Journal of Archaeological Science 76 (2016) 48–55

Contents lists available at ScienceDirect

Journal of Archaeological Science

journal homepage: http://www.elsevier.com/locate/jas

Remote sensing landscapes of water management on the Victorian goldfields, Australia

Peter Davies*, Jodi Turnbull, Susan Lawrence

Archaeology Program, La Trobe University, Bundoora, Vic, 3086, Australia

ARTICLE INFO

Article history:
Received 24 May 2016
Received in revised form
17 October 2016
Accepted 29 October 2016

Keywords:
Remote sensing
LiDAR
Water
Mining
Australia

ABSTRACT

The integration of remote sensing technologies, GIS and mobile mapping platforms is producing new insights into the archaeology of historic water management systems. Our case study of the gold rush in 19th-century Victoria, Australia, has identified ditches, dams, mining claims and sediment sinks at site and landscape scales that are normally obscured by dense vegetation. New technologies including LiDAR provide solutions to these challenges and make possible the analysis and interpretation of these spatially diffuse but historically linked sites. For the first time it is possible to record and analyse a complex archaeological landscape in north-east Victoria that is the result of alluvial mining activity in the later 19th and early 20th century. This approach offers a significant advance in Australasian archaeological science and provides an important model for other researchers examining industrial landscapes.

Crown Copyright © 2016 Published by Elsevier Ltd. All rights reserved.

1. Introduction

The integration of various remote sensing techniques has become increasingly common in archaeology in recent years, including the investigation of ancient and early modern water supply networks (e.g. Evans and Fletcher, 2015; Fernández-Lozano et al., 2015; Hanus and Evans, 2016) and historical archaeological landscapes (e.g. Johnson and Oiumet, 2014; McNeary, 2014; Poirier et al., 2013; Ryzewski and Cherry, 2015; Štular et al., 2012). The approach facilitates the identification of subtle archaeological features at the landscape scale that might otherwise remain undetected in conventional field survey. LiDAR imagery in particular provides a powerful tool to examine archaeological landscapes at a range of scales. To date, however, the integration and use of these datasets has been rare in Australian and indeed Southern Hemisphere archaeological contexts. This may be due in part to the high cost of surveying countries of large land mass. Even in Victoria, a relatively densely settled part of Australia, airborne LiDAR coverage to date is only 34% of the state, or about 78 000 km^2 out of a total land area of 228 000 km^2 (Geoscience Australia, 2016).

In this paper we combine new remote sensing technologies including LiDAR with advances in mobile mapping platforms to observe and accurately map large-scale archaeological features associated with the management of water during the Australian gold rush of the 19th and early 20th century. We identify individual mining locations and reservoirs in relation to landscape features including the ditches (known as races) used to transport water, along with downstream landforms created by redeposited mining sediment, in order to develop more nuanced interpretations of how water was used and managed at a systemic level. This research intersects with industrial, historical, environmental and geospatial archaeologies and offers an important new approach to understanding these extensive archaeological networks.

Water was crucial to every aspect of gold mining in 19th-century Australia, with miners going to great lengths to capture and divert supplies to their claims. Their activities left enduring physical scars on the landscape that show up archaeologically as elaborate networks of water races, dams and reservoirs, dumps of mining debris, eroded waterways and downstream sedimentation. The Ovens goldfield in north-eastern Victoria was an important centre of water management with surviving evidence of extensive mining water systems and large scale environmental change dating from the 19th century. Much of this evidence, however, is now obscured by dense vegetation cover. The case study presented here concerns the activities of John Pund, who worked the Three Mile Creek area at Baarmutha from 1865 until his death in 1915, along with a number of contemporary miners who constructed mining water

* Corresponding author.
E-mail addresses: peter.davies@latrobe.edu.au (P. Davies), j.turnbull@latrobe.edu.au (J. Turnbull), s.lawrence@latrobe.edu.au (S. Lawrence).

http://dx.doi.org/10.1016/j.jas.2016.10.009
0305-4403/Crown Copyright © 2016 Published by Elsevier Ltd. All rights reserved.

systems in the same area (Fig. 1). We integrate LiDAR airborne survey data with geo-referenced historical plans, 3D modelling and archaeological survey to investigate and understand this complex landscape of colonial water management.

The integration of historical GIS with remote sensing data provides an efficient and effective approach to archaeological survey at the landscape scale. Miners diverted large volumes of water from one watershed into another, exploiting not only surface and groundwater flows but the shape of the land as well. Our approach facilitates the deconstruction of these industrially and temporally rich landscapes and provides new ways to visualise and analyse changes over space and time. The approach reveals the scale and complexity of water diversions on the goldfields and the widespread and enduring environmental impact of mining activity in the 19th century.

2. Materials and methods

Airborne LiDAR imagery has been crucial for our work on the Ovens goldfield because the area is heavily vegetated with limited surface visibility of archaeological features. LiDAR survey of waterways was undertaken by Victorian government agencies in 2010–2013 to assess riparian stream conditions across the state using remote sensing data. The project included the generation of multi-phase LiDAR data to map physical form metrics including stream bed, top of bank and river centre lines. Generally a swathe of 1.5 km along the waterway was captured in survey, which means that historical water races and associated archaeological remains of mining activity are often included in LiDAR coverages. The available coverage for our study areas extends for approximately 7 km along Three Mile Creek and thence along Hodgson Creek.

The data resolution of LiDAR had an average point density of 4.00 pts/m with horizontal accuracy of $\pm$ 30 cm and vertical accuracy of $\pm$ 20 cm. This resolution was highly effective for identifying mining features including minor water races heavily obscured by vegetation. For visualising the landscape we used a 2D 1 m digital terrain model (DTM) provided by the Statewide Rivers Project, with the grid projected on the unthinned ground point dataset. The gridded DTM dataset has been interpolated across voids that may be caused by either no-return due to water bodies, or removal of buildings, vegetation or other above-ground features. Hill shading (north-east sun position at 45° angle) provided the most intuitive visualization of features. Slope shading did not aid interpretation (Hesse, 2013; Štular et al., 2012; Zakšek et al., 2011).

Another important source of evidence has been historical maps and water survey plans held by Public Records Office Victoria. Large scale plans were created by District Mining Surveyors as part of miners' applications for water right licences, based on regulations under the *Mining Statute* 1865. Race alignments were originally surveyed in short contiguous segments, with each segment marked with magnetic bearings and distances in links (7.92 inches or 201 mm each). Most of the plans available for our study date to the 1870s and 1880s. Plans show the intended alignment of a water race, pre-existing races and mining claims, along with dams and tracks, creeks and gullies, neighbouring property boundaries and springs that increased the water supply. The total volume of water to be diverted was also indicated, which on the Ovens goldfield was often between 500,000 and 1 million gallons (2.27–4.55 megalitres) per licence each day.

We have geo-referenced a series of these plans using MapInfo GIS software with base data supplied by the Victorian government (Vicmap) including cadastral, vegetation, transport and hydrology datasets. The historical maps can then be used to identify potential archaeological features, including races, dams and other water supply infrastructure, in association with modern geographical markers. Races and dams can be traced and superimposed on topographic maps, Google Earth or LiDAR to reveal the location of and relationships between separate elements of mining water systems and modern surface features.

We have utilized mobile mapping applications such as Avenza PDF maps and Galileo in iPads as an alternative to conventional dGPS. The larger screen interface is particularly well suited for locating and recording features shown on geo-referenced historical maps while in the field. The ability to incorporate spatial data from

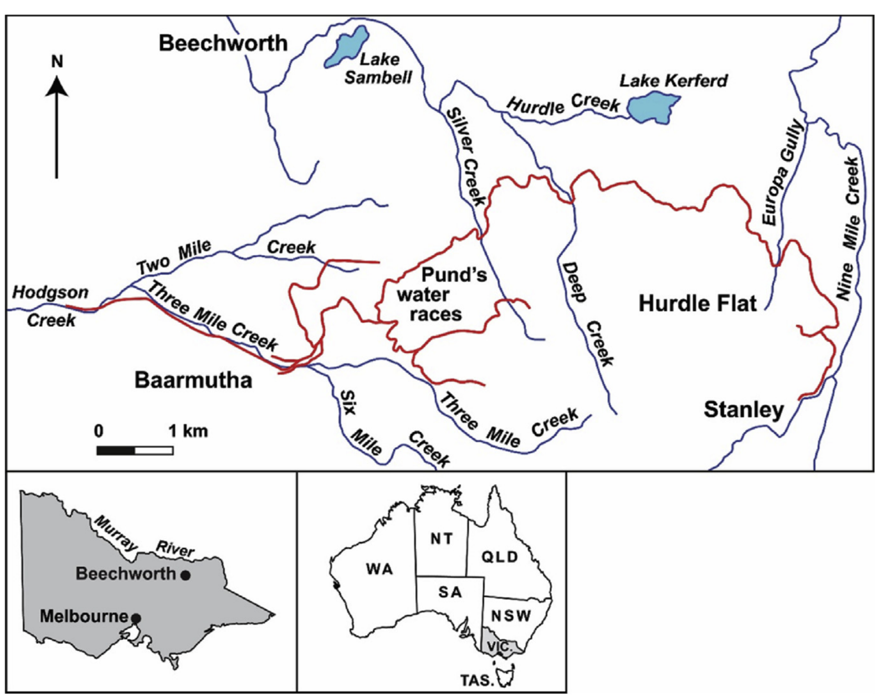

Fig. 1. Location map showing Pund's water race network.

Download English Version:

https://daneshyari.com/en/article/5112093

Download Persian Version:

https://daneshyari.com/article/5112093

Daneshyari.com