Community drive the construction of Engineered Log Jams in South East QLD

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Key Points

- A community engagement model is critical for success of NRM projects, such as stream bank repair
- A local steering committee, who support landholders undertaking NRM projects, facilitates the uptake of best management practice by rural communities
- Significant stream bank erosion occurred in SEQ in 2011 and 2013
- Engineered Log Jams can protect stream banks and are viewed as an asset by the community

Abstract

- Management of stream bank erosion is a top priority activity to protect and improve South East Queensland's (SEQ) waterways, retain valuable soil resources, and build landscape resilience to flooding. The current erosion and sediment discharge rates in SEQ are estimated to be 30 times that of pre-European settlement, predominantly from rural catchments with over 50% derived from stream bank erosion.

- The Queensland State Governments' Healthy Country program aims to reduce sediment discharge from rural catchments and applies a community based approach to engaging landholders underpinned by scientific decision support tools. Through this program the Upper Warrill community supported the installation of two Engineered Log Jams (ELJs) in the Warrill Creek, a tributary of the Brisbane River.

- ELJs consist of carefully placed and anchored hardwood trees that are constructed within the creek channel and keyed into the creek bank. The ELJs defect the water flow off the bank, giving creek banks and farming land protection during floods. This provides instream habitat for aquatic animals, stability to the bank allowing vegetation to establish and reduces the amount of sediment from being washed downstream.

- The implementation of ELJ technology required a change in paradigm for rural communities. Through the Healthy Country Program and the successful implementation of ELJs in south east Queensland, initial scepticism by the community of using logs to protect stream banks has turned. Managed large woody debris is now viewed as an asset and the community are seeking funding to strategically install more ELJs in Warrill Creek.

Keywords

Community Engagement, Sustainable Land Management, Stream Bank Erosion, Stream Bank Repair, Engineered Log Jams, Water Quality.

Introduction

In South East Queensland (SEQ) the current sediment discharge rate into our waterways is estimated to be 30 times that of pre-European settlement (NLWRA, 2001), 80% of which is sourced from rural catchments (SEQHWP 2007). A significant proportion of sediment comes from stream bank and bed erosion (Caitcheon et al., 2005, Laceby et al., 2015), hence stabilisation of riparian areas is a top priority activity to improve SEQ waterways and build landscape resilience against extreme climatic events.

To address the loss of productive land and degradation of SEQ waterways, the Queensland Government initiated the Healthy Country Program in 2007. The Program was launched as a 'proof of concept' where key sediment producing subcatchments were identified for catchment rehabilitation works that focused on reducing sediment and nutrient runoff. Three focal areas within the Logan, Bremer and Lockyer catchments were targeted for the Program (Crimp, 2011). From 2012-2015 the Upper Warrill subcatchment, within the Bremer catchment was the focus of the Healthy Country Program and saw 18 projects implemented within the catchment to reduce land and waterway degradation due to erosion (Figure 1).

Science

The Upper Warrill had previously been identified as a high sediment producing catchment (Mooney et al., 2008 and Olley et al., 2010). Given that the Upper Warrill had been independently identified as a priority focal area and that it joined the Bremer focal area, it was agreed that it would become a new focal area for the Healthy Country Program.

However, choosing a focal area is only the first step in determining prioritisation of on ground works in a catchment. In most catchments, 60-80% of sediment export comes from 20% of the catchment (Ewater, 2015 and SEQHWP, 2007), hence it is critical to identify priority landscape areas and properties for rehabilitation works to ensure resources are utilised efficiently and works are targeted. To this end the SEQ Catchment's GIS team used Light Detection and Ranging (LiDAR) topographic change data to calculate the elevation differences between LiDAR imagery flown in March 2011 and March 2013 (SEQ Catchments, 2016). This modelling provided elevation gain/loss values for the entire Upper Warrill catchment, allowing land areas suffering the highest erosion rates to be determined.

A great advantage of using LiDAR for site prioritisation is that this information can also be used for the delineation of both creeks and their associated subcatchments on a range of custom scales. This assisted with the prioritisation of individual rehabilitation sites in the identified priority subcatchments. LiDAR also provided the data required for hydrological modelling, helping with the design of individual projects.

Community Engagement

The Healthy Country Program has been successful in gaining landholder support by using a community-based approach where the local community drive projects that are supported and underpinned by data driven decision support tools. The Program seeks to build partnerships with local and state government agencies, universities, the local community catchment group, local contractors and the local community.

One of the first priorities when starting the Healthy Country Program in a new catchment is the formation of a local steering committee. The group is chosen from interested, local landholders that are well respected in the community. This group is integral to the success of the Program and provides a critical link between the program coordinator and the community. The timely formation of a strong steering committee was facilitated by the longstanding extension support offered in SEQ through the Regional Natural Resource Management body, SEQ Catchments.

The Upper Warrill steering committee (Figure 1) met regularly (every 3 months), during the implementation phase of the project, where subcatchment priority areas were refined from the modelled data. Then, when conceptual models for site specific works were developed, the steering committee guided project development, suggested changes to proposed projects and gave their approval for project implementation.

At the steering committee meetings best practice erosion control methods were regularly discussed, one particular meeting it was proposed that Engineering Log Jams be used at two badly eroded creek sites. However, there was concern around putting logs into creeks and the committee requested more information. At the next meeting a detailed presentation was given on Engineered Log Jam design and evidence was presented which showed there would be very little risk of works failing and damaging community

infrastructure. The steering committee subsequently endorsed the Engineered Log Jam Projects and were strong advocates of these projects in their community when others expressed concerns.

Figure 1 – Map of SEQ and the location of the Upper Warrill Projects (adapted from http://www.health-e-waterways.org) and the Local steering committee meeting in the fire brigade shed in Aratula, SEQ.

At the end of the project Mal Abbot (the steering committee's chair) included a forward in the final report to the Queensland Government, in which he stated:
'The Healthy Country Project has been successful in introducing many projects to our community that have helped to reduce erosion, stopping valuable soil being washed from our catchment. As a steering committee we've picked a variety of projects targeted in smaller catchments, known to have erosion problems, which have successfully met their objectives. The Healthy Country Program has helped us know where to go to get the knowledge and experience to fix other problems in our area – so we are not on our own. The field days and bus tours have brought the community together and has shown that there is interest in the area for these kind of projects. Through the program we have been introduced to many contacts that are out there, who can support us in managing our catchment'.

By combining the science and local working knowledge from the Upper Warrill steering committee, priority subcatchments were identified, project sites were scouted, and conceptual models of site specific on-ground works developed. These projects were then implemented through landholders; a process which engaged them in the landscape repair process, and allowed them to contribute to the detailed project design, and in so doing, saw them become advocates for best management practice in their communities.

Engineering Log Jam Project 1 (November 2014)

Three neighbouring farms adjacent to Warrill Creek were involved in this project. Together they stock about 250 head of cattle and cultivate 50 Ha of lucerne and fodder crops on their river flats. During the past 5 years the landholders have undertaken a range of erosion remediation activities costing over $300,000 (of their own money) on their riparian areas, in what was an ultimately unsuccessful attempt to protect valuable and productive cultivated land. This site was identified during project scoping as one of the highest yielding sediment zones along the Upper Warrill Creek.

Project work

- Nine Engineered Log Jams
- Three rock revetments and
- Revegetation of riparian areas with plantings of 600 Lomandra and 600 native trees

The landholders had previously attempted to stabilise the creek banks with large cement blocks in 2011 and a large rock groyne in 2012, however, these structures were removed by floods in 2011 and 2013, depositing some of the blocks more than 500 m downstream. The Healthy Country Program brought the landholders together and supported them to find new solutions to repair the damaged section of creek. A project was developed where all three landholders would partner to repair and stabilise this badly damaged section of the Warrill Creek. A series of nine Engineered Log Jams (ELJs) and three large hybrid rock-log revetments were constructed to protect 1.6 km of creek bank (Figure 2 and Figure 3). The rock used in the new structures was recovered from the earlier failed structures, and placed on top of a bed of 10 m logs, with additional logs and piles pinning the rock in place. The hybrid rock-log structure effectively reduces scouring around the rocks, reducing the chance that the rock revetments will fail.

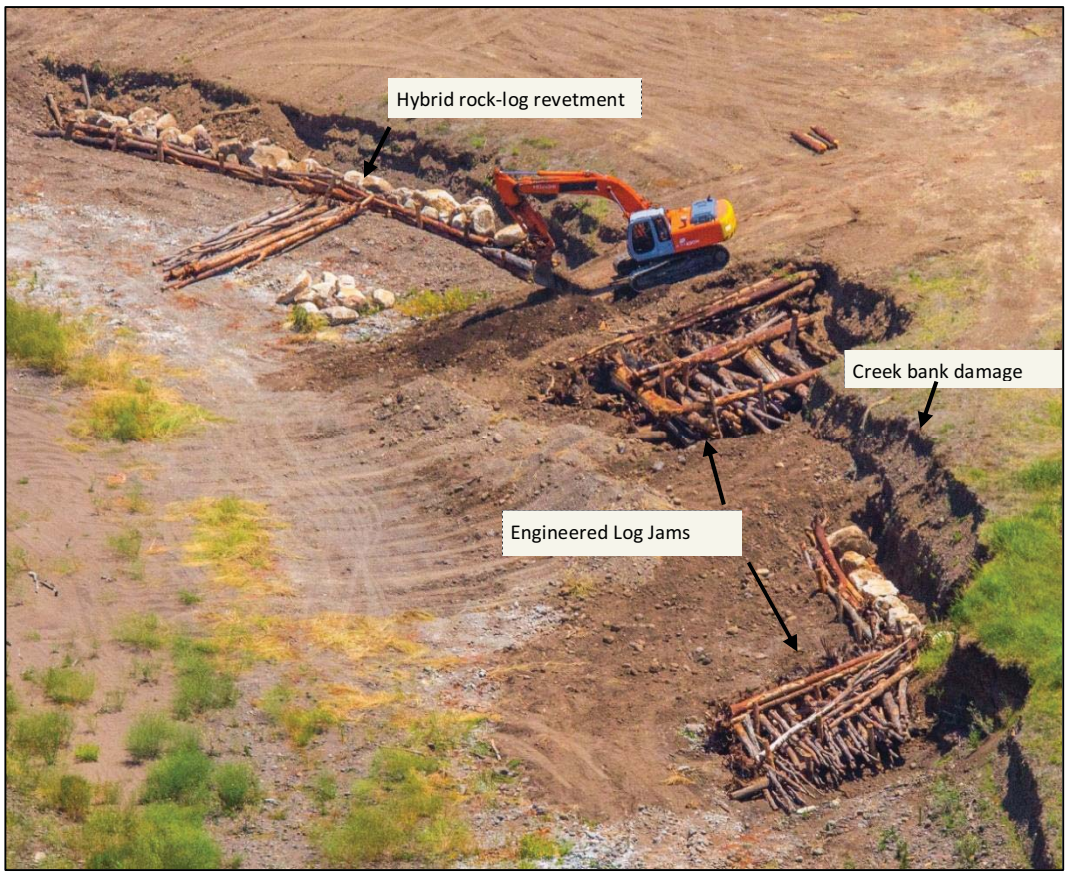


Figure 2 - Aerial photograph of the construction of ELJ's in the Warrill Creek

To construct the log jams, ten metre long hardwood logs were placed in a criss-cross stack, keyed into the creek bank with their roots facing upstream, pinned and tied together with steel cable as per the guidelines of Brooks et al., 2006.

Figure 3 - Precise placement of logs to create the log jams in the Warrill Creek

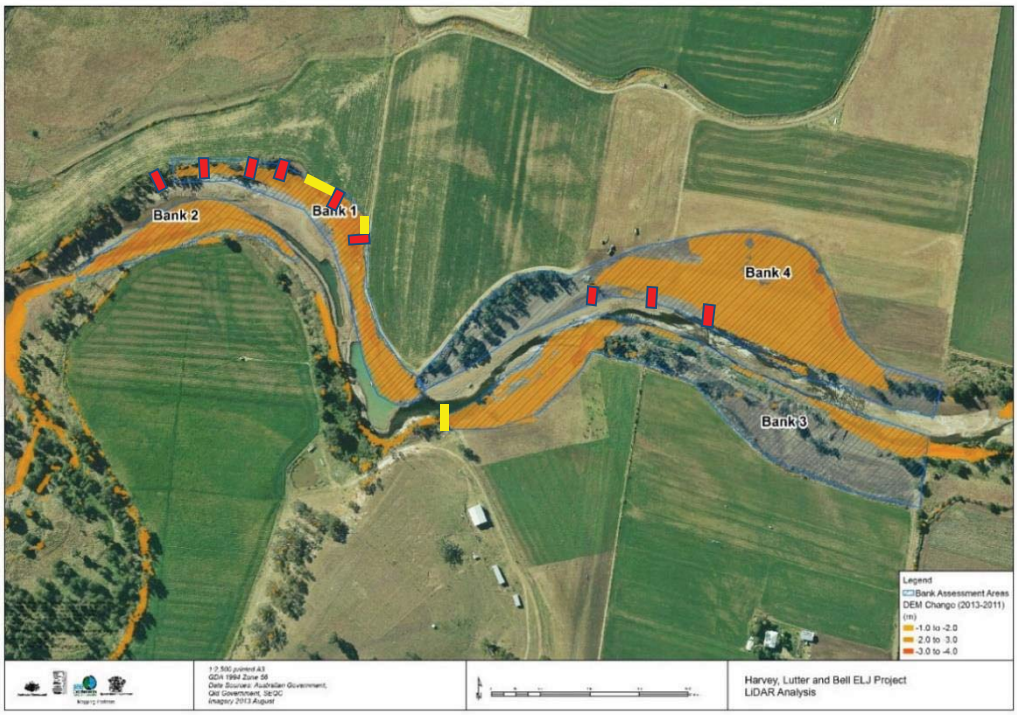


Figure 4 - LiDAR change from March 2011 - March 2013, showing stripping of between 1 - 2m in light orange hatching, and 2 - 3m in darker orange). The red markers indicate the location of ELJs, the yellow markers indicate the location of the hybrid rock-log revetments

LiDAR change analysis showed that approximately 156,500 tonnes of sediment was eroded from the banks in the area from 2011-2013 (Figure 4), most of this erosion occurred in the 2013 flood. As there was no LiDAR

capture post 2013, erosion from 2013-2014 was estimated from site assessments in 2013 where the average length, depth and widths of bank erosion were measured in the field and multiplied by 1.4 (to account of the density of soil) to convert to tonnes (Thomson et al., 2012). These were compared to the average length, depth and width of bank erosion scars prior to installation of the works, following the same method used by Thomson et al., 2012. The export rate for the stream bank was calculated so that the impact of stopping further erosion at the site could be quantified. According to this analysis approximately 7500 tonnes was eroded in the period 2013-2014. The period 2014-2015 had similar runoff events to 2013-2014. Assuming that the channel continued to behave in a similar fashion to the period 2013-2014, we estimate the log jams have saved between 5,000-10,000 tonnes of sediment from being washed from these vulnerable banks into Warrill Creek.

Engineering Log Jam Project 2 (March 2015)

This project was located on a 40 Ha property that runs along the upper Warrill Creek in the Bremer catchment. This farm has grazing and cropping on its river flats, where forage sorghum and soybeans are grown. In addition, the owners have conducted riparian revegetation projects over the last 15 years, creating a wildlife corridor along the creek.

The creek is quite high in the catchment, with a gradient of 1.5%, resulting in high velocity flows, which cause bank scour during large rainfall events. During the past five years, the landholders have revegetated the creek banks a number of times, however these remediation activities have been severely damaged and required instream works to support future plantings.

Project Work

- Four Engineered Log Jams (ELJ)
- Revegetation of riparian areas to enhance natural regeneration and provide long term bank stability

A series of four Engineered Log Jams were constructed as described above to protect 200 m of creek bank and save farmland, which suffered damage during the 2013 floods (Figure 5).

Figure 5 - Construction of ELJ, (A) the pit dug into the creek, (B) placement of logs, (C) completed ELJ

LiDAR change analysis (around the orange section highlighted blue) shows that 1950 tonnes of sediment was eroded from the area between March 2011 and March 2013 (Figure 6). Further erosion occurred in 2013-2015 after the creek bank was repaired by the landholder, with the creek scouring an average of 5 m wide by 1 m deep along 80 m of bank (approximately 560 tonnes). The steering committee supported another ELJ project on this property and with support from the landholders the project was completed in March 2015.

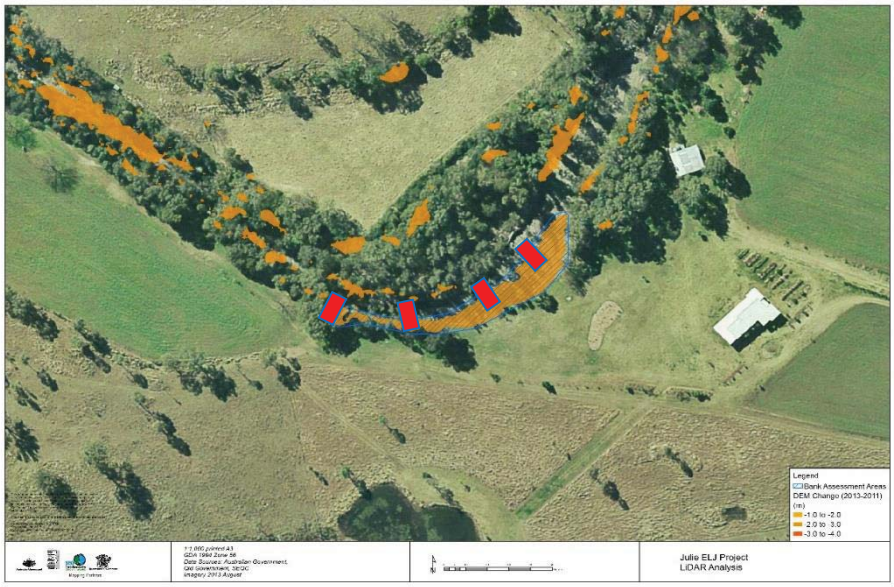
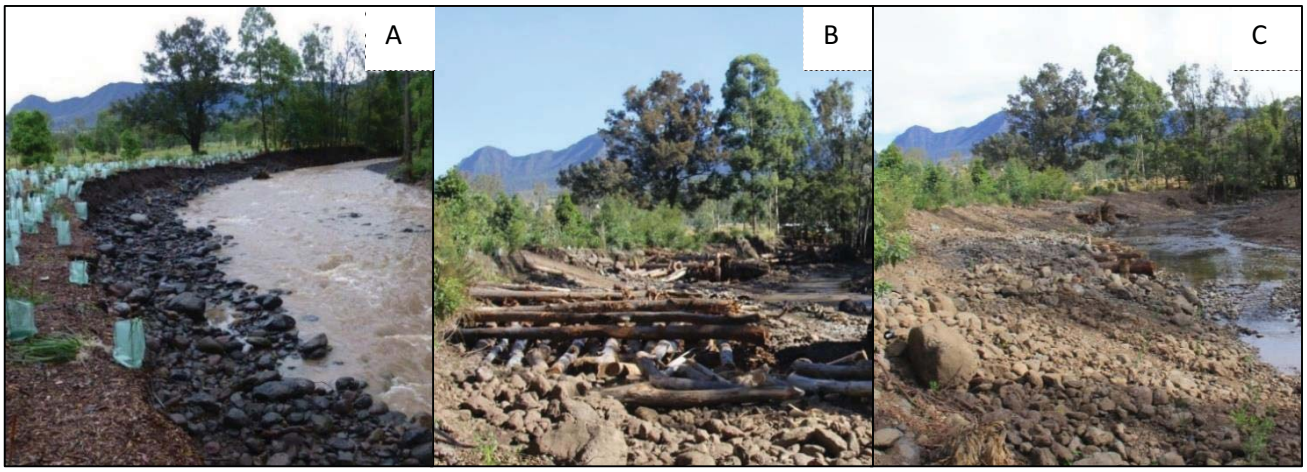


Figure 6 - LiDAR change of bank scour from March 2011 - March 2013. The southern bank was analysed for bank scour. The red markers indicate the location of ELJs

These log jams have not yet been tested by any significant runoff events. However, scour pools have started forming around them from two small runoff events. These pools are enhancing the immediate creek ecosystem by providing habitat for aquatic animals. The ELJs are protecting revegetation efforts and will keep high velocity water flow off the weak creek banks to give banks and farming land protection (Figure 7).



Creek Bank Damage

After bank repairs and revegetation following the Australia day floods in 2011, a flood in 2013 caused banks and vegetation to be torn out again. This cycle of regular damage and repair is costly. Proven techniques are needed to protect banks. Not only will log jams reduce sediment loss from banks, but save landholders and the government the cost of continued bank repairs.

Creating log jams to protect creek banks

10 m logs are placed in a criss-cross stack, with their roots facing upstream so the on-coming water can't penetrate the structure. Piles are driven through gaps in the log stack to hold it, and gravel is pushed back over the structure, making each log jam weigh 100's of tonnes, an immovable structure.

Engineered Log Jams after construction

The Engineering Log Jams were completed in March 2015. 300 Lomandra and 300 native trees were planted over the bank and Log Jams to provide long term stability to the bank and stop further sediment eroding into the creek.

Figure 7 - Time sequence photos of the site. (A) shows damage after a one in 5 year event in March 2014, (B) shows construction of four ELJs and (C) the site after ELJs and earthworks were completed

Conclusions

The Healthy Country Program has built partnerships with local and state government agencies, universities, the local community catchment group, local contractors and the Upper Warrill community. Local ownership of the Upper Warrill Healthy Country Program was fostered through the local steering committee, who guided and supported individual project works. The Program was promoted to the community through; media releases, property management planning workshops, field days, bus tours and community forums. These activities supported community awareness of the program, built knowledge of sediment erosion control practices, and facilitated adoption of these practices on farming properties in the Upper Warrill Catchment. Two exciting projects involved using Engineering Log Jams to protect vulnerable creek banks, and initial scepticism by the community of using logs to protect stream banks has been turned around to a point where the community are now active proponents of such an approach. Managed large woody debris is now viewed as an asset and the community have supported the building of more ELJs in the Upper Warrill Creek in 2016.

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