NRM North

Tamar Estuary and Esk Rivers

Sedimentation management in the kanamaluka/Tamar estuary

An overview of the Trevallyn Flow Releases Study and Sediment Raking Review projects

Dr Rebecca Kelly

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Introduction

Sedimentation in the upper kanamaluka/Tamar estuary is commonly cited as an issue of concern by community members. In particular the presence of visible mudflats in and around Launceston has frequently been raised as a concern. Visible mudflats and sedimentation were a feature of the estuary before European settlement. Extensive dredging between the 1880's and 1960's was used to reduce sedimentation and increase navigability of the estuary to allow large ships to navigate to the port in Launceston. In the 1960's the port facilities were moved to Bell Bay and the need for large scale dredging for navigation ceased. Dredging recommenced in 1988 in areas south of the Ship lift with a smaller scale program which ran until 2009. This program ceased due to the costs being unsustainable.

In 2012 the Launceston Flood Authority (LFA) ran a trial of sediment raking. This involves agitation of bottom sediments using a scallop dredge with the intention that these unconsolidated sediments are then able to be dispersed downstream with river flows. In 2013 the LFA received a 5-year permit from the EPA allowing them to continue sediment raking activities[1]. This permit required water quality monitoring in the vicinity of the silt rake during and immediately following sediment raking activities (upstream and in the plume).

In 2017 the Tamar Estuary Management Taskforce received community submissions related to management of the Tamar estuary. Through the public consultation process, the Taskforce received a number of submissions proposing action to ameliorate the impacts of sedimentation on the amenity values of the estuary. Consequently, the Taskforce commissioned BMT WBM to provide expert advice on the merits of those proposals. One action, targeted release of flows from Lake Trevallyn as a method to reduce sedimentation, was deemed worthy of more detailed consideration and funding was allocated to its investigation.

A working group was formed under the Tamar Estuary and Esk Rivers (TEER) Program to provide advice on the scope of the projects and the objectives against which targeted flow releases and sediment raking were to be assessed. These objectives covered aesthetics with regard to the visible sediment shoals around the western bank, Royal Park, North Bank and Seaport, recreational access and navigability of the channel and mitigation of flood risks through reduced sedimentation in the Yacht Basin and upper estuary. Other impacts raised as important to consider by the working group related to water quality and ecosystem health.

This document briefly summarises the main findings from the two studies:

- Trevallyn Flow Releases Study – using the 3D hydrodynamic model to evaluate the impacts of targeted flow releases and sediment raking on bathymetry and Total Suspended Sediment (TSS) concentrations.
- The sediment raking review – using historic data to assess the impacts of sediment raking on bathymetry and a broad range of water quality parameters.

[1] Information in this section has been taken from LFA (2016).

Targeted flow releases

The Trevallyn Flow Releases Study considered the impacts of targeted flow releases relative to several objectives around aesthetics in terms of visible shoals around the West Tamar, Royal Park and Riverbend/North Bank and recreation and navigation in terms of the channels and access and amenity of the Seaport .This study considered a range of scenarios which represent feasible targeted flow releases equivalent to the operating volume in Lake Trevallyn, as well as a natural spill event of a scale expected roughly once per year. Some scenarios also included sediment raking of the Western Shoal.

The results of the modeling study predict that:

- there would be no net movement of sediment out of the upper estuary under any of the scenarios tested.

- flow releases and sediment raking both have the potential to mobilise sediments but they act in different ways to provide different outcomes on sediment management objectives.

- the highest modelled targeted flow release from Lake Trevallyn without sediment raking, 50 cumecs for 2 days, can be expected to move an insignificant amount of sediment from key areas of concern around Launceston (including the Western Shoal, channel and Royal Park). This flow release is expected to cost at least $100,000 in terms of lost revenue from electricity that would otherwise be generated.

- a flow event the size of an annual flood (peak of 138 cumecs, with spill for 6 days) was also modelled and also moved an insignificant amount of sediment from key areas of concern around Launceston. The mobilised sediment from targeted releases or the annual flood is expected to be redeposited in the upper estuary within 3 months.

- sediment raking can move sediment out of the Western Shoal (approx. 20cm without a targeted flow release; up to 24cm with the feasible flow release) but the majority of this sediment falls directly into adjacent channels leading to infill (approx. 18cm in the channel at the confluence with the North Esk and 6cm in the channel upstream from this).

- targeted flow releases combined with sediment raking act to create temporary improvements in aesthetics of the Western Shoal at the cost of navigation in the channel. The sediment raking campaign modelled would cost approximately $90,000 so these actions together can be expected to cost approximately $190,000 in direct costs and lost potential revenue from electricity production.

- both flow releases and sediment raking can be expected to increase Total Suspended Solids (TSS) concentrations above base flow levels between the Shiplift and Freshwater Point. The greatest impacts are expected at the Shiplift with higher flows generally pushing TSS further downstream (just past Legana in the modelled scenario options) than sediment raking alone (which impacts to the Tamar wetlands). Sediment raking causes higher spikes as well as a more sustained increases in TSS concentrations than flow releases alone. Elevated TSS generally ceases shortly after the release and/or raking campaign end.

Sediment raking

The report on the sediment raking review details comprehensive analysis of bathymetry data from the upper estuary around Launceston. This analysis considers changes in sediment volumes and average depths in 9 regions of the upper estuary extending from Kings Bridge to just past the Shiplift and into the lower North Esk and Seaport. The analysis focuses on three historic periods – the period of data before sediment raking commenced (Jan 2008 to Jun 2013 – note this includes the small sediment raking trial in Sept 2012); the period after sediment raking commenced until the 2016 flood (Jul 2013 to early Jun 2016); and the period after the flood which also included sediment raking (mid Jun 2016 to Nov 2018). The period after the commencement of the sediment raking was split to before and after the 2016 flood to reflect the large impact a flood event of this scale[2] would be expected to have on sedimentation regardless of any sediment raking activities.

This analysis showed that:

- aesthetics - sediment levels in the West Bank have been reduced as a result of sediment raking. Sediment raking has not had a sustained benefit in terms of reduced visible shoals around Royal Park and North Bank, with greater levels of sediment in these areas by the end of the period of raking just before the 2016 flood than was the case pre-raking.

- navigation and access – sediment raking has led to significant infilling of the main channel with between 0.5m to 1m of additional sediment in the channel compared to pre-raking. The 2016 flood was not able to reduce sediment levels in parts of the channel to pre-raking levels. Sediment levels in the channels have continued to increase since this flood. These increases are likely to be impacting on the navigability of the channel, particularly with regards to access to the Seaport, for the Home Point tourist boat and to the Shiplift.

- flood risk – a detailed assessment of the impacts on sediment raking on flood risk was not within the scope of this project. In the past mass movement of sediment out of the upper estuary has been used as the primary indicator for assessing changes in flood risk. Sediment raking did not lead to mass movement of sediments out of the upper estuary; sediment volumes just before the 2016 flood were higher than volumes recorded in the period before raking commenced. The 2016 flood did mobilise large volumes of sediment out of the upper estuary but much of this sediment has since returned even with continued sediment raking programs through this period. Since sediment raking commenced the evidence shows significant infilling of the channel and reduced effectiveness of large scale flood events such as the 2016 flood to scour the channel, which is not consistent with reduced flood risk.

- Seaport and North Esk - reduced sediment levels in the Seaport have been achieved by frequent prop washing of sediments from the marina into the North Esk. The data shows

[2] The June 2016 flood was a 1 in 200 year event in the North Esk and 1 in 50 year event in the South Esk. During the flood there were 4 consecutive days of more than 1500 cumecs of total flow entering the kanamaluka/Tamar Estuary from the two river systems.

that sediment returns relatively rapidly to this area between interventions but that repeat prop washing is able to maintain reduced sediment levels. Access to the Seaport has however been compromised with infill of channels in the North Esk and around its confluence with the kanamaluka/Tamar estuary.

The analysis of the bathymetry data shows clearly that sediment raking has not achieved the majority of objectives for which it has been proposed in the past and that there are substantial trade-offs between achieving objectives associated with aesthetics of the shoals and navigability of the channels associated with sediment raking activities.

Impacts of sediment raking on water quality

Two sources of water quality data were used to assess the impacts of sediment raking on water quality:

- Data collected by the Launceston Flood Authority during sediment raking campaigns immediately upstream and downstream of raking activities. This data provides information on the localised (temporal and spatial) impacts of sediment raking on water quality.

- Data collected by the TEER Ecosystem Health Assessment Program (EHAP) consisting of monthly grab samples collected for the length of the estuary (at 16 to 18 sites) over a ten year period. This data has gaps where data was previously collected on a 2 year on-2 year off basis. While this data was not collected for the purposes of evaluating the impacts of sediment raking it provides a useful source of long term data which can be used to look for evidence of longer term and broader spatial scale impacts.

Analysis of localised water quality impacts shows that:

- sediment raking releases large amounts of sediments, nutrients and heavy metals into the water column.
- increases are seen across total nutrients, suspended solids and metals as well as for some dissolved nutrients and metals.
- increases in parameter concentrations are in many cases one to two orders of magnitude greater than the ANZECC default guideline value for the parameter (and for aluminium closer to three orders of magnitude greater), indicating impacts on localised water quality that are likely to be ecologically significant.

A further analysis looking for longer term and larger spatial scale impacts was then conducted using data collected as part of the TEER EHAP. This data consists of monthly ambient water quality samples collected on a two year on, two year off basis at 16 sites along the extent of the estuary. This data was never collected with the intention of assessing impacts of sediment raking and so is not ‘fit-for-purpose’ to reject the hypothesis that there have been water quality impacts. It is possible however to use this data to look for evidence of impacts of sediment raking on water quality. Data on heavy metals is particularly limited with significant temporal gaps (it was collected quarterly rather than monthly) and issues where data, particularly for dissolved metals, falls below the limits of reporting. Two types of impacts were explored with this EHAP data –

immediate impacts within the days following a raking event (up to a week); and, longer term impacts out to 3 weeks post sediment raking considering the relative sediment raking effort within that period. While there were limited data points from which to develop regression models for each water quality parameter, results across nutrients, sediments and metals data showed very consistent patterns of impact. In general, the data shows evidence that:

- sediments and total pollutants increase in the upper estuary (to around Blackwall) in the days after sediment raking (out to a week after sediment raking ceases).
- dissolved pollutants, turbidity and some heavy metals including total aluminium are then impacted over a longer time scale, with impacts seen further downstream as the length of the preceding period considered increases.
- impacts on dissolved reactive phosphorous, ammonia, nitrates and nitrites, turbidity, total aluminium and total iron are seen to Clarence Point when raking has occurred in the preceding two to three weeks. Importantly the relative effort of raking within the period impacts concentration, not just the presence or absence of raking in the period. Some nutrients and heavy metals also remain elevated in the upper estuary for at least 2 to 3 weeks after raking ceases.
- a 'pulse' effect appears where initial impacts are focused in the upper estuary but impacts on dissolved nutrients, turbidity and some metals extend to the lower estuary over a longer period of time. The effects of flows on these relationships were also considered. It was found that in most cases where pollutant concentration is significantly correlated with sediment raking, catchment inflows are either not correlated with pollutant concentrations or act to reduce the impacts of sediment raking effort on concentrations, presumably through dilution of pollutants.

The number of data points on which broad-scale water quality findings are based is limited and the data have not been collected for the purpose of analysing the impacts of sediment raking, however considering the consistency of results, strength of the relationships found and the feasibility of findings given the way in which these pollutants are transported in the tide through the estuary, it is likely that these results reflect a true impact of raking on water quality. The results do suggest that in order to accurately determine what the impacts of sediment raking are in the estuary, a 'fit for purpose' monitoring regime requires data collection through the mid and lower estuary, should consider nutrients and metals as well as sediments and should be event based, measuring water quality before, during and for a period of several weeks after sediment raking.

Conclusions

The Trevallyn Flow Releases Study modelling and the sediment raking review are two separately funded projects commissioned to evaluate management of the sedimentation in the upper kanamaluka/Tamar estuary. The modelled results from the Trevallyn Flow Releases Study work are confirmed by the field observations in the sediment raking review. Both projects demonstrate that flows equivalent to an annual flood event, sediment raking, or a combination of both, are ineffective at removing sediment from the upper estuary. Sediment raking alone, and in combination with flows, moves sediment from the shoals into the channels, negatively impacting on navigability. Furthermore, the suspension of sediments and associated nutrients and heavy metals into the water column from sediment raking has significant negative localised and downstream impacts on water quality.