

Cadastral Integrity Loss from Riparian Boundaries

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ABSTRACT

The loss of cadastral integrity is not something that would be expected in today's systems of record keeping and enforced regulations that surveyors must adhere to in order to contribute to the cadastre. But there are some areas of the cadastre that are not reliable, and indeed wrong, despite all efforts to ensure that the records are correct. One area where the integrity of the cadastre can degrade is around riparian boundaries. By virtue of their ambulatory nature and the ways in which our cadastral system deals with that ambulatory nature, the end result of not dealing correctly with riparian boundaries can create issue with the integrity of the cadastre. Combine the impacts of ambulatory boundaries with the effects of poor and inappropriate management practices in the record keeping of the cadastre, then the integrity of the cadastre can be severely compromised. This paper shows that ignorance, or negation, of the rules pertaining to riparian boundaries can have a destabilising effect on the integrity of the cadastre.

KEYWORDS: *Cadastral integrity loss, riparian boundaries.*

1 INTRODUCTION

Everyone has a stake in the cadastre, from individual property owners, Government and its agencies to information seekers data mining the wealth of attached attributes so they can make critical decisions on investment, infrastructure and development. It is not an unreasonable hypothesis that all these people would expect the cadastre to be of a reasonably high quality and that it is maintained in such a condition. After all, everyone has a personal stake in these expectations being upheld. Someone might only be interested in the small land holding they own but others such as Government are making critical decisions that do affect everyone. None of these people would be pleased if they learnt that the cadastre had little or no validity. They might not own what they thought they did or they might not own anything at all or that critical infrastructure development was positioned in the wrong place. Just as data mining through the cadastre can yield misinformation if the base layer is incorrect, the mine head could be placed on the wrong parcel that the operator did not have title to and drilling could miss the mother lode with the whole operation only producing fool's gold.

There is the expectation that this doomsday scenario of an unreliable cadastre is not true, thanks to diligent survey practice in defining the land parcels that underpin the cadastre, rigorous checking of information and input that builds the cadastre and comprehensive record keeping. At least the State Government does not adhere to the doomsday scenario in that it also has a significant stake in seeing that the integrity is maintained.

The Board of Surveying and Spatial Information (BOSSI – see www.bossi.nsw.gov.au) sets and regulates competency standards for surveyors and surveying practices in NSW. These

standards are designed to maintain the integrity of land boundaries across the State (i.e. the State's cadastre), which in turn maintains the integrity of the NSW property market and ensures community interests are protected. Spatial Services, a unit of the Department of Finance, Services and Innovation (DFSI), implements and monitors these standards on behalf of the Board (DFSI Spatial Services, 2019).

But what if the doomsday scenario is true? Not all areas of the cadastre throughout the State are reliable as each other. There are some areas where the integrity of the cadastre is questionable despite all efforts to ensure its validity. But are there areas where the integrity has been lost or never existed and what is on record does not actually represent what is there. There could be land parcels that are potentially in another place, or do not exist in reality.

This paper shows that ignorance, or negation, of the rules pertaining to riparian boundaries (e.g. Songberg, 2016) can have a destabilising effect on the integrity of the cadastre. However, before we can ponder the dilemma into the validity of the cadastre, some groundwork must first be undertaken such as establishing what the cadastre actually is.

2 MEANING OF THE CADASTRE

A few online dictionaries provide the following definitions of the cadastre:

- “A cadastre is a comprehensive land recording of the real estate or real property's metes and bounds of a country.” (Wikipedia)
- “An official register of the quantity, value, and ownership of real estate used in apportioning taxes.” (Merriam_Webster)
- “An official register of the owners of land and of the amount and value they own, used for calculating the amount of taxes owed.” (Cambridge English Dictionary)
- “An official register showing details of ownership, boundaries, and value of real property in a district, made for taxation purposes.” (Collins English Dictionary)
- “A register showing the extent, value, and ownership of land for taxation.” (Oxford English Dictionary)
- “An official register of property showing boundaries.” (NSW Cadastre Web Service)

Despite the small differences between the definitions shown, there is a commonality throughout which goes on in a similar vein in other resources. Basically, a cadastre is a record of land parcels throughout the State or country together with various attributes that are associated with each parcel. The extent of the attributes depends upon what is required of the cadastre by the maintainers of it. In NSW, the cadastre is recognised under the heading of Digital Cadastral Database (DCDB). Prior to this electronic form of the cadastre, the record of the State's land parcels was maintained within analogue paper maps and plans.

The cadastre, be it the former maps and plans or the newer electronic version, was built over an extended period of time. Over that time it is hoped that the quality of the information improves but sometimes, despite all efforts to the contrary, it degrades.

3 CAUSES OF CADASTRAL INTEGRITY LOSS

For the most part the accuracy of modern surveying techniques, combined with the diligence of today's surveyors and modern cadastral records management systems, ensures the integrity

of the cadastre is upheld. However, there are some instances where, despite best practice, there are exceptions and the cadastre loses integrity:

- The integrity was not there in the first place. Cadastral management in early times was not up to the standard of today, and there are places where the only record available is the old, and unreliable.
- Poor surveying practice. This is very rare today but it sometimes does happen. If it does, then generally the error is fixed quickly. But the standard of surveying throughout the State was not always of a high standard. To be fair, some early surveys have been found to be of a high standard of accuracy, even by today's standard. But some of the less accurate surveys did happen and the results still exist today.
- Survey errors. The survey may appear within itself to be of a high standard but simple unnoticed errors do occur. These errors can have impacts on the validity of the cadastre, ranging from minor right up to and including major. The errors can also radiate outward, causing impacts not only to the immediate cadastre but also to surrounding areas.
- Loss of reference mark infrastructure. If the underpinning infrastructure of permanent survey marks is removed, for whatever reason, there can be destabilising effect on the positional validity of the surrounding cadastre. The more extensive the mark loss is, the greater the impact.
- Poor record keeping. Today we have a digital record, which is quickly and easily verifiable for misplacement and extent of errors that lead to shortfalls or overlaps. The earlier record, however, was undertaken with pen and paper. As things changed, it was up to the record keeper to erase the old and replace it with the new. The act of making the changes often resulted in information becoming indistinct, unreadable or even lost. The changes themselves may also not have been completely valid as sometimes the interpretations made by the person drafting the change were not correct.
- Inappropriate record manipulation. As the record changed from one map version to the next and even the change into the digital record, errors crept in. Vital pieces of information were left off, and sometimes invalid pieces were added. What was left for the next user was a record with some entities missing and other entities that appeared to exist in the database but in reality did not.
- Derivation of incorrect cadastral elements from misinterpretation of written descriptions and or vague sketches or scaled diagrams. The path from physical entity through interpretations into text and/or diagram, then onto the cadastral record, often went through a number of different people. Along the chain, translation errors easily crept in so that what is represented in the cadastre is not necessarily a true representation of what is on the ground.
- Changes wrought by riparian boundary ambulation. There are a set of rules that must be followed to record changes in riparian boundaries. Sometimes those rules are not applied correctly so that what is created as part the cadastre is not correct. Sometimes it may not be the incorrect application of the rules but incorrect definition and/or depiction of the riparian boundary that creates an apparent change that really does not exist. There is also sometimes a fundamental difference between the cadastral entity and the physical entity. In a cadastral sense the entity, such as a river, does not exist but physically it does, and vice versa.
- Any combination of the above.

This list is probably not completely comprehensive. There are likely other happenstances that have an impact on the validity of the cadastre. The list, however, covers the basic elements.

During the course of their career, most surveyors will get to see or experience the impact of one or two of the first four elements. They may even have a passing acquaintance with the next two. But it is the last few, particularly the impact of riparian boundary ambulation combined with the preceding three elements, which a lot of surveyors never experience. Rather than be correctly guided, surveyors can instead be misled by the invalid integrity of the cadastre into making judgements and determinations that are themselves ultimately invalid.

4 NORTH HAVEN

The Camden Haven River enters the sea on the Mid North Coast of New South Wales between North Haven and Camden Head. The river once ran wild to the sea, and from logging practices in the late 1800s the banks of the river have seen many changes. The river has been an important navigation route into the hinterland, with the construction of training walls during 1899-1902 about the entrance to improve navigation being the most significant change. In one reach of the river what was once the navigation channel is now an almost closed lagoon (Gogleys Lagoon) with only a narrow entrance remaining through which the tidal current races (Figure 1).



Figure 1: Camden Haven River entrance, North Haven on the left and Dunbogan Camden Haven on the right.

The cadastre has also seen changes over the same period. Some of those changes are a direct result of the ambulation of the riparian boundaries which, for the most part, no longer ambulate thanks to the constructed rock walls. Along the north side of the river, the North Haven side, the cadastre appears to be in a neat and ordered state (Figure 2). It shows no hint of being invalid. But if you scratch beneath the surface and look a little deeper, the state of the cadastre is anything but in order. There are elements that are literally invalid and the attributes associated with those elements give a picture that is far from the truth. The cadastre, particularly outside the surveyed elements within North Haven, has little or no integrity. To be able to understand what has occurred and to uncover how the cadastral integrity became lost, the use of time warp surveying techniques (Songberg, 2007) is required for delving through history to uncover the tangled web.



Figure 2: Cadastre north of Camden Haven River entrance.

5 CADASTRAL ENTITIES

In Figure 2, the white band north of the river and south of the green is shown to be two entities. Interrogation of the cadastre reveals the one next to the river is lot 7020 DP1001333 and it is Crown Land. Further enquiry with Crown Lands provides information that the land, amongst other attributes, is Reserve for Access 10324. The other is revealed as Public Road. Although both entities exist in the real world, the record of them in the cadastre is invalid. Neither are shown at their correct extent or location. In fact, what is shown as R10324 is not. The impact of just this one error translates latterly into other parts of the cadastre, creating further errors. Since the initial errors were made, other elements have been created when they should not have. There would be great uncertainty in their validity as they were made based on information that was incorrect.

5.1 Public Road

The road was gazetted in 1930 (Figure 3), extending from the road crossing of Stingray Creek (“the continuation of the most northerly public road through R8210”), along the entrance to Queens Lake, further up the estuary, down the estuary, then northerly to the southern boundary of portion 91. The road was also stipulated to be 20.115 (1 chain) wide against the landward boundary of R231 and R10324.

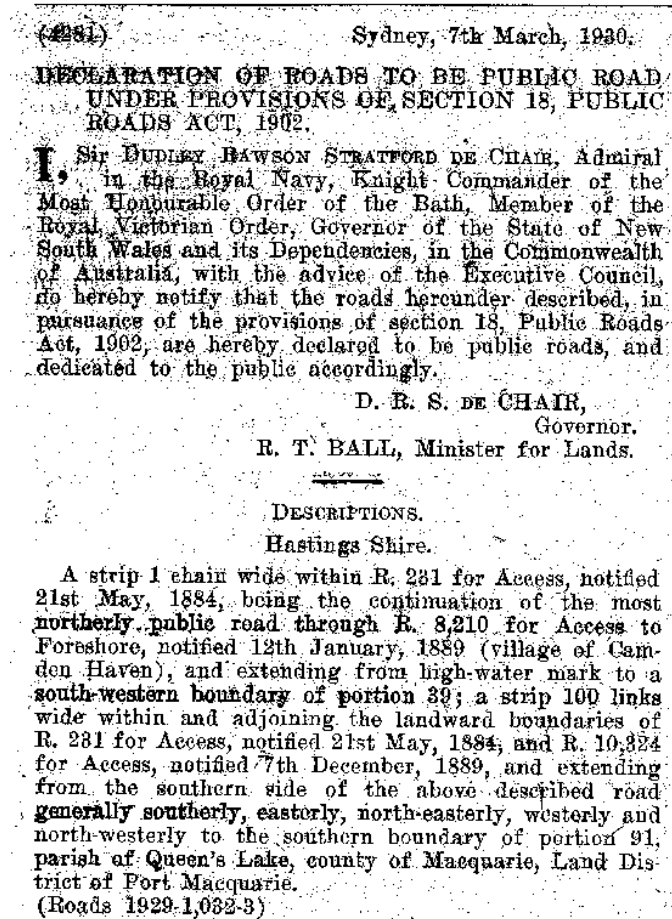


Figure 3: Public road gazette, 7 March 1930.

The only thing that is shown correctly, or at least partially correct, in the cadastre is the road being depicted against the landward boundary of the reserve. There have been no closures of this road so it should still be in existence to the south boundary of portion 91. But where is portion 91? It certainly is not at the end of the road as shown in the cadastre (Figure 2), where it is depicted to end at the beach beside the north training wall of the river entrance. Closer examination of Figure 2 reveals 91/DP754444 to the top right of centre of the image. This is portion 91, and according to the gazette the road should extend to the south boundary. So why does it not? What has gone wrong in the cadastre?

To determine what the error in the road is, the components that locate the position of the road need to be firstly determined. Portion 91 is fine, we know where that is. The commencement of the road is further up the river and does not have an impact on the area under examination (for completeness, there were no errors found at this end). It is the area through reserve 10324 and reserve 231, not identified by the cadastre, which must be examined in closer detail.

5.2 R10324

Reserve 10324 for Access was gazetted on 7 December 1889 (Figure 4). According to the gazette, the reserve is 150 links wide, running beside the mean high water of the Pacific Ocean southerly from the north boundary of the North Haven village reserve to the termination of Reserve 231. The reserve is supposed to run south but what is depicted runs almost west. The reserve also should be beside the ocean and not the Camden Haven River. Does it or does it not extend up the river as is shown in the cadastre? It should go to the end of R231, wherever that

is located. The northern village reserve boundary as it once was is located north further along the coast so R10324, that is supposedly beside the ocean, should still exist, but it is not shown so where did it go? There is also the issue of including the training walls that extend from the shore into the river and the ocean within the reserve. They did not exist at the time the reserves were gazetted so they should not be included. On the basis of these simple observations, it looks like what is shown as R10324 cannot be, but what is it? The record of R10324 within the current cadastre is basically invalid and needs to be completely reconstructed.

[9479]

Department of Lands,
Sydney, 7th December, 1889.

RESERVES FROM SALE FOR ACCESS.

In His Excellency the Governor, with the advice of the Executive Council, directs it to be notified that, in pursuance of the provisions of the 101st section of the Crown Lands Act of 1884, the land specified in the Schedule appended hereto shall be reserved from sale for access, and is hereby reserved accordingly.

JAMES N. BRUNKER.

EASTERN DIVISION.

LAND DISTRICT OF MUSWELLBROOK.

No. 10,313. County of Brisbane, parish of Ellis, within the suburban boundaries of Kyoga, containing an area of 1 rood. The Crown Lands within the boundaries of measured portion 206 of 1 rood,--as shown on plan catalogued B. 2,746-2,096 Roll.

[Ms. 89-14,781]

LAND DISTRICT OF PORT MACQUARIE.

No. 10,324. County of Macquarie, parish of Queen's Lake, containing an area of about 10 acres 2 roods. The Crown Lands within the following boundaries: Commencing at a point where north boundary of the village reserve, notified under general notice, 24th December, 1861, cancelled this date, meets the high-water line of the Pacific Ocean; and bounded thence by part of that boundary bearing west to a point 1 chain 50 links in rectangular distance from the high-water line aforesaid; thence by a line parallel to that high-water line southerly to the north-eastern boundary of reserve 231 for access to navigable waters, notified 21st May, 1884, at Camden Haven; thence by that boundary south-easterly to the high-water-line of the Pacific Ocean; and thence by that high-water line bearing northerly, to the point of commencement.

[Ms. 89-15,418]

Figure 4: Reserve 10324 gazette, 7 December 1889.

6 THE CADASTRAL ERRORS

How the errors in the public road and R10324 came about is not easily found. Data mining the current cadastral records will not reveal the sought after information. That mine of information will only yield fool's gold as the cadastre is invalid. It is only through engaging time warp surveying techniques (Songberg, 2007) in data mining through historical records and events that the source of the errors is brought to light. The errors causing the cadastral errors are not from one issue but are from a combination of issues.

By far the most significant source of error stems from the treatment of riparian boundaries defining the reserves along the foreshore. There are a number of rules that dictate how riparian boundaries are defined and redefined as they ambulate. Two rules play a significant role in this case:

- Rule 1: If the mean high water changes by means other than gradual and imperceptible erosion or accretion, then the boundary does not change.
- Rule 2: The landward boundary of a reserve is fixed at the time of creation (McGrath v. Williams (1912) 12 SR NSW 447) and does not ambulate.

Neither of these rules were applied as both boundaries have been changed in the cadastre from what was gazetted. The mean high water has physically changed but there has been no specific administrative action taken to change the location of the reserve.

From a commencement in 1893, the Public Works Department of New South Wales undertook to reconstruct the entrance to the Camden Haven River. In doing so, they straightened the course of the river near the river mouth and aligned both banks with rock revetment walls, extending the walls out into the ocean to train the entrance at a particular location (see Figure 1). Undoubtedly, this work made for a more reliable and safer entrance to the river but it did not make for a safer and more reliable cadastre. The river mouth reconstruction caused considerable changes to both the river alignment and location of the mean high water mark. This work constitutes a major man-made, non-gradual change in the riparian boundaries. By correct application of the riparian boundary rules, the location of the reserve, and subsequently the road, should be as they were before the change came about. But that is not what happened throughout time within the cadastre.

Adding to the riparian boundary errors, poor record keeping also crept in, compounding the problem. As changes were made to the parish map records, erasures and additions obliterated some aspects so that they became lost. The sections of reserve and road north along the coast disappeared, not in reality but only within the cadastre record. As the parish map editions changed, so did the depictions in location of the reserve and road, as each version showed a slightly different cadastre. The reserve and road were depicted in the wrong location, not where the riparian boundary rules dictated, but where the reconstructed river forced a new alignment to North Haven shoreline.

Another addition to the integrity loss was that interpolations onto the graphic cadastre record of the parish map from the written gazette descriptions were not made correctly. Compiling the data from gazettes of R10324 for access (Figure 4), R231 for access (Appendix B) and R27270 for harbour improvements (Appendix C), the only conclusion that can be reached is R10324 did not extend into the inlet and only faced the Pacific Ocean. That which is shown in the current cadastre as R10324 is really R231. The graphic for R10324 did not make it to the electronic cadastre.

Then to top off the problem, inappropriate record management added the training walls, where they stuck out into the river and ocean, into the reserve area. There is no basis for the inclusion of these features other than at the whim of the operator creating the graphics for the electronic cadastre. They were not part of the cadastral elements in the previous analogue parish map system.

It follows that there are at least four factors of cadastral integrity loss that have combined to create a problem that is basically unknown. Users of the cadastre have used this invalid data to undertake decision making and take actions which in the end were invalid despite spending valuable time and resources.

7 GAZETTED CADASTRE

The solution as to where the reserve and road boundaries should be located still lies in the early cadastral records and gazettes, although the information may point in unusual directions. The real task is to correctly interpret all the information so as to correctly locate all the entities as they should be located prior to it all unravelling. To physically locate the entities in space, the ideal piece of information would be a survey for the entities that complements the gazette. Such was not done, otherwise the survey plan would have been identified in the gazette. The location of the mean high water prior to the river entrance reconstruction, preferably close to the time of the gazettes, is however necessary to solve the riparian boundary location problem.

The gazette for R10324 mentions a village reserve. A plan of this village reserve still exists (Figure 5).

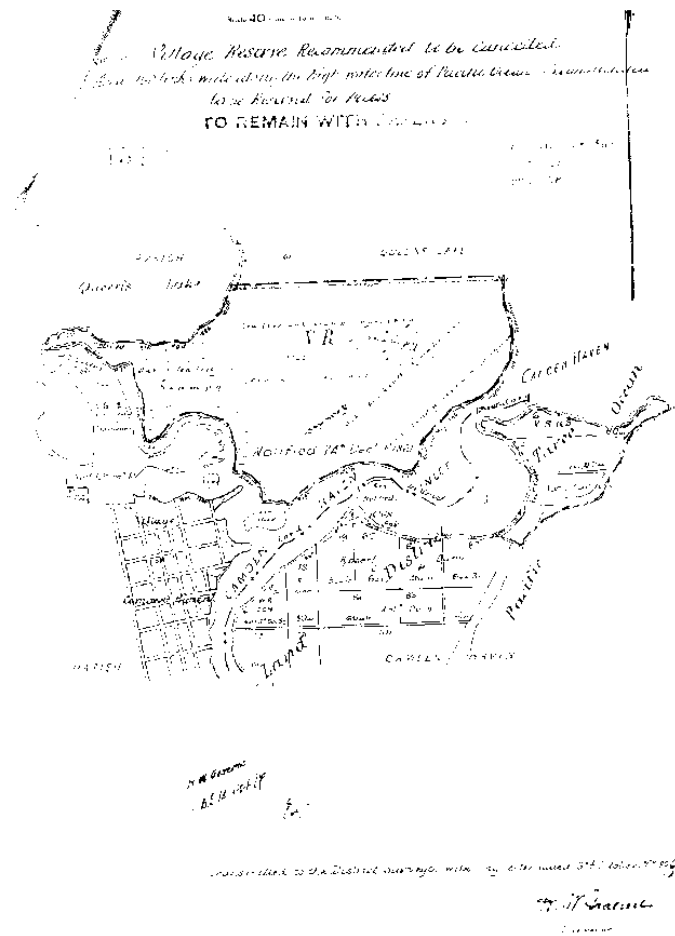


Figure 5: Village reserve, c. 1861.

The village reserve plan shows the shape of the Camden Haven Inlet significantly different to that of the current cadastre depiction as it predates the entrance reconstruction. The plan is dated 1889 because it was used to identify what was to be revoked in a reserve restructure in 1889. It does however show the extent of R231 going down the Camden Haven inlet to the entrance. It does not show R10324 but gives the area along the coast as a proposed reserve. This plan is not in agreement with the Queens Lake parish maps of the era. Editions 1 and 2 (Appendix A1 & A2) show R231 only extending to the junction of the Queens Lake Inlet and the Camden Haven River, although edition 1 does not depict the Camden Haven parish to the south or the Camden Haven River. It simply labels the area as Camden Haven which may have caused some of the

confusion. By contrast, Camden Haven is shown on the village plan as the bay within the ocean beyond the mouth of the Camden Haven River. The gazette for R231 (Appendix B) describes the reserve as going around Queens Lake, then down the inlet to Camden Haven and along the shores of Camden Haven.

The gazette for R10324 (Figure 4) describes it as extending south down the coast from the northern boundary of the village reserve and encompassing 10 acres 2 roods. Converting the area to a linear dimension, the reserve is a little less than 1.4 km long. This locates the common boundary between R10324 and R231 to be about the former Camden Haven River entrance, as is shown in the village reserve plan. If it were located at the Camden Haven – Queens Lake junction as per the parish maps, then the area of R10324 should have been about 22 acres. The gazette description of R27270 (Appendix C) confirms the location by describing the part of R27270 that abuts R231 as extending south-east then north-east along the river from the eastern boundary of portion 26. Both parish map editions 1 and 2 show portions 25, 26 and R27270 yet still label the reserve along the foreshore as R10324. Clearly the R231-R10324 common boundary is not at the river junctions but rather at the river entrance to the ocean. The textural descriptions were not translated correctly and all cadastre records starting from the first edition of the parish Queens Lake have incorrectly identified the extent of both R231 and R10324. The parish maps also could not have been used to derive the descriptions of the reserves, otherwise the maps would have been correct. Extrapolating this to the current cadastre, unlikely though it is, would mean that what is shown as R10324 is really R231. But where is the common boundary physically located in today's cadastre?

The problem with the village plan and parish maps is that they are only diagrammatic. Edition 1 of the parish map is confusing, edition 2 not much different to the village plan which does not show any survey base of how it was derived. A graphical overlay tie to the present cadastre would be very loose. What is needed is a plan that is based on surveyed data and which could be linked to the present cadastre with a reasonable degree of accuracy.

Edition 2 of the parish map, in use from 1898 to 1914, despite its lack of quality graphics, does provide further information that leads to a surveyed plan but not one of the land. The shoreline is noted as being reduced from a plan within the works department. As it turns out that plan was still being held in the Public Works plan room at the time of research. It was the hydro plan (Figure 6) of the inlet and immediate coast conducted in 1897 prior to the commencement of site works to realign the entrance.

The plan shows some of the cadastre within North Haven as well as part of a reserve notified 21 May 1884 (R231), extending eastward past the eastern boundary of portion 26 to about the river entrance where it vaguely disappears as though the precise termination is unclear. This plan agrees with the information on the village reserve and what can be deduced from the gazetted descriptions. It again confirms the location of the R231 and R10324 common boundary as being at the river entrance to the ocean. The hydro plan also shows the location of the pilot station on the south side of the river. There is subsequently sufficient information on the plan to orientate this survey in time and space reasonably accurately over the present cadastre. The survey may not have been carried out over the land but it is detailed enough to reasonably locate the mean high water mark in relation to the land parcels. Despite being conducted 8 years after the gazette of R10324 (1889) and 13 years after the gazette of R231 (1884), the times are close enough that this representation can be considered as sufficiently accurate to locate the reserves. It is also the only surveyed information available.

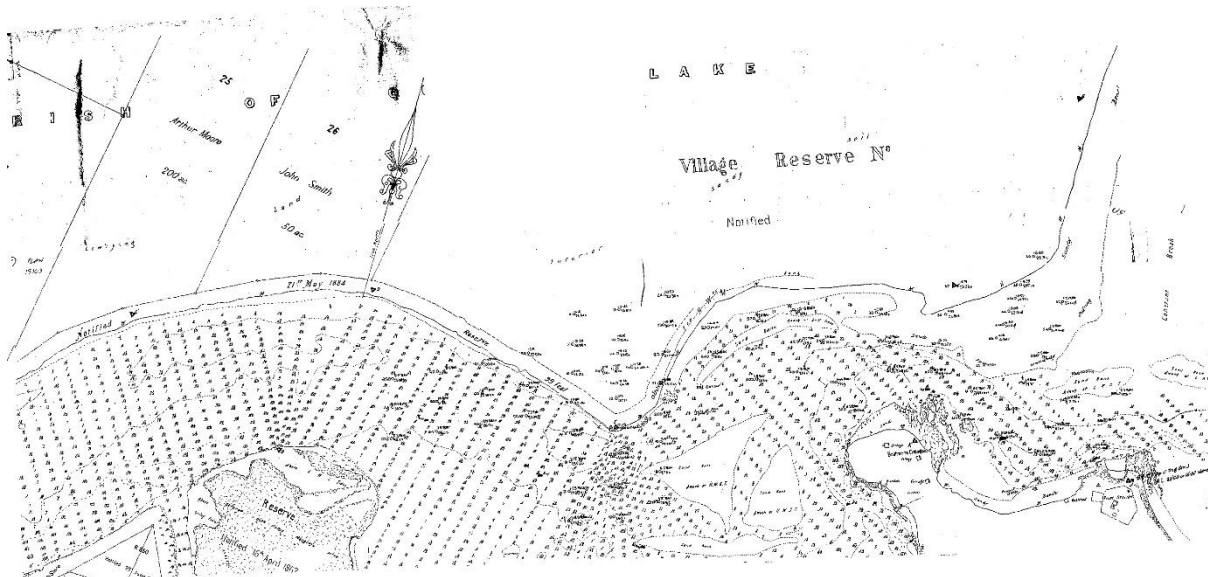


Figure 6: Part of hydro survey of Camden Haven Inlet, c. 1897.

So what did Public Works do that made things go so horribly wrong with the cadastre? They straightened up the course of the river by dredging through the south-facing spit, leaving part of it on the south side of the reconstructed river and blocking off the reach of the river to the south with constructed rock walls (Figure 7). What was once a broad sweep of the river to the south became Gogleys Lagoon which now has two narrow entrances, only one of which is navigable by small craft. The entrance training walls have since been extended from what is shown as the plan was an early edition during the full course of the works. Although the project was commenced in 1893, planning and preliminary works such as the hydro survey (1897) were conducted prior to construction. The preliminary construction on the entrance was not carried out until 1899-1900 (Coltheart and James, 1987).

Strict adherence to the two rules for riparian boundaries previously mentioned (see section 6) is required to determine the location of the reserves and road as is described by the gazettes. Because of the purposeful reshaping of the river and foreshores after the gazette dates (1884 and 1889), the mean high water boundary of R10324 and R231 should not be changed. The location of the landward boundary of the reserves and thus the road can also be found by offsetting the mean high water mark determined by the hydro plan.

A simple graphic overlay of the hydro plan to the existing cadastre is sufficient to provide an adequate picture and reveal some startling anomalies (Figure 8). Not only is the gazetted location of the reserves, and thus the road, in complete contrast to what the cadastral record portrays, there are overlapping entities, some of which would have adverse impacts upon people's personal holdings. Most impacts are fortunately upon what has been often referred to as the Crown Estate. The impacts mostly affect other reserves and the course of the river itself. The boundary between R231 and R10324 can also now be located though still only approximately as there is a bit of latitude as to what position along the foreshore the entrance of the river is found. As the boundary between the reserves was at the entrance to the river, by extrapolation that boundary, if the riparian boundary rules were ignored, would still be at the entrance which is now located out through the training walls. The reserve inside the entrance should be R231 and that outside R10324. Thus it can be established that what is shown in the current cadastre as R10324 should have been shown as R231, all be it in the wrong place.

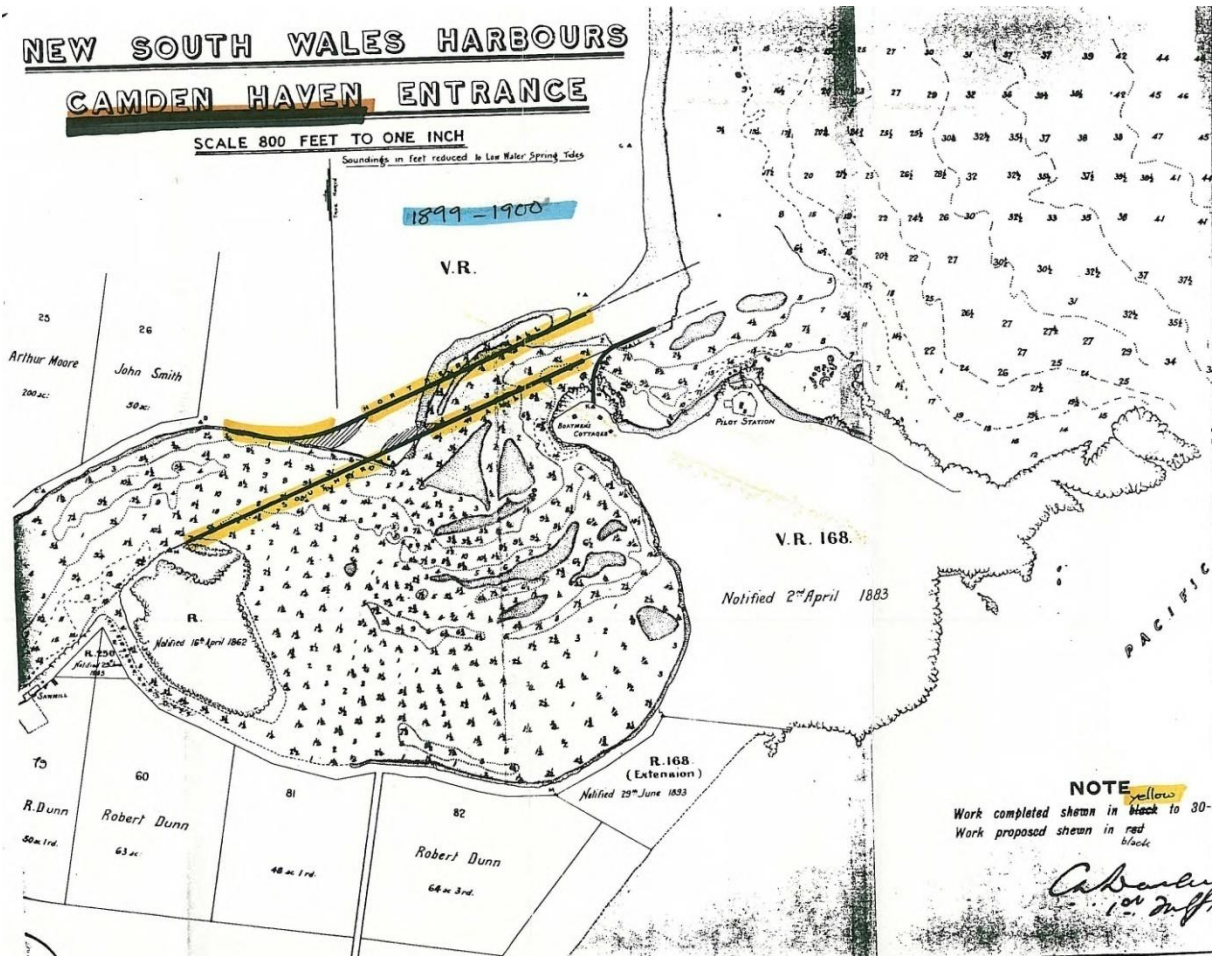


Figure 7: Extent of Camden Haven entrance construction 1899-1901 (Colthart and James, 1987).

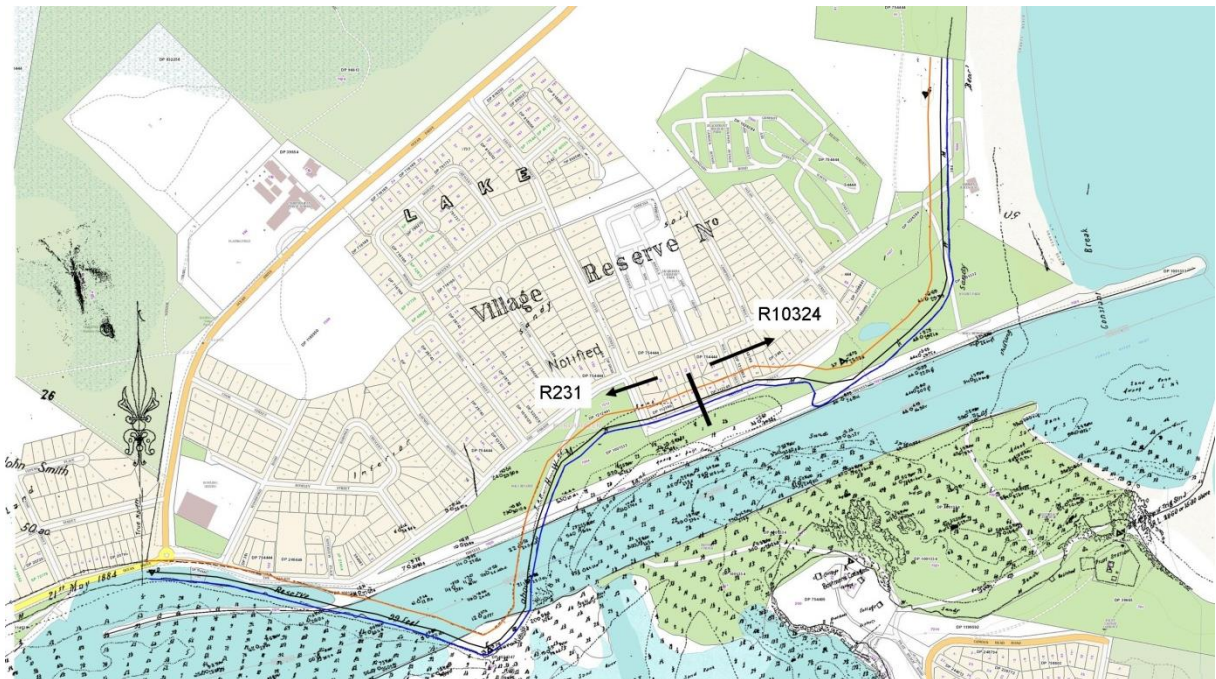


Figure 8: Hydro survey overlaid to cadastre. Landward boundary of R231-R10324 and side of road marked in orange. Opposite side of public road marked in black, and mean high water marked in blue.

The list of impacts, what they affect and how they can be managed is not part of this discourse. It is more important to show how the errors came about. The non-application of rules about riparian boundaries has been easy to understand and show. The interpretation of written gazette descriptions to physical entities was a little harder. Even the charting officers of the time made mistakes through poor interpretation and translation from gazettes to the maps. The impact of poor management throughout the cadastral record history is not as easy to follow. However, if the parish maps (Appendix A), both head office copy and local office copy, are examined in sequence, the changing picture starts to show what could have gone wrong.

The shape of the foreshore is in accordance with the village reserve plan on editions 1 and 2 of the parish map. Edition 3 is missing but edition 4 (Appendix A3) shows a difference of opinion in how the foreshore should be shown between the head office version and the local office version. The local office is the first to change the shape of the foreshore. It is not until edition 5 (Appendix A4) that the head office map follows suit. The old alignment is manually erased and the new shown. Edition 5 brings a new alignment into the foreshore, both within the estuary and north along the coast. As each edition of the map record evolves, the alignment of the shoreline changes. The recorded location of the reserve is also changed to coincide with the changed foreshore, in complete disregard to cadastral boundary rules for riparian boundaries. Throughout all editions up to 8, the existence of R10324 is shown north of the river, though at times indistinct due to erasures and missing notes. But on edition 9 (Appendix A8 & A9), the line work is removed and only note 10 gives any indication that the reserve exists. The diagram A of edition 9, however, negates to show the reserve north along the coast. In all maps that part of the reserve along the Camden Haven River is mistakenly shown as R10324 where in reality it should have been R231.

In the changeover to the electronic record, the developers took it upon themselves to also include the training walls extending out into the water within the river and out into the ocean. These could be considered as oversized solid filled jetties. They are not part of the land but encumbrances upon the land and certainly not part of the reserve. None of this location change in the foreshore or reserve has ever been gazetted. The changes have only come about at the hands of the drafting people responsible for holding the record of the cadastre in good standing. Unfortunately they failed. The reserve north along the coast failed to make it into the electronic record.

The road suffers a similar treatment and fate. It appears on edition 6 (used from 1927 to 1938) as would be expected, all be it in the wrong place, and continues to be shown up to edition 8 (1959 to 1978), ever changing in location with the reserve, but disappears off edition 9 on the part up the coast. The coastal part never makes it to the electronic cadastre.

8 EPILOGUE

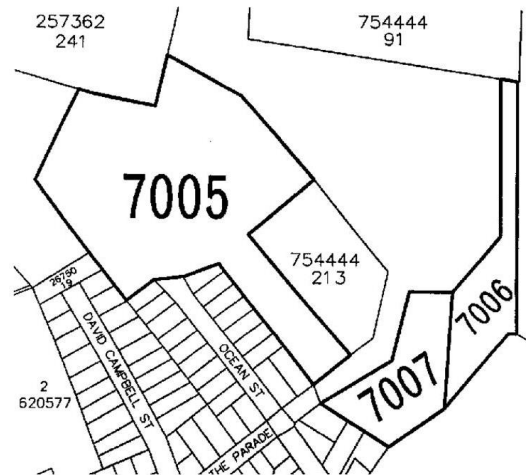
During the course of investigation into the riparian boundaries anomaly, other errors were also uncovered. In the intervening time since, some of those errors have been corrected, others have not.

Lot 7005 DP1026384 is another example of how descriptions and diagrams in gazettes that establish the existence of a cadastral entity can get misinterpreted. Add to this inappropriate record manipulation, and the result is another part of the cadastre is in error. Figure 9 shows the various states of the cadastral record in comparison to the gazette diagram that created the

entity. Only one version of the cadastral record depicts the entity with a reasonable degree of reliability, and it is not the current cadastral record.

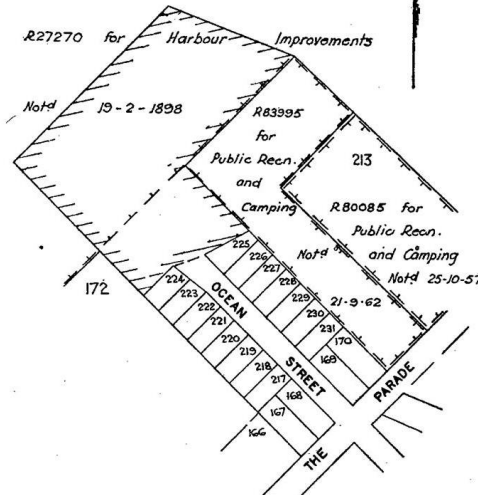


Electronic cadastre



DP1026384

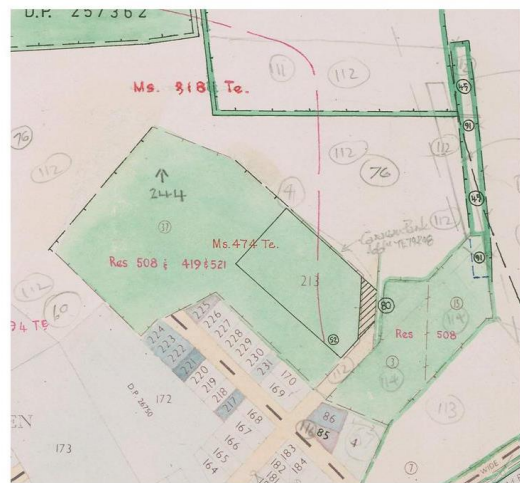
Diagram from Gazette 25 September 1970 addition to reserve R83995



Of particular note is the north west boundary of lot 7005. Only one version of the cadastral record shows the boundary in its correct alignment.



Parish Queens Lake edition 9 Diagram A
 Head office version



Parish Queens Lake edition 9 Diagram A
 Local office version

Figure 9: Boundary anomalies with lot 7005 DP1026384.

Also of note in Figure 9 is the position of portion 91 in the electronic cadastre and how it relates to other surrounding entities. The long parcel coming up the coast striking the south-east corner is depicted differently in the local office version of the parish map. Portion 91 does not even show up on the head office version. The question is what is out of position? Which is correct and which is wrong? Is it likely to be portion 91?

Across the physically reshaped river, in the parish of Camden Haven, the cadastre depicts lot 7019 DP1024347 (Figure 10).

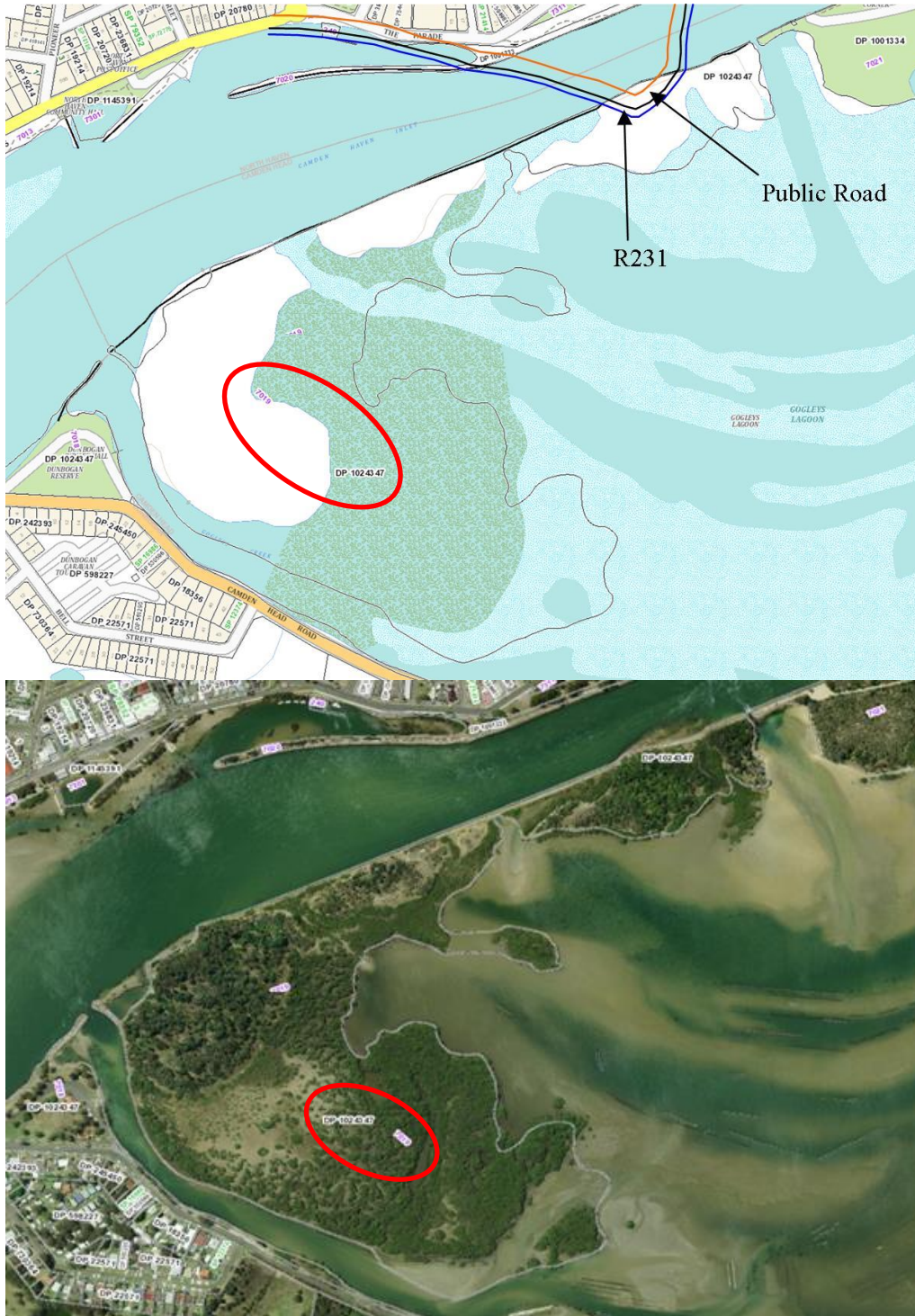


Figure 10: Lot 7019 DP1024347, an invalid parcel inappropriately created in the electronic cadastre.

Prior to the creation of the electronic cadastre, this parcel did not exist. It was inappropriately created solely from the imagination of the builders of the electronic cadastre and has no basis for existing from any activities throughout the analogue era of the cadastre. By rights much of the parcel should be the Camden Haven River.

As can be seen from the aerial photography, the fictitious parcel covers a number of different landforms including the remains of the spit that should by rights be on the northern side of the river and in the parish of Queens Lake. There may have been attributes assigned to the parcel since the commencement of the electronic record, but as the parcel is invalid so too are these attributes. The only attribute valid within the area at the close of the analogue cadastre was over the small island located in the western corner of lot 7019. This was Reserve 88143 for future public requirements and certainly did not extend beyond the mean high water mark of the island. The remains of the spit from the north side of the river in the north-east should be another lot. The instance of R10324 and the associated public road have already been established as being recorded incorrectly. The correct location of these entities also impacts on this fictitious parcel. These are but a few of the errors that still exist in this area.

9 CONCLUDING REMARKS

With very little work, but with the correct information, it has been relatively easy to show that ignorance, or negation, of the rules pertaining to riparian boundaries can have a destabilising effect on the integrity of the cadastre. In North Haven, the cadastre surrounding the immediate foreshore is invalid and needs correcting. How the cadastre is to be corrected is another matter but it cannot be left as is. The avenues for correcting the problems are likely to be quite varied and complex, but while the cadastre remains invalid authorities and surveyors will make decisions and conduct business based on an error. The outcome of their efforts is also likely to be in error and equally as invalid as the cadastre. Data mining through the invalid cadastral layers will produce attributes that are attributed to the wrong parcel.

The case presented in this paper is only one site where riparian boundaries have been reshaped by either capital works or natural events. Many river entrances have been treated similarly to North Haven. How has the cadastre fared in those cases? There are also likely to be instances along all our rivers where cadastral errors have crept in through changes to riparian boundaries. If it is anything like North Haven, then there are likely to be many instances, not only along the busy coastal strip of New South Wales, but throughout the State, where the cadastre is invalid because the rules pertaining to riparian boundary definition have not been followed. Add to this poor management of the cadastre throughout the analogue history and through the change to the present electronic cadastre, then issues like North Haven could extend right across the State. What confidence then is there in the current cadastre and what mine of misinformation is being extracted?

Anyone data mining through the electronic cadastre could turn up results similar to those about North Haven that although are seemingly valid could instead be invalid. This also leads the user to wonder what quality assurance, if any, exists in the current cadastre. In areas of accurate and repeated survey of the land, the cadastre (barring recording errors) is likely to be very good. As the assurance of good quality survey reduces, so too does the integrity of the cadastre. It is where there are impacts from riparian boundaries that in even good surveyed areas the quality of the cadastre can reduce. Combine the effects of riparian boundary uncertainty with the lack of quality survey, then the cadastre is more likely to be invalid than be a true representation of

what is. Only by comparing the results with the historical records can any level of validity be established. Unfortunately, in many areas the future of data mining in the cadastre is for the miner to first assume the cadastre is wrong. The second step is to either validate the data through historical research or determine what the correct dataset is. Then, and only then, one can proceed in a direction pending the outcome of step 2.

There are likely to be many areas where the cadastre is as uncertain as it is in the example presented here. But the big question is, where are these areas? Data mining the current cadastre will not tell you where!

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- DFSI Spatial Services (2019) Cadastral integrity, http://spatialservices.finance.nsw.gov.au/surveying/surveying_services/cadastral_integrity (accessed March 2019).
- Songberg G. (2007) Surveying in a time warp, *Proceedings of Association of Public Authority Surveyors Conference (APAS2007)*, Canberra, Australia, 27-29 March, 57-65.
- Songberg G. (2016) Riparian cadastral boundaries: A step toward reform, *Proceedings of Association of Public Authority Surveyors Conference (APAS2016)*, Leura, Australia, 4-6 April, 74-86.

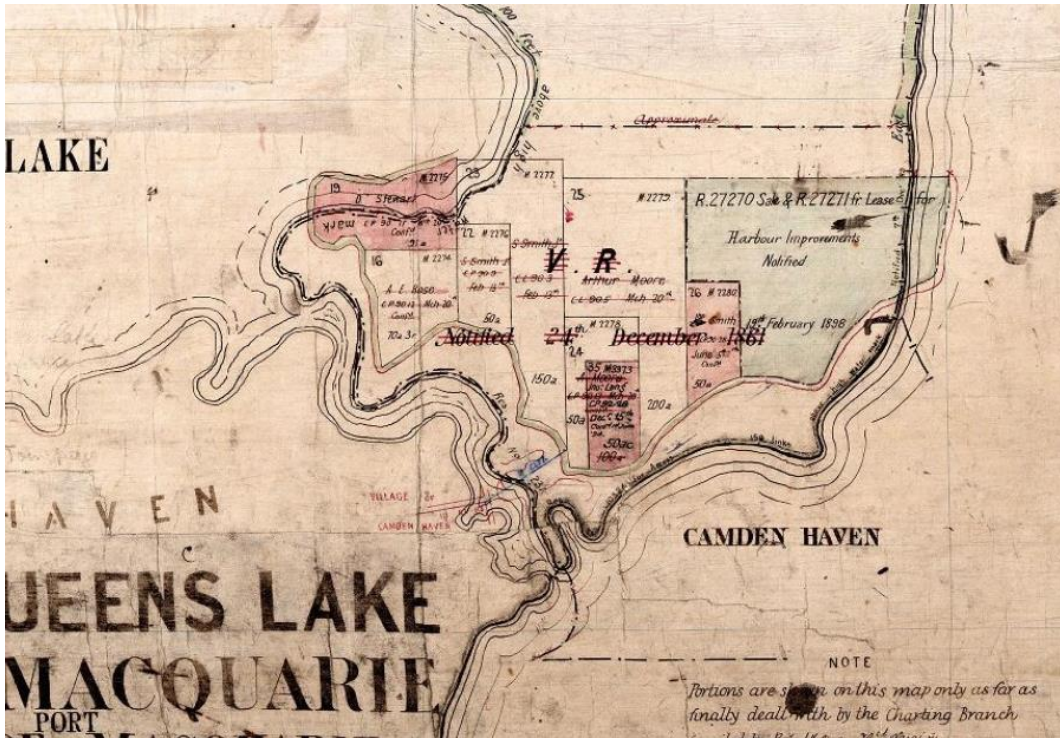
APPENDIX A

Sections of historical parish maps, County of Macquarie, Parish of Queens Lake. Only the graphical part of the map relevant to the case is included. All other information can be obtained from the Historical Land Records Viewer (<http://hldr.nswlrs.com.au/pixel.htm>).

Edition 3 was either missing or not used. The cancellation date of edition 1 coincides with the commencement date of edition 4. Edition 8 of the head office version was missing and so was not included in the sequence of maps.

Appendix A1

Edition 1, in use from 1881 to 1898. There was no indication as to why the double image should occur.



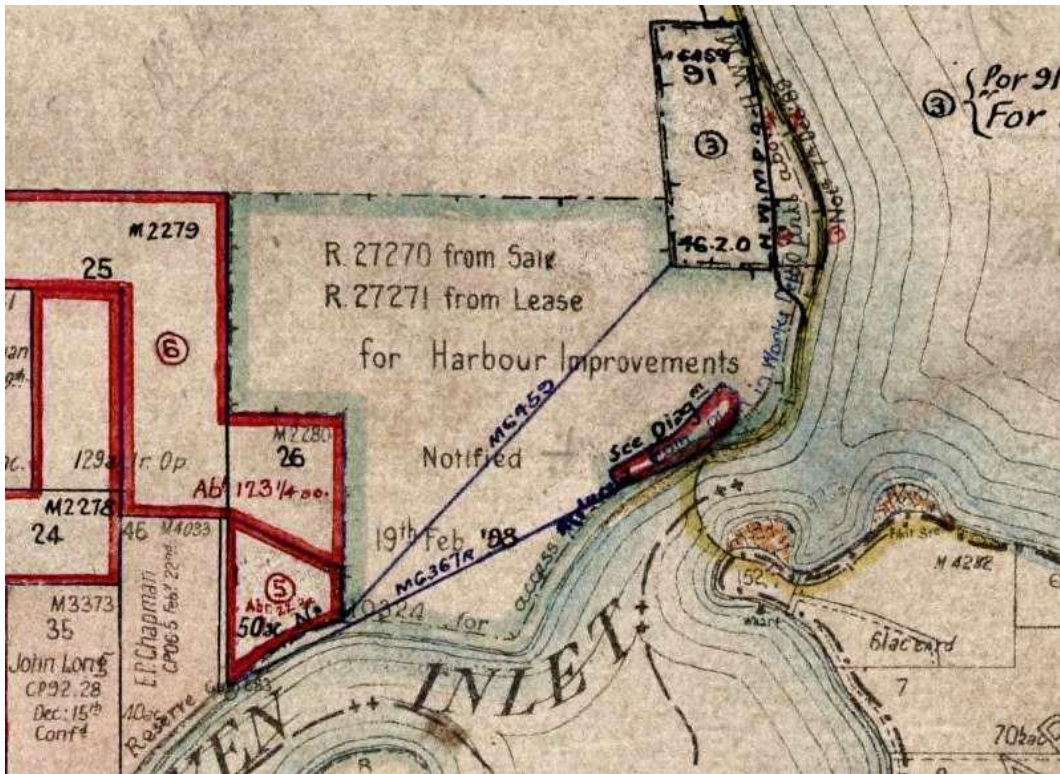
Appendix A2

Edition 2, in use from 1898 to 1914.



Appendix A3

Edition 4, head office version, in use from 1914 to 1922.

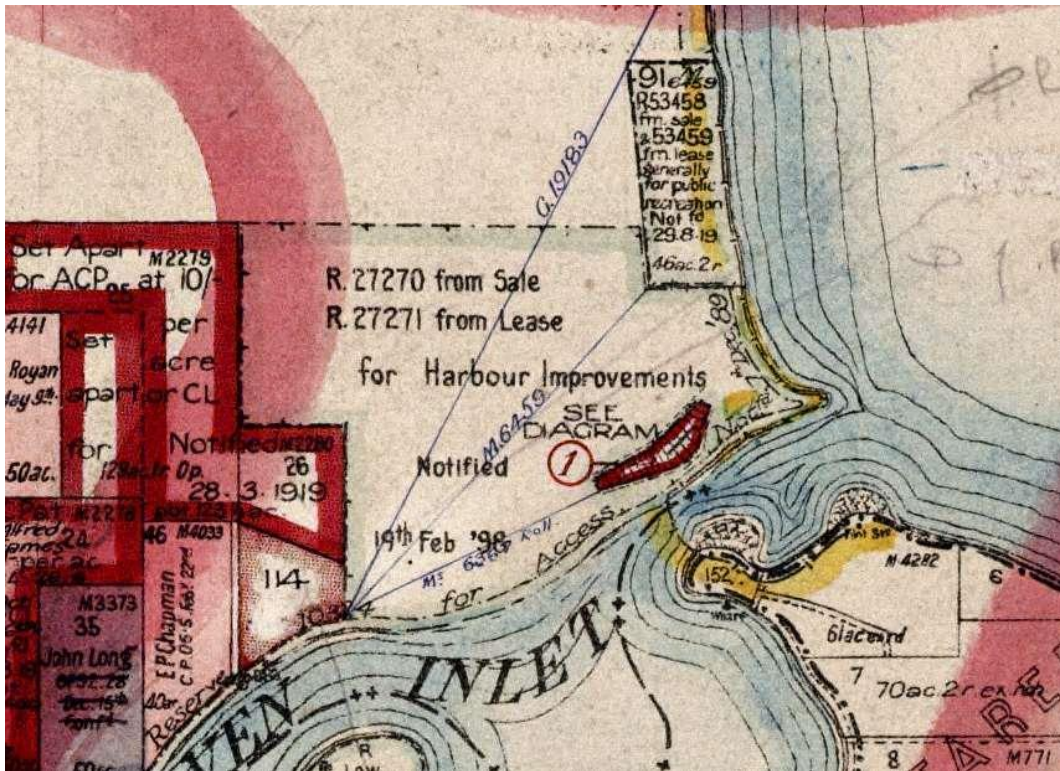


Edition 4, local office version, in use from 1914 to 1922.

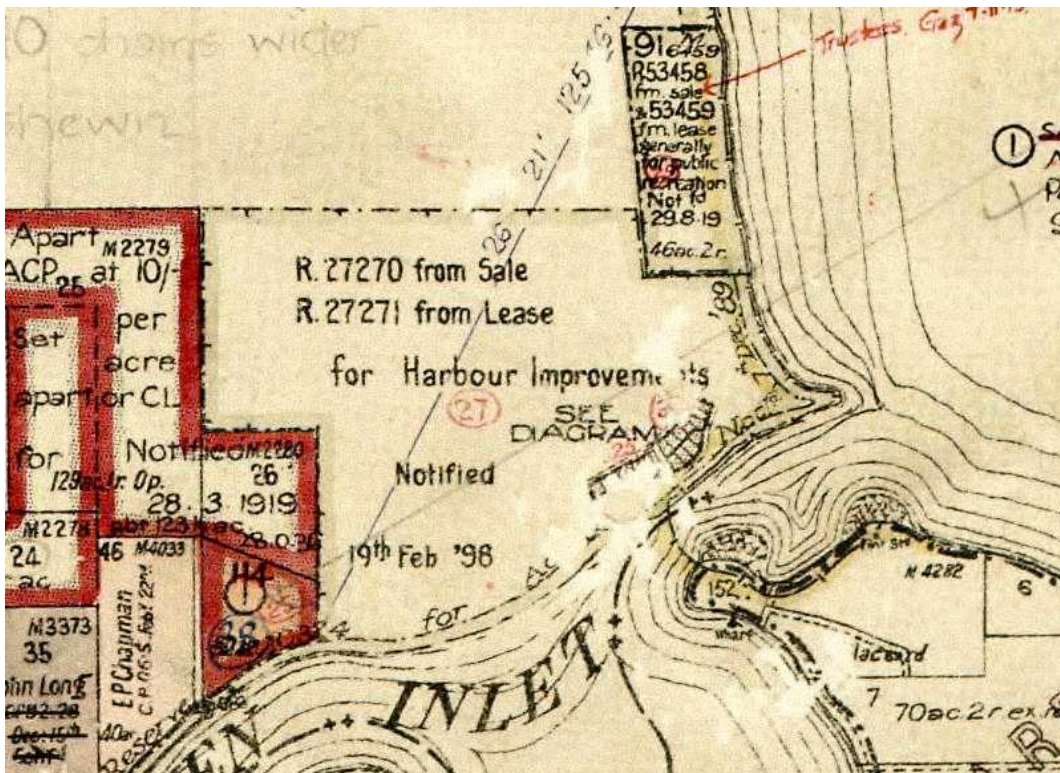


Appendix A4

Edition 5, head office version, in use from 1922 to 1927.

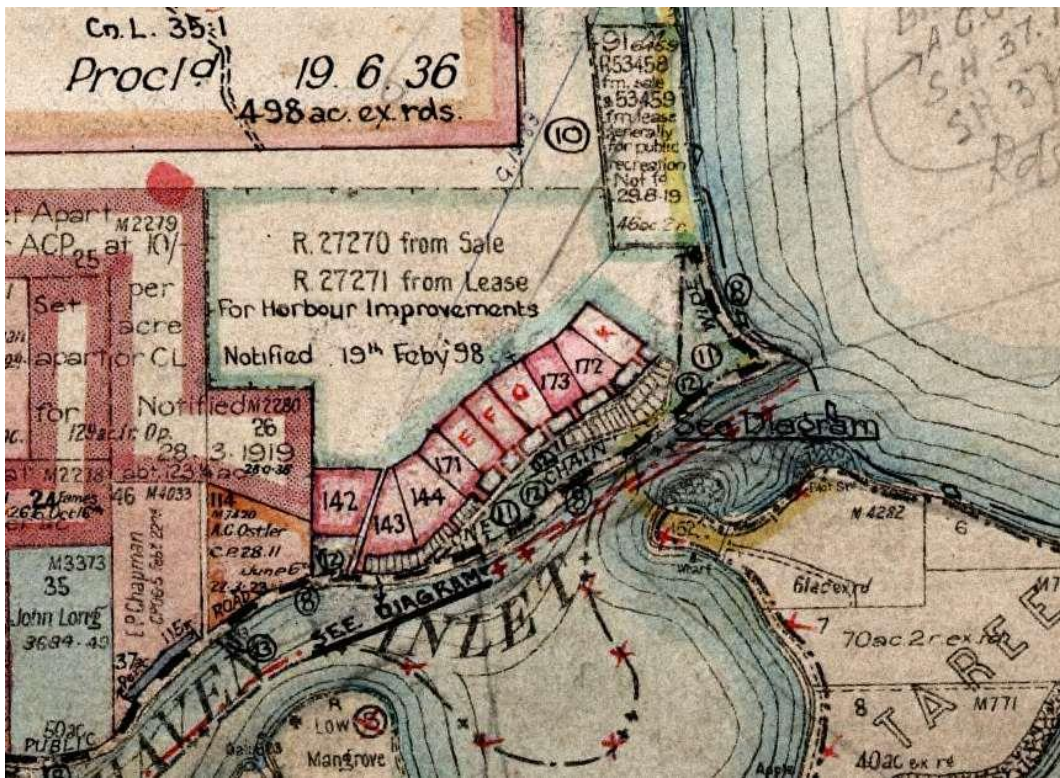


Edition 5, local office version, in use from 1922 to 1927.

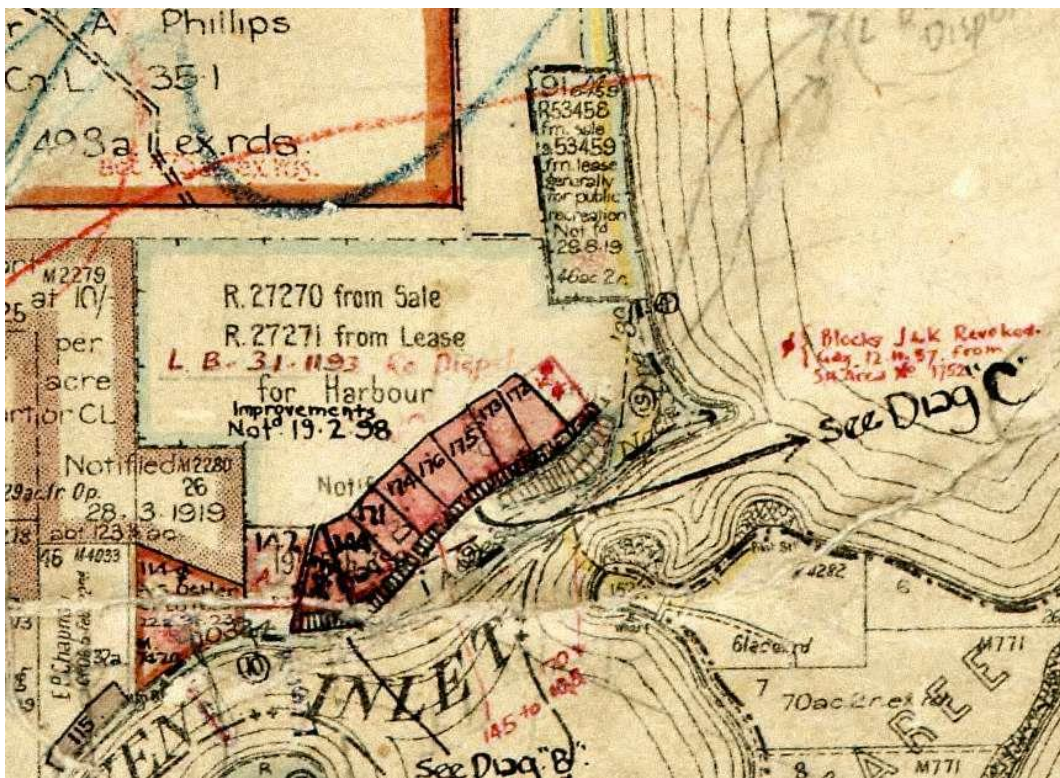


Appendix A5

Edition 6, head office version, in use from 1927 to 1938.



Edition 6, local office version, in use from 1927 to 1943.



Appendix A6

Edition 7, head office version, in use from 1938 to 1958.

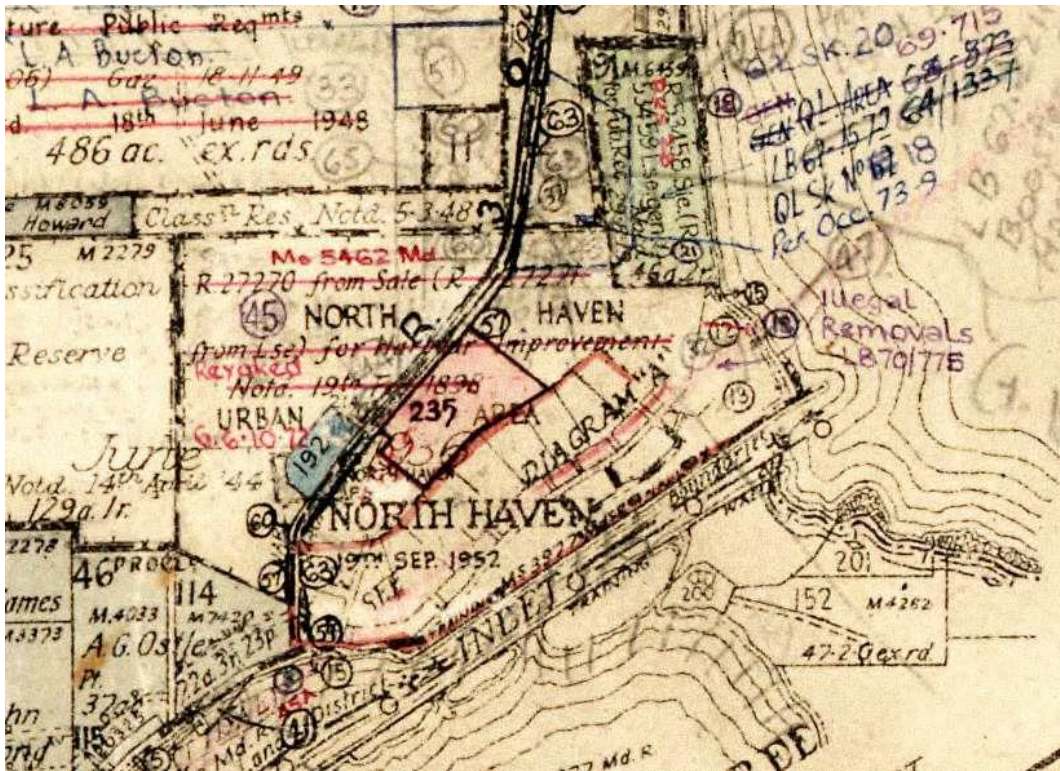


Edition 7, local office version, in use from 1943 to 1959.

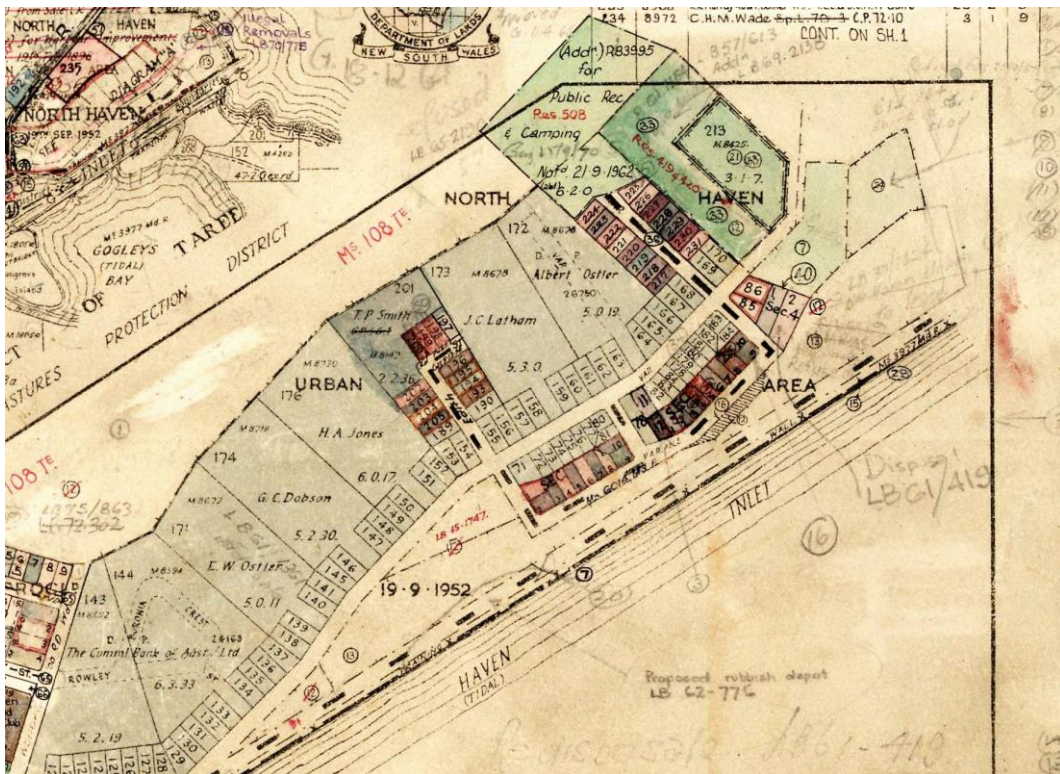


Appendix A7

Edition 8, local office version, in use from 1959 to 1978.

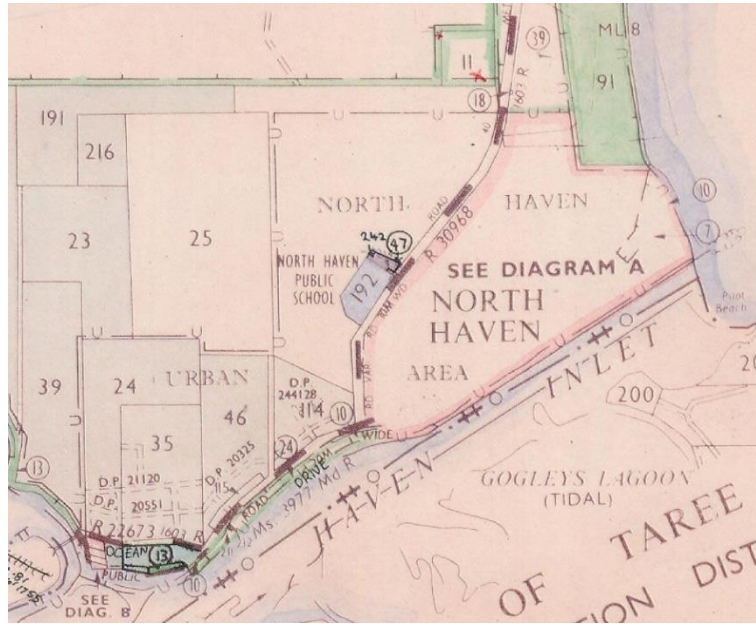


Edition 8, diagram A, local office version, in use from 1959 to 1978.



Appendix A8

Edition 9, head office version, in use from 1977 to 2002.

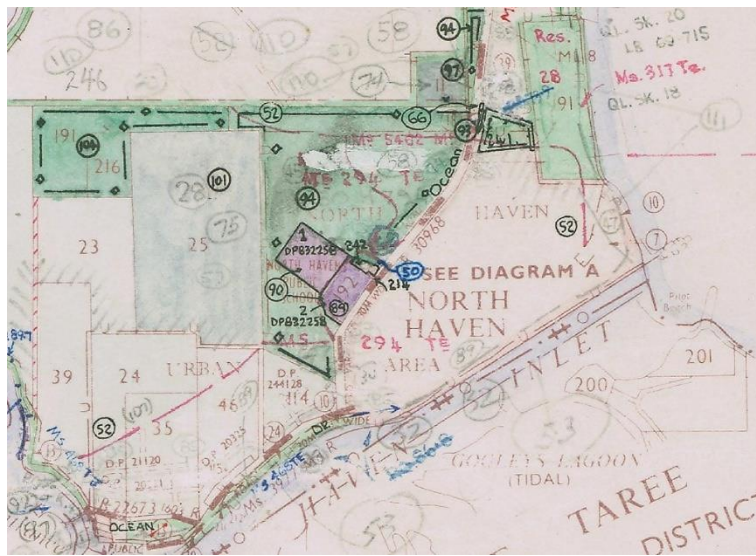


Edition 9, diagram A, head office version, in use from 1977 to 2002.

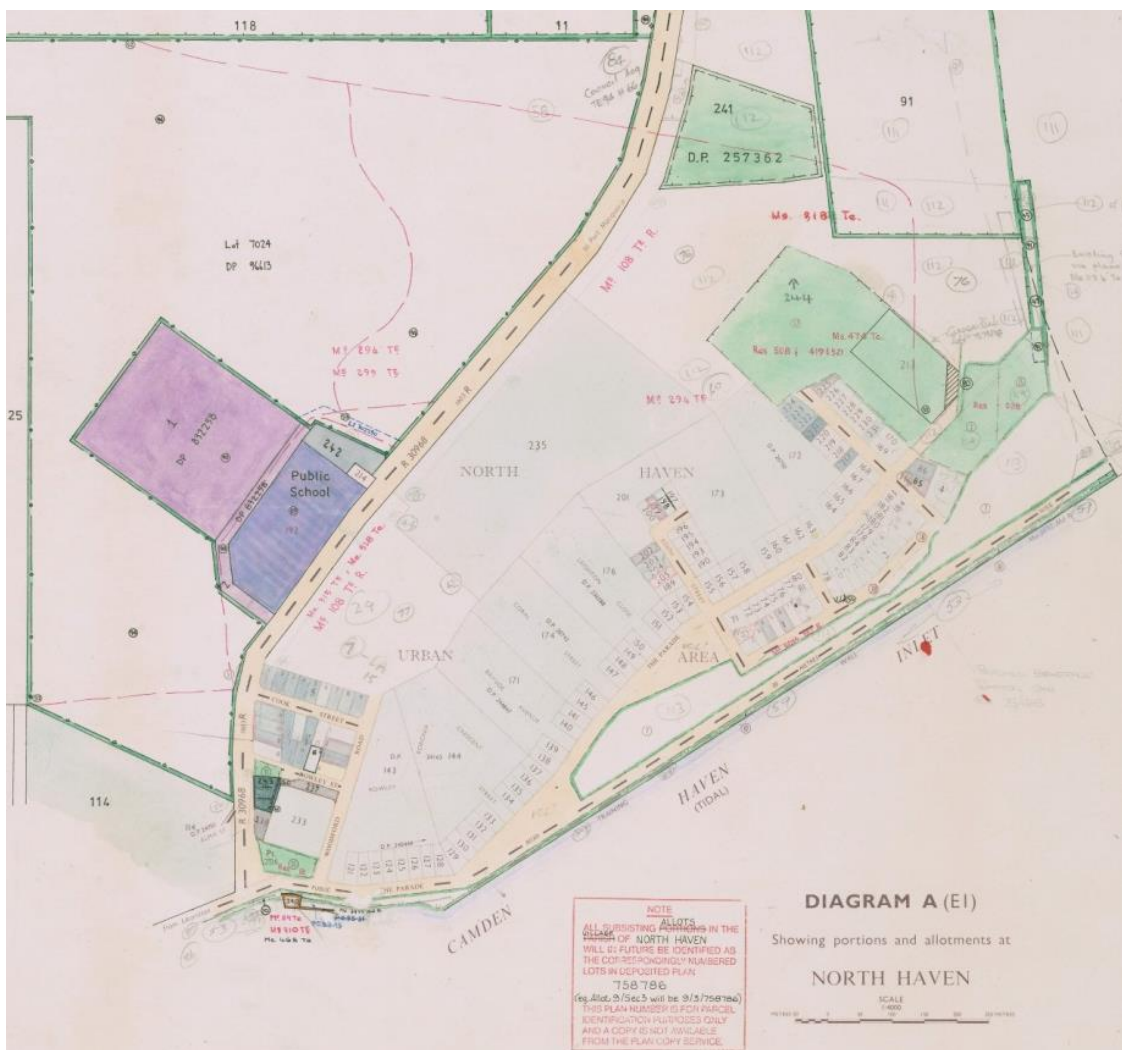


Appendix A9

Edition 9, local office version, in use from 1978 to 2002.



Edition 9, diagram A, local office version, in use from 1977 to 2002.



APPENDIX B

Gazette reserve 231 for access, 21 May 1884.

[3366]

Department of Lands,
Sydney, 21st May, 1884.

RESERVE FROM SALE FOR ACCESS TO NAVIGABLE WATERS.

HIS Excellency the Governor, with the advice of the Executive Council, directs it to be notified that in pursuance of the provisions of the 4th section of the Crown Lands Alienation Act of 1861, the land specified in the Schedule appended hereto shall be reserved from sale for access to navigable waters.

JAMES S. FARNELL.

No. 231. County of Macquarie, parishes of Queen's Lake and Camden Haven, area about 132 acres. The Crown Lands within the following boundaries: Commencing on the south boundary of forest reserve No. 33 west and south extension, notified 1st November, 1880, at a point 100 feet in rectangular distance above the high-water mark on the left bank of Queen's Lake River; and bounded thence by a line parallel to that high-water mark, the high-water mark on the western, northern, and eastern shores of Queen's Lake, and the high-water mark on the left bank of the outlet of that lake, generally south-easterly, north-easterly, and again south-easterly to Camden Haven; thence by the shores of Camden Haven, the left bank of the outlet of Queen's Lake, the eastern, northern, and western shores of Queen's Lake, and the left bank of Queen's Lake River generally north-westerly, south-westerly, and again north-westerly to a point west of the point of commencement; and thence by part of the south boundary of forest reserve No. 33, west and south extension aforesaid east to that point. Again commencing on the south boundary of forest reserve No. 33, west and south extension, notified 1st November, 1880, at a point 100 feet in rectangular distance above the high-water mark on the right bank of Queen's Lake River; and bounded thence by a line parallel to that high-water mark, the high-water mark on the southern shore of Queen's Lake, and the high-water mark on the right bank of the outlet of Queen's Lake generally south-easterly to Camden Haven; thence by the shores of Camden Haven, the right bank of the outlet of Queen's Lake, the southern shore of Queen's Lake and the right bank of Queen's Lake River generally north-westerly to a point east of the point of commencement; and thence by part of the south boundary of forest reserve No. 33 west and south extension aforesaid, west to that point.

[Ms. 84-9,364]

APPENDIX C

Gazette reserve 27270 from sale (also R27271 from lease) for Harbour Improvements, 19 February 1898.

[8593]

Department of Lands,
Sydney, 19th February, 1898.

RESERVE FROM SALE FOR HARBOUR IMPROVEMENTS.

HIS Excellency the Governor, with the advice of the Executive Council, directs it to be notified that, in pursuance of the provisions of the 101st section of the Crown Lands Act of 1884, the land hereunder described shall be reserved from sale pending determination of the portion to be set apart for harbour improvements, and is hereby reserved accordingly

J. II. CARRUTHERS.

EASTERN DIVISION.

LAND DISTRICT OF PORT MACQUARIE.

No. 27,270. County of Macquarie, parish of Queen's Lake, containing an area of about 336 acres. The Crown Lands within the following boundaries: Commencing at the north-east corner of portion 25; and bounded thence by part of the east boundary of that portion bearing south to the north-west corner of portion 26; thence by the north and east boundaries of that portion east and south to reserve 231 for access, notified 21st May, 1884; thence by that reserve generally south-easterly and north-easterly and reserve 10,324 for access, notified 7th December, 1889, generally northerly to a point west from the point of commencement; thence by a line bearing west to that point.

Identical with reserve 27,271 from lease, notified this day.

[Ms. 97-9,492 Dep.]