

# The role of historical sources in the restoration of Long Swamp, Discovery Bay, Victoria

By Mark R. Bachmann

*Inspired by the success of restoration efforts in the adjacent Piccaninnie Ponds Karst Wetlands Ramsar site, the local community was anxious for progress to address observed changes to the hydrology of Long Swamp, near Nelson, Victoria. Uncertainty about the original character and condition of the wetland system required deep exploration of a vast range of historical reference material. This is a story of how disparate sources of historical information can complement modern scientific methods, help resolve contentious issues and contribute to refining reference ecosystem models to improve restoration outcomes.*

**Key words:** Discovery Bay Coastal Park, Glenelg Estuary, Ramsar, reference models, Wetland restoration.

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**Figure 1.** Long Swamp from Oxbow Lake (A) to Lake Momboeng (B), showing the Glenelg River Mouth (1) and ocean outlet locations at White Sands (2) and Nobles Rocks (3). The hypothesised original main direction of surface flows was from east to west (from B to A). N = north.

## Introduction

East of the Glenelg River mouth, on the far south west coast of the State of Victoria (in south-eastern Australia), lies Long Swamp, a 15 km long continuous chain of wetlands, impounded by the adjacent sand dunes of Discovery Bay. The wetland system commences at Lake Momboeng (a permanent, ground water-fed freshwater lake) in the east and slowly flows in a westerly direction towards sea level, via Oxbow Lake and the Glenelg River estuary, supplemented along its length by rainfall and ground water discharge from a shallow, unconfined tertiary limestone aquifer.

Despite progressive reservation of Long Swamp since 1966 (as part of what is now the 10,460 hectare Discovery Bay Coastal Park), various members of the local community in the nearby township of Nelson had expressed concern for decades about

the impact that two direct outlets to the ocean through the sand dunes were having on wetland condition (Fig. 1).

Although most locals appeared to be certain that these outlets were artificial, there was no modern consensus among the relevant government authorities on the matter, nor was there a clear or shared understanding of what regulation or blocking of these outlets might achieve. As a result, the issue stalled for many years, with the unmet local appetite for action leading to community frustration.

This account describes how a deep investigation into a wide range of original historical materials complemented modern scientific methods and understanding to build a new consensus for action which ultimately resulted in restoration works at Long Swamp (reported in EMR summary <https://site.emrprojectsummaries.org/2016/03/07/long-swamp-discove>

ry-bay-coastal-park-victoria/). This blended approach to restoration planning – particularly the more rigorous identification of reference ecosystem models (SER 2004; Gann *et al.* 2019) – is relevant to those interested in tackling complex projects that involve long-term ecological changes which precede modern data collection methods. It encourages ecological restoration practitioners to consider parallel investigation and analysis of historic information sources, in its diversity of formats, to complement the use of modern scientific methods.

### **An Invitation from the Local Community (2012)**

Despite the size, reserved status and impressive biodiversity values of Long Swamp, including supporting a diverse suite of nationally threatened species, the local community – especially members of the Nelson Coast Care Group – had expressed concern for decades about changes they were witnessing in the character and vegetation composition in Long Swamp. Locals often spoke of open water aquatic habitats being replaced by dense stands of reeds and sedges, in many places even being invaded by encroaching shrubs. They considered that this observed change was associated with a long-term drying trend, which they linked to the presence of two ocean outlets through the dunes (Fig. 1).

Impressed with restoration (outlet regulation and drain blocking) works at the nearby Piccaninnie Ponds Karst Wetlands from 2007 (see Bachmann 2016a), Nelson locals gained renewed hope that similar activities might be possible in Long Swamp. Consequently, Leila Huebner OAM, on behalf of the Nelson Coast Care Group, invited Nature Glenelg Trust (NGT) to help them overcome perceived agency resistance to restoring the hydrology of Long Swamp. From that point forward, NGT became actively involved in Long Swamp, also

liaising closely with the main government agencies with an interest in the site; namely Parks Victoria, the Glenelg Hopkins Catchment Management Authority (GHCMA) and the Victorian Department of Environment, Land, Water and Planning (DELWP).

Before getting started, and sensing their frustration, NGT recommended that the local community end communications of an adversarial nature with the government agencies; instead focussing on building trust and our collective scientific understanding of the site (Bachmann 2018). This was important because it was immediately clear from reviewing what limited information was readily available that the past and present eco-hydrological values of the site had not yet been adequately documented, despite this being critical to inform a discussion about potential next steps (Bachmann 2016b). A lack of clarity about whether the drying of Long Swamp was indeed a trend caused by anthropogenic drainage, or whether it was within the range of natural conditions for the wetland, explained the hesitation within government agencies to act. Put simply, we needed to develop a new shared and objective understanding of the wetland in both its modern condition and over the historic record, before the need and/or benefits of restoration could be ascertained and appropriate reference ecosystem models and targets could be identified.

To do so, parallel investigations into Long Swamp were initiated by NGT: a field-based scientific assessment of key aquatic values at the site today (new survey work and data collection focussing on fish and frogs funded by the GHCMA; Bachmann *et al.* 2013), as well as a broad historic assessment to determine how the site had changed over time. The latter involved collation of a wide range of historical materials to review, including: survey maps, aerial photographs, diaries and newspaper accounts. While undertaking a scientific assessment of present condition and values

is standard practice in modern ecology, an adequate review of complementary historic information sources is often overlooked.

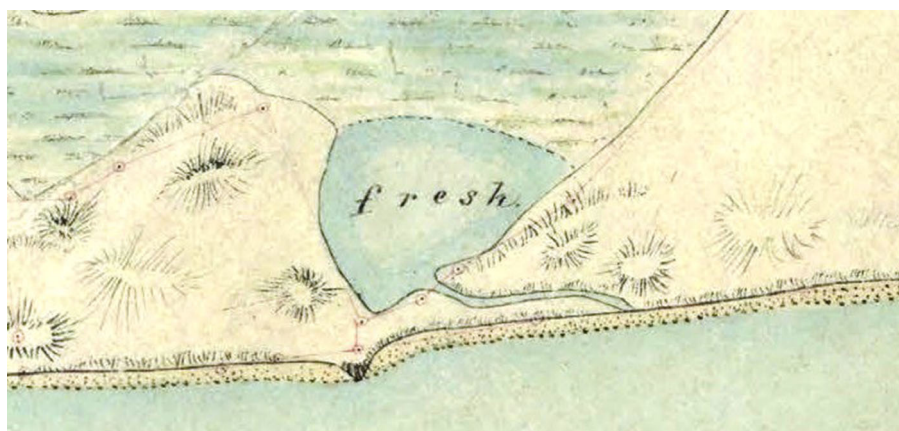
The parallel investigations referred to here, ran both officially (the modern scientific data collection and analysis component) and informally (the historic component) for several years (see Bachmann *et al.* 2018), overlapping with restoration trials in 2014 and 2015 and ultimately leading to permanent works in 2019. The historic investigation is referred to as being informal because the majority of it was completed in the author's own time and was never an officially funded activity nor a formal research project – despite becoming intimately interwoven with the scientific assessment and being fundamental to project success, as described in the following sections of this paper.

### **First Steps towards Defining Site Character and History, and Setting Restoration Goals (2012–2013)**

As the compilation of historic material commenced, I also began informally communicating with people who had a long association with the wetlands of Discovery Bay. As an ecologist with qualifications in environmental science, I did not consciously adopt professional oral history methodologies, as I was not aware of them at the time; however, all conversations were documented (via notes, email exchanges or audio recordings) and informants agreed to share their observations. I first spoke with retired Fisheries and Wildlife officer, Gavin Cerini, who told me of his ultimately unsuccessful attempts to have the two outlets to the sea closed with sand in the early 1970s, using a local bulldozer contractor (Frank Johnson from Greenwald). Gavin told me that he also took personal notes from informal conversations he conducted around that time with elderly

locals. Although he wasn't sure where the files that contained his written notes on the conversations had ended up since his retirement, he recalled that this experience had left him with no doubt that the outlets were artificial (Gavin Cerini, pers. comm., 2012). His account matched a recorded discussion I held a short time later with Edna Millhouse (now deceased) in March 2012, who was in her 90s but had spent the summers of her youth along that section of coast (her father Albert had a property a short distance east of Nelson, adjacent to Long Swamp). Edna stated very clearly that there was no outlet at Nobles Rocks, until she and her sister Joan came across it a short time after it was deliberately opened up in the 1930s (Edna Millhouse, pers. comm., 2012). After this occurred, she observed an immediate reduction in the amount of water that flowed downstream past her father's property, through what was known as Eel Creek, the main flow-path inter-connecting the wetlands of Long Swamp. This narrative fits very neatly with the modern account of a drying Long Swamp, undergoing considerable shifts in ecological character over the decades since. Interestingly, Edna also had no knowledge of the second outlet at White Sands (Edna Millhouse, pers. comm., 2012) which was situated closer to her father's property and indicates that it was not constructed at the same time.

Around the same time, however, potentially conflicting details also emerged. For example, another local landholder and resident (Jim Ewing) who was observing changes associated with drying in Long Swamp adjacent to his property, told me about an old map he had come across that he considered problematic (Jim Ewing, pers. comm., 2012). I eventually tracked down a high quality scan of this map in the Public Records Office of Victoria, the Discovery Bay coastline drawn by Assistant Surveyor Lindsay Clarke in 1850, which very clearly



**Figure 2.** Inset of Lindsay Clarke's coastal survey map from 1850 in the vicinity of Nobles Rocks.

showed an outlet to the sea at Nobles Rocks, in the approximate vicinity of its modern equivalent (Fig. 2).

Jim felt that the channel could have been cut very early on by graziers and, on the basis of similar acts elsewhere to open up more country for grazing, this sounded highly plausible. However, this didn't mesh particularly well with the modern story of a channel at the same location being cut later, by hand, in the 1930s. Of note, natural subsequent closures of this particular outlet over an 80 year period, at least in its modern state and location, had never occurred; casting doubt over whether a natural closure was in fact technically possible at this location. Equally puzzling, the same map also shows a permanent open waterbody, marked 'fresh', connected with that outlet, in a location where no-one in modern times had ever seen a permanent lake as a result of the depth and efficiency of the current outlet. Hence whatever its origin story, it is immediately apparent that this 1850 outlet was in no way functioning like its modern equivalent.

So with more initial questions than answers and substantial gaps in the historic record, I resolved to continue to gather materials in an attempt to resolve these apparent contradictions. For the period of history after 1950, we have the benefit of aerial

photography, government records, other records and first-hand witness accounts of a small number of elderly locals and ex-government employees to draw upon to create an accurate, cross-referenced and scientifically verifiable understanding of the modern state of the wetland. However, gaining deeper insights into site history prior to that time involved locating old maps, explorers' journals, newspaper articles and searching the government archives in Melbourne and Sydney; noting that what later became the colony, and then the state, of Victoria was originally the Port Phillip District of NSW, administered from Sydney until 1851.

While the early history was clearly going to take some time to unravel, the scientifically based historic assessment continued and was able to take advantage of the aerial photographic record in particular. This enabled us to verify that vegetation change in Long Swamp, as observed by locals during their lifetimes, was indeed supported by the photographic record over the past 60–70 years. At the same time, this material also showed substantial changes in the landscape around Long Swamp. On the coastal side, previously bare drifting dunes – their apparent 'natural' state in this location prior to European settlement, when under high density occupation and use by Indigenous people –



appeared to be consuming parts of the wetland in the early photographs. Over time, facilitated by deliberate plantings of marram grass, these drifts have now largely been stabilised by other species of native coastal vegetation. On the inland side of the wetland, vast areas had also undergone dramatic land use change via conversion from mostly open, rough coastal grasslands that were grazed, to commercial Radiata Pine plantation forests (as shown in Fig. 1). Over the same period, many areas of Long Swamp itself, previously leased or owned by graziers who burned it regularly to promote fresh growth for their livestock (according to the recollections of many older locals), had been progressively destocked and left to regenerate as the site was formally reserved and permanently fenced off by the state government.

Indeed, the issue of the potential impact of the plantations on the water balance of the site – given its reliance on ground water discharge – loomed large. Elsewhere in this region, pine plantations established over areas with shallow, unconfined limestone aquifers, which are highly responsive to rainfall, have been shown to have a direct impact on ground water levels and expression (Prosser & Walker 2009). This is a result of both interception of rainfall, preventing recharge (Greenwood 2013) and/or direct extraction, from the root zone of the trees where they reach the water table (up to at least 6 m below the surface) (Benyon *et al.* 2006).

As a result and in summary, it is very difficult to disentangle the potential hydrological impact of three key factors:

- 1 land use change (both within and around Long Swamp);
- 2 the outlets to the sea; and,
- 3 recent climatic trends, on both the water balance and vegetation character of the site.

Indeed, the legitimate uncertainty associated with this question is precisely what had contributed to the hesitation among government agencies about what, if any, course of intervention should be adopted. However, it was and remains NGT's position that this complexity at any site is not sufficient reason for inaction, especially when a collective detrimental impact was leading to observed undesirable ecosystem change, and where proactive management options exist.

Crucially, the broad-scale vegetation transitions that locals had witnessed and we had now documented and independently verified since 1950, such as the invasion of terrestrial coastal dune species (Fig. 3) and wetland shrub invasion (Fig. 7a) into the wetland proper, were no longer in dispute.

In a fortuitous turn of events, around this time, in mid-2012, we also discovered that nature had given us some clues about what was likely to occur, should we decide to act to restrict or prevent flows from the coastal outlets. It turned out that the

smaller of the two ocean outlets at White Sands, which is only accessible by hiking along this remote stretch of coast and unbeknownst to many locals, had in fact gone through an undocumented natural permanent closure since approximately 2005, as a result of a lack of outflows during the Millennium Drought. Subsequent sand deposition along the coast, before the drought broke, resulted in the formation and consolidation of a substantial primary dune, effecting the natural restoration of this central portion of Long Swamp (see Figs 4,5).

Despite being the smaller of the two direct ocean outfalls, this natural closure gave us a key insight into what happens when a decades-long drying trend is reversed through prevention of direct outflows to the ocean from Long Swamp. A dramatic vegetation shift in the deepest recreated wetland habitat near to the coast had occurred, where terrestrial species were drowned and aquatic habitats, including Water Ribbons (*Triglochin procerum*) reed beds – ideal fish and frog habitat – reformed (see Fig. 6).



**Figure 3.** Coast Wattle (foreground) establishing in sedgeland habitat in Long Swamp near Nobles Rocks in 2012, where an area of deep fresh water was mapped in 1850 (refer to Fig. 2). Photo: Mark Bachmann.





**Figure 4.** Panorama of White Sands outlet location on the 25th of July 2012, showing the new fore-dune and the remnants of the former outlet channel to the coast. Photo: Mark Bachmann.



**Figure 5.** Aerial images showing the natural permanent closure of the outlet at White Sands. Note sand deposition and vegetation establishment on the dunes across the former outlet.



**Figure 6.** Drowning of Coast Wattle and transition from terrestrial communities back to aquatic habitat at White Sands in 2012. Photo: Mark Bachmann.

Our early scientific field assessment of fish and frogs in 2012 had also detected small populations of nationally threatened species within isolated portions of Long Swamp where suitable habitat still occurred. On the basis of the aerial photographic record, these habitats were uniformly

shrinking over time, except at White Sands, where vegetation transitions were reversed and threatened fish had been recorded behind the closed outlet. Hence, we determined that any activities that improved the availability of aquatic habitat and wider wetland habitat condition in Long

Swamp were worth considering (Bachmann *et al.* 2013).

Irrespective of the relative contributions of the different threats identified to the observed trend of decline, we deemed that the only viable management intervention available that was capable of reversing the drying of Long Swamp was to manage outflows at Nobles Rocks; noting that approximately 11 km of downstream wetlands potentially dependent on these flows (around two thirds of the wetland system) also occur between this location and the Glenelg River mouth to the west.

### Initial Historic Research and Commencement of the Restoration Trial (2014–2016)

The pursuit of historical information can seem simpler to logically convey and summarise in retrospect than is often the case during the investigation process. Key information from these sources does not generally emerge in a linear or predictable fashion and is more akin to slowly searching for and placing together the pieces of a large jigsaw puzzle whose final picture we do not know in advance. When by chance you discover a critical new piece, the previous perspective of the whole picture can suddenly change. But also, like a puzzle, often you can begin to see enough of the picture as you gather and fit the pieces together, before it is complete, to become increasingly confident about the clearer



understanding you are steadily working towards.

This was effectively the state of play by early 2014, when – although still missing some key pieces of information – the scientific assessments had validated the changes observed by locals and were increasingly being backed by a wider range of historic source material that indicated that the modern outlet at Nobles Rocks had indeed been constructed in the

1930s. For example, consistent with the first oral account I recorded of Edna Millhouse, it emerged from my research that the Glenelg River Angling Club had taken an active interest in closing the outlet at Nobles Rocks in 1953, concerned about the impact of reduced fresh inflows on fishing in the Glenelg River estuary (refer to Appendix S1).

While their efforts were ultimately unsuccessful, the references in the

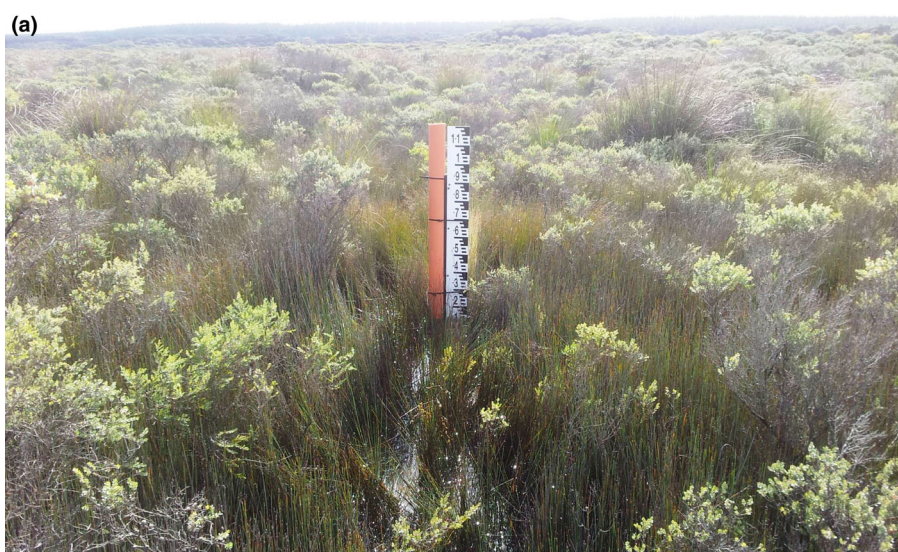
## Box 1. Long Swamp Restoration Trial

### Methodology and Results

NGT's preferred low-impact, adjustable and stable method for undertaking restoration trials, successfully employed at many sites since 2012, is to use durable geo-fabric sandbags filled using local material, constructed by hand. In Discovery Bay, local sand for the job was obtained off the nearby beach thanks to the assistance of Parks Victoria. This fully reversible (i.e. easily deconstructed if necessary) method also provides for management flexibility in real time, and in this instance enabled works to proceed in this sensitive coastal environment, cognisant of known cultural heritage values in the vicinity. This method also provided the previously frustrated local community and other project supporters a tangible way of proactively participating in the project, as they were invited as volunteers on a number of occasions to help fill and shift sandbags during construction. The trial resulted in the recreation of a permanent waterbody in the same location marked in the 1850 map (Fig. 2; also refer to Fig. 12 in Appendix S2) and was highly effective in both arresting the drying trend within Long Swamp and reversing associated vegetation shifts in the vicinity of Nobles Rocks, as shown in Figure 7.

For more information on the operation, design, monitoring and review of the trial, please refer to the EMR summary and Bachmann *et al.* 2018.

*The Long Swamp Restoration Project was the joint winner of the Society for Ecological Restoration Australasia - 2018 Award for Large-Scale Restoration Excellence.*



**Figure 7.** Habitat change (reversal of shrub invasion and other floristic transitions) near Nobles Rocks between (a) May 2015 and (b) October 2017 in response to increased depth and duration of inundation, after the Phase 3 structure was completed (in April 2015) and raised (in September 2015). Photos: Mark Bachmann.



local newspaper (Border Watch) of their meetings in 1953 and 1954 provide unambiguous accounts about the two outlets to the sea; including their artificial status and observed impacts on the wetlands of Long Swamp.

With growing confidence in the historic context and the need to act to address hydrological changes underway in Long Swamp, and backed by the demonstrated effects of natural outlet closure at White Sands, grant funding was sought by NGT to undertake a carefully staged and monitored wetland restoration trial at Nobles Rocks. The grant, awarded by DELWP in 2014, resulted in the trial being undertaken in three phases over two years, culminating in the construction of the main Phase 3 structure (ultimately consisting of a total of 7000 sandbags) in 2015 (see Box 1 and Fig. 10).

### Consolidating the Early Accounts and Finalising the Case for Permanent Restoration (2017–2018)

The success of the trial (Box 1 and Fig. 10) rapidly led to the GHCMA making funding available for NGT to formally review the outcomes of the trial, with a view towards achieving permanent hydrological restoration; both of static water levels in the wetland at Nobles Rocks and to facilitate the ongoing delivery of flows to downstream wetlands and the Glenelg River estuary. At this time, the listing of Long Swamp as a wetland of international importance (as part of the Glenelg Estuary and Discovery Bay site) under the Ramsar Convention was imminent; this status was ratified by the Australian Government in April 2018. This provided additional impetus to continue to locate, interrogate and assemble more pieces of the historic 'jigsaw puzzle' and to arrange those references to the site prior to 1950 into chronological order for the first time.

Closer examination of Clarke's early 1850 map (Fig. 8) led to a



**Figure 8.** Inset of section between Bully Lake at Nobles Rocks (bottom left) and Lake Momboeng (middle right). Drawn by Lindsay Clarke, Assistant Surveyor, September 1850.

number of eventual important discoveries, with three of these explored here (and detailed more comprehensively in Appendix S2).

Firstly, the map clearly shows that two deep and fresh, open water bodies were present in Long Swamp, information corroborated by diary entries from Tyers (Tyers 1840a) and other records referring to a second lake named 'Bully Lake' in the vicinity of Nobles Rocks (Holmes 1937; Coulson 1940; Mitchell 1949). This lake had disappeared since the 1930s and as a result had simply been lost from the living memory of locals. Secondly, the early map shows the outlet from Bully Lake at Nobles Rocks, with a longer flow-path, located further east than its modern equivalent. Thirdly, the map shows the location of the station hut established nearby at Lake Momboeng, which is significant because it showed the relatively close physical proximity of the stock keepers residence to the site where these early (pre-1850) drainage works took place. Further, detailed descriptions of hydrology in the location by Tyers (1840a,b) failed to mention an outlet from Bully Lake to the sea, at a time of year (December) when it would definitely have been flowing, if present, and despite his detailed diary observations of waterways elsewhere on his journey. Of note, we also know for certain from his diary entries that he traversed the coastal side of Bully Lake on his way to the

Glenelg River, so if the outlet channel were there in 1839, he would have crossed it.

Another piece of corroborating evidence, to support the probable early construction of an outlet by the squatters between 1845 and 1850, is the recorded dimensions of Bully Lake. When mapped by Lindsay Clarke in 1850, the lake is clearly much smaller than the dimensions described in 1839 by Tyers, indicating that the first outlet was impacting on the ability of Bully Lake to retain the same depth and extent of water as first observed in 1839. This is consistent with modern observations of the impact associated with an artificial ocean outlet on inundation patterns at this location.

At this stage, only limited information is available to help unravel events between this time and when the first aerial imagery was taken in the 1940s. Based on available observational accounts, it would appear that this early recorded channel at Nobles Rocks was ineffective, not maintained and became naturally blocked over subsequent decades.

An account in the Border Watch in 1883 described the area by stating that 'the dunes form a bulwark close by the sea, and inside of them is an extensive sheet of permanent fresh water, half lake half swamp' (Border Watch 1883). It is not entirely clear if this account means the outlet had closed by that date, but it is certainly indicative of extensive areas of open

water and a less efficient outlet (if present) at Nobles Rocks. If not, other evidence indicates that a natural closure was certainly imminent.

Bureau of Meteorology data for Nelson, recorded only 10 km to the west, indicates the severity of the Federation Drought years (1896–1902) on local rainfall (Commonwealth of Australia 2019). Of note, five of these seven years recorded <490 mm of rainfall at Nelson, including four years in a row of <480 mm of rainfall (1897–1900), compared to the long-term Nelson average of 765.1 mm. Not only has such a sustained low rainfall pattern never been repeated since, there is actually only one other year in 131 years of data (1914) where <500 mm of annual rainfall has been recorded at this location. By comparison, during the Millennium Drought years of 2005 and 2006, when the White Sands outlet naturally closed, Nelson still had recorded rainfall of 641.1 and 536.5 mm. In this context, the natural closure of an earlier, less efficient Nobles Rocks outlet during the Federation Drought around 1900, due to (a) sand drift (at a time when the dunes in this area were not consolidated) and (b) a lack of outflows, is highly plausible.

Additional supporting information, although limited, includes all of the government maps of the area produced in the early 1900s, which do

not show a channel at this location (where later maps and aerial photographs do, as shown in Fig 9).

According to the maps and consistent with the rainfall record, it appears likely that the early outlet at Nobles Rocks was absent in the early 1900s. However, a new cutting appears to have been made by the time the military map was prepared in 1942, and this is also evident in the first aerial photograph from 1947.

An additional valuable resource, for reconstructing a more complete timeline of events, is the recorded testimony of locals from several different oral and written accounts. These accounts were eventually rediscovered at the Public Records Office of Victoria, within the archived Fisheries and Wildlife file that Gavin Cerini had compiled in the 1970s (detailed in Appendix S3).

Although some aspects of these accounts do not entirely match (as can always be expected with verbal accounts recorded many decades later), the general picture that emerges does appear to confirm the sequence of key events that took place, and their impact, as follows:

- 1 An earlier (and on the basis of prior land use, probably also human constructed) outlet existed at Nobles Rocks, and this closed due to sand drift and drought, around 1900. It

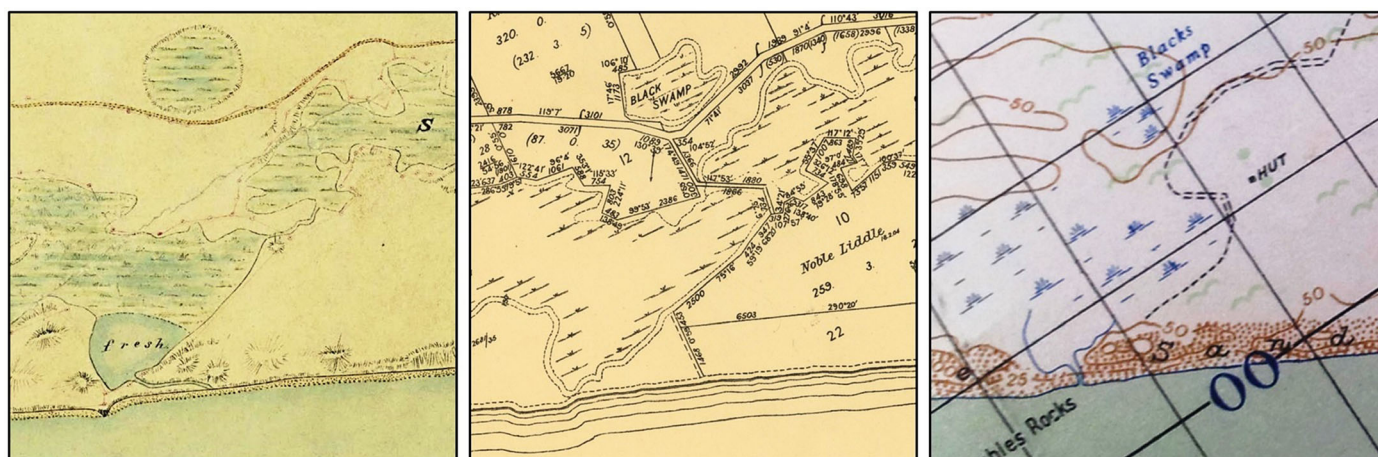
was definitely closed by the very early 1900s.

- 2 All the early recollections before the opening of the modern Nobles Rocks drain are of a much 'wetter' system, characterised by substantial areas of open water that would enable a boat to traverse a considerable length of the swamp.
- 3 The present artificial outlet at Nobles Rocks was artificially opened in the mid-1930s (see Appendix S4 for relevant impacts of this event), and the White Sands outlet was formed after that date but sometime before 1953.

This sequence of events, including rainfall patterns, the resulting condition of the outlet and eventual stabilisation of the wider dune environment, has meant that the Nobles Rocks drain has been incapable of naturally closing again, as it did approximately 120 years ago (around 1900).

## Completion of Permanent Restoration (2019)

To summarise, by compiling, analysing and consolidating all of the records gathered from various historic sources in chronological order, it is now possible to reconstruct a timeline of the most probable condition



**Figure 9.** Early maps of the coast and Long Swamp in the vicinity of Nobles Rocks. 1850: Lindsay Clarke's coastal survey map; 1913: Warrain Parish Plan, which also shows the location of the property of Noble Liddle (after whom Nobles Rocks is named); 1942: Victoria, Nelson 1:63,360 Military Map.



of the ocean outlet at Nobles Rocks since 1839:

- Dune closed prior to the mid 1840s;
- Drain flowing between c. 1845 and c. 1900 (likely opened by squatters);
- Dune closed from c. 1900 to c. 1935 (natural closure of outlet due to low rainfall and sand drift);
- Drain flowing between c. 1935 and 1971 (likely opened by Kerr or Kerr and Cowland);
- Attempted closure by Glenelg River Angling Club failed in 1953;
- Dune closed in 1971 (Cerini), which failed later that year;
- Drain flowing between late 1971 and February 1972;
- Dune closed between 1972 and c. 1974 (Cerini), before failing again;
- Drain flowing between c. 1975 and 2014;
- Drain flowing but partially regulated in 2014/15, via Phase 1 and 2 trial structures (NGT);
- Dune closed by the Phase 3 trial structure from 2015 (NGT);
- **Dune permanently reinstated in autumn 2019 (NGT).**

Suddenly, the earlier, seemingly incongruous information first encountered in 2012 when we began working on this project, now fits logically and seamlessly into a more comprehensive timeline of events and aids our collective eco-hydrological understanding of the reference model for this site. Hence, with the history of the site now documented in such detail, accompanied by parallel scientific information (not presented in detail in this paper; refer to Bachmann *et al.* 2018), permanent closure of the outlet at Nobles Rocks was recommended.

Soon after the completion of this work in 2018, detailed designs were

finalised and the relevant permits sought to enable a reinstated sand dune to be reformed around the Phase 3 trial structure (Roberts *et al.* 2018). This soon led to grant funding being awarded to NGT by DELWP, enabling completion of permanent restoration works in autumn 2019 (Fig. 10).

Using a direct comparison of maps and aerial photography in conjunction with the information gathered from historic records, the physical changes in the appearance of the Nobles Rocks outlet, Bully Lake and the nearby dunes, is summarised and explained in Figure 11.

The final image shows the approximate original extent of Bully Lake, as first reported by Tyers in his 1839 journal (minus areas consumed by sand drift). In clear contrast to the reduced area of open water mapped by Clarke in 1850, in the presence of the first artificial outlet, this '*large lake about 1 mile long and ½ mile broad, running parallel with the coast*' (Tyers 1840a) is now evident again after the successful completion of restoration works (also refer to Figure 12, in Appendix S2).

## Discussion And Concluding Comments

This manuscript was written to explore the use of historic materials in the project at Long Swamp, by simply telling the story of my experiences as a person with a scientific background, not as a formally trained historian. Undertaking voluntary historic research as a hobby after hours, alongside my normal professional duties, led to the work proceeding sporadically and following leads as time permitted. Despite the limitations of this unstructured approach, the immense value of historical sources to environmental science is clearly apparent in what I discovered, yet in my personal experience, these fields of complementary research do not overlap as regularly as they ideally

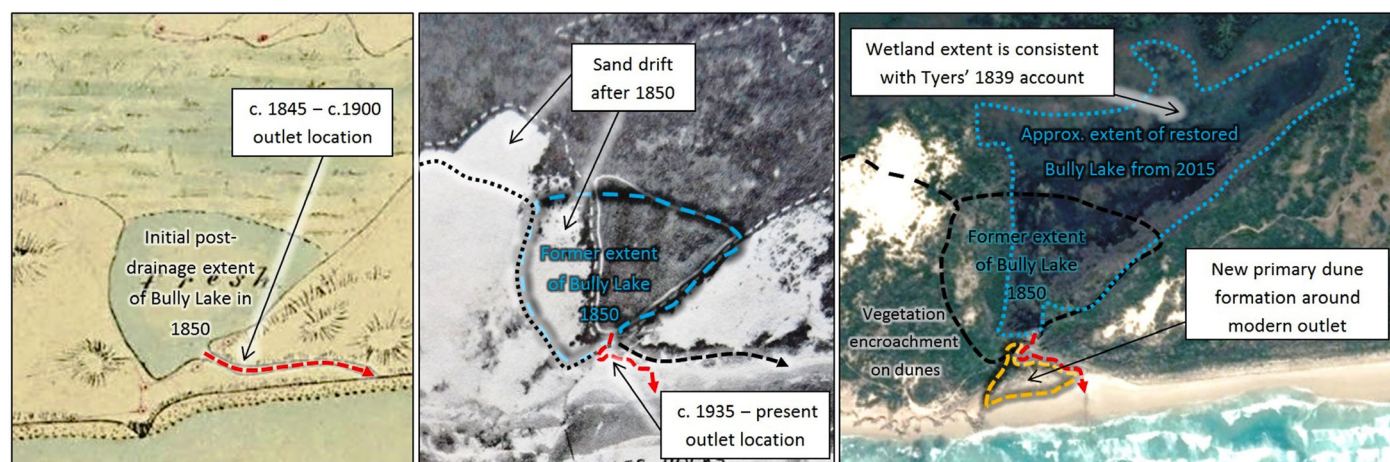
might. I have observed that this may be partly due to an inherent disciplinary bias in the scientific method towards more recently collected, measured and scientifically robust forms of data, but also because thorough research of historic sources typically requires a different methodological approach and skills, and the adequate investment of time. As historic sources were not originally recorded with this modern ecological use in mind they are often difficult to find, typically making this work very time consuming. Fortunately, despite my personal experiences, it appears that a growing number of restoration ecologists globally are adopting similar inter-disciplinary methods to guide their work (for an excellent example, see Stein *et al.* 2010). To do this well means overcoming the fact that restoration projects often have limited resources and time constraints, so practitioners are simply encouraged to integrate historic information sources to the best of their ability, or to seek out the support of project partners or volunteer researchers (with the requisite skills) who can assist them in this regard.

The reviewers of this paper also introduced me to useful guidance materials for related fields of social science. For example, in the field of oral history, it is known that personal recollections can be influenced by numerous factors that impact upon memory and recall (Raymond *et al.* 2010), notwithstanding the fact that water regimes in wetlands have been recognised as being especially well suited to this method, as they are more likely to be accurately recollected (Robertson & McGee 2003). The limited number of potential informants for Long Swamp prior to 1950 also prevents any definitive analysis of oral testimonies. For those who specifically wish to collect oral testimony according to current recommended methods, overcome these known limitations and follow ethical practices, please refer to guidance





**Figure 10.** Evolution of works on the artificial outlet at Nobles Rocks, from trial structures to permanent restoration with a reinstated sand dune. A reformed Bully Lake is to the right. Photos: Mark Bachmann.



**Figure 11.** Changes in and around Bully Lake, between 1850 (left: already significantly reduced in area since Tyers' 1839 account), c. 1970s (centre: aerial image adapted from Godfrey 1983) and present (right).



material published by Oral History Australia ([www.oralhistoryaustralia.org.au](http://www.oralhistoryaustralia.org.au)).

Fortunately in the case of this paper, the oral testimonies do not stand alone and can be 'explicitly triangulated against data from other sources' (Tibby *et al.* 2008), which is important for ensuring the veracity of this historic information within the narrative of environmental change. Indeed, it is very often a combination of all historic information sources (e.g. testimonies, maps, newspaper records, diary entries), carefully interrogated alongside modern data (e.g. aerial photography, digital elevation models, ecological information and, in some cases, sediment (diatom) analysis), that enable logical assessments capable of supporting objective decision making. At Long Swamp, this process occurred progressively over a period of seven years (2012–2019), resulting in the collation of a wide range of valuable historical reference material and a small number of verbal testimonies, placed into an appropriate chronology and scientific context. New insights that inevitably emerge as this process unfolds are often more important than may first meet the eye, helping to develop and verify site reference models, and are therefore critical for guiding contemporary ecological restoration planning and works.

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## Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

**Appendix S1.** Long Swamp hydrology observations and the first attempt at blocking the Nobles Rocks outlet, from meeting notes of the Glenelg River Angling Club in 1953.

**Appendix S2.** A closer examination of the 1850 map and an 1839 account of Long Swamp.

**Appendix S3.** Reviewing local 1970s testimonies, and a more recent account from the son of Ken Kerr, who purportedly cut the outlet at Nobles Rocks in the 1930s.

**Appendix S4.** The hydrological impacts and erosion associated with the Nobles Rocks cutting in the mid-1930s.



## Appendix S1

# Long Swamp hydrology observations and the first attempt at blocking the Nobles Rocks outlet, from meeting notes of the Glenelg River Angling Club in 1953.

In extracts of the Glenelg River Angling Club meeting notes published in the Border Watch (a local newspaper), the net effect of past hydrological changes were described (my location notes are not italicised and marked **bold** in brackets):

*'Years ago a good stream of fresh water flowed into the Sanctuary at Nelson from Bung Bung Lake (i.e. **Lake Momboeng**). This has become a mere trickle...'*

Border Watch (1953a)

More detailed history of the change in Long Swamp between Lake Momboeng and the Glenelg River was included in another article later that year:

*'The lake runs, into a creek for 3 miles where a greater portion of the water runs into the sea (this outlet was artificially cut some years ago) (i.e. **Nobles Rocks**). Another outlet two miles further on (i.e. **White Sands**) also reaches the sea, but this flow is only taking place during winter. From this point, for a further 4 miles, the water flows (almost a trickle) into the sanctuary in the Glenelg River at Nelson... Many, local anglers will remember years ago the good fishing to be had at the "creek." It was the water coming from Bung Bung which made the attraction,*

*for fish, as it does every fresh water outlet to the open sea...'*

Border Watch (1953b)

In September 1953, when describing the work required at Long Swamp, they suggested:

*'The first outlet to the sea (i.e. **Nobles Rocks**) could be blocked with a wall of sandbags and rock, diverting this water back to its normal natural course... The second outlet (i.e. **White Sands**) is only a minor worry and can be easily diverted. The blocking of the two mentioned outlets will mean a very healthy flow of fresh water into the Glenelg River (via **Eel Creek**) – a very vital matter for the River.'*

Border Watch (1953b)

One month later in October 1953, it was reported that the Committee of the Glenelg River Angling Club had:

*'decided to close the creek running out of "Bung Bung" and in co-operation with the Nelson Progress Association, the work will be put into effect next Sunday....Directing the waters from the sea to the River is going to prove very beneficial.'*

Border Watch (1953c)

However by December 1953, it was being reported that the group's attempt to block the Nobles Rocks outlet had failed:

*'Efforts to erect a barrage against the Lake Bung Bung outlet into the sea and so divert its waters to a natural course into the Glenelg River have proved unsuccessful.'*

Border Watch (1953d)

Finally in August 1954, the Glenelg River Angling Club admitted defeat:

*'The Club had ideas of harnessing the waters from Bung Bung Lake. After an attempt to do this, the committee came to the conclusion that the job was not possible and was beyond the finances of the Club.'*

Border Watch (1954)

This sequence of events is the last mention made of blocking the channel in local newspapers in the 1950s.

The prospect of restoration was not revisited again until the attempts made by Gavin Cerini approximately 20 years later in the early 1970s, as part of his work for what was then the Victorian Department of Fisheries and Wildlife.

## Appendix S2

### A closer examination of the 1850 map and an 1839 account of Long Swamp

The 1850 map of Long Swamp is of fundamental importance for determining the historical status of the ocean outlet at Nobles Rocks, for three key reasons:

A. Firstly, the map clearly shows that two deep and fresh, open water bodies were present in Long Swamp. The larger of the two corresponds to present day Lake Momboeng, a spring fed lake which has continued to persist, while the second is situated adjacent to Nobles Rocks, an area where an open waterbody was no longer evident in modern times. Consistent with the loss or modification of this habitat, this defined feature (an open water body) does not appear on any subsequent map, but the original presence of permanent water at this location is corroborated by other key evidence that began to emerge during the investigation.

The earliest evidence comes in the form of a diary entry of Charles Tyers, on his journey along the coast in December 1839 to mark the boundary between the colonies of South Australia and New South Wales. In addition to his published account that became more widely available (Tyers 1840b), additional information on his journey can be found in his personal daily diary entries and draft manuscripts (Tyers 1840a; now held in the Mitchell Library, State Library of NSW, Sydney).

By reconstructing his journey on a map using this primary source material, it is possible to place many of the observations at features along the coast that we can still name and recognise today with a reasonable degree of confidence and accuracy. For a full reconstruction and typed version of his hand-written account over the key dates, please refer to Appendix C in Bachmann *et al.* 2018.

Noting that the majority of places are unnamed in the manuscripts, it is possible to identify Lake Momboeng in his account of making camp on the evening of the 14<sup>th</sup> of December 1839, before setting off towards Nobles Rocks on the 15<sup>th</sup>. They were late leaving that morning after searching for two horses that broke loose overnight. His diary states that after a shortened day of travel:

*'Encamped early in the afternoon on large lake about 1 mile long and ½ mile broad, running parallel with the coast. This lake communicates with the other. Sand hills with very little grass (later draft version says "nearly bare") and no trees divide the lakes from the sea. On the opposite side of the lakes, the land is rather undulating, pasture good and thickly timbered.'*

(Tyers 1840a)

Given the distances recorded in his journal between camps, and the size and location of the lakes described,

including his account of the visible evidence of flows between them, this description can only realistically refer to Lake Momboeng and a second lake situated a little further along the coast to the west, on his way towards the Glenelg River. This waterbody is clearly marked on Lindsay Clarke's later map from 1850, as shown in Figure 8.

Over 100 years later, in his 1949 publication based on decades of research, *Stone-Age Craftsmen*, Stanley Mitchell also gave a very specific account of the very same stretch of the Discovery Bay coast. He said:

*'Immediately behind the shoreline, east of the outlet of the Glenelg River, there is a chain of swamps – Long Swamp, **Bully Lake** and Lake Momboeng, all about sea-level'.*

(page 171, Mitchell 1949)

Not only does this description demonstrate his familiarity with this area and its features, but it is very precise in its geographic placement and naming of a second lake, close to sea level, between the Glenelg River and Lake Momboeng. So it is apparent that the waterbody behind Nobles Rocks had become known as Bully Lake since European settlement. Unlike Lake Momboeng, we can be certain that this was not an Aboriginal name for the site, because the lake was named by Europeans after a



prominent local Indigenous man, present at the time of first contact.

We don't know Bully's Indigenous name, but we do have the following introductory information from Gideon Lang's account of his time on the pastoral run in Discovery Bay:

*'The most formidable individual of this tribe was a young man of great intelligence, whom we named **Bully**, and subsequently retained in our employ for several years'.*

(Lang 1865)

Although the spelling has subsequently varied in some references, this is the same Indigenous man after whom the Bully (or Bulleys/Bullies) Range, Swamp and Track in the southern central portion of the nearby Lower Glenelg National Park are now named.

Two other earlier references have so far been found to Bully Lake:

1. The first reference appears in the reminiscences of W.E. Holmes in the Portland Guardian in October 1937, which started with the following passage (but also later in the article referred to 'Bully's Ranges'):

*"'Wanted at the muster.'" How those words thrilled little Tommy and little Teddy Holmes. McKee had passed the word along – "All hands assemble down by **Bully's Lake**," and like the general that he was, he issued orders – "You go with Billy Egan, and you with Noble Liddle'.*

(Holmes 1937)

2. The second reference appeared in an article about the coastal dune systems written by Alan Coulson in 1940, which stated that:

*'along Discovery Bay is a chain of*

*swamps and lakes, namely, Long Swamp, **Bulley Lake**, Lake Mombeong (Bong Bong), Malseed's Lake, Swan Lake and Bridgewater Lakes'.*

(Coulson 1940)

Together with the much earlier map, these important references specifically confirm and document the continued presence of a deeper, open water body – Bully Lake – near Nobles Rocks in the early 1900s, when the authors spent time in the area.

**B.** Secondly, upon close examination, the early map in Figure 8 shows the outlet from Bully Lake at Nobles Rocks consisting of a longer flow-path and located further eastward of its modern equivalent. The fact that this outlet is present adjacent to a deeper area of fresh water that is much smaller than the dimensions of the water body observed by Tyers in 1839 (as illustrated in Figure 11), indicates that it also could not have been functioning in any way like the outlet at this location today, and has undergone significant changes.

**C.** Thirdly, the map shows the location of the station hut established nearby at Lake Momboeng (by the time of this map owned by John McLean), where flows through Long Swamp commence, but of course can't tell us whether early pastoralists were responsible for cutting the channel from Bully Lake to the sea.

It is important to note that by the time Lindsay Clarke visited the area, James Dickson, the Lang Brothers and McLean Brothers had held this pastoral run for a total of at least five years between them (see Appendix B in Bachmann *et al.* 2018). Based on the recorded early interference with coastal wetlands elsewhere in the region, where drains were often cut by hand to open up more land for grazing or improve access, the same was

clearly possible – indeed highly likely – in this instance.

Tyers' account from December 1839 is again an incredibly valuable primary source for exploring this topic further, as the only significant early recorded evidence to include more detailed (albeit still limited) observations of Long Swamp, prior to the establishment of the first pastoral station in the area in c. 1844/45. However in this instance, as will be explained, Tyers' account is even more notable for what it doesn't say.

Tyers makes a number of references to hydrology in his hand written accounts, which can be simply explained. As well as undertaking a survey, he was also instructed by his superiors to note during his travels *"all the peculiarities and natural productions of the country"* (see copy of memorandum dated 13<sup>th</sup> September 1839, Tyers Collection, Mitchell Library), with a view to ascertaining its potential for future development. Water is obviously one of the most vital and valuable natural resources, so it features regularly in his notes.

For instance, during his journey he made the following observations:

12th December 1839, near Cashmore:

*'Left at 8am, bogged in the swamp for an hour after 1 mile of dense country. Came to a heath and road through it 4 miles long. Many springs in it of good water.'*

(Tyers 1840a)

14<sup>th</sup> December 1839, at Swan Lake:

*'Came to a Lake about ¼ mile long. Water very good. High water mark nearly 10 feet above the present level. The lake (**Swan Lake**) receives its water from the numerous springs in the large heath behind Richmond Hill.'*

(Tyers 1840a)

15<sup>th</sup> December 1839, at Bully Lake:

*'Encamped early in the afternoon on large lake about 1 mile long and ½ mile broad, running parallel with the coast. This lake (**Bully Lake**) communicates with the other (**Lake Momboeng**).'*

(Tyers 1840a)

16<sup>th</sup> December 1839, at Long Swamp proper:

*'Proceeded in the same direction keeping the sand hills on our left and a swamp on our right (**Long Swamp**), which runs parallel with the coast and communicates with the Glenelg Basin.'*

(Tyers 1840a)

17<sup>th</sup> December 1839, at Oxbow Lake:

*'The basin (**Oxbow Lake**) was literally covered with black swans, geese, ducks and pelicans.'*

*The water was salt, but a creek running through the middle of the swamp into it (**Eel Creek**) is hopefully fresh and good.'*

(Tyers 1840a)

From the description of his journey, we can ascertain that after travelling past Swan Lake and skirting the inland side of the nearby mobile coastal sand drifts, Tyers travelled a path that followed the coastal edge of Long Swamp from Lake Momboeng until a point a mile or two beyond Bully Lake. From that location, his party travelled along the beach for about five miles, before crossing the dunes again and returning to the edge of the swamp within a couple miles of the Glenelg River mouth.

With such detailed descriptions of the movements, nature and quality of

water along his journey, how is it that Tyers could have either failed to observe or mention an outlet from Bully Lake to the sea, at a time of year (December) when it would definitely have been flowing (especially considering that Eel Creek was later seen and documented flowing into Oxbow Lake)?

Of course the only logical explanation is that it isn't described because there almost certainly was no outlet there at the time, and as a result Bully Lake was a much larger feature than when it was later drawn in Clarke's 1850 map.

For an oblique photographic view of the modern - now reinstated - Bully Lake, both before and after commencement of Phase 3 of the restoration trial in 2015, please refer to Figure 12.



October 2014



June 2015

**Figure 12.** This oblique photo-point shows the recreation of Bully Lake in 2015, as a result of Phase 3 of the restoration trial; a significant waterbody within Long Swamp that had been lost from recent local memory. The images are looking west from a vantage point in the dunes, across the area where Bully Lake was originally observed (1839), mapped (1850) and described (early 1900s) across the range of historical sources referred to above, until it was drained in the 1930s. Please also refer to corresponding maps and diagrams in Figure 11. Photos: Mark Bachmann.



## Appendix S3

# Reviewing local 1970s testimonies, and a more recent account from the son of Ken Kerr, who purportedly cut the outlet at Nobles Rocks in the 1930s.

The recorded testimony of locals from several different oral and written records referred to both the absence of an outlet in the early 1900s and the later deliberate cutting of a channel at Nobles Rocks.

For example, a landholder with land adjacent to Long Swamp (several kilometres from Nobles Rocks) Albert Franklin Millhouse, father of Edna Millhouse, wrote to the Department of Fisheries and Wildlife on the 29<sup>th</sup> of May 1970, in which he stated:

*'I have owned land at Nelson since 1922. For many years I and my family have been very concerned at the sad decline in wildlife...*

*I am concerned at present with the erosion and sand drift that is occurring and that I think can be attributed to the Long Swamp being released into the sea at Noble Liddles Rocks. Since the Long Swamp has ceased to follow its natural course in the sanctuary the sand has drifted across in a few places causing it to dry up to a marked degree. The water birds, water hens, black ducks, heron and even a few Cape Barren Geese which abounded until a few years ago have vanished from this area.*

*I would appreciate if you could have the above investigated....'*

A series of verbal accounts were also recorded when Gavin Cerini (1971) subsequently spoke to a number of locals and took notes in 1970 and 1971 (including from Albert Millhouse), and these now make fascinating (sometimes contradictory) reading. Importantly however, all of these accounts broadly agree on the key matters summarised in the overall chronology presented in the paper. Their comments are summarised as follows:

Mr. A. F. Millhouse:

*Nobles Rocks outfall .... took them several years to establish the creek so that it would flow continuously. The only reasons given by Mr. Millhouse were "for extra grazing" and "the eelers wanted it open".*

Mr. D. Cameron:

*The Nobles Rocks outlet was opened after 1928 when he settled at Nelson, but well before the first pines were planted in 1950.*

Mr. Amos. C. Jones:

*Formerly of Nelson, aged 74. Nobles Rocks creek was running when he was a boy (c. 1900). Drift sand caused the creek to move about one quarter mile west to about its present location and then it sanded up completely, necessitating the excavation which reopened it.*

*In his early years it was possible to sail a boat up the swamp almost to Noble Liddles but sand drift caused the loss of the deeper water areas.*

Mr. Hugh Dewar:

*Owner of the land in the vicinity of the Nobles Rocks outlet since 1946. Amos Jones never mentioned to Hugh that Nobles outfall had been opened before. Hugh quoted T. Lamond: "It was reopened in about 1934/35, about the end of the depression when marram grass was being planted south west of Lake Momboeng."*

*George Cowland and Ken Kerr, both now dead, opened the dune with shovels. If they had not, Lamond thought, the flow would have started anyway because water was bubbling up on the beach below the dune. Kerr had the marram planting contract. Mr. Dewar has no knowledge of the origin of the White Sands outlet.*

Mr. S. J. McEachern:

*Born at Nelson in 1900. Up to 1921, water never flowed from Long Swamp except into the River. There were no outlets to the sea and he had never heard of any then.*

*Water came onto the deck of Eel Creek bridge (at Nelson) at times*

*but usually through banking up of the River when the mouth was closed, or during river floods.*

*The swamp never held as much water after it was let out to the sea.*

*Mr. McEachern's father leased the dunes from Nelson to a point one mile west of Nobles Rocks. They rode this area and east to Lake Momboeng regularly.*

Mr. P. Lampe:

*Claims that the volume of fresh water flowing via Eel Creek into Mud (Oxbow) Lake has been reduced since Long Swamp was drained directly to the sea, and that this affects fish production in Mud Lake.*

*Regularly travels along the beach from Nelson. States that Nobles Rocks drain flows eight months of the year, from early May to early*

*January approx. White Sands outfall flows for a lesser period, probably six or seven months.*

A more recently recorded discussion held in November 2019 between the author and Jack Kerr, aged 94, formerly a farmer from Winnap but now retired and living in Portland, revealed some interesting additional insights into the outlet at Nobles Rocks. Jack's father owned a coastal block on the range country adjacent to Long Swamp nearby, used for sheep grazing, which along with his neighbours was sold to pines in the late 1940s. Jack never visited Nobles Rocks with his father before the outlet was cut, being a young boy at the time. However, he relayed the later story of his father, Ken Kerr, using what he called a "trap hoe" (which he using for setting rabbit traps in the ground) to make the 1930s cutting at Nobles Rocks. As it was backing up

and almost breaching the sand dune at the location at the time, he said it didn't take much effort to get to get the water running (J. Kerr, pers. comm. 2019).

Jack wasn't aware of George Cowland's involvement (as per Hugh Dewar's account), but he did state that George Cowland and his uncle Glen Kerr, "used to go to the Rocks fairly often" (J. Kerr, pers. comm. 2019). With this in mind, George Cowland's involvement at some point cannot be excluded, especially if the outlet took several years to establish to flow continuously (as per Albert Millhouse's account). Based on his age at the time, Jack Kerr suggested the opening of the outlet at Nobles Rocks occurred in the early-mid 1930s, which also corresponds with Hugh Dewar's account.



## Appendix S4

# The hydrological impacts and erosion associated with the Nobles Rocks cutting in the mid-1930s

Once the channel was artificially cut through the sand dune at Nobles Rocks by Ken Kerr and then possibly maintained and/or deepened for several years, to establish it at the new location, it remained open until 2014, despite failed attempts at closure in the 1950s and 1970s. This channel appears to have deepened further over time as a result of the significant erosive force of outlet flows over the years, given the sandy substrate and the difference in elevation between the swamp bed (> 3m AHD) and sea level (Bachmann *et al.* 2018).

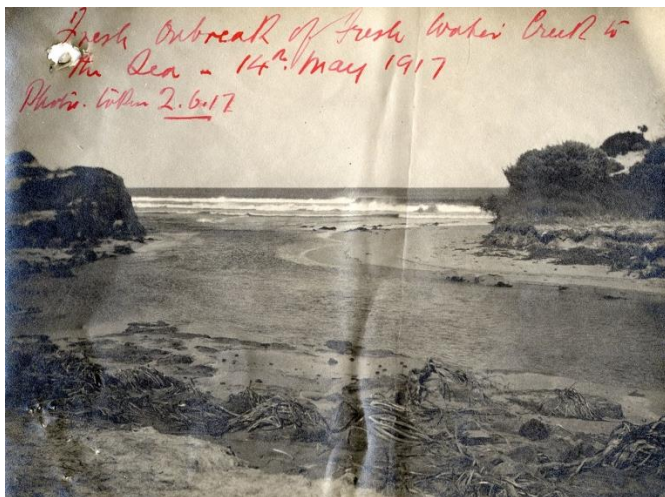
In retrospect, what occurred is entirely consistent with what happened at another location in Discovery Bay in

1917, when a cutting was made by hand through the dunes to divert the Freshwater Creek from Piccaninnie Ponds to the sea (Bachmann 2016a). This location (Fig. 13) was situated near to the state border, on the opposite side of the Glenelg River mouth.

After the 1930s, the depth of what was previously semi-permanent flows water through Long Swamp via Eel Creek dropped significantly and slowed to a trickle. Where Edna Millhouse recalled rowed a small boat with her sister, see Figure 14, there was no longer a sufficient depth of water for this activity, and the vegetation changed in response –

becoming more densely vegetated with reeds (Millhouse, pers. comm. 2012).

This recollection and the general change in condition of the swamp is corroborated by the oral accounts recorded by Cerini (1971), as presented in Appendix S3, as well as aerial photographic analysis and a further account recorded in 1964. At that time, another neighbour to Long Swamp, Mr. Don Kilsby stated that *'no open water has been visible for many years although it was once possible to row from end to end in a small boat'* (Cerini 1964).



**Figure 13.** A photograph taken shortly after the diversion of the Freshwater Creek from Piccaninnie Ponds to the sea in 1917. The total loss of the fore-dune at this nearby site in Discovery Bay demonstrates the erosive force of water through sand in a very similar dune environment to that found adjacent to Long Swamp at Nobles Rocks.



**Figure 14.** Eel Creek in front of the Millhouse property in 2014. This is where the Millhouse sisters used to set off in a small row boat in the early 1930s to explore Long Swamp upstream. Photo: Mark Bachmann