



Review of the Belongil EOS – Berm Scraping

Review Items	Discussion and Context	Response
<p>Berm Scraping - background to its inclusion in the current EOS</p>	<p>Berm scraping to water level is contemplated in the EOS (2019) as the preparation of the EOS coincided with the Tallow Creek June 2019 fish kill event. As such 'berm scraping' was added as an option for trial based on our learnings from Tallow Creek and wanting to have an opening strategy that provides an ability to include a more natural approach, rather than solely relying on mechanical opening. This natural approach uses rainfall and berm lowering as an attempt to promote a natural an opening. The EOS (2019) states that the decision to undertake berm scraping is generally based on predicted rainfall, i.e. if high intensity rainfall and flash flooding is predicted, then a full opening should be undertaken to reduce any flood risk. However, if the berm (as surveyed) is close to WL height and a 'low intensity' rainfall event is predicted in the next 48 hours then you can decide to scrape to water level.</p>	<p>The decision steps leading up to contemplating a 'berm scrape' are outlined in the Decision Support Framework of the EOS. However, some wording in the tool is unclear and has created confusion within Team ICOLL. The level of rainfall forecast for a 'significant', 'high intensity' and 'low' intensity events was never prescribed which gave no clarity when decisions were being made. Berm scraping has been considered a fist-step in most of the situations of high water levels in Belongil over the past 2 years, apart from March 2021 (which went straight to opening). Berm scraping been trialled and is outlined below as to the success of it as a management option for on-going inclusion in the EOS.</p>
<p>Feb-20 2 x Berm Scrapes</p>	<p>A berm scrape was conducted on 3 February 2020 in anticipation of >300mm of cumulative rain that was forecast in the coming days. On the 3 February there was no rain. Between 04/02 and 06/02 there was perhaps approx. 50mm. Significant rainfall fell on 07/02 but despite a total of 316.4 mm of rainfall by the morning of the 7th February, the creek failed to open due to sand being re-deposited on the berm from tidal activity and wave action. The rising waters of Belongil Creek “by-passed” the berm scrape and filled in the low-lying area of the beach to the west of the scrape. Instead of mechanically opening the mouth, an additional scrape of the berm was completed to remove the redeposited sand and by 3pm (on the 7th February) the mouth opened.</p>	<p>Two berm scrapes were attempted. The first was completed too early in anticipation of rain when there was not enough hydraulic head created for break-out of the entrance. The scraped area infilled with remobilised sand. The heaviest rainfall fell on 07/02 which is the day that the second scrape was undertaken. The second scrape was successful on the afternoon of the 07/02, however there was a lag-effect in water escaping the creek and WLs in the creek remained high in the creek due to ocean processes. The success of the second scrape is thought to have been a function of the significant rainfall that had fallen and the current high WLs in the creek. With an opening of the creek after such high water levels the creek remained opened for many weeks (higher WLs will scour more sand out of the entrance and create an open system for a longer time).</p> <p>Key Outcome: Major rainfall is a key factor in the success of berm scraping. If the berm does not open shortly after the scraping, ocean processes during the next high tide are highly likely to close over the channel.</p>
<p>Jul-20 1 x Berm scrape 2 x Mechanical opening</p>	<p>Belongil Creek reached its watch level of 1.0 m AHD around the 19th July and by the 24th July had risen to 1.11 mAHD. With over 100mm of rain forecast and the most recent berm survey (22nd July 2020) revealing levels between 1.10 and 1.23 mAHD, a berm scrape to water level was conducted at low tide on 24 July. With the forecast rainfall it was deemed possible that a natural breach would be initiated, however, the berm was reinstated due to large tides and a building east to northeast ocean swell. By the 25th July water levels were beyond 1.2 mAHD and due to the increased rain forecast, the mouth was mechanically opened at 2pm that afternoon. However, that evening the channel closed and the berm was reinstated again due to a combination of tide and swell. With water levels at 1.39m AHD on the 26th July the mouth was mechanically opened again and this time was successful.</p>	<p>The berm scrape was undertaken on the day that 20mm of rain fell (24/07). This was not enough to initiate an opening against spring tide (1.85m ISLW = 1.1m AHD) and southerly 2m wave conditions. Due to the low breach level of Belongil, ocean processes are the major dominating factor. Mechanical opening was then done but it is likely the depth of the channel dug was not deep enough (on the first attempt).</p> <p>Key Outcome: When ocean processes and ocean levels dominate (swell, tides and ocean anomalies) berm scraping or a shallow opening depth (0.2m stated in the EOS) are not likely to be successful. During dominant ocean conditions, a deeper channel should be dug or consideration of timing of the scouring to coincide with low tide. Ocean conditions and tides likely play a big influence on the success of opening, i.e. a successful opening relies on adequate difference in the head pressure between the creek and the ocean. Rainfall is also a key factor in creating a successful channel.</p>



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<p>Dec-20</p> <p>1 x Berm scrape 1 x Mechanical opening</p>	<p>A berm scrape was undertaken on 11 December 2020 when WLs were < the watch trigger due to forecast rainfall and ocean event, however it was unsuccessful. The berm reinstated itself, rain fell and WLs increased to 1.1m AHD. A mechanical opening was initiated on the 13th December. Whilst it was successful, the large swells, high tides and >50mm of rainfall lead to water levels in the creek reaching 1.75m AHD on the 14th December before starting to subside as the swell and tides decreased.</p>	<p>On this occasion there was not enough water volume and head pressure difference between the creek and the ocean to initiate an opening from a berm scrape. Scraping is generally down to water level with the expectation that rainfall and catchment inflow reach a tipping point that starts to develop a weir and scouring of the scraped channel. If scouring does not appear soon after scraping of the channel, then the channel simply infills with sand and closes over.</p> <p>Key outcome: Berm scraping is unsuccessful during times of high ocean levels.</p>
<p>Mar-21</p> <p>1 x Mechanical opening</p>	<p>An opening (to 0.2m depth below sand level) was undertaken on 19 March 2021 with WLs of 1.24m AHD and rainfall forecast of up to 100mm in the next 72 hours. A large swell event was forecast for 21/03/21. While the opening completed on 19/03 was successful (the creek was flowing when team left site), large swells, high tides and rainfall led to WLs remaining high before starting to subside and showing tidal influence on 24/03.</p>	<p>Berm scraping was not attempted as a first action, however this opening event illustrates that a shallow dug channel is similar to berm scraping and unsuccessful during a swell event with high ocean levels.</p> <p>Key outcome: Channel depth is too shallow to create an open entrance against a swell event.</p>
<p>Jul-21</p> <p>1 x berm scrape 1 x mechanical opening</p>	<p>A berm scrape was completed on the 28 June 2021 with WL at 1.27m AHD with small, predicted rainfall (up to 40mm). The scrape was unsuccessful and a mechanical opening was completed on 1 July 2021. While the opening permitted outflow of the creek, substantial outflow was not observed until the outgoing tide on the 2 July (a lag-effect).</p>	<p>Based on current understanding from the events reviewed already, it is assumed that the scrape was unsuccessful as it was completed prior to rainfall. Although it is noted that even with significant rainfall it may not have opened as there are likely other factors at play (tides, ocean conditions, WLs). Due to the amount of rainfall and unsuccessful first berm scrape there would have been a lot of water held in the upper reaches that could not escape, and hence WLs in the creek increased substantially.</p> <p>Key outcome: Berm scraping is unsuccessful during times of high ocean levels.</p>



Recommendation - outcomes of the review

Over these past 2 years Team ICOLL have been very conscious about exposure and/or risk of a large fish kill event which has resulted in cautious entrance related management decision for Belongil Creek. Since the fish kill Team ICOLL have consistently tried to attempt berm scraping as a first-pass activity for opening the creek and have avoided any openings in absence of rainfall. Team ICOLL have acted in good faith. However, the outcomes of this review and now the benefit of hindsight provide the opportunity to assess our decisions and actions undertaken over the past 2 years to improve management of the system.

It is clear from the review of opening events that major rainfall is required and/or high WLs are needed for potential berm scraping success. Although success of a scrape is also likely influenced by ocean processes and tides. If given the chance, waves (especially on the high tide) will re-deposit the sand at the entrance channel and close it over. For an opening there needs to be difference in head pressure between the creek and ocean for scouring and critical flow to commence.

Rainfall appears to be critical in creating a sustainable entrance channel and is likely no point scraping if rainfall is not occurring. What this difference in head pressure is and how much rainfall is needed is not known and there would need to be a lot of trial and error, monitoring and review to understand if berm scraping is to remain in the EOS.

Any management action or intervention undertaken at Belongil should be controlled with the aim of opening the creek under the right conditions (and on the first attempt), and before WLs get too high. It is not advised to spend time and resources on an action (i.e. berm scraping) that is likely to be unsuccessful. Belongil ICOLL is a wave dominated system and ocean processes have a strong influence on their closing and remaining in a closed state for the majority of the time. Conversely it would appear that catchment processes (rainfall and WLs etc) need to dominate to overcome ocean processes for a successful opening.

This review outlines that scraping is unlikely to provide an efficient or feasible option for entrance management at Belongil Creek, and most certainly cannot be looked at on a long-term basis in the context of climate change as ocean levels rise. Belongil and Tallow Creek are two very different systems and cannot be compared or managed like-for-like. If scraping were to be undertaken within the 'natural breakout range', i.e. at much higher WLs, it would likely have more success in certain circumstances. Though reflecting on the openings undertaken over the past 2 years, the various factors that appear to determine whether a berm scrape is successful or not are not completely clear. This review has outlined that berm scraping on some occasions was never going to be successful and the decision to undertake a full opening should have been made. On some occasions undertaking a berm scrape has resulted in an opportunity missed to undertake an opening under the right conditions, i.e. with rainfall and/or prior to high ocean levels.

The EOS (2019) states on page 33; "*Scraping has not previously been undertaken in the Belongil Creek estuary. Given the low watch and immediate breach levels scraping alone may not facilitate an effective opening event due to the low hydraulic gradient. As a result, the effectiveness of scraping needs to be monitored and the framework modified if required. If scraping proves to be ineffective after several trials under varied conditions then it should be removed from the framework*".



Berm scraping has generally proven unsuccessful and should be discontinued. It is recommended that berm scraping as an option for entrance management be removed from the EOS and the Decision Support Framework amended.