

The Use of Historical Data in Community River Management Planning

Barry Starr

SUMMARY: This paper outlines sources of material used in stream management plans that are based on historical data. Examples of the use of that data are given. An historical approach to planning has been adopted as an addition to, or replacement of, the usual form of plan that prescribes actions based upon existing condition. Post-European settlement changes are used to educate community groups on river processes within a local context. The approach seeks to counter two problems common with community stream managers. Firstly, there are those who place too high an expectation on rehabilitation programs. Flood damage is too often viewed as failure, with programs being abandoned. Secondly, rehabilitation is often viewed as restoration to a pre-European state, which often cannot be achieved. An understanding of how a stream has behaved in the past, and why it has done so, provides an anticipation of change and a more realistic community expectations.

THE MAIN POINTS OF THIS PAPER

- There is a large amount of readily available historical data on which to base studies on post-European settlement changes to streams.
- These data consist of two sets, the first being planar (maps and air photos) and the second ground material (written, anecdotal and relic).
- Inclusion of local historical material in stream management plans has evoked considerable interest within community groups and has aided in establishing long-term management strategies.

1. THE VALUE OF LOOKING BACK

River management in New South Wales for the purpose of controlling river erosion processes has, up until the last decade, largely been limited to programs that have been specifically funded and agency managed. Management has included works that protect infrastructure (particularly urban) and programs to protect rivers that are adjusting to changed flow regimes as a result of flow regulation (dams releases extending the period of higher flows). "Hard" engineering, with the use of rock revetment and other high cost works, has been favoured, giving a reasonable protection against failure during extreme events.

In NSW, the advent of Total Catchment Management and Landcare has meant that management of streams has extended to community groups. Restoration of streams to conditions that existed prior to recent (post-European settlement) changes is, along with control of erosion rates, an expectation of community based programs. As the pre-European condition of streams, and the mode and extent of change, are often unknown, restoration programs are often based on assumption. This leads to expectations that have a limited chance of achievement. In particular, attempts at introducing vegetation communities that did not exist prior to the changes, often result in failure.

The need for funding to be distributed as widely as possible has meant that "soft" engineering has been favoured. Structural works are usually temporary in nature, having a main purpose of aiding in vegetation establishment. Revegetation with low cost structural

support, such as gravel mesh sausages, is more prone to damage than rock revetment or vegetation embayments protected by steel pile and chain mesh structures. Community groups often view damage as total failure, this view acting as an impediment to follow-up repair of works and maintenance of vegetation.

A knowledge of the extent of change to streams and the processes of change are key to maintaining community group involvement. Damage to low cost structural works and vegetation during floods becomes an expectation, with a need for continued management anticipated. As a result of experiences with disillusioned community stream managers, a change in planning methods has been made by the NSW Department of Land and Water Conservation in areas such as the Murrumbidgee River catchment area. In the past prescriptive plans were produced. These simply indicated works and management needs on an air photo base. In the new approach, local historical material is used as a replacement or an addition to the prescription of works and management. This material is not aimed only to indicate the extent and the timing of change but is also used as a means of explaining river processes that are of particular relevance to the local situation.

The first produced in the Murrumbidgee River catchment area (Starr 1995) has resulted in a demand for the inclusion of historic material in others (Starr *et al.* 1997, Smith 1996, Smith *et al.* 1996). A continuation of community motivated management in areas where formal plans have been produced or where groups have been briefed with historic material indicates success of the approach.

Historical studies are often viewed as time consuming and costly, involving extensive literature searches and detailed analysis of air photos, surveys and other planar material. The techniques used, however, are well established (Eyles 1977, Wasson *et al.* 1998, Brierley 1998). Experience in developing educational type plans has shown that researching historical material is not difficult, particularly if it is staged by using the most readily accessible material first and then progressing through other data until enough information is found.

2. SOURCES OF INFORMATION

Historical data can be grouped into planar and on-ground material. The former comprises of maps, plans and air photos and the latter of written records, anecdotal and relic material. It is recommended that, when taking a systematic approach, data collation and analysis commence with planar material. This can be readily accessed and provides an overview that can indicate the extent of study that may be required.

2.1 The planar view - looking from above

Planar information is available in original survey records, cadastral material (parish, town, village and county maps), air photos and original survey records.

Some topographical maps include cadastral material superimposed on landscape features plotted from aerial photographs. Where these are unavailable the source material ie aerial photographs and parish maps, can be used. As rivers and creeks formed the boundaries of many surveyed portions, their location in comparison to that of the current stream channel will indicate if there has been any net change. Open-ended portion boundaries on topographical maps usually indicate the location of the stream channel at the time of survey (Figure 1). Not only can the extent of movement be ascertained but also a comparison made between channel features. Care must be taken when drawing conclusions on the latter, however, as alluvial material may have filled the prior channel.

Aerial photographs provide a second stage of data acquisition. In 1944, aerial photographs were taken of much of Australia. These photos, which are of high quality and with most at a scale of 1:25 000 are of great value. The photographs are currently available from United Photo and Graphic Services P/L of Blackburn Victoria.

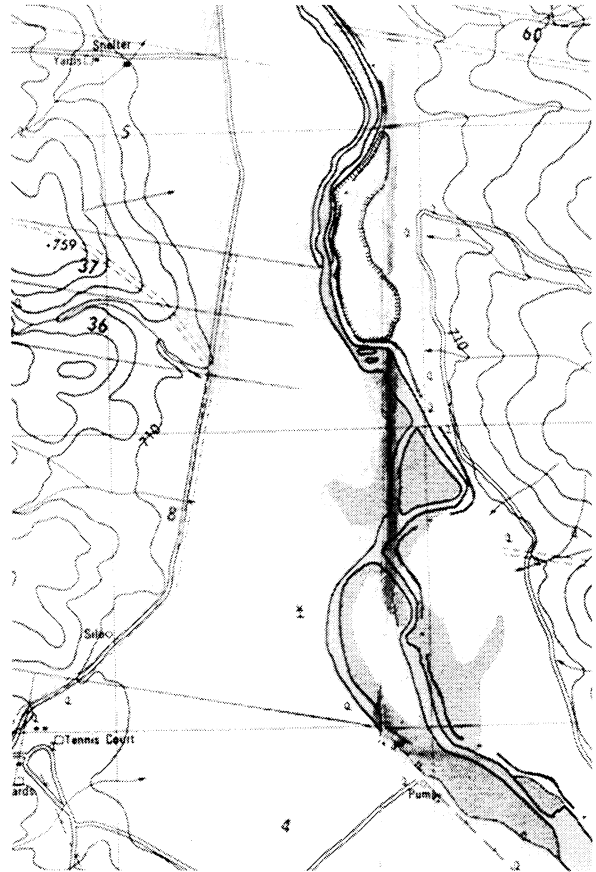


Figure 1: Detail from a 1:25 000 scale topographical map showing the location of a creek channel where it formed the boundary of surveyed portions.

In 1944, much of the landscape was at its most degraded state since European settlement, with rabbit infestations at a peak, and the impact of drought apparent. In south-eastern New South Wales the impact of the major flooding of the 1920's is also apparent (Figure 2). Aerial photographs have been produced regularly since 1944, providing data by which change can be assessed, particularly in relation to recorded flow events. When using air photos it needs to be noted that:

- It is particularly important that all available air photos are used to ascertain absolute, or total, change that has occurred. Conclusions reached from net change of, for example between 1944 and the most recent air photo, may be valid for assessing the headward extension (or lack of) of hillslope gully networks, but must be used with caution for stream changes. Channels not only respond to the flow of water but also to the movement of sediment, often in the form of slugs. These and their impact on the riverine corridor may be missed if a long term net approach is taken to air photo and cadastral map interpretation (Figure 3).

- Air photos show seasonal variations in groundcover. This is particularly valuable in locating prior channels, particularly those surveyed soon after settlement. At times of increasing moisture stress prior channels will be moisture favoured in comparison to adjacent prior banks or bars and will often be clearly discernible. The detail of channels, banks and bars shown in air photos often reflect the accuracy of early surveys on which cadastral maps are based (Figure 4).
- With one millimetre representing twenty-five metres at a 1:25 000 scale, channel changes are often difficult to detect. The relative location of fixed features such as fencelines, buildings or even gullies that are adjacent to, or connected to channels, provide the most accurate means of estimating or measuring change.

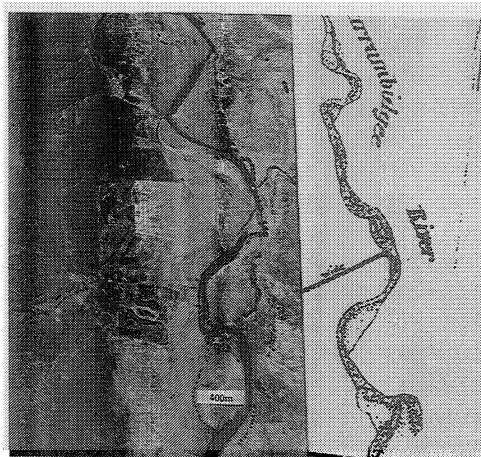


Figure 2: A section of Murrumbidgee River channel that relocated during floods of the 1920s as the result of the deposition of a sediment slug. The location of the channel prior to the events, and as originally surveyed is indicated by the line of willows (from Starr *et al.* 1997)

Cadastral maps not only provide the location of channels as surveyed, but are also a reference to more detailed information. Many portions on recently produced parish maps have notations of "M" or "Ms" followed by numbers. Reference of these to land titles office can give access to original title survey detail or the original survey books. The latter often contains a wealth of detail not available elsewhere.

2.2 Relics and writings - on-ground information

A major gap in planar information exists in the period between the first surveys and the start of aerial photography in 1944. In south-eastern Australia most of the hillslope erosion evident as gully networks occurred in the first half of this period (Wasson *et al.* 1998). Streams responded to both elevated sediment loads and increased catchment discharges, primarily the result of channelisation (Wasson *et al.* In prep.) Data from this period of major change is critical to a

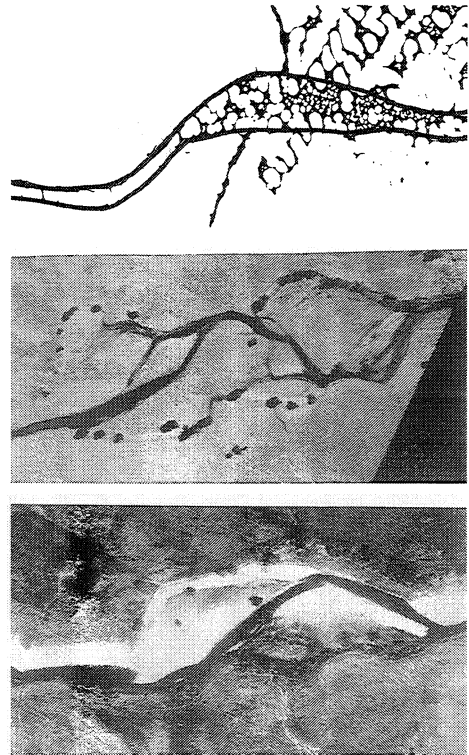


Figure 3: A section of Murrumbidgee River as surveyed in 1867 (upper) bears a close resemblance to the channel 100 years later (lower). Between these times, however, the channel was filled with a sediment slug (middle).

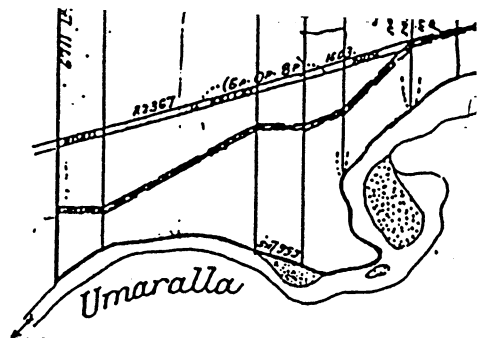


Figure 4: A 1967 air photo and 1871 survey of the Numeralla River. Vegetation moisture variation permit the surveyed point of land and connected bar to be easily located and the extent of meander migration to be measured.

comprehensive post-European history of stream changes. The written observations of early explorers, settlers and other travelers through the landscape contain much information on the state of streams prior to European-induced change. Sketches were commonly used prior to the general use of cameras and some contain remarkably detailed information (Figure 5). There is a plethora of published and unpublished works, handwritten journals and sketches held in libraries or in private collections. A limitation to their access is knowledge of the existence of the material. Local amateur historians and historical societies can, however, provide a reference list.

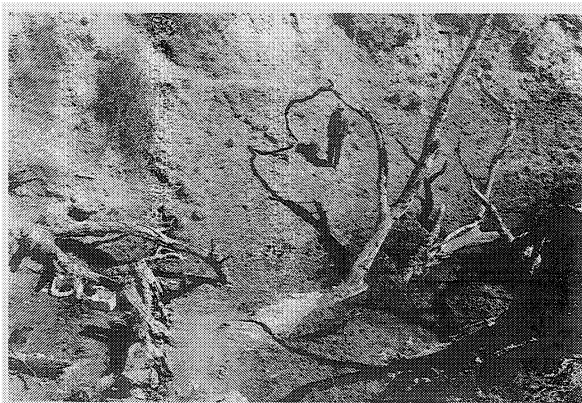


Figure 5: A sketch of "The Well in the Deep Creek" from an 1848 journal of the teenage John William Buckle Bunn of Woden Station ACT (upper). The exposed roots of the *Eucalyptus spp.* indicates then recent channel incision of what is known as Woden Creek. Cross-section comparisons that were made when the tree and well were recently located indicates that channel dimensions of this creek have changed little in the ensuing 150 years (from Wasson *et al.* In Prep)

Due to the fact that channel change occurs during noteworthy flood events, and the fact that rivers and creeks were, and are, central to a rural existence, observations on changes that occurred are contained in many early works. Anecdotal information of extreme events and their impact is also available, particularly in areas long settled by the one family. The same families often have collection of photographs that date back into the 19th Century and contain landscape detail, usually as backdrop material.

A wide range of relic material including that left by settlers or deposited by floods can be used to develop a sequence of change. One relic of the impact of European settlement is the deposits of "post-settlement alluvium" (PSA), that are sourced from soil eroded in the last two centuries or less. Along many incised stream channels the PSA consists of coarse silt and sands that form a distinct layer over a rich dark humus soil. The humus soils indicate former swampy meadows and chains-of-ponds that were covered by upstream or upslope eroded soils prior to being incised (Wasson *et al.* 1998). The protruding remains of bridges and other crossings are not only artefacts that confirm that alluvial deposits are, in fact, of the post-European settlement period, but can also reveal the timing of deposition and incision (Starr 1989). Vegetation introduced by Europeans can be useful, particularly if rates of growth and longevity of particular species is generally consistent in an area. Willows stranded on banks or exposed willow roots indicate bed lowering. If the age of the willows can be estimated so can the level of the bed of a stream at the time the trees commenced growing.

3. PUTTING IT TOGETHER

While accessing planar data is a simple process, the collation of relic data and local documented and anecdotal information can be time consuming. The task is best shared with the community group for which, or with whom, the historical study is being carried out. Their participation in the process, once a briefing has been given as what is being looked for and why, can ensure an expansive database.

Interpretation of planar data is essentially the location and measurement of change. Relic, anecdotal and other on-ground information needs to be examined in a logical manner with erosion, deposition and incision sequences (and various combinations of) being developed from what is usually a scattering of information. It is important that, wherever possible, anecdotal material and written observations be corroborated. This is mainly due to its subjective nature and difficulties in interpreting what the witness actually meant. Corroboration can either be sought through planar or other on-ground data. Examples of the use corroborative data are shown in Figure 6 and Figure 7.

Moore (1982) wrote of major changes that occurred to the Murrumbidgee River at Lanyon (Australian Capital Territory) as a result of a major flood in 1852. Prior to that event the river consisted of deep holes interspersed with gravel beds. Following the 1852 flood the river had doubled in width and had infilled with sand. Extensive bank erosion had occurred. Moore does not reference the source of information of the 1852 change. An 1883 resurvey of a portion bounded by the river does, however, provide confirmation (Figure 5). The original survey was of both banks, not the centre thread of the river. The resurvey shows a new river boundary with the space between that and the prior bank being of "sand and gravel". From the scale it is apparent that a doubling in width had occurred.



Figure 6: An 1887 resurvey of a portion of land at Lanyon ACT which a change in location of the bank of the Murrumbidgee River since the original survey. The strip of "sand and gravel" corroborates anecdotal material on changes to the river that occurred on and after a major flood of 1852.

Stewart Ryrie (1840), in one of his "tours" of south-eastern Australia encountered the Numeralla River and wrote of it being "... very small, being no more than a running creek, a yard and a half wide. There are many large and deep holes in it". At the same location today the Numeralla River has a vertical bank of two metres height and is forty metres wide. The only deep holes occur at the outside of meander bends. It appears that the channel has expanded markedly since 1840. What Ryrie does not make clear, however, is whether he is writing of the total channel or just the flow of water that was present at the time. The former case is indicated by the presence of relic information in the form of a perched prior channel that is filled with alluvium and is of dimensions similar to that mentioned by Ryrie (Figure 6). It is apparent that, in 1840, the Numeralla River that Ryrie wrote of was a chain-of-ponds, a common drainage feature that has largely disappeared.



Figure 7: A prior channel infilled with post-settlement alluvium. This channel is of the 1840 dimensions of the Numeralla River as indicated by Stewart Ryrie and is exposed on the now two metre high vertical bank of the river.

4. SUMMARY

The use of local historical material in community river planning in the Murrumbidgee River catchment as an educational tool has aided in establishing long term management. Interest in the approach has resulted in an demand for such plans. The following recommendations summarise a methodology that can be used in preparing an historical study of river changes:

- Commence with planar material and in particular topographical maps that contain cadastral information.
- Use all available air photos to analyse the absolute, or total changes that have occurred since 1944.
- Additional information of original surveys can be obtained by accessing survey books and copies of original plans.
- On-ground information, written, anecdotal and relic, is critical to assessing the processes of change that occurred before 1944. A wide database can be developed by involving community groups.
- Corroboration of subjective, or unreferenced material is important, but often not difficult.

5. ACKNOWLEDGEMENTS

The original of the J W B Bunn sketch is held by the Mitchell Library, Sydney and has been reproduced with the permission of the State library of NSW. The section of topographical map (Figure 1) and 1967 air photo (Figure 3) are Crown Copyright and are reproduced with the permission of the Surveyor-General's Department of the Department of Land and Water Conservation, Panorama Avenue, Bathurst, 2795. The section of 1944 (Figure 2) is Copyright Commonwealth of Australia, AUSLIG, all rights reserved. Reproduced by permission of the General Manager, AUSLIG, Department of Administrative Services Canberra ACT.

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