone retaining walls and building foundations, landscape features that include cuttings and depressions interspersed with areas of thick vegetation (Figure 1). The lack of extant buildings and the thick vegetation provide only a small insight into how the site looked and functioned while operating. Digital technology represents an opportunity to increase understanding and improve visitor experience to the site. It meets the best practice management principles suggested by the Burra Charter by minimising any irreversible physical impact on the site (Australia ICOMOS 2013).

Reconstructing Point Puer

An accurate reconstruction of the Point Puer Prison was enabled because of the large amount of archival information available. Maps, building plans, contemporary reports and archaeological surveys help us to build a picture of how Point Puer may have looked (Tuffin 2007).

The convict architect Henry Laing completed a record of all the buildings on the Tasman Peninsula in 1836. Each building has a plan and elevation (Figure 2), some with additional internal layouts (TAHO 2014). Each feature in Laing's plans (size of doors and windows, pitch of the roof, and overall building dimensions) were measured and recorded. These measurements were then used to create digital representation of all the buildings. Each feature was constructed out of a series of basic polygons using the 3D modelling software *Sketchup*. *Sketchup* was used as it is free to download, exports models that can be displayed directly in *Google Earth*, and is used widely as an education tool in

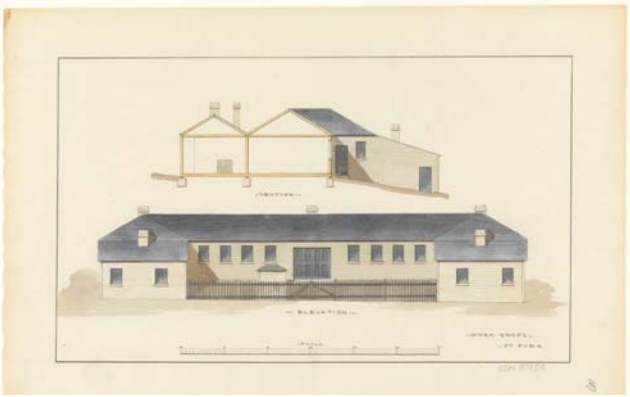

Figure 2: Architectural plan and elevation of the Point Puer Workshops, drawn by the convict architect Henry Laing in 1836 (Tasmanian Archive and Heritage Office CON87-1-59)

schools (Wells et al. 2010). Textures were created using photos of existing buildings so that the collection of basic shapes was made to resemble weatherboard, brick or stone walls.

A total of 23 buildings and features were reconstructed in this way. Each building or feature was constructed in a separate file, therefore if any changes or edits were needed, this could be done without affecting the rest of the models. These individual models represent the first time in over 160 years that the buildings drawn by Henry Laing could be seen in three dimensions. Allowing a user to view the buildings from different angles makes the buildings come to life on the screen. Location information was then required for each feature in order to place the buildings in the correct 2D space.

Accurate spatial information is imperative for any successful recreation of an historic site, and a basic GIS is the starting point for all virtual recreations (Winterbottom and Long 2006). Location information was derived from two maps drawn in 1838 and 1845, which were georeferenced in using the GIS software *ArcGIS*, using spatial data from the *Land Information System Tasmania* (DPIPWE 2012). The georeferenced maps were used to identify the location of each building, and to extract measurements for buildings where detailed plans could not be found.

In a similar fashion to the *Rome Reborn* project each feature was classified according to how much information was available, and the degree of confidence attributed to the reconstruction (Dylla et al. 2010). Where Laing's plans were available and archaeological remains support these plans the building was given a Class I rating; indicating a high degree of confidence. If the archaeological remains differ in some way to the architectural plans (ie. the Bakery or Chapel) the building was given a Class II rating. Class III buildings have very limited information available but were identified in maps and reports (i.e. the officer's barracks which were built post-1836 and therefore not recorded by Laing). Class III features were reconstructed using building plans from other convict sites in Tasmania, and therefore not claimed to represent a highly accurate representation of these buildings. These represent buildings of similar use, at prisons in operation at the same time period, and in all likelihood, designed by the same engineers as that at Point Puer. Another option was to leave the buildings out, but this would be less accurate as buildings were clearly marked on maps, and recorded in reports. This classification system, stored in a separate database, identifies the limitations of the reconstruction as recommended by Winterbottom and Long (2006), and allows for edits to be made if additional information is discovered in the future.

Digital elevation model

A Digital Elevation Model (DEM) is a GIS representation of the Earth's surface, usually derived from 2D contour information, and presented in a 3D digital format (Delaney 1999). The creation of DEMs for historic sites has proven difficult and time consuming for previous projects (Bailey and Schroader 2011; Wells et al. 2010). For this project it was initially planned to import a DEM directly from *Google Earth*, however it was found that this was not accurate enough for the purpose. Instead a contour map with 1m interval was created in *ArcGIS* by extracting height information from an airborne LiDAR dataset. LiDAR is a remote sensing technique that uses reflected light to create an image of an object, the use of this technology is becoming common in the archaeological sector (Challis et al. 2011).

This accurate contour map was exported from *ArcGIS* as a KML (Keyhole Markup Language) file, which is the file format created for *Google Earth* containing spatial information, and imported into *Sketchup* where the 3D models of buildings were stored (Lyle and Eby 2010). These contour lines were used to create a wiremesh reconstruction of the terrain. The completed 23 buildings were then placed on the 3D terrain, at the locations identified on the georeferenced maps. Textures were added to this surface, creating the impression of grass fields and stone outcrops, and additional features were added including trees, paths, fences and people to create a final model (Figure 3).

Figure 3: Complete digital recreation of what the Point Puer Boys' Prison may have looked like in 1845, when the population of the prison peaked at approximately 800 juvenile inmates (created by the author, May 2013)

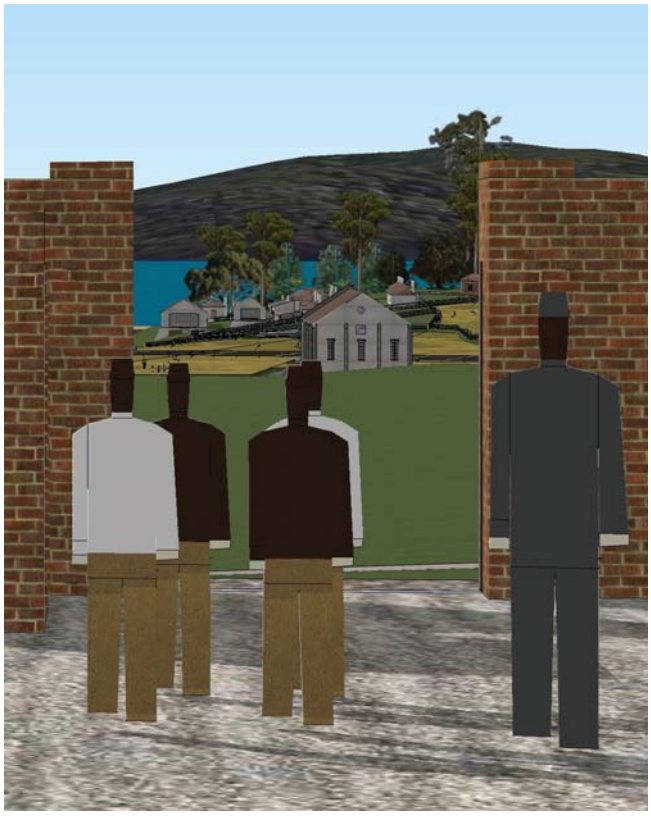

Figure 4: Reconstructed view from the entrance gate of the Gaol, looking directly at the Chapel and Trades Area beyond (created by the author, May 2013)

Analysis

The completed model can be viewed from any angle, including the eye level of a person, allowing for visual analysis to be conducted. Traditional viewshed analysis in a GIS environment has limits (Winterbottom and Long 2006) but in a real-time 3D world it is possible to look at the same scene as a person at the prison 160 years ago. In the case of the Point Puer reconstruction this has created some interesting findings. Commandant Booth, who oversaw the construction of the prison, was criticised for the placement of some buildings, especially the large distance between the Trades Area where the well-behaved boys were accommodated and the Gaol, where misbehaving boys were sent to be punished (Horne 1843).

When we stand in the gateway of the virtual Gaol (Figure 4), the same doorway which the boys would have walked through each day on their way to perform hard menial labour, we can see the Chapel directly in front and the Workshops behind. This was not a coincidence, boys would only be released from Point Puer when they were proficient at reading and writing which was taught at the Chapel, and had mastered a trade which they learned at the Workshops, separating the miss-behaving boys was itself a form of psychological punishment that was common in the convict system (Horne 1843). Every time a prisoner walked out of the gates of the prison he was reminded of his transgressions, and of the opportunities that he was missing out on compared to his better behaved colleagues. It is not possible to obtain this same view at the site today as the Gaol area is now overgrown with vegetation, nor would a binary viewshed analysis in GIS identify such hidden details (Ogburn 2005).

As the reconstruction is created in a digital environment, it is easy to create copies, to make changes, and to compare different versions. Different models were created of the site at five year intervals, illustrating how the site developed over time. This was achieved by simply copying the original model and turning the layers on or off according to the year that a building was built. Some of these changes represent the evolution of ideas pertaining to juvenile detention in the post-enlightenment world, while others demonstrate how the staff adapted to external pressures such as directions from London and Hobart, and an influx of boys sent directly from England in the mid-1840s (Tuffin 2007). This is a major benefit offered by a digital model over a physical reconstruction, which can only capture one time period (Frischer 2008).

Figure 5: Stone foundations of the Chapel at Point Puer, and the same view as seen using a smartphone which combines the digital reconstruction (created by the author, October 2012)

Interpretation

The completed 3D model represents a tool that can be used to help interpret Point Puer. Currently interpretation at the site consists of a guided tour which takes about 1 hour and stops at the remains of several buildings, all in the Trades Area of the prison. A map and one set of buildings plans are presented as visual aids. As discussed in Section 1.2 it is possible to construct a fully immersive AR environment using Head Mounted Display (HMD) technology to interpret the site but this is not practical, and it is not certain that is what the clients want (Nassar and Meawad 2010). Instead a smart-phone based AR option was investigated for Point Puer which represents a significant advance over the current interpretation, while not taking visitors out of their comfort zones.

It is not anticipated that the Port Arthur Historic Site Management Authority will alter the current guided tour setup in the near future. This simplifies the setup of an AR interpretation because the location component, which is often the most complex to set up (Nassar and Meawad 2010), is not required. Instead a visitor can view an AR image at each stop while the tour guide is explaining the significance of that feature (Figure 5).

At Point Puer the ability to combine information from the virtual world with that of the real world is very important as half the site is covered in thick vegetation. The guided tour is restricted to well-defined tracks in the Trades Area, but the smart-phones can be used to visualise the view from this area towards the Chapel and the Gaol area, which had previously been very hard to visualise. A smartphone-based AR interpretation does not just benefit visitors at the site. It can also help those with restricted mobility, who cannot take part in the guided tour due to the rough terrain and steps, but can still gain an understanding by seeing an AR display from either the Port Arthur side of Carnarvon Bay or from the comfort of a boat tour.

Education

Australian History is now taught as part of the Australian Curriculum, and school teachers are seeking interesting and entertaining ways to present this information to their students (Australian Curriculum 2012). A series of still shots has been collated as a mockup of a tablet-based application where students can pick a historic character from Point Puer and join them for a day in the life of a convict prison. They can experience life as a First Class Convict, a Third Class Convict (a boy who had reoffended and was sent to the Gaol area), a Soldier or the Superintendent (Figure 6). During this virtual tour a student learns what was on the menu for breakfast at a convict prison, what clothes the boys wore, what farm tools were used in the paddocks, and what the boys did for entertainment. This information is based on diary entries and official reports (Horne 1843; Humphrey 1997).

The *Sketchup* file of this digital recreation can be imported directly into *Google Earth* and viewed as a complete model in a format in which many students are already familiar (Wells et al. 2010). No longer are digital recreations only accessible by academics or seen on television documentaries. The model can be accessed in a classroom, where students can take control of their own experience, viewing the site from different angles and zooming in on areas of interest. Figure 7 shows a screen shot of the model displayed as a *Google Earth* layer, complete with flags above buildings that can be clicked for additional information.

Figure 6: Screenshots from a mockup for an interactive tablet based lesson about life in a convict prison (created by the author, May 2013)

Conclusions

This project is a technology demonstration for the heritage sector. It illustrates how digital technology can be used as a management tool at historic sites while using free software that is accessible to the general public. It is hoped that this project has demonstrated that the cost of this technology is not prohibitive and that 3D modelling does not require any skills beyond the reach of a current GIS user.

It is clear that more quantitative research into the experience and expectations of visitors at historic sites is required. This is especially important as the use of technology is advancing rapidly and people are becoming more familiar with the use of mobile phones and tablets to access information. Interpretation platforms should be based around client expectations and requirements. It is difficult to confidently develop such technologies until this initial research is done.

This project has gained unexpected interest from many sources in the

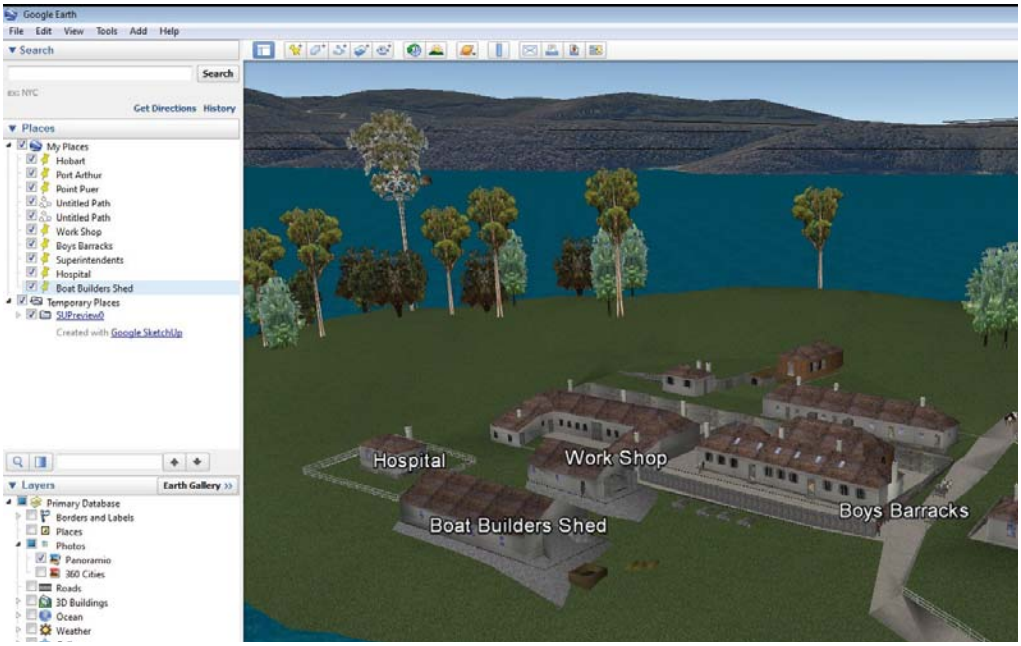

Figure 7: Digital Reconstruction displayed as a layer in Google Earth (created by John Stephenson, October 2012)

cartographic, heritage and education sectors. It is hoped that this growing interest in the field will inspire others to experiment with interpretation technologies that can be used by the archaeology and heritage sectors.

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Correspondence to the Editor should be addressed to:

The Editor, Dig It c/o ArchSoc
Department of Archaeology
Flinders University
GPO Box 2100
Adelaide, 5001

or email <dig.it@flindersarchsoc.org>

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