2019 STREAM HEALTH AND STABILITY REPORT

Mount Thorley Warkworth

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.12941-R01-v0.1	19 December 2019	Stephane Peignelin / Samuel McDonald	Paul Delaney	Paul Delaney
630.12941-R01-v0.2	11 March 2020	Stephane Peignelin / Samuel McDonald	Paul Delaney	Paul Delaney

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) was previously engaged in December 2017 by Bulga Surface Operations (BSO) and Mount Thorley Warkworth (MTW) to conduct channel stability and stream health monitoring of creeks adjacent to the mine sites. An integrated channel monitoring program was developed as both mines discharge into the same drainage lines (e.g. Loder Creek). The monitoring program includes channel stability and stream health assessments at six specific monitoring points (two of which are only specific to BSO and one point which is only specific to MTW). In addition it also includes a visual inspection of Loder Creek from the Hunter River to the MTW discharge point to identify any areas of increased erosion.

SLR was subsequently engaged to undertake the 2018 and 2019 annual channel stability and stream health monitoring to identify any changes to the creeks including any new erosion features in accordance with regulatory requirements. This report has been specifically prepared for the MTW monitoring points and should be read in conjunction with the 2017 and 2018 reports for better understanding.

MTW advise there have been nil discharge events from the MTW discharge point between the 2018 stream health monitoring event and the 2019 monitoring event. There has been 283 mm of rainfall recorded within the on-site rainfall gauge for the period November 2018 to October 2019. In comparison, the Bureau of Meteorology shows an average of 502 mm at Singleton (Singleton STP 61397) for the same period. This indicates that this round of monitoring was subjected to a significantly drier year than what occurs on average within the region.

2 METHODOLOGY

In accordance with the accepted scope of works the following procedure was undertaken at each monitoring site:

1. Documenting locations and dimensions of significant erosive or depositional features;
2. Photographs upstream, downstream and at both banks;
3. Rating the site with the Ephemeral Stream Assessment protocol developed by the CSIRO to assess the erosional state of the creek at the monitoring location (a measure of channel stability);
4. Rating the site with the Rapid Appraisal of Riparian Condition protocol developed by Land & Water Australia. This assesses the ecological condition of riparian habitats using indicators that reflect functional aspects of the physical, community and landscape features of the riparian zone (a measure of stream health); and
5. Taking measurements of the channel cross-sections (transects) for comparison purposes for any future monitoring.

2.1 Rapid Appraisal of Riparian Condition (RARC)

The RARC is an assessment method incorporating indicators of geophysical and biological properties and processes which are likely to provide reliable estimates of ecological condition in riverine ecosystems (Land & Water Australia, 2005). The RARC index is made up of five sub-indices, each with a number of indicator variables which can be seen in **Table 1** below.

Table 1 Summary table of indicators, functions and components assessed in the RARC (Land and Water Australia, 2005)

Functions of the riparian zone at different levels of organisation	Components of the riparian ecosystem that perform those functions	Indicators of the functions used in the RARC
Physical:		
Reduction of erosion of banks	Roots, ground cover	Vegetation cover*
Sediment trapping	Roots, fallen logs, ground cover	Canopy cover, fallen logs, ground cover vegetation, leaf litter cover
Controlling stream microclimate/ discharge/water temperatures	Riparian forest	Canopy cover
Filtering of nutrients from upslope	Vegetation, leaf litter	Ground cover vegetation, leaf litter cover
Community:		
Provision of organic matter to aquatic food chains	Vegetation	Vegetation cover*, leaf litter cover
Retention of plant propagules	Fallen logs, leaf litter	Fallen logs, leaf litter cover
Maintenance of plant diversity	Regeneration of dominant species, presence of important species, dominance of natives *versus* exotics	Native canopy and shrub regeneration, grazing damage to regeneration, reeds, native vegetation cover*
Provision of habitat for aquatic and terrestrial fauna	Fallen logs, leaf litter, standing dead trees/hollows, riparian forest, habitat complexity	Fallen logs, leaf litter cover, standing dead trees, hollows, vegetation cover*, number of vegetation layers
Landscape:		
Provision of biological connections in the landscape	Riparian forest (cover, width, connectedness)	Vegetation cover*, width of riparian vegetation, longitudinal continuity of riparian vegetation, proximity to other habitat
Provision of refuge in droughts	Riparian forest	Vegetation cover*

* Vegetation cover = canopy, understorey and ground cover

In accordance with previous annual stream health surveys undertaken at the site classifications have been assigned based on the total score as assessed by the RARC methodology. It is useful to compare this total score over time to see how the biodiversity and functionality of the riparian zone is progressing at each of the monitoring points. **Table 2** below outlines these classifications.

Table 2 Summary RARC Classification System

RARC Total Score	Classification
40-50	Excellent
35-39	Good

RARC Total Score	Classification
30-34	Average
25-29	Poor
<25	Very Poor

2.2 CSIRO Ephemeral Stream Assessment

The CSIRO *Ephemeral Stream Assessment* procedures (CSIRO, date unknown) were used to assess the channel stability of the creeks in the vicinity of the MTW Mine. The assessment uses four main classes of indicators to evaluate the degree of stream-bed condition:

1. The type and condition of the vegetation present, if any;
2. The shape and profile of the drainage line and type of materials on the drainage line floor;
3. The nature of the drainage line wall materials; and
4. The nature of the stream bank bordering flats and/or slopes and regulation of lateral flow into the drainage line.

The indicators produce a rating based on a scoring system, and the combined total of the indicators rank each location from very actively eroding through to very stable as shown in **Table 3.** This enables an assessment to be made as to whether the section of creek has changed since previous rounds of annual monitoring.

Table 3 Classification of different drainage line states (CSIRO)

Activity Rating (%)	Classification	Discussion of Classification
80 +	Very Stable	Drainage line is very stable and likely to be in original form. It is able to withstand all flow velocities that have previously occurred in this area and only minimal monitoring is required, predominantly after high flow events, to ensure condition does not deteriorate.
70-80	Stable	Drainage line is stable. It is important to assess this zone in relation to the other classifications and define whether this zone is moving from potentially stabilising to a more stable form, or if it is deteriorating from a very stable form. The nature of this relationship will identify the type of monitoring required.
60-69	Potentially Stabilising	Drainage line is potentially stabilising. Ongoing monitoring is required while rehabilitation works are not needed in the immediate future.

Activity Rating (%)	Classification	Discussion of Classification
50-59	Active	Drainage line is actively eroding and remedial actions are required. It is important to classify if erosion is caused primarily by upstream flows, lateral flows or unstable wall materials so that appropriate rehabilitation can be carried out.
< 50	Very Active	Drainage line is very actively eroding and immediate remedial actions are required. It is important to classify if erosion is caused primarily by upstream flows, lateral flows or unstable wall materials so that appropriate rehabilitation can be carried out.

Table Source: CSIRO Ephemeral Stream Assessment (CSIRO, date unknown)

2.3 Transects at Monitoring Points

Transect data is collected at the monitoring points to provide a representation of the drainage line profile. The transect assessment allows for simple identification of any deposition of sediments within the channel bed or scouring of the banks by comparison with profile measurements on a yearly basis.

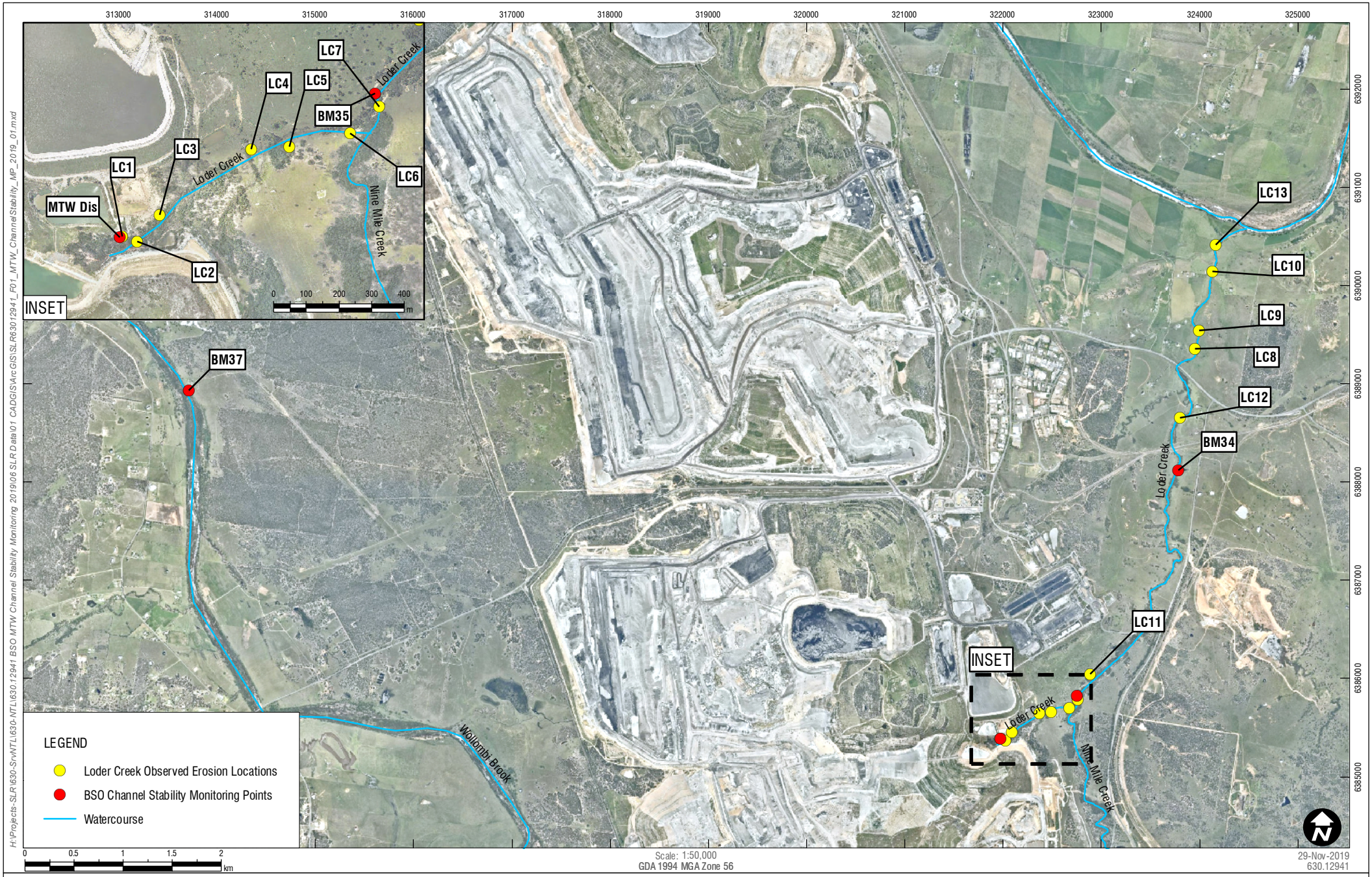
The transect assessment is undertaken by extending a tape measure laterally across the drainage line to two permanently fixed posts which are located within the riparian zone. A survey staff is then used to measure the vertical distance between the tape and the ground surface at approximately 0.5 m increments or at points which capture any sudden changes in channel geometry (e.g. steep channel banks).

2.4 Visual Assessment of Loder Creek

A visual inspection of Loder Creek from the Hunter River to the MTW discharge point was undertaken to identify any areas of increased erosion. Where erosion was observed within this reach of Loder Creek the following were recorded:

- Documented locations and dimensions of notable erosive or depositional features;
- Photos so that comparisons could be made in future surveys; and
- Rating the site with the *Ephemeral Stream Assessment* protocol developed by the CSIRO to assess the erosional state of the creek at the monitoring location.

Any visible changes that occurred since the preceding inspection will be documented by comparison to the photos taken during the previous surveys.



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MTW Channel Stability Monitoring Points - 2019

FIGURE 1

3 Results

3.1 Channel Stability / Stream Health Monitoring Site Results

3.1.1 MTW Dis (321966 E 6385379 N)

This monitoring point is located at the Mount Thorley discharge point. This section of creek has been upgraded and now includes rock armouring of the creek bed as well as jute mesh and seeding of both banks. Overall, the creek stability at this location has improved from the previous monitoring cycle and is now stabilising.

The banks are characterised by patches of scattered eucalypts with Bull Oak (*Allocasuarina luehmannii*) and Swamp Oak (*Casuarina glauca*) dominating the canopy. The understorey is sparse consisting mainly of Acacia shrubs scattered on the bank. Very little groundcover was observed with most areas consisting of bare earth especially around jute mesh. It should be noted there is very little diversity in either canopy or groundcover species. Both banks of the creek contain an almost continuous band of riparian vegetation in widths less than 40m wide with the exception of the cleared area where construction works have occurred. Exotic grass and bare soil (mine workings and vehicle tracks) surround riparian vegetation. Debris such as leaf litter and small numbers of fallen logs are evident. Linkage to larger areas of native vegetation is absent. Regeneration of native canopy species is evident across the site. The channel of the creek line contained dense native *Juncus* spp.

RARC Stream Health Assessment Classification – **Poor**

CSIRO Ephemeral Stream Assessment Classification – **Potentially Stabilising**

Photos taken at the established photo points for this monitoring point are shown in Plate 1 to Plate 4.

Plate 1 Right Bank

Plate 2 Upstream

Plate 3 Downstream

Plate 4 Left Bank

For the purpose of monitoring any changes to the creek, a creek line transect was established. The transect is shown in **Figure 2** and was taken from left to right looking downstream. It can see from this transect that the channel hasn't changed significantly since the previous monitoring cycle. It should also be noted that as part of the upgrade works, the peg on the left bank was removed which explains why this round of monitoring shows a shorter length of transect. Difference in the data appears to be within the expected transect accuracy tolerances, and it is not possible to discern if there has been bed erosion across at transect location.

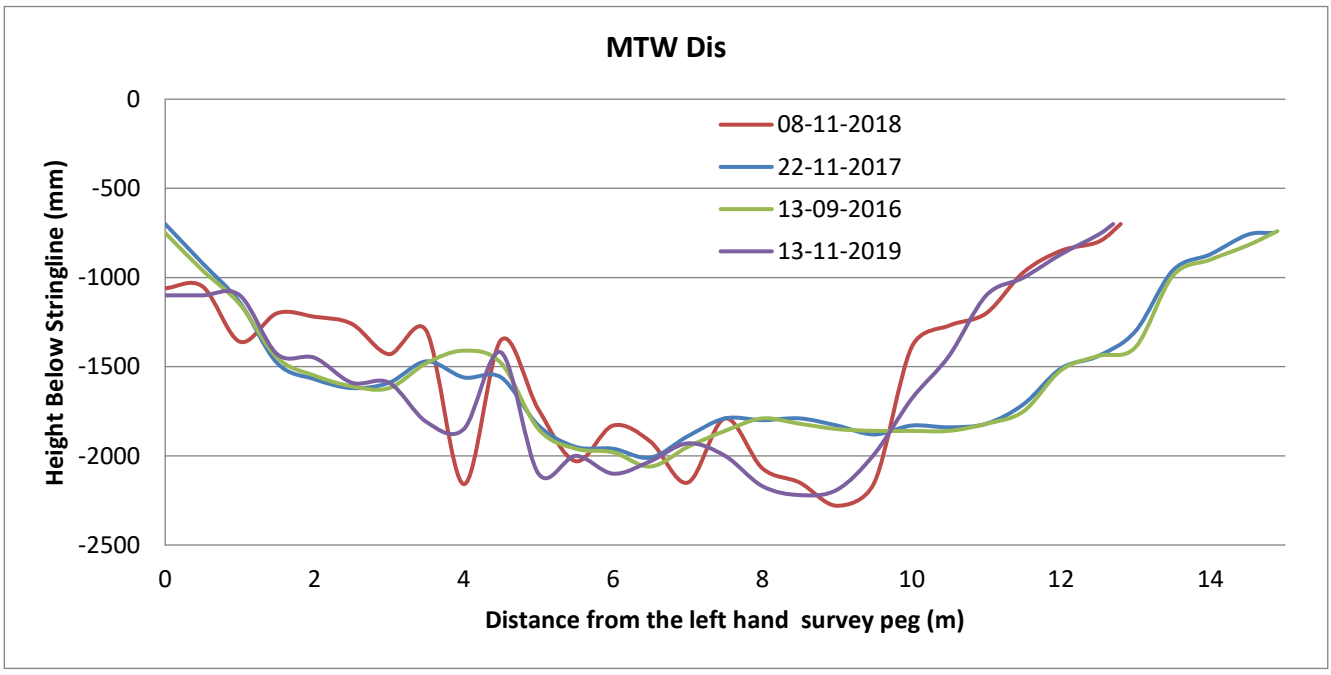

Figure 2 MTW Dis Transect Results

3.1.2 BM35 (322746 E 6385819 N)

The channel at this location was observed to have a good coverage of long grass across the bed. The left bank also appears stable with good grass coverage. The right bank contains some lateral erosion (approximately 0.5m

high) at the top of the bank. The lateral erosion is forming some rill/gully erosion down this bank, however the rest of the right bank appears to be stable with good grass coverage. Overall, this location shows similar conditions to the previous monitoring cycle.

The creek banks are characterised by Swamp Oak (*Casuarina glauca*) with scattered eucalypts upslope. Both banks of the creek contained an almost continuous band of riparian vegetation in widths mostly around 15m wide with one patch downstream extending to 40m wide. The understory consisted of weeds including Lantana, Paddy's Lucerne and Rhodes Grass. Exotic pastures surrounded riparian vegetation and linkage to other areas of native vegetation was absent. The channel of the creek line contained dense native *Typha* spp. with exotic grasses. Regenerating canopy tree (mostly *Casuarina glauca*) species were abundant.

RARC Stream Health Assessment Classification – **Poor**

CSIRO Ephemeral Stream Assessment Classification – **Active**

Photos taken at the established photo points for this monitoring point are shown in Plates 5 to 9.

Plate 5 Right Bank

Plate 6 Upstream

Plate 7 Downstream

Plate 8 Left Bank

Plate 9 Erosion (top of right bank)

For the purpose of monitoring any changes of the creek, a creek line transect was established. The transect is shown in **Figure 3** and was taken from left to right looking downstream. It suggests that no significant scouring has occurred on the banks or creek bed since the previous monitoring cycles. Difference in the data appears to be within the expected transect accuracy tolerances.

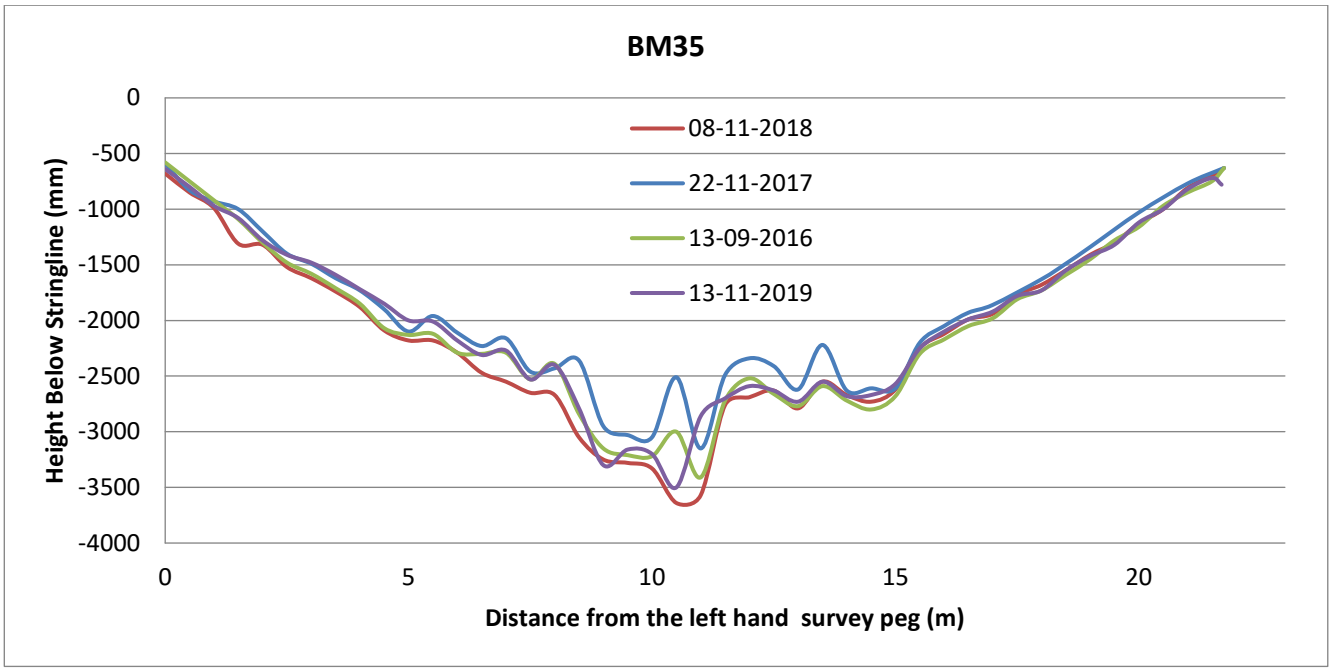

Figure 3 BM35 Transect Results

3.1.3 BM34 (323779 E 6388119 N)

The creek bed at this monitoring point is covered by reeds and is stable. Both the left and right banks have good grass coverage and appear to be stable with gentle-moderate slopes. The creek upstream and downstream of the monitoring point also appears to be stable. The creek has a very slight meander at this monitoring point. Overall this location has remained the same as the previous monitoring cycle conditions.

The banks were characterised by dense Swamp Oak (*Casuarina glauca*), tall River Oak *(Casuarina cunninghamia)* with scattered eucalypts. The creek is congested with *Juncus spp* and *Phragmites australis.* The understory contained high levels of weed infestation. Lantana, Paddy's Lucerne and in particular African Boxthorn were abundant below the canopy particularly upstream of the monitoring point. It should be noted that there has been a slight increase in the density of African Boxthorn since the 2018 monitoring event. Native Weeping Grass (*Microlaena stipoides*) was present in small patches beneath the denser canopy areas. Both banks of the creek contained an almost continuous band of riparian vegetation in widths less than 30m wide. Exotic pastures surrounded riparian vegetation and linkage to other areas of native vegetation was absent. Regenerating canopy tree (mostly *Casuarina glauca*) species were abundant. BM34 increased from the upper range of 'poor' to the lower range of 'average' due to an increase in canopy cover.

RARC Stream Health Assessment Classification – **Poor**

CSIRO Ephemeral Stream Assessment Classification – **Stable**

Photos taken at the established photo points for this monitoring point are shown in Plates 10 to 13.

Plate 10 Right Bank

Plate 11 Upstream

Plate 12 Downstream

Plate 13 Left Bank

For the purpose of monitoring any changes of the creek, a creek line transect was established. The transect is shown in **Figure 4** and was taken from left to right looking downstream. It suggests that no significant scouring has occurred on the banks or creek bed since the previous monitoring cycles. Difference in the data appears to be within the expected transect accuracy tolerances at most locations. The data also suggests that across the bed and right hand bank it is likely that there has been erosion over the past 3 years.

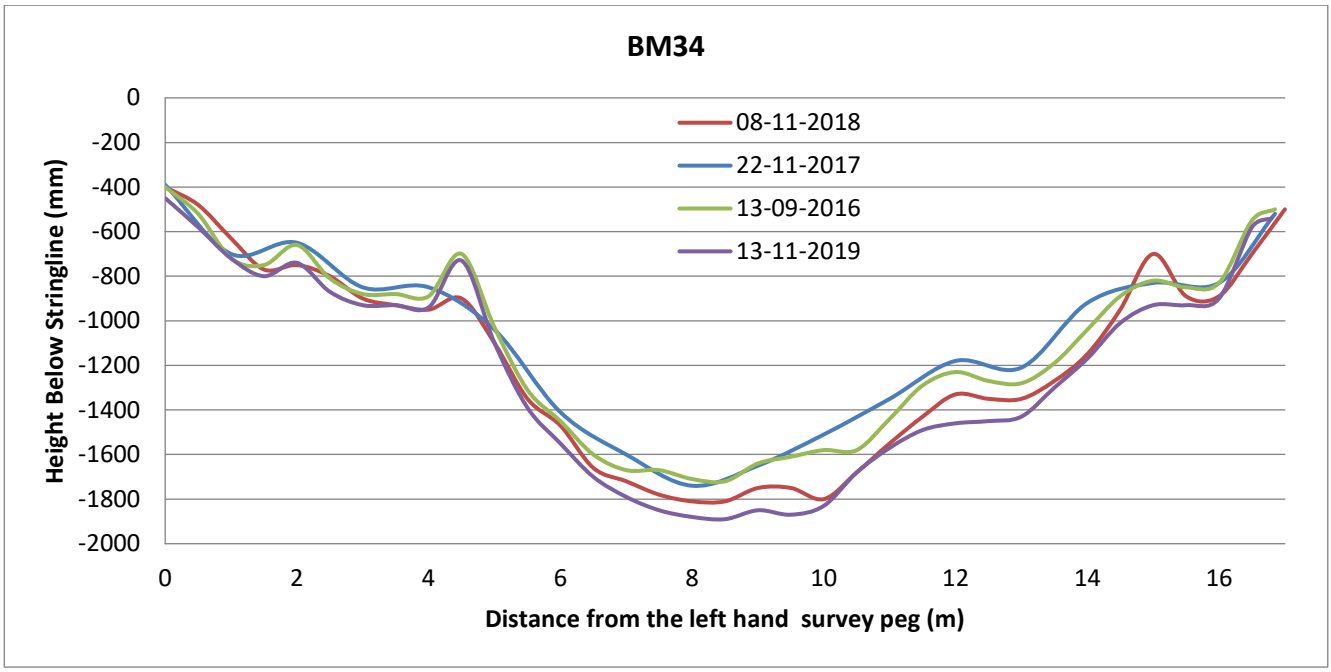

Figure 4 BM34 Transect Results

3.1.4 BM37 (313709 E 6388933 N)

Monitoring point BM37 is the only monitoring point that is located on Wollombi Brook Wollombi Brook is a large tributary of the Hunter River, with channel widths ranging from 10m to 60m. Generally Wollombi Brook has flowing water in it except during extreme drought periods. Water was observed to be ponding but not flowing at the time of the inspection. Both the left and right banks appeared to be generally stable with both banks containing trees. The right bank is steeper than the left bank with a moderate slope and a height of approximately 2m. A pipe outlet exists immediately downstream of the monitoring point on the eastern bank and has scoured out the bank slightly with some exposed moderately dispersive soils (approximately 0.3m high). Some wombat holes were also observed on the eastern bank. Overall this location has remained the same as the previous monitoring cycle conditions.

At sample site BM37, only the eastern side of Wollombi Brook was surveyed, as the width and depth of the stream prevented transects being extending across the full width of the stream. Riparian vegetation along a 280 meter reach of the stream was surveyed, with four parallel transects established across the riparian zone upstream and downstream of the sample site (marker point). Generally only a thin band (of between 5m to 15m in width) of native riparian forest exists along the banks of the stream. The innermost parts of the riparian zone, extending over a series of steep terraced banks, comprise of a narrow band of modified open forest of mainly Swamp Oak (*Casuarina glauca*), River Oak (*Casuarina cunninghamiana*) and occasional Cabbage Gum *Eucalyptus amplifolia*. The lower bank edges contain patches of dense reeds, including *Typha orientalis*, *Phragmites australis* and the exotic *Juncus acutus*. Patches of Parramatta Green Wattle *Acacia parramattensis*, as well as juvenile (or early mature) eucalypts and casuarinas, form a mid-canopy in places; however, generally the vegetation lacks a shrub layer. Leaf litter, as well as exotic grasses and herbs, dominates the ground layer, with common species being Paddy's Lucerne *Sida rhombifolia*, Panic Veldt Grass *Ehrharta erecta* and Common Sowthistle *Sonchus oleraceus*. The native Weeping Grass (*Microlaena stipoides*) occurs occasionally in shaded bank areas.

Upslope of this vegetation, extending to the outer parts of the riparian zone, the forest canopy gives way to cleared land comprising with exotic pasture grass, supporting a range of common exotic grasses and herbs, including African Lovegrass *Eragrostis curvula*, Narrow-leafed Carpet Grass *Axonopus fissifolius*, Couch *Cynodon dactylon* and several other species. No significant change was noted.

RARC Stream Health Assessment Classification – **Poor**

CSIRO Ephemeral Stream Assessment Classification – **Potentially Stabilising**

Photos taken at the established photo points for this monitoring point are shown in Plates 14 to 19.

Plate 14 Right Bank

Plate 15 Upstream

Plate 16 Downstream

Plate 17 Left Bank

Plate 18 Erosion

Plate 19 Erosion

3.2 Loders Creek Erosion Visual Assessment

3.2.1 LC1 (321974 E 6385382 N)

The erosion at LC1 has been remediated as part of upgrade work on the Mount Thorley discharge point. The works undertaken at this erosion site included rock armouring of the creek bed as well as jute mesh and seeding of both banks. Overall, this location has improved greatly from the previous monitoring cycle and is now considered stable.

CSIRO Ephemeral Stream Assessment Classification – **Stable**

Photos taken at the established photo points for this monitoring point are shown in Plates 20 to 23.

Plate 20 Right Bank

Plate 21 Upstream

Plate 22 Downstream

Plate 23 Left Bank

3.2.2 LC2 (322019 E 6385367 N)

The erosion observed at LC2 included a steep near vertical section of exposed dispersive material (approximately 2m high) on the right bank. This area appeared to be actively eroding including some areas immediately downstream. However, this monitoring location appears to be similar to what was observed in the 2018 survey. A tree was observed to have fallen over at this section of the exposed creek bank. The creek bed and left bank appear to be stable at this location.

CSIRO Ephemeral Stream Assessment Classification – **Active**

Photos taken at the established photo points for this monitoring point are shown in Plates 24 to 26.

Plate 24 Upstream

Plate 25 Downstream

Plate 26 Erosion

3.2.3 LC3 (322087 E 6385446 N)

This location is positioned at a small channel entry point to Loders Creek (on the left bank). The channel appears to be stable, however the confluence point has some significant erosion with some slight undercutting and tunnelling of the dispersive soil. Overall, this monitoring location appears very similar to the previous monitoring cycle.

CSIRO Ephemeral Stream Assessment Classification – **Very Active**

Photos taken at the established photo points for this monitoring point are shown in Plates 27 to 30.

Plate 27 Upstream

Plate 28 Downstream

Plate 29 Erosion

Plate 30 Tunnel Erosion

3.2.4 LC4 (322367 E 6385647 N)

LC4 is located under a powerline in an area where it appears that vegetation has been maintained within the powerline easement. The near vertical left bank on the outside of the creek meander is about 4-5m high and has some exposed dispersive material (approximately 1m high) near the top of the bank however this erosion has shown signs of potentially stabilising. The right bank is much flatter and appears to be stable, as does the creek bed. Overall, this monitoring location has shown similar conditions to the previous monitoring cycle.

CSIRO Ephemeral Stream Assessment Classification – **Potentially Stabilising**

Photos taken at the established photo points for this monitoring point are shown in Plates 31 to 33.

Plate 31 Right Bank

Plate 32 Left Bank

Plate 33 Downstream

3.2.5 LC5 (322484 E 6385655 N)

LC5 is located in a historic diversion of Loders Creek. The erosion observed at LC5 included erosion extending up the right bank approximately 20-30m. The area has 0.5-1.0m high steep exposed walls surrounding 5m of exposed soil. The creek bed and left bank appear to be stable. Overall, this monitoring location has shown similar conditions to the previous monitoring cycle.

CSIRO Ephemeral Stream Assessment Classification – **Active**

Photos taken at the established photo points for this monitoring point are shown in Plates 34 to 37.

Plate 34 Right Bank

Plate 35 Upstream

Plate 36 Downstream

Plate 37 Erosion (top of right bank)

3.2.6 LC6 (322670 E 6385697 N)

The erosion observed at LC6 included significant lateral erosion near the top of the right bank. This erosion was approximately 1m high with an alluvial fan extending approximately 2m from the near vertical bank. The rest of the right bank appears to stable as does the creek bed and the left bank. Overall, this monitoring location appears similar to the previous monitoring cycle. The active erosion appears to be primarily the result of a historic disturbance of the top of the right bank which has exposed the highly dispersive soils at this location.

CSIRO Ephemeral Stream Assessment Classification – **Active**

Photos taken at the established photo points for this monitoring point are shown in Plates 38 to 40.

Plate 38 Right Bank

Plate 39 Erosion

Plate 40 Erosion

3.2.7 LC7 (322759 E 6385778 N)

The erosion observed at LC7 included an area of active erosion of a steep comprising exposed dispersive clay material (approximately 0.8m high) on the right bank, however this erosion is not laterally extensive. The erosion appears to have been caused by lateral flow across the bare banks in the area. The right bank appears to be stable downslope of the eroded area, as does the creek bed and the left bank. Overall, this monitoring location has shown similar conditions to the previous monitoring cycle.

CSIRO Ephemeral Stream Assessment Classification – **Active**

Photos taken at the established photo points for this monitoring point are shown in Plates 41 to 45.

Plate 41 Right Bank

Plate 42 Upstream

Plate 43 Downstream

Plate 44 Left Bank

Plate 45 Erosion

3.2.8 LC8 (323948 E 6389351 N)

The erosion observed at LC8 included significant erosion of the left bank (approximately 0.8m high with the overall bank at approximately 2.5m high) at a location with a slight meander in the creek as shown on Plate 57. The erosion has some minor undercutting with a section of vertical banks partly stabilised by tree roots. The soil appears be alluvial and not particularly dispersive. Trees at this location are at risk of falling over due to loss of support. The creek bed and right bank appear to be stable. Overall, this monitoring location has shown similar conditions to the previous monitoring cycle.

CSIRO Ephemeral Stream Assessment Classification – **Potentially Stabilising**

Photos taken at the established photo points for this monitoring point are shown in Plates 46 to 49.

Plate 46 Right Bank

Plate 47 Upstream

Plate 48 Downstream

Plate 49 Left Bank

3.2.9 LC9 (323996 E 6389540 N)

The erosion observed at LC9 included some loss of exposed slightly dispersive material on the right bank which may have been caused by livestock in the area. This bank is about 2m high and has about 0.8m of exposed soil. The area appears to be stabilising. The creek bed and the left bank appear to be stable. Overall, this monitoring location has shown similar conditions to the previous monitoring cycle.

CSIRO Ephemeral Stream Assessment Classification – **Potentially Stabilising**

Photos taken at the established photo points for this monitoring point are shown in Plates 50 to 53.

Plate 50 Right Bank

Plate 51 Upstream

Plate 52 Downstream

Plate 53 Left Bank

3.2.10 LC10 (324131 E 6390142 N)

The erosion observed at LC10 is located immediately downstream of a concrete lined chute. The soil is alluvial and non-dispersive. The erosion has been created from scouring of the right bank during large flow events with the upstream chute increasing the velocity of the water to this downstream section of channel. This scouring has exposed some tree roots of some of the trees that line the creek bank. The creek has steep slopes on both banks (approximately 4m high). The creek is generally stable upstream and downstream except for some cattle tracks immediately upstream on the right bank. Limited vegetation exists in the creek bed. Overall, this monitoring location has shown similar conditions to the previous monitoring cycle.

CSIRO Ephemeral Stream Assessment Classification – **Potentially Stabilising**

Photos taken at the established photo points for this monitoring point are shown in Plates 54 to 57.

Plate 54 Right Bank

Plate 55 Upstream

Plate 56 Downstream

Plate 57 Left Bank

3.2.11 LC11 (322881 E 6386043 N)

The erosion observed at LC11 includes some significant tunnelling and active erosion on the left bank with exposed vertical dispersive soil. Potential causes for this erosion include wombat holes as well as the presence of a contour bank overflow (which is located immediately upslope of the erosion). Trees were observed on both banks and creek bed. The creek bed and the right bank both show stable conditions. Overall, this monitoring location has shown similar conditions to the previous monitoring cycle.

CSIRO Ephemeral Stream Assessment Classification – **Active**

Photos taken at the established photo points for this monitoring point are shown in Plates 58 to 61.

Plate 58 Upstream

Plate 59 Downstream

Plate 60 Erosion

Plate 61 Erosion (Top)

3.2.12 LC12 (323802 E 6388650 N)

The erosion observed at LC12 includes some erosion (approximately 2m high) on the left bank with exposed vertical dispersive soil. It is likely that this erosion was at least partially caused by a fallen tree at the monitoring point location. The left bank at the monitoring point is significantly higher than the right bank. The creek bed and the right bank both show stable conditions. Overall, this monitoring location has shown similar conditions to the previous monitoring cycle.

CSIRO Ephemeral Stream Assessment Classification – **Potentially Stabilising**

Photos taken at the established photo points for this monitoring point are shown in Plates 62 to 65.

Plate 62 Right Bank

Plate 63 Upstream

Plate 64 Downstream

Plate 65 Left Bank

3.2.13 LC13 (324160 E 6390408 N)

LC13 includes some erosion extending for approximately 5m on the steep left bank with exposed soil which doesn't appear to be highly dispersive. This erosion was most likely caused by livestock tracks observed upstream and downstream of the monitoring location or a localised slope failure. The creek and the right bank both show stable conditions. Overall, this monitoring location has shown similar conditions to the previous monitoring cycle.

CSIRO Ephemeral Stream Assessment Classification – **Active**

Photos taken at the established photo points for this monitoring point are shown in Plates 66 to 69.

Plate 66 Right Bank

Plate 67 Upstream

Plate 68 Downstream

Plate 69 Left Bank

4 Summary of Results

Monitoring Site	RARC Stream Heath Assessment Classification			CSIRO Ephemeral Stream Assessment Classification			Primary Cause of Erosion
	2017	2018	2019	2017	2018	2019	
MTW Dis	Poor	Poor	Poor	Active	Potentially Stabilising	Potentially Stabilising	Lateral Inflows
BM35	Poor	Poor	Poor	Active	Active	Active	Unstable Wall Materials
BM34	Poor	Poor	Average	Very Stable	Stable	Stable	NA
BM37	Average	Poor	Poor	Stable	Stable	Potentially Stabilising	NA
LC1	NA	NA	NA	Active	Stable	Stable	NA
LC2	NA	NA	NA	Active	Active	Active	Unstable Wall Materials
LC3	NA	NA	NA	Very Active	Very Active	Very Active	Upstream Flows
LC4	NA	NA	NA	Potentially Stabilising	Potentially Stabilising	Potentially Stabilising	Unstable Wall Materials
LC5	NA	NA	NA	Potentially Stabilising	Active	Active	Unstable Wall Materials
LC6	NA	NA	NA	Active	Active	Active	Unstable Wall Materials
LC7	NA	NA	NA	Active	Active	Active	Lateral Inflows

Monitoring Site	RARC Stream Heath Assessment Classification			CSIRO Ephemeral Stream Assessment Classification			Primary Cause of Erosion
	2017	2018	2019	2017	2018	2019	
LC8	NA	NA	NA	Potentially Stabilising	Potentially Stabilising	Potentially Stabilising	Upstream Flows
LC9	NA	NA	NA	Potentially Stabilising	Potentially Stabilising	Potentially Stabilising	Unstable Wall Materials
LC10	NA	NA	NA	Potentially Stabilising	Active	Potentially Stabilising	Upstream Flows
LC11	NA	NA	NA	Active	Active	Active	Wombat Activity, Contour Bank Overflows
LC12	NA	NA	NA	Active	Active	Potentially Stabilising	Fallen Tree
LC13	NA	NA	NA	Active	Active	Active	Livestock Tracks

5 Conclusion and Recommendations

MTW advise there have been nil discharge events from the MTW discharge point between the 2018 stream health monitoring event and the 2019 monitoring event. There has been 283 mm of rainfall recorded within the on-site rainfall gauge for the period November 2018 to October 2019. In comparison, the Bureau of Meteorology shows an average of 502 mm at Singleton (Singleton STP 61397) for the same period. This indicates that this round of monitoring was subjected to a significantly drier year than what occurs on average within the region.

The results of this monitoring survey indicate that both stream health and channel stability fluctuate over different sections of Loder Creek. The survey identified that some sections of Loder Creek are currently eroding and are vulnerable to further erosion with areas of significant erosion observed. These areas are generally associated with exposed dispersive sub-soils, which hamper vegetation establishment by the development of a hard surface crust when the soil is dry, and the 'melting' nature of the soil when wet.

The survey identified that the majority of Loder Creek displayed stable environments. Generally the monitoring identified that the creeks have not significantly changed from what was observed during the 2018 survey, however some evidence of minor erosion progression were observed at some of the monitoring points. Many sections of the creek experience active erosion as a result of natural influences. Improvements were also identified during the 2019 survey, resulting from both natural occurrences as well as man-made upgrade works.

In one instance, the CSIRO rating has downgraded from what was observed during the 2018 inspection although the observed conditions were similar. This is largely related to the subjectivity using the methodology proposed by CSIRO and therefore is subjected to change where there is a change in assessor.

The RARC stream health assessment identified that the monitoring points on Loder Creek were classified as poor and average. It should be noted that BM34 situated on Loder Creek increased from the upper range of 'poor' to the lower range of 'average' due to an increase in canopy cover. The single monitoring point on Wollombi Brook was classed as poor with little change observed since monitoring in 2018.

It is recommended that MTW adopt a risk based approach to determine whether mitigation measures and/or improvement works are required at the monitoring points where erosion was observed. Different remediation measures may be utilised depending on the type of erosion that has occurred (as listed in **Section 4**).

For example, erosion caused by lateral flows and unstable wall materials may be remediated by re-grading the batter slope (as required) to a maximum gradient of 3(H):1(V), ripping the soil and then seeding with a suitable vegetation species. Gypsum may also be used as a soil ameliorant and applied at a rate of 1kg/m^2. Bunding may also be used to control upslope lateral flows. Creek erosion caused by the shear stresses associated with the upstream flows may be remediated by armouring of the creek bed / banks (i.e. rock, jute mesh, erosion blanket etc), as was observed to have been implemented by MTW at location MTW Dis during the 2018 survey.

6 References

Land & Water Australia (2005), Rapid Appraisal Of Riparian Condition – Version Two (River and Riparian Technical Guideline No. 4a)

Commonwealth Scientific and Research Organisation (CSIRO) (date unknown) - Ephemeral Stream Assessment, date accessed 14/09/09,

http://www.cse.csiro.au/research/ras/efa/resources/ephemeraldrainagelineassessment.pdf

APPENDIX A

Rapid Appraisal of Riparian Conditions

Rapid Appraisal of Riparian Condition

Site Number: MTW DIS

Site: Mount Thorley Discharge **GPS start:** See figure

Date: 13/11/2019 **Observer:** SM **GPS end:**

Longitudinal continuity of riparian canopy vegetation (>5m wide)

Map	Score
	2

0 = <50%, 1 = 50-64%, 2 = 65-79%, 3 = 80-94%, 4 = ≥95% vegetated bank;

with ½ point subtracted for each significant discontinuity (>50m long)

Width of riparian canopy vegetation

Transect	Channel Width (CW)	Vegetation Width (VW)	Score
1	3	75	4
2	3	15	2
3	5	45	4
4	7	55	4
Average			3.5

Channel ≤10m wide: 0 = VW <5m, 1 = VW 5-9m , 2 = VW 10-19m, 3 = VW 20-39m, 4 = VW ≥40m

Channel >10m wide: 0 = VW/CW <0.5, 1 = VW/CW 0.5-0.9, 2 = VW/CW 1-1.9, 3 = VW/CW 2-3.9, 4 = VW/CW ≥4

Proximity

Score
1

Nearest patch of native vegetation >10ha:

0 = >1km, 1 = 200m-1km, 2 = contiguous,

3 = contiguous with patch >50ha

Vegetation cover: Canopy >5m, Understorey 1-5m, Ground cover <1m

Transect	Canopy	Native canopy	Understorey	Native understorey	Ground cover	Native ground cover	# layers
1	3	3	1	1	2	1	3
2	2	2	0	0	2	1	3
3	2	2	1	1	2	1	3
4	2	2	1	1	2	1	3
Average	2.25	2.25	0.75	0.75	2	1	3

Canopy and ground cover: 0 = none, 1 = 1-30%, 2 = 31-60%, 3 = >60%

Understorey cover: 0 = none, 1 = 1-5%, 2 = 6-30%, 3 = >30%

Debris

Transect	Leaf litter	Native leaf litter	Standing dead trees	Hollow-bearing trees	Fallen logs
1	3	3	0	0	1
2	3	3	1	0	1
3	3	3	0	0	0
4	3	3	0	0	0
Average	3	3	0.25	0	0.5

Leaf litter & native leaf litter cover: 0 = none, 1 = 1-30%, 2 = 31-60%, 3 = >60%

Standing dead trees (>20cm dbh) & hollow-bearing trees: 0 = absent, 1 = present

Fallen logs (>10cm diameter): 0 = none, 1 = small quantities, 2 = abundant

Features

Transect	Native canopy species regeneration	Native understorey regeneration	Large native tussock grasses	Reeds
1	1	0	1	2
2	1	0	1	2
3	1	0	1	2
4	1	0	1	2
Average	1	0	1	2

Regeneration <1m tall: 0 = none, 1 = scattered, and 2 = abundant, with ½ point subtracted for grazing damage

Reeds & large tussock grasses: 0 = none, 1 = scattered, and 2 = abundant

Calculation of scores

Site Number:	MTO DIS

Longitudinal continuity of riparian canopy vegetation

Score
2

Width of riparian canopy vegetation

Average	3.5

Proximity

Score
1

Vegetation cover

	Canopy	Native canopy	Understorey	Native understorey	Ground cover	Native ground cover	# layers
Average	2.25	2.25	0.75	0.75	2	1	3

Debris

	Leaf litter	Native leaf litter	Standing dead trees	Hollow-bearing trees	Fallen logs
Average	3	3	0.25	0	0.5

Features

	Native canopy species regeneration	Native understorey regeneration	Large native tussock grasses	Reeds
Average	1	0	1	2

TOTALS

Site:	Habitat	Cover	Natives	Debris	Features	Total
(out of)	11	12	9	10	8	50
	6.5	8	4	6.75	4	29.25

Rapid Appraisal of Riparian Condition

Site Number: BM34

Site: Loaders Creek **GPS start:** see figure

Date: 14-11-2019 **Observer:** SM **GPS end:**

Longitudinal continuity of riparian canopy vegetation (>5m wide)

Map	Score
	4

0 = <50%, 1 = 50-64%, 2 = 65-79%, 3 = 80-94%, 4 = ≥95% vegetated bank;

with ½ point subtracted for each significant discontinuity (>50m long)

Width of riparian canopy vegetation

Transect	Channel Width (CW)	Vegetation Width (VW)	Score
1	6	25	3
2	6	20	3
3	6	15	2
4	6	15	2
Average			2.5

Channel ≤10m wide: 0 = VW <5m, 1 = VW 5-9m , 2 = VW 10-19m, 3 = VW 20-39m, 4 = VW ≥40m

Channel >10m wide: 0 = VW/CW <0.5, 1 = VW/CW 0.5-0.9, 2 = VW/CW 1-1.9, 3 = VW/CW 2-3.9, 4 = VW/CW ≥4

Proximity

Score
2

Nearest patch of native vegetation >10ha:

0 = >1km, 1 = 200m-1km, 2 = contiguous,

3 = contiguous with patch >50ha

Vegetation cover: Canopy >5m, Understorey 1-5m, Ground cover <1m

Transect	Canopy	Native canopy	Understorey	Native understorey	Ground cover	Native ground cover	# layers
1	3	3	2	0	3	2	3
2	2	2	2	0	3	2	3
3	3	3	2	0	3	2	3
4	3	3	2	0	3	2	3
Average	2.75	2.75	2	0	3	2	3

Canopy and ground cover: 0 = none, 1 = 1-30%, 2 = 31-60%, 3 = >60%

Understorey cover: 0 = none, 1 = 1-5%, 2 = 6-30%, 3 = >30%

Debris

Transect	Leaf litter	Native leaf litter	Standing dead trees	Hollow-bearing trees	Fallen logs
1	1	1	0	0	0
2	1	1	0	0	0
3	1	1	0	0	0
4	1	1	0	0	0
Average	1	1	0	0	0

Leaf litter & native leaf litter cover: 0 = none, 1 = 1-30%, 2 = 31-60%, 3 = >60%

Standing dead trees (>20cm dbh) & hollow-bearing trees: 0 = absent, 1 = present

Fallen logs (>10cm diameter): 0 = none, 1 = small quantities, 2 = abundant

Features

Transect	Native canopy species regeneration	Native understorey regeneration	Large native tussock grasses	Reeds
1	1	1	1	2
2	1	1	1	2
3	1	1	1	2
4	1	1	1	2
Average	1	1	1	2

Regeneration <1m tall: 0 = none, 1 = scattered, and 2 = abundant, with ½ point subtracted for grazing damage

Reeds & large tussock grasses: 0 = none, 1 = scattered, and 2 = abundant

Calculation of scores

Site Number:	BM34

Longitudinal continuity of riparian canopy vegetation

Score
4

Width of riparian canopy vegetation

Average	2.5

Proximity

Score
2

Vegetation cover

	Canopy	Native canopy	Understorey	Native understorey	Ground cover	Native ground cover	# layers
Average	2.75	2.5	2	0	3	2	3

Debris

	Leaf litter	Native leaf litter	Standing dead trees	Hollow-bearing trees	Fallen logs
Average	1	1	0	0	0

Features

	Native canopy species regeneration	Native understorey regeneration	Large native tussock grasses	Reeds
Average	1	1	1	2

TOTALS

Site:	Habitat	Cover	Natives	Debris	Features	**Total**
(out of)	11	12	9	10	8	50
	8.5	10.75	4.5	2	5	30.75

Rapid Appraisal of Riparian Condition

Site Number: BM35

Site: Loaders Creek **GPS start:** See figure

Date: 13-11-2019 **Observer:** SM **GPS end:**

Longitudinal continuity of riparian canopy vegetation (>5m wide)

Map	Score
	3

0 = <50%, 1 = 50-64%, 2 = 65-79%, 3 = 80-94%, 4 = ≥95% vegetated bank;

with ½ point subtracted for each significant discontinuity (>50m long)

Width of riparian canopy vegetation

Transect	Channel Width (CW)	Vegetation Width (VW)	Score
1	5	18	2
2	5	25	3
3	5	30	3
4	5	60	4
Average			3

Channel ≤10m wide: 0 = VW <5m, 1 = VW 5-9m , 2 = VW 10-19m, 3 = VW 20-39m, 4 = VW ≥40m

Channel >10m wide: 0 = VW/CW <0.5, 1 = VW/CW 0.5-0.9, 2 = VW/CW 1-1.9, 3 = VW/CW 2-3.9, 4 = VW/CW ≥4

Proximity

Score
1

Nearest patch of native vegetation >10ha:

0 = >1km, 1 = 200m-1km, 2 = contiguous,

3 = contiguous with patch >50ha

Vegetation cover: Canopy >5m, Understorey 1-5m, Ground cover <1m

Transect	Canopy	Native canopy	Understorey	Native understorey	Ground cover	Native ground cover	# layers
1	2	2	2	0	2	0	3
2	2	2	2	0	2	0	3
3	3	3	2	0	2	0	3
4	3	3	2	0	1	0	3
Average	2.5	2.5	2	0	1.75	0	3

Canopy and ground cover: 0 = none, 1 = 1-30%, 2 = 31-60%, 3 = >60%

Understorey cover: 0 = none, 1 = 1-5%, 2 = 6-30%, 3 = >30%

Debris

Transect	Leaf litter	Native leaf litter	Standing dead trees	Hollow-bearing trees	Fallen logs
1	3	3	0	0	1
2	3	3	0	0	1
3	3	3	0	0	0
4	3	3	0	0	1
Average	3	3	0	0	0.75

Leaf litter & native leaf litter cover: 0 = none, 1 = 1-30%, 2 = 31-60%, 3 = >60%

Standing dead trees (>20cm dbh) & hollow-bearing trees: 0 = absent, 1 = present

Fallen logs (>10cm diameter): 0 = none, 1 = small quantities, 2 = abundant

Features

Transect	Native canopy species regeneration	Native understorey regeneration	Large native tussock grasses	Reeds
1	1	1	1	2
2	1	1	1	2
3	1	1	1	2
4	1	1	1	2
Average	1	1	1	2

Regeneration <1m tall: 0 = none, 1 = scattered, and 2 = abundant, with ½ point subtracted for grazing damage

Reeds & large tussock grasses: 0 = none, 1 = scattered, and 2 = abundant

Calculation of scores

Site Number:	BCC01

Longitudinal continuity of riparian canopy vegetation

Score
3

Width of riparian canopy vegetation

Average	3

Proximity

Score
1

Vegetation cover

	Canopy	Native canopy	Understorey	Native understorey	Ground cover	Native ground cover	# layers
Average	2.25	2.25	2	0	2	0	3

Debris

	Leaf litter	Native leaf litter	Standing dead trees	Hollow-bearing trees	Fallen logs
Average	3	3	0	0	0

Features

	Native canopy species regeneration	Native understorey regeneration	Large native tussock grasses	Reeds
Average	1	1	1	2

TOTALS

Site:	Habitat	Cover	Natives	Debris	Features	Total
(out of)	11	12	9	10	8	50
	7	9.25	2.25	6	5	29.5

Rapid Appraisal of Riparian Condition

Site Number: BM37

Site: Wollomi Brook **GPS start:** See figure

Date: 13/11/2019 **Observer:** SM **GPS end:**

Longitudinal continuity of riparian canopy vegetation (>5m wide)

Map	Score
	3

0 = <50%, 1 = 50-64%, 2 = 65-79%, 3 = 80-94%, 4 = ≥95% vegetated bank;

with ½ point subtracted for each significant discontinuity (>50m long)

Width of riparian canopy vegetation

Transect	Channel Width (CW)	Vegetation Width (VW)	Score
1	20	15	1
2	10	17	2
3	20	20	4
4	10	35	3
Average			2.5

Channel ≤10m wide: 0 = VW <5m, 1 = VW 5-9m , 2 = VW 10-19m, 3 = VW 20-39m, 4 = VW ≥40m

Channel >10m wide: 0 = VW/CW <0.5, 1 = VW/CW 0.5-0.9, 2 = VW/CW 1-1.9, 3 = VW/CW 2-3.9, 4 = VW/CW ≥4

Proximity

Score
2

Nearest patch of native vegetation >10ha:

0 = >1km, 1 = 200m-1km, 2 = contiguous,

3 = contiguous with patch >50ha

Vegetation cover: Canopy >5m, Understorey 1-5m, Ground cover <1m

Transect	Canopy	Native canopy	Understorey	Native understorey	Ground cover	Native ground cover	# layers
1	2	2	2	1	3	1	3
2	2	2	2	1	3	1	3
3	2	2	2	1	3	1	3
4	2	2	2	1	3	1	3
Average	2	2	2	1	3	1	3

Canopy and ground cover: 0 = none, 1 = 1-30%, 2 = 31-60%, 3 = >60%

Understorey cover: 0 = none, 1 = 1-5%, 2 = 6-30%, 3 = >30%

Debris

Transect	Leaf litter	Native leaf litter	Standing dead trees	Hollow-bearing trees	Fallen logs
1	2	2	0	0	0
2	2	2	0	0	1
3	2	2	0	0	0
4	2	2	0	0	1
Average	2	2	0	0	0.5

Leaf litter & native leaf litter cover: 0 = none, 1 = 1-30%, 2 = 31-60%, 3 = >60%

Standing dead trees (>20cm dbh) & hollow-bearing trees: 0 = absent, 1 = present

Fallen logs (>10cm diameter): 0 = none, 1 = small quantities, 2 = abundant

Features

Transect	Native canopy species regeneration	Native understorey regeneration	Large native tussock grasses	Reeds
1	0	0	1	2
2	0	0	1	2
3	0	0	1	2
4	0	0	1	2
Average	0	0	1	2

Regeneration <1m tall: 0 = none, 1 = scattered, and 2 = abundant, with ½ point subtracted for grazing damage

Reeds & large tussock grasses: 0 = none, 1 = scattered, and 2 = abundant

Calculation of scores

Site Number:	BM37

Longitudinal continuity of riparian canopy vegetation

Score
3

Width of riparian canopy vegetation

Average	2.5

Proximity

Score
2

Vegetation cover

	Canopy	Native canopy	Understorey	Native understorey	Ground cover	Native ground cover	# layers
Average	2	2	2	1	3	1	3

Debris

	Leaf litter	Native leaf litter	Standing dead trees	Hollow-bearing trees	Fallen logs
Average	2	2	0	0	0.5

Features

	Native canopy species regeneration	Native understorey regeneration	Large native tussock grasses	Reeds
Average	0	0	1	2

TOTALS

Site:	Habitat	Cover	Natives	Debris	Features	**Total**
(out of)	11	12	9	10	8	50
	7.5	10	4	4.5	3	29

APPENDIX B

CSIRO Ephemeral Stream Assessment Database

BSO MTW CSIRO Ephemeral Stream Assessment Database

Site Number	Distance US/DS from Survey Peg (m)	Date of Monitoring Assessor Channel Characteristic	Nov-18 SLR Rating	Nov-19 SLR Rating
LC1	0m (At Survey Peg)	Vegetation on D/L Floor	3	3
		Vegetation on D/L Walls	3	3
		Shape of D/L Cross-Section	3	3
		Longitudinal Morphology	3	3
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	3	3
		Nature and Shape of Bank Edge	4	4
		Nature of Lateral Flow Regulation	3	3
		Sum of Ratings	**23**	**23**
		Activity Rating	**72**	**72**
		Classification	**Stable**	**Stable**
LC2	0m (At Survey Peg)	Vegetation on D/L Floor	3	3
		Vegetation on D/L Walls	1	1
		Shape of D/L Cross-Section	2	2
		Longitudinal Morphology	2	2
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	1	1
		Nature and Shape of Bank Edge	4	4
		Nature of Lateral Flow Regulation	4	4
		Sum of Ratings	**18**	**18**
		Activity Rating	**56**	**56**
		Classification	**Active**	**Active**
LC3	0m (At Survey Peg)	Vegetation on D/L Floor	3	3
		Vegetation on D/L Walls	1	1
		Shape of D/L Cross-Section	2	1
		Longitudinal Morphology	2	1
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	1	1
		Nature and Shape of Bank Edge	3	3
		Nature of Lateral Flow Regulation	2	2
		Sum of Ratings	**15**	**13**
		Activity Rating	**47**	**41**
		Classification	**Very Active**	**Very Active**
LC4	0m (At Survey Peg)	Vegetation on D/L Floor	3	3
		Vegetation on D/L Walls	3	3
		Shape of D/L Cross-Section	3	2
		Longitudinal Morphology	3	3
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	1	1
		Nature and Shape of Bank Edge	4	4
		Nature of Lateral Flow Regulation	4	4
		Sum of Ratings	**22**	**21**
		Activity Rating	**69**	**66**
		Classification	**Potentially Stabilising**	**Potentially Stabilising**
LC5	0m (At Survey Peg)	Vegetation on D/L Floor	3	3
		Vegetation on D/L Walls	2	2
		Shape of D/L Cross-Section	2	2
		Longitudinal Morphology	2	2
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	2	2
		Nature and Shape of Bank Edge	3	3
		Nature of Lateral Flow Regulation	4	4
		Sum of Ratings	**19**	**19**
		Activity Rating	**59**	**59**
		Classification	**Active**	**Active**
LC6	0m (At Survey Peg)	Vegetation on D/L Floor	3	3
		Vegetation on D/L Walls	2	2
		Shape of D/L Cross-Section	2	2
		Longitudinal Morphology	2	2
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	1	1
		Nature and Shape of Bank Edge	3	3
		Nature of Lateral Flow Regulation	3	3
		Sum of Ratings	**17**	**17**
		Activity Rating	**53**	**53**
		Classification	**Active**	**Active**
LC7	0m (At Survey Peg)	Vegetation on D/L Floor	3	3
		Vegetation on D/L Walls	1	1
		Shape of D/L Cross-Section	2	2
		Longitudinal Morphology	2	2
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	2	2
		Nature and Shape of Bank Edge	4	4
		Nature of Lateral Flow Regulation	2	2
		Sum of Ratings	**17**	**17**
		Activity Rating	**53**	**53**
		Classification	**Active**	**Active**
LC8	0m (At Survey Peg)	Vegetation on D/L Floor	2	2
		Vegetation on D/L Walls	1	1
		Shape of D/L Cross-Section	3	3
		Longitudinal Morphology	3	3
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	2	2
		Nature and Shape of Bank Edge	4	4
		Nature of Lateral Flow Regulation	4	4
		Sum of Ratings	**20**	**20**
		Activity Rating	**63**	**63**
		Classification	**Potentially Stabilising**	**Potentially Stabilising**
		Vegetation on D/L Floor	3	3
		Vegetation on D/L Walls	3	3
		Shape of D/L Cross-Section	3	3

LC9	0m (At Survey Peg)	Longitudinal Morphology	2	2
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	3	2
		Nature and Shape of Bank Edge	3	4
		Nature of Lateral Flow Regulation	4	4
		Sum of Ratings	**22**	**22**
		Activity Rating	**69**	**69**
		Classification	**Potentially Stabilising**	**Potentially Stabilising**
LC10	0m (At Survey Peg)	Vegetation on D/L Floor	1	1
		Vegetation on D/L Walls	1	1
		Shape of D/L Cross-Section	2	2
		Longitudinal Morphology	2	1
		Particle Size of Materials on Floor	1	3
		Nature of D/L Wall Materials	4	4
		Nature and Shape of Bank Edge	4	4
		Nature of Lateral Flow Regulation	4	4
		Sum of Ratings	**19**	**20**
		Activity Rating	**59**	**63**
		Classification	**Active**	**Potentially Stabilising**
LC11	0m (At Survey Peg)	Vegetation on D/L Floor	3	2
		Vegetation on D/L Walls	1	2
		Shape of D/L Cross-Section	2	3
		Longitudinal Morphology	2	2
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	1	2
		Nature and Shape of Bank Edge	3	3
		Nature of Lateral Flow Regulation	4	4
		Sum of Ratings	**17**	**19**
		Activity Rating	**53**	**59**
		Classification	**Active**	**Active**
LC12	0m (At Survey Peg)	Vegetation on D/L Floor	2	2
		Vegetation on D/L Walls	2	2
		Shape of D/L Cross-Section	3	3
		Longitudinal Morphology	2	3
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	2	2
		Nature and Shape of Bank Edge	3	3
		Nature of Lateral Flow Regulation	4	4
		Sum of Ratings	**19**	**20**
		Activity Rating	**59**	**63**
		Classification	**Active**	**Potentially Stabilising**
LC13	0m (At Survey Peg)	Vegetation on D/L Floor	1	1
		Vegetation on D/L Walls	2	1
		Shape of D/L Cross-Section	3	2
		Longitudinal Morphology	2	2
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	2	3
		Nature and Shape of Bank Edge	4	4
		Nature of Lateral Flow Regulation	4	4
		Sum of Ratings	**19**	**18**
		Activity Rating	**59**	**56**
		Classification	**Active**	**Active**
MTW Dis	0m (At Survey Peg)	Vegetation on D/L Floor	1	1
		Vegetation on D/L Walls	2	2
		Shape of D/L Cross-Section	3	3
		Longitudinal Morphology	2	2
		Particle Size of Materials on Floor	3	3
		Nature of D/L Wall Materials	3	3
		Nature and Shape of Bank Edge	4	4
		Nature of Lateral Flow Regulation	2	2
		Sum of Ratings	**20**	**20**
		Activity Rating	**63**	**63**
		Classification	**Potentially Stabilising**	**Potentially Stabilising**
BM34	0m (At Survey Peg)	Vegetation on D/L Floor	3	3
		Vegetation on D/L Walls	3	3
		Shape of D/L Cross-Section	5	5
		Longitudinal Morphology	3	3
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	3	3
		Nature and Shape of Bank Edge	3	3
		Nature of Lateral Flow Regulation	4	4
		Sum of Ratings	**25**	**25**
		Activity Rating	**78**	**78**
		Classification	**Stable**	**Stable**
BM35	0m (At Survey Peg)	Vegetation on D/L Floor	3	3
		Vegetation on D/L Walls	2	2
		Shape of D/L Cross-Section	2	2
		Longitudinal Morphology	2	2
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	2	2
		Nature and Shape of Bank Edge	3	3
		Nature of Lateral Flow Regulation	3	3
		Sum of Ratings	**18**	**18**
		Activity Rating	**56**	**56**
		Classification	**Active**	**Active**
BM37	0m (At Survey Peg)	Vegetation on D/L Floor	1	1
		Vegetation on D/L Walls	3	3
		Shape of D/L Cross-Section	4	4
		Longitudinal Morphology	3	3
		Particle Size of Materials on Floor	1	1
		Nature of D/L Wall Materials	3	2
		Nature and Shape of Bank Edge	4	4
		Nature of Lateral Flow Regulation	4	4
		Sum of Ratings	**23**	**22**
		Activity Rating	**72**	**69**
		Classification	**Stable**	**Potentially Stabilising**

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