

# THE AMAZING TALE OF TENTHILL CREEK BRIDGE.

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## **Abstract**

**The programmed maintenance of a timber bridge went from a \$40,000 project in 1997 to a complete replacement with a concrete structure costing \$780,000 in 2001! This paper tells the amazing tale of how the scope of this project could change so drastically.**

The timber bridge on Tenthill Creek near Gatton was recently replaced with a concrete structure as an alliance project between Gatton Shire Council and the Department of Main Roads for a cost of approx \$780,000. The original structure was erected in the 1950's and replacement of some of the deck units was programmed in 1997/98 using funding from the maintenance budget amounting to \$40,000. Due to its age and condition, the complete replacement of the deck and several girders was programmed, with a ball park estimate of \$200,000. The proposal involved uncertainty – further findings of unserviceable girders and/or piles were likely. With the potential for further cost escalation, an evaluation of the whole of life costs was undertaken, whereby the service life of a 'renewed' timber bridge was compared with a replacement concrete bridge.

Main Roads were nearing completion of construction of a concrete bridge at a nearby site. This presented an opportunity to assess the viability of construction of a new bridge. The concept involved construction by Main Roads and Council's workforces, utilising a partnership approach. A submission was presented to Council recommending approval to proceed with complete replacement of the bridge for a preliminary budget estimate of \$593,000. This included seeking funding assistance under a 50/50 subsidy Transport Infrastructure Development Scheme (TIDS) arrangement.

Council adopted the concept. Main Roads were commissioned to undertake survey, geotechnical investigation, and detailed design. Council was successful in obtaining funding under the TIDS programme, and construction was completed in late 2001 with a final cost of \$780,000.

**Key Words: project, bridge, replacement, scope of works, cost, alliance, partnership, timeliness.**

## Introduction

Gatton Shire Council is a medium sized local government with responsibility for the provision of adequate road systems within its boundaries. This report discusses the replacement of the Tenthill Creek bridge project and evaluates the processes used to establish the final estimate of cost.

The Tenthill Creek bridge was a timber structure having been constructed in the 1950's. Replacement of some of the deck units was proposed 1997/98 under normal maintenance from the maintenance budget of \$40,000.00. Due to its age and condition, special maintenance involving replacement of the deck and several girders was programmed, with a *ball park estimate* of \$200,000.00. Funding of \$40,000.00 was allocated from the maintenance budget in 1997/98. This amount was carried over to 1998/99, and together with a capital allocation of \$155,000.00, provided the funding required to complete the project. A new type of deck system 'bridgewood' was proposed.

The proposal involved uncertainty – further findings of unserviceable girders and/or piles were likely. Hence the potential for cost escalation existed. In addition, an evaluation of whole of life costs was undertaken, whereby the service life of 20 years for a 'renewed' timber bridge was compared to that of 100 years for a replacement concrete bridge.

In early 1999, the Department of Main Roads were nearing completion of a concrete bridge at Ma Ma Creek, approx. 10km from the Tenthill Creek bridge site. This presented an opportunity and Council approached Main Roads to ascertain if they could assist with construction of a new bridge, and to provide a preliminary estimate of cost for Council to appraise the viability. A preliminary estimate of \$593,000.00 was developed, with savings identified due to reuse of formwork, lower site establishment costs, etc. The concept

involved construction using the day labour workforce of the Main Roads, together with Council's workforce, rather than going out to formal tender. This represented significant savings in not having to prepare contract documents for open tender.

A report was presented to Council recommending approval to proceed with replacement of the bridge for a preliminary budget estimate of \$593,000.00, rather than renewing the deck only at a cost of \$200,000.00. The report also recommended seeking funding assistance under a 50/50 subsidy Transport Infrastructure Development Scheme (TIDS) from the Main Roads, or other available sources. The proposal was based on construction being undertaken jointly by Main Roads and Council.

Council adopted this concept. In late 1999, Council commissioned Main Roads to undertake detailed survey, geotechnical investigation, and detailed design to obtain a more detailed estimate. Council was successful in obtaining funding of \$300,000.00 under the TIDS programme, and in 2000/2001 allocated a further \$93,000.00 which when combined with the carried forward funds of \$200,000.00, provided sufficient funding for commencement of the project.

Since funding was not initially available, there was no urgency for the detailed design, which was subsequently completed in April 2001. At this stage where resources were to be assigned, the detailed estimate of cost amounted to \$780,000.00. The escalation in cost was attributed to three areas:

- i) the Main Roads bridge gang had moved away to another project – hence opportunity for cost savings was lost
- ii) increases in costs over the time period from acceptance of concept to completion of detailed design, and
- iii) no allowance in original estimate for survey, design, approach earthworks and other miscellaneous works.

There had also been a change of Council in the intervening period, whereby the new

Council had decided to raise the height of the bridge by one metre, to reduce the risk of closure due to flooding.

Council decided to proceed in May 2001, with funding for the extra \$180,000.00 to be allocated from following year's budget. It was also decided to approach Main Roads, using the alliance concept, for additional funds. Main Roads provided funding of an extra \$80,000.00 with the balance of \$100,000.00 being allocated by Council in the 2001/02 budget. Construction commenced in June 2001 and the project was completed in October 2001.

Copies of reports to Council and correspondence with the Department of Main Roads are included in Appendix 1. Details of the estimates for the various stages of the project are also included.

## **Processes used in the amazing change to the scope of works.**

### ***a) The Client***

Initially, when the scope changed from normal to special maintenance of a timber bridge, Council was the owner/client. When it developed into a replacement concrete structure, Council was still the owner, however, since funding of 50% subsidy was being provided by Main Roads, and an alliance was being established with Main Roads, the preparation of an estimate became critical. It had to be acceptable to both parties. The focus shifted to consideration of long-term relationships as well as the construction of a bridge. Essentially Council was happy to provide additional funds to achieve both aims.

There are a number of common budgeting methods: top-down, bottom-up, the programme budget (Meredith and Mantel p291). Each of these methods were utilised during the development of various stages of the project resulting in the revision of estimates. The project was absorbed as part

of the programme management (Council's Capital Works Programme).

### ***b) Stage 1 – Concept***

The initial concept of replacing the deck utilised top down budgeting for planning purposes. The revised project of the bridge replacement was estimated again using top down budgeting – a ball park figure was produced for conceptual consideration by Council. In both cases the use of the work breakdown structure (WBS) supplied the elements, which were required to enable costing to be carried out. Elements included site establishment, removal of the old bridge, piles, deck, deck-wearing surface, approach works and administration. The estimate was needed for economic evaluation of the project – to determine whether it should be carried out or not. It was anticipated that construction would commence immediately, with Council borrowing funds if necessary.

The advantage of using top down estimating at this stage was that the effect of variation due to size was the major factor to consider. Other factors such as inflation, labour-material cost ratios, effect of distance from supply centres, exchange rates, and even changes in environmental and social factors over time were not relevant, due to the similar project being undertaken nearby.

### ***c) Stage 2 – Detailed Design***

The completion of the detailed design in April 2001 enabled a detailed estimate to be prepared. The project was broken down into a large number of smaller elements at the lower levels of the WBS and costed, then aggregating the costs. This bottom up approach after final detailed design, combined with the use of unit rates resulted in the detailed estimate of the cost. Several items were calculated using measured quantities with unit rates, whilst other items were lump sums calculated from estimated requirements for materials, labour and plant. To this, site overheads, administration overheads and contingencies were also added.

#### **d) Management Considerations**

It was at this stage that the total estimated cost was found to exceed the budgeted allocation, which had been based on preliminary figures. This necessitated a report to Council outlining the factors that led to this situation. In hindsight this situation could have been managed better by clearly stating the accuracy applicable to each stage of the estimates.

#### **Analysis of estimating processes**

##### **a) Issues**

In the development of projects, it is important to keep the client fully informed with no unexpected surprises. Hence during each stage, the level of accuracy and scope of work need to be clearly communicated. There are many case histories where the final cost of a project far exceeds preliminary expectations. Prime examples are the Sydney Opera House, the building of Parliament House in Canberra, and the Pacific Motorway from Brisbane to the Gold Coast.

##### **b) Strengths**

As noted by Turner (1999, Chapter 8) the civil construction industry includes relatively stable technology and a good information base. The construction of a prestressed reinforced concrete bridge involves many standard systems and processes. Thus estimators can estimate more accurately than in new technologies where rapid development is occurring.

By having the Main Roads officers prepare the estimate and workforce undertake construction of the structure utilising an 'alliance' concept, the Department of Main Roads became part 'owners' of the project. Experienced bridge branch staff are a specialist group who can collect and provide accurate information. The bridge

construction team comprised workers with specialist skills. Hence Council received estimates for which a high degree of confidence existed. In addition, it enabled Council to exert 'pressure' on Main Roads for extra funding.

The establishment of an alliance partnership provided for building a relationship of trust and openness. Wood and Chew (1998 p9-14) suggest that principles exist to ensure delivery of a project to meet or exceed the performance criteria set in relation to targets of key performance indicators for quality, cost, schedule and safety. This aspect was certainly provided for during the construction phase.

By utilising a relatively short construction period, construction costs could be kept to budget. With experienced staff, scheduling and funding issues were controlled. Issues such as cost escalation with time, variations, and changes in environmental and social factors did not impact on actual costs compared to estimates.

Similarly, the quality of works was kept to a high standard by utilising the Main Roads quality assurance system. No rework was required, thereby eliminating wastage and increased costs. Adequate staffing on site, for example a full time cost clerk, also enabled control of costs.

Upon receipt of the detailed design, a Council officer was assigned to coordinate various aspects of the project. This human resourcing issue enabled proper reporting to Council and liaison with Main Roads staff. It is difficult for any completed project to have actual costs in line with estimates without adequate management resources.

An additional strength in having Main Roads staff prepare estimates was that it fostered future strategic alliance relationships between Council and Main Roads. This was provided at the political level and at officer level, where

training of staff in preparation of estimates was a consideration.

### **c) Weaknesses**

The project involving replacement of the bridge looked simple, easy and relatively fast to senior management. Merideth and Mantel (2000 p284) suggest that 'honest' errors occur on the part of project managers due to the fact that projects look easier to senior managers than those who must do the work. Since experienced Main Roads staff were involved, Council staff tended to fall into this trap.

It could be suggested that there was a deliberate attempt to have the cost estimates kept low to convince Council of the desirability of replacing the old structure. This stems from a perception that there is a certain amount of high profile status in being involved with a large 'new' construction project rather than undertaking maintenance to an existing structure. This can be compared with building a new house rather than buying an old existing one.

Once the initial estimate of cost was considered by Council, it created impressions based on the data. This led to the anchoring of subsequent thoughts and judgements. This is a hidden trap in decision-making known as 'the anchoring trap' in reading by Hammond, Keeney and Raiffa (1998 p47-58). This led to unnecessary dramas once the detailed design and estimate were known.

One of the major weaknesses related to the level of detail in the reporting to Council. In the initial stage when the estimate was \$593,000.00, the items that were not included were not sufficiently highlighted. During the later stage of the project, when a 'new' Council was in power, the value of these items turned out to be rather significant.

The project was absorbed along with routine operations as part of the programme management. It did not have sufficient or

dedicated resources (staff) allocated to it, particularly in the early stages.

The extended duration of the project resulted in a loss of detailed knowledge of what was included in the estimate by staff and Councillors. Combined with increases in cost due to inflation, this time issue impacted adversely on the project.

Lack of a detailed design at an early stage combined with too long a gap to obtaining a final design, was a further weakness. During this time, there were changes in Main Roads personnel who were administering the design phase, which resulted in lack of continuity in planning. Fern (1991 p77-81) suggests that whilst it is in the contract phase that the costs show up, cost overruns will have resulted from inadequate planning earlier in the project.

## **Future Projects**

### **a) Improvements to the Processes**

In future projects realistic estimates need to be provided at an early stage. Sufficient detail should be tabled, listing any uncertainties, to ensure that policy makers are acutely aware of likely variances. The effect of changes needs to be highlighted – in the bridge project, the decision by Council to raise the height of the deck by one metre increased the cost by \$20,000.00. This information was certainly given to Council during discussions, but should have been clearly highlighted from that point on. The client needs to be informed of the cost of changes initiated by him.

Clear reporting to the client (Council) needs to occur, and endeavours made to take the politics out of the equation. This is sometimes difficult in Local Government, however, more effort should be devoted to clearly stating the facts relating to the issue. In the early stages of project formulation, the range for the estimate (eg.  $\pm 20\%$ ) should be

provided. This will emphasise that there is uncertainty in the estimate.

When projects are added to the duties of staff responsible for existing programmes, sufficient additional resources need to be provided. This will avoid the project becoming relegated to being 'just another task'. It requires dedicated staff to keep the project on track.

The effects of time should be identified. Not just the inflationary aspects, but also the loss of corporate memory, particularly in local government where changes occur with elected members over time. If possible, the anticipated time frame for the project should be considered and sufficient escalation costs built into the estimate.

#### ***b) Features to be adopted in Future Projects***

One of the strengths of this bridge project was the creation of an alliance with the Department of Main Roads. This tended to add value and promoted ownership by both parties involved. Those involved worked to ensure a high quality product was completed on time and to budget, particularly during the construction phase. The use of skilled experienced staff cannot be underestimated.

For relevant projects, it is recommended that specialist experienced people be used for the preparation of estimates. If they are not available in-house, then they should be outsourced.

No specific system was evident in the early stages of the project. Once funding was secured, construction was undertaken utilising the Main Roads proven quality assurance system. The use of a quality system will enhance the probability of success with future projects, by reducing waste and the cost of unnecessary rework.

The allocation of a dedicated Council officer for the construction phase of the project was also a major strength. The provision of adequate resources to manage all phases of a project is essential. This is particularly important when a project is undertaken in a matrix organization.

One final aspect that should be highlighted is staff training. Council staff gained from working alongside skilled Main Roads staff. Every opportunity for improving skills and training of staff should be pursued in future projects. This will assist with a broader understanding of systems and processes and lead to an improved estimating ability.

#### **Conclusion**

It is essential in project management to keep the client fully informed. Various phases of this project did not include adequate information of scope of works and cost estimates to Council, resulting in 'explanation' reports being required.

Any estimate of cost provided to the client should include provision of escalation allowance to cater for situations where the project is likely to be funded at some time in the future.

Uncertainty in the estimate of cost should be clearly stated. This will prevent situations where surprises occur to an unsuspecting client.

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## Appendix A

### CL.?

#### FILE NO. 2.4/10/31 & 2.14/1/1

#### TENTHILL CREEK BRIDGE UPGRADE

A recent prestart meeting was held between Gatton Shire Council officers and Main Roads representatives, concerning the construction of a pre-stressed concrete bridge over Tenthill Creek (Logan Bridge). Construction has been scheduled to commence on Tuesday, 12 June 2001, with a timeframe of approximately four months.

An estimate of cost for removal of the existing timber bridge and construction of a 4 span concrete bridge has been provided by the Department of Main Roads. The amount estimated is \$660,820 excluding GST. This alliance project will be carried out by the construction branch of Main Roads (RTCS) and where appropriate utilise Gatton Shire Council resources.

The above estimate does not include bridge approach works and associated activities that will be carried out by Council at an estimated cost of \$79,760. This work includes:

- Approach Roadworks	\$39,000
- Guardrail Works	\$17,000
- Bridge Deck Wearing Surface	\$ 5,760
- Name Boards	\$ 1,000
- Services Relocation	\$ 5,000
- Traffic Control	<u>\$12,000</u>
	<b><u>\$79,760</u></b>

The construction estimate of \$660,820 does not include the initial survey and design undertaken for the project at \$44,730. Additionally if substantial work is carried out before this financial year a saving of approximately \$12,000 in RTCS overheads will be passed on to the project.

This brings the total estimate for the project at \$773,310 excluding GST:

- Bridge Construction	\$660,820
- Approach Works	\$ 79,760
- Survey & Design	\$ 44,730
- Saving in Overheads	<u>\$ -12,000</u>
	<b><u>\$773,310</u></b>

An amount of \$300,000 has been contributed towards this project by Main Roads through TIDS:

- Actual Exp. June 2000	\$ 12,343
- 2000-2001 Carryover	\$120,457
- New Funds	<u>\$167,200</u>
	<b><u>\$300,000</u></b>

An amount of \$293,000 has been dedicated from Council funding and consists of the following:

- Carryover	\$143,000
- Loans	<u>\$150,000</u>
	<b><u>\$293,000</u></b>

.../2.

Thus the total funding allocated towards this project is \$593,000:

- Main Roads	\$300,000
- Gatton Shire Council	<u>\$293,000</u>
	<b><u>\$593,000</u></b>

The revised estimate of cost for the project (\$773,310) is \$180,310 higher than the allocated funding at \$593,000. It is noted that some of this additional cost is related to raising the deck level to one meter higher than the existing structure.

In view of this outstanding amount (\$180,310) it is proposed that the following be considered:

- Additional funding sought from Main Roads to 50% (\$90,155) of the outstanding balance.
- The remaining 50% (\$90,155) be dedicated from the 2001-2002 Capital Works Program.

### **MANAGER ENGINEERING SERVICE'S RECOMMENDATION**

It is recommended that the outstanding amount of \$180,310 is sourced as follows:  
Additional funding sought from Main Roads to 50% (\$90,155) of the outstanding balance.  
The remaining 50% (\$90,155) be dedicated from the 2001-2002 Capital Works Program.

#### ***Reason for Decision***

To gain funding for completion of the Tenthill Creek Bridge Upgrade project.

#### ***Effect on Corporate Plan***

Improvement of the road network within the shire.

#### ***Effect on Budget***

1. An additional allocation of \$90,155 is required from the Department of Main Roads.
2. The remaining \$90,155 is required from the 2001-2002 Capital Works Program.

## Appendix A (Cont'd)

2.4/10/31

Phil Bambrick

1 October 2002

Mr Gil Heaton  
District Director (Southern)  
Department of Main Roads  
PO Box 645  
TOOWOOMBA QLD 4350

Dear Mr Heaton

### Construction of Bridge Over Tenthill Creek

Construction is underway to replace the Logan Bridge (formerly known as the Tenthill Creek Bridge) with a 4 span concrete bridge. Completion of this alliance project between RTCS and Council is anticipated by September 2001.

The project at concept stage was estimated to cost in the order of \$600,000; \$300,000 contributed by the Department of Main Roads and the balance funded by the Council. It is noted that a total subsidy amount of \$287,657 was allocated in the Transport Infrastructure Development Scheme 2000-2001.

However, the detailed construction estimate of cost received by Council is \$660,820 (excluding GST) which only considers removal of the existing structure and construction of the new bridge. This estimate does not include bridge approach work and associated activities that will be carried out by Council at an estimated cost of \$79,760. This work includes:

Approach Roadworks	\$ 39,000
Guardrail Works	17,000
Bridge Deck Wearing Surface	5,760
Name Boards	1,000
Services Relocation	5,000
Traffic Control	<u>12,000</u>
	<b><u>\$ 79,760</u></b>

The construction estimate of \$660,820 does not include the initial survey and design undertaken for the project at \$44,730. Additionally, since substantial work was carried out before the end of the 2000/2001 financial year a saving of approximately \$12,000 in RTCS overheads is expected to be passed on to the project.

.../2.

Accordingly, the revised estimate of cost for the project is \$773,310 as follows:

Bridge Construction	\$660,820
Ancillary Works	79,760
Survey and Design	44,730
Saving in Overheads	<u>-12,000</u>
	<b><u>\$773,310</u></b>

This brings the project to a total estimated cost of \$773,310, which is \$173,310 higher than the initial estimate of \$600,000.

In view of the new estimate, Council has sought your consideration for additional funding in the order of 50% of the increased amount, through subsidy under the Transport Infrastructure Development Scheme 2001/2002. Recent discussions have been held with your office and your verbal acknowledgement of an additional \$80,000 allocation toward this project is noted.

In light of this, Council awaits your confirmation for inclusion of these funds under the Roads Implementation Program for the 2001/2002 period, so that it may commit the necessary financial arrangements.

Council looks forward to continuing this joint venture with RTCS.

Yours faithfully

Phil Bambrick

**MANAGER ENGINEERING SERVICES**

JLC:SJM

## Appendix A (Cont'd)

### Summary of Tenthill Bridge Funding and Costs

#### Original Estimate of Cost (Undetailed)

Existing bridge demolition and new bridge construction by Main Roads	\$510,000
Additional cost due to no immediate construction after Ma Ma Ck bridge	<u>\$ 83,000</u>
	<b><u>\$593,000</u></b>

Estimate did not include:

- Investigation, Survey, Design, Review of Environmental Factors
- Installation & removal of temporary earthworks
- Approach works and deck wearing surface

#### Dedicated Funding

An amount of \$300,000 has been contributed towards this project by Main Roads through TIDS:

- Actual Exp. June 2000	\$ 12,343
- 2000-2001 Carryover	\$120,457
- New Funds 2001-2002	<u>\$167,200</u>
	<b><u>\$300,000</u></b>

An amount of \$293,000 is available from Council funding and consists of the following:

- Carryover	\$143,000
- Loans	<u>\$150,000</u>
	<u>\$293,000</u>

<b>Main Roads</b>	<b>\$300,000</b>
<b>Gatton Shire Council</b>	<b><u>\$293,000</u></b>
<b>Total</b>	<b><u>\$593,000</u></b>

#### Updated Estimate based on Current Design

Existing bridge demolition and new bridge construction by Main Roads (includes construction & removal of temporary earthworks bunding and minor earthworks for the structure, not included in first construction estimate)	\$660,820
Overheads savings passed on to project by RTCS due to construction commencing this financial year	-\$ 12,000
Investigation, Survey & Design	\$ 44,730
Approach works and associated activities	<u>\$ 79,760</u>
<b>Total</b>	<b><u>\$773,310</u></b>

#### Points to note in relation to lowering bridge 1m below original design level

##### **Savings**

1. Approach works activities estimated at \$53,160, a saving of approximately \$26,600
2. Less concrete to be order at an approximate saving of \$9,000
3. Slightly less steel required – however steel has already been ordered, cut and bent for delivery

## Additional Cost Incurred

- Alterations will need approval MRD design Branch – any redesign work required will result in:
  - Lost productivity and added costs in waiting for approval.
  - Redesign to check and redraw cost in excess of \$10,000. To amend drawing and steel schedule, an extra \$1,500 required.
- Piling works are scheduled to commence this week. Additional pile stripping may be required if the bridge is lowered after the piling is completed – possible additional costs.

## Other Points to Note

- The stiffening beams below headstocks will remain despite reduction in column lengths. The presence of these beams account for lateral forces due to flood flows.
- Reduction in bridge deck height will reduce the vertical spacing between the bridge deck and stiffening beams, potentially acting as debris traps in times of flooding.

## Summary

### Original Estimate

(Ex. Approach works, temporary earthworks, investigation, survey & design)	\$510,000
Additional setup cost – work not carried out after Ma Ma Ck bridge	<u>\$ 83,000</u>
<b>Total</b>	<b><u>\$593,000</u></b>

### Current Estimate

(Ex. Approach works, investigation, survey & design but includes temporary earthworks bunding and structure minor earthworks)	
<b>Total</b>	<b>\$660,820</b> (Ex GST)

### Difference in construction estimates

Current Estimate	\$660,820
Original Estimate	<u>\$593,000</u>
<b>Difference Approx.</b>	<b><u>\$ 67,000</u></b>

## Total Cost For Construction

To original design	
- Construction	\$660,820
- Less O/H saving	-\$ 12,000
- Investigation, survey and design	\$ 44,730
- Approach & Ancillary Activities	<u>\$ 79,760</u>
	<b><u>\$773,310</u></b>

1m Below original design	
- Original Construction Cost	\$660,820
- Less O/H saving	-\$ 12,000
- Saving in concrete	-\$ 9,000
- Redesign, Recheck and redraw	\$ 11,500
- Investigation, survey and design	\$ 44,730
- Approach & ancillary activities	<u>\$ 53,160</u>
	<b><u>\$749,210</u></b>

The approximate figure of \$750,000 does not include down time which may be incurred due to redesign. Say at 5-10 days at \$3,000 per day.

## Author Biography



Phil Bambrick is presently an Engineering Management Consultant working in the South East Queensland region. He was formally the Director of Engineering Services with Gatton Shire Council, a position he held for eight years, with previous experience in the consulting and education fields. With qualifications in engineering, education and management, Phil's interests lie in promoting the role of engineering in society and the training of staff at all levels of an organization.

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