SONOMA MINE MANAGEMENT PTY LTD

Two Mile Creek Diversion Operations Monitoring 2019

Sonoma Coal Mine

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EXECUTIVE SUMMARY

Annual operations monitoring of Two Mile Creek Diversion, at Sonoma Coal Mine SCM), was performed by Engeny Water Management (Engeny) on the 9th of April 2019. This was the sixth year of operations monitoring since the diversion was constructed and became operational in 2013. Monitoring was undertaken in accordance with the program established for the Two Mile Creek Diversion (Engeny, 2014).

Three assessment reaches were established within Two Mile Creek at the time of the initial inspection in 2014. The monitoring program (Engeny, 2014) to be undertaken during the sixth year of operation requires a reduced level of inspection activities. Consequently, the Index of Diversion Condition (IDC) assessment was not undertaken as part of the 2019 annual monitoring.

There was minimal rainfall in the weeks preceding the 2019 diversion inspection. Based on the stream flow monitoring data for Pelican Creek, observed flood levels in the Two Mile Creek Diversion and site rainfall monitoring data, it is evident that any flow event in the Two Mile Creek Diversion during the period May 2018 to April 2019 would have been of small magnitude (i.e. less flow than a 50% (1:2) AEP event).

The diversion is generally considered to be in good condition and performing as per the design intent. However, several areas of flood damage remain since the 2017 inspection (caused during Tropical Cyclone Debbie in March 2017), which will require management action to prevent ongoing deterioration of the diversion.

The visual inspection and comparison against the photographic record indicates that the upstream and downstream reaches have remained in a stable condition over the previous year. The extent of riparian ground cover has increased across all reaches.

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1. INTRODUCTION

1.1 Overview

QCoal Sonoma Pty Ltd (Sonoma) is required to monitor the performance of the Two Mile Creek Diversion as a condition of the Sonoma Coal Mine (SCM) Environmental Authority (EA) EPML00707713 (take effect date 22/2/2019). Engeny Water Management (Engeny) was commissioned by Sonoma to conduct annual operations monitoring of the Two Mile Creek Diversion in April 2019 following the 2018/19 wet season (i.e. the sixth year of diversion operation).

The monitoring program for the Two Mile Creek Diversion has been established in accordance with the Australian Coal Association Research Program (ACARP) guidelines for *Monitoring and Evaluation Program for Bowen Basin River Diversions* (ID&A Pty Ltd, 2001). This guideline sets the standard for monitoring of watercourse diversions within the Bowen Basin and the criteria for assessment.

1.2 Two Mile Creek Diversion

Two Mile Creek is an ephemeral tributary of the Bowen River, which is a major tributary in the Burdekin River catchment. The catchment area upstream of the diversion is approximately 30 km^2. Two Mile Creek flows from east to west through the centre of the SCM. Downstream of the SCM lease, Two Mile Creek flows into Pelican Creek, which discharges into the Bowen River some 28 km north west of the mining lease.

The catchment upstream of the SCM open cut mining operations maintains open woodland cover. The waterway reaches immediately upstream of the diversion are typically low capacity incised channels in broad valley floor floodplains, which would be regularly engaged by flood flows. There are two tributaries in the upstream catchment that cross under road and rail infrastructure before entering the diversion.

Prior to mining and diversion construction, Two Mile Creek flowed through an area now occupied by the SCM Main Pit. The diversion was constructed during 2012/13 with completion in August 2013. The diversion comprises a constructed meandering low flow channel within a high flow channel to match the sinuosity of the existing creek. The low flow channel is rock lined for the length of the diversion with an average depth of 1.5 m and 1V:4H batters to convey the 2 year average recurrence interval (ARI) peak flow. The high flow channel comprises a wide channel with benches grading towards the low flow channel. A rock lined perimeter drain and chutes were constructed to convey runoff from the high flow benches to the low flow channel. The high flow channel benches were designed to be planted with grasses and the embankments of the high flow channel with trees and shrubs. Design details for the diversions are contained in the design report prepared by Brisbane Stormwater Management (BSM, 2012).

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1.3 Regulatory Requirements

The Two Mile Creek Diversion Water Licence was granted in October 2012 under the Water Act 2000. The Queensland Government approval for the operation of the Two Mile Creek Diversion (including approval conditions and referenced certified designs), was subsequently transferred from the Water Act 2000 licence, into the SCM EA EPML00707713 (take effect date 22/2/2019), which is administered under the Environmental Protection Act 1994 (EP Act 1994). Accordingly, Water Licence Number 607384 was surrendered by QCoal Sonoma Pty Ltd (notice dated 6/12/2017).

Key EA conditions relevant to the diversion inspection are presented below:

- **Condition J7**: The holder of this authority is required to monitor the performance of all diversions by way of a performance report prepared for each diversion by a registered professional engineer (RPEQ) at the following times:
  - April of each year; and at any time when poor performance and/or potential failure of the diversion are observed.
  - Monitoring of the works must include recommendations as per ACARP Project C9068 "Monitoring and Evaluation Program for Bowen Basin River Diversions". An electronic copy shall be submitted to the administering authority by 30 June each year.
- **Condition J8**: The performance report must detail the following:
  - (a) The performance of the diversion by way of comparison with the relevant approved Design Plans, specifications and monitoring/maintenance strategies therein;
  - (b) Surveys to identify and quantify any changes to the channel bed and permanent corridor width subjected to settlement;
  - (c) Detail any remedial works to be undertaken including a timetable for completion of proposed works; and
  - (d) Any recommendations on measures to be taken to ensure the physical integrity of the works.

1.4 Scope of Work for Operations Diversion Monitoring

A formal operations monitoring program for the Two Mile Creek diversion was initiated in 2014 (the first full year in which the diversion was operational). This report documents the sixth monitoring inspection undertaken since completion of construction of the diversion.

The 2019 diversion monitoring assessment included the following activities in accordance with the monitoring program for the diversion (Engeny, 2014) and EA requirements, with field inspections undertaken on the 9th of April 2019:

- Establishment of photographic records of the condition of the waterway at the monitoring sites.

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- Review of rainfall and stream flow monitoring data for the 2018/19 wet season to provide context to the diversion monitoring assessment.
- Survival of works assessment including assessment of flood damage and maintenance/management intervention requirements.

An Index of Diversion Condition (IDC) assessment was not performed as part of the 2019 monitoring activity which is in accordance with the diversion monitoring program (Engeny, 2014).

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2. MONITORING PROGRAM

A monitoring program for the Two Mile Creek Diversion was developed as part of the diversion design and approval process in 2012. The proposed program included IDC assessment, fixed photo points, aerial photography analysis, cross section survey, flow event analysis, vegetation assessment and event-based damage assessment. This original monitoring program was reviewed and revised at the time of the 2014 inspection (Engeny, 2014) to better align with the ACARP diversion monitoring standards and current industry standards.

2.1 Monitoring Reaches

The monitoring program for the Two Mile Creek diversion has been structured to assess and compare the condition of the diversion reach against the upstream and downstream reaches of Two Mile Creek.

The Two Mile Creek diversion has two distinct upstream reaches that flow from the east and discharge into the diversion after crossing the Bowen Developmental Road and Collinsville Newlands Branch Railway. The diversion reach is defined as the approximately 5,700 m length of the constructed diversion between the Bowen Developmental Road and the downstream limit of construction. The downstream reach is defined as the natural reach of Two Mile Creek between the limit of the constructed diversion and point at which the creek crosses the southern boundary of the Cows Coal Mine (CCM) mining lease (ML10345) boundary. The reach was limited to the mining lease boundary due to access constraints. The locations of the upstream, diversion and downstream reaches are listed in Table 2.1.

Table 2.1 Location of Two Mile Creek Diversion and control reaches

Reach	Upstream Limit (m GDA94)		Downstream Limit (m GDA94)	
	Easting	Northing	Easting	Northing
Upstream Reach (TMC US1, TMC US2)	590,708	7,719,266	590,066	7,719,708
Upstream Reach (TMC US3, TMC US4)	590,598	7,718,049	589,923	7,718,636
Diversion Reach	590,066 589,923	7,719,708 7,718,636	587,100	7,718,317
Downstream Reach	587,100	7,718,317	585,821	7,717,891

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2.2 Monitoring Sites

Monitoring sites have been established to provide reasonable representations of the geomorphic and riparian vegetation characteristics and condition within each of the reaches. Monitoring locations were initially determined through inspection of aerial photography with sites located in areas with different observable features within each reach. This included straight sections of low flow channel, low flow channel meanders and deeply incised sections. Monitoring sites have been located at relatively uniform intervals.

During the initial field investigation in 2014, a number of monitoring locations were altered based on access and observed ground conditions at each location. GPS coordinates were recorded at each monitoring site to ensure consistency as part of the ongoing monitoring program. Physical markers were installed at the monitoring sites prior to the 2016 inspection. These markers help to ensure consistency in location and provide a photo reference point for the purpose of ongoing monitoring. Several of the markers were washed away during the Tropical Cyclone Debbie flow event in March 2017 (TMC-US2, TMC-US3, TMC-US4, TMC-Div3 and TMC-DS2), and have not been reinstated. It is recommended that these physical markers be replaced in order to maintain consistency in the photo locations.

A total of 12 monitoring sites have been established along Two Mile Creek for the diversion monitoring which include:

- Four sites in the upstream reach (TMC-U1 to TMC-U4) with two sites on each of the main tributaries of Two Mile Creek upstream of the diversion.
- Four sites in the diversion reach (TMC-Div1 to TMC-Div4).
- Four sites in the downstream reach (TMC-D1 to TMC-D4).

The locations of the monitoring sites are shown in Figure 2.1 while the coordinates of the monitoring sites are provided in Table 2.2.

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Figure 2.1 Diversion Monitoring Site Locations

Table 2.2 Monitoring site locations

Site ID	Creek Bank Location	Easting (m GDA94)	Northing (m GDA94)
Two Mile Creek Upstream Reach			
TMC-US1	Left	590,606	7,719,248
TMC-US2	Left	590,223	7,719,627

Site ID	Creek Bank Location	Easting (m GDA94)	Northing (m GDA94)
TMC-US3	Left	590,578	7,718,098
TMC-US4	Left	590,102	7,718,493
Two Mile Creek Diversion Reach			
TMC-Div1	Left	589,834	7,718,817
TMC-Div2	Left	588,903	7718641
TMC-Div3	Right	588,000	7,719,197
TMC-Div4	Right	587,556	7,718,327
Two Mile Creek Downstream Reach			
TMC-DS1	Right	586,996	7,718,228
TMC-DS2	Right	586,565	7,717,975
TMC-DS3	Left	586,502	7,717,849
TMC-DS4	Right	585,821	7,717,891

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2.3 Monitoring Frequency

The recommended frequency of monitoring is provided in the *Monitoring and Evaluation Program for Bowen Basin River Diversions* (ID&A Pty Ltd, 2001). The monitoring should be undertaken annually in April with a report submitted to the Department of Environment and Science (DES) prior to 30 June each year to satisfy the conditions of the EA. The activities proposed as part of the annual monitoring are outlined in Table 2.3.

Table 2.3 Diversion monitoring activities and frequency

Monitoring Activity	Year of Diversion Operation (Year 1 = 2014)									
	1	2	3	4	5	6	7	8	9	10
Flow Events	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Index of Diversion Condition (IDC)	✓	✓	✗	✗	✓	✗	✗	✓	✗	✓

Monitoring Activity	Year of Diversion Operation (Year 1 = 2014)									
	1	2	3	4	5	6	7	8	9	10
Photographs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Survival of Works	✓	✓	✗	✗	✓	✗	✗	✓	✗	✓
Cross Section Survey	✓	✗	✗	✗	✓	✗	✗	✗	✗	✓

Additional monitoring is recommended following flow events of a magnitude sufficient to potentially cause damage to the diversion reach or seriously affect the survival or establishment process of constructed diversion works. The trigger for this event-based monitoring is a 5 year Average Recurrence Interval (ARI) flood event or greater as defined by the *Two Mile Creek Diversion Design Report* (BSM, 2012). It is recommended that this monitoring include a visual inspection of the diversion reach with recommendations to rectify any areas of damage that could trigger on-going deterioration of the diversion.

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3. RAINFALL AND STREAM FLOW MONITORING

3.1 Stream Flow Monitoring

There is currently no stream flow monitoring being conducted on Two Mile Creek. Sonoma Mine maintains a water quality and stream flow gauging station on Pelican Creek (BG1), which flows to the north of the SCM. The recorded levels and estimated flows at BG1 over the twelve month period since the previous diversion inspection are presented in Figure 3.1.

The figure indicates a number of minor stream flow events during the period of interest. The largest of these occurred in early March with a peak flow of approximately 70 m^3/s. By comparison, the peak flow that occurred at the end of March 2017 as a result of Tropical Cyclone Debbie exceeded 750 m^3/s. The performance of the diversion during the March 2017 event is documented in a previous diversion monitoring report (Engeny 2017).

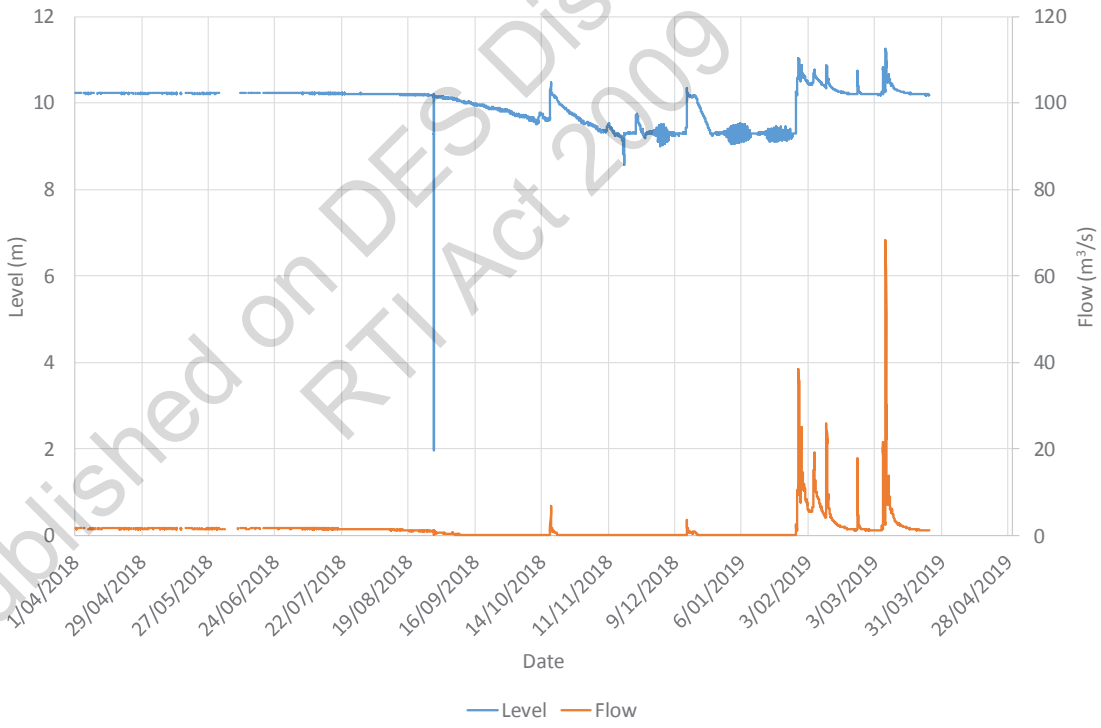

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Figure 3.1 Stream Flow in Pelican Creek Upstream of Coral Creek (BG1)

3.2 Rainfall Monitoring

Sonoma Mine maintains a site rainfall monitoring station. Recorded rainfall at the station for the period from May 2018 to March 2019 has been obtained and assessed for the purpose of inferring the magnitude of flow events during the 2018/19 wet season.

3.2.1 Monthly Rainfall

The site monthly rainfall totals for the 2018/19 wet season were compared to the average rainfall recorded at site (2008 – current) and the long-term average rainfall for the Bureau of Meteorology Collinsville Post Office rainfall station (Station No. 330013) (1940 to current). These results are presented in Table 3.1 and Figure 3.2.

A comparison between average rainfall and recorded rainfall shows that annual rainfall over the period of interest has been significantly below average. However, slightly higher than average rainfall occurred in three months (i.e. October, January and April).

Table 3.1 Monthly rainfall comparison

Month	Site Rainfall 2018/19 (mm)	Site Average (2008 – current) (mm)	Long-Term Average Rainfall for Collinsville (mm)
May 2018	2	33	33
Jun 2018	0	23	27
Jul 2018	1	20	20
Aug 2018	0	21	17
Sep 2018	0	10	11
Oct 2018	41	25	22
Nov 2018	10	85	50
Dec 2018	25	109	93
Jan 2019	155	133	135
Feb 2019	62	97	156
Mar 2019	42	95	97
Apr 2019	70 [1]	28	42
Annual Total	406	709	704

Note 1: Obtained from BOM Collinsville Post Office station (33013)

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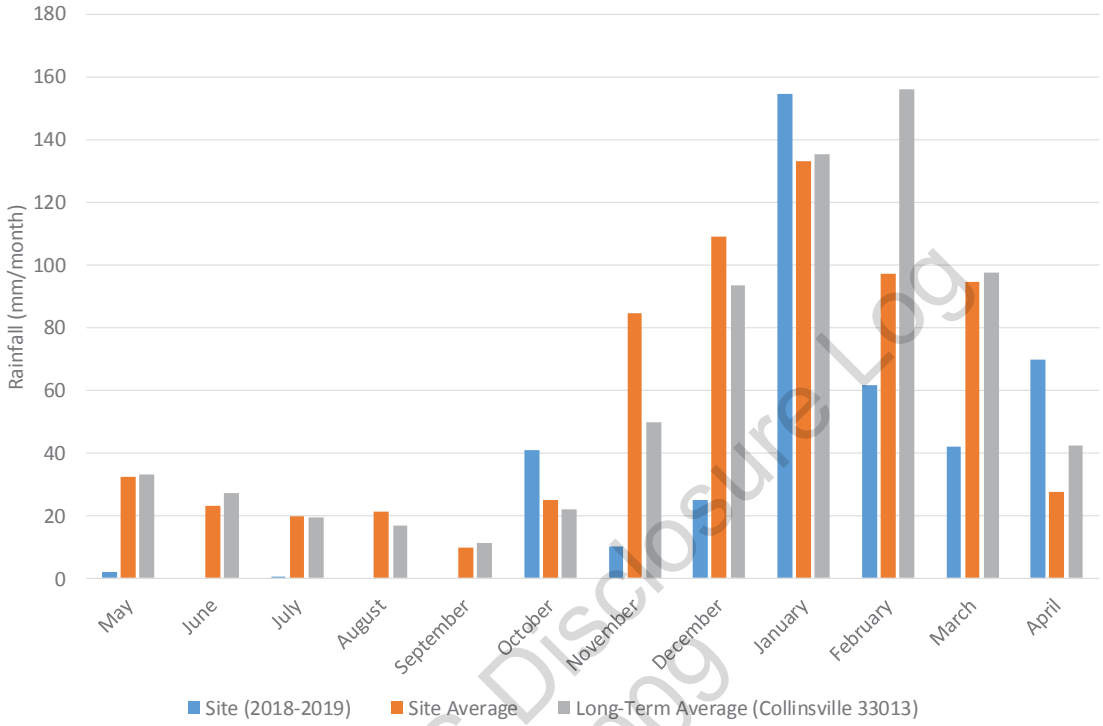

Figure 3.2 Monthly Rainfall Comparison

3.2.2 Daily Rainfall

Daily rainfall recorded at SCM between May 2018 and late March 2019 is summarised in Figure 3.3. The largest daily rainfall totals were recorded on 29th January 2019 (68 mm) and 17th October 2018 (30 mm). The 29th January rainfall followed 28 mm in the two previous days; however, there had been no rainfall for two weeks prior to that. There was negligible rainfall prior to the 17th October rainfall.

There were some minor rainfall totals recorded two weeks prior to the 2019 diversion inspection.

3.2.3 Pluviographic Rainfall

Site pluviographic rainfall data between May 2018 and late March 2019 are compared to design event rainfall totals (2016 revision of Australian Rainfall and Runoff) in Figure 3.4 below. The figure indicates that the rainfalls were generally of low intensity (i.e. rainfalls greater than or equal to these intensities would be expected in most years).

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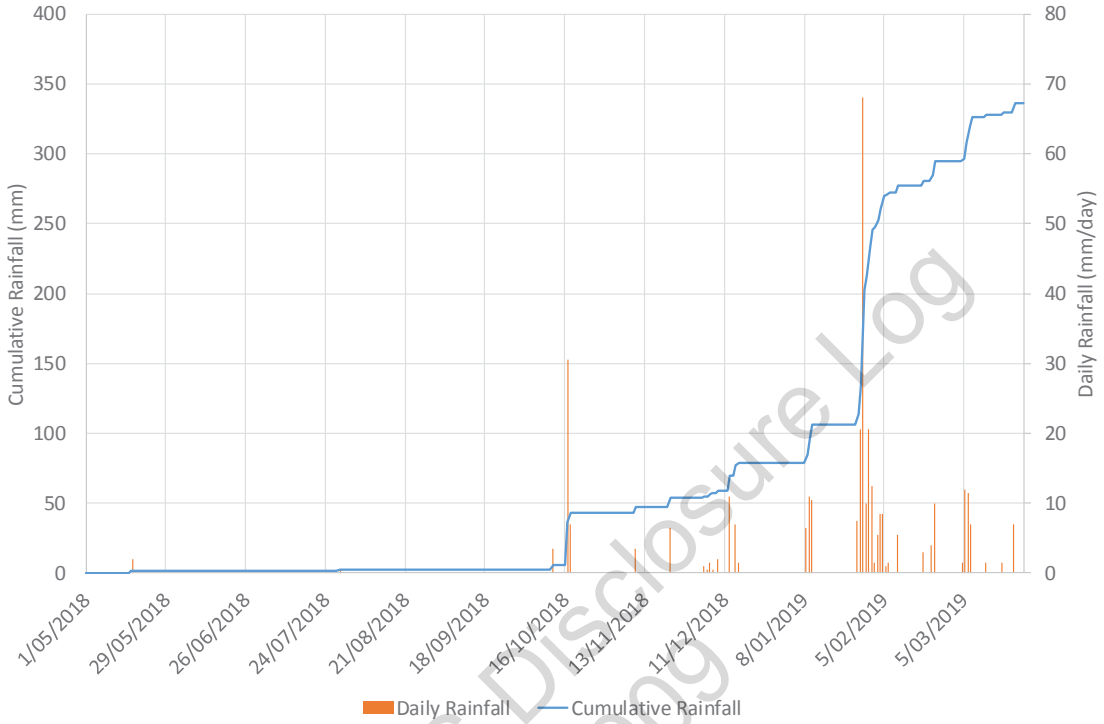

Figure 3.3 2018/19 Recorded Daily Rainfall Data at Sonoma Mine

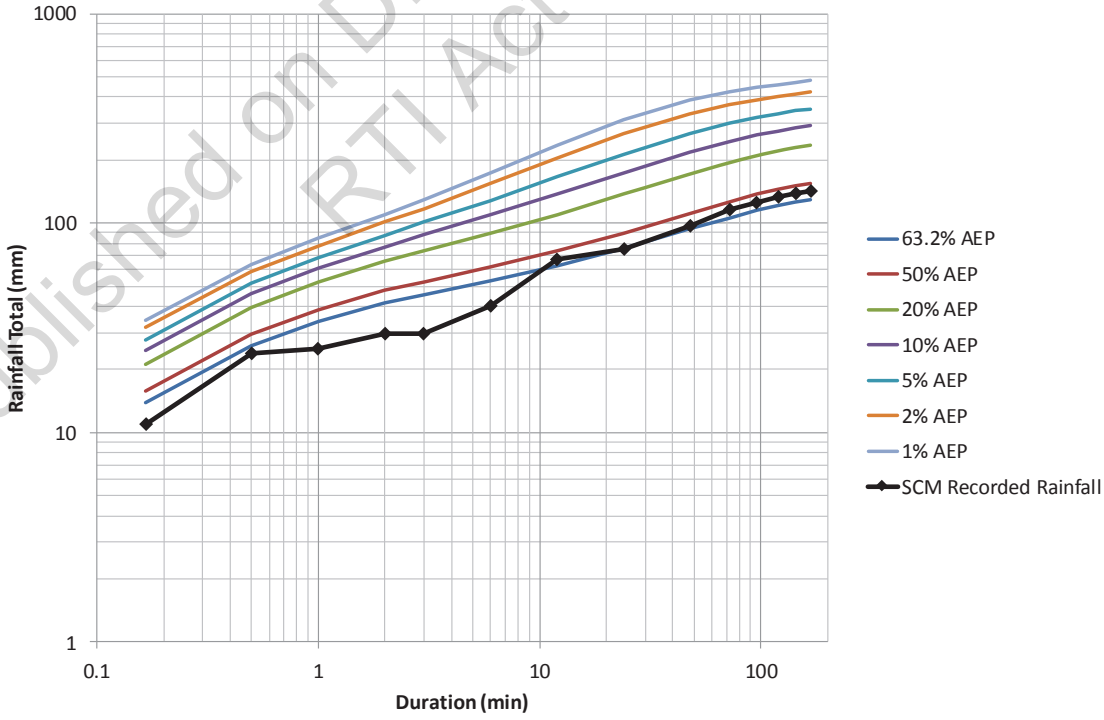

Figure 3.4 Comparison of Recorded and Design Event Rainfall Totals

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3.3 Conclusion

Anecdotal information from site indicates that the diversion did not experience any significant flows during the period of interest. Based on this advice and the review of stream flow monitoring data for Pelican Creek, observed flood levels in the Two Mile Creek Diversion and site rainfall monitoring data, it is evident that any flow event in the Two Mile Creek Diversion during the period of interest would have been of small magnitude (i.e. less flow than a 50% (1:2) AEP event). The recent flows are smaller than the threshold flow that would trigger additional monitoring activities.

In addition, the total rainfall for the period of interest was below the long-term average, which may be expected to result in reduced vegetation establishment and/or regeneration.

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4. PHOTOGRAPHIC RECORD OF CREEK CONDITION

The monitoring inspection was undertaken by sch4p4(6) Person of Engeny and sch4p4(6) Persona of QCoal on 9th of April 2019. Photographs were taken of Two Mile Creek at the monitoring sites to provide a record of the current condition of the creek at these locations. A minimum of 6 photos were taken at each location. Photos taken include:

- Upstream (US) – Looking upstream from the monitoring site.
- Cross Stream (CS) – Looking across to the opposite bank from the monitoring site.
- Downstream (DS) – Looking downstream from the monitoring site.
- Upstream Bed (UB) – Looking upstream from the centre of the creek bed.
- Cross Bed (CB) – Looking from the centre of the creek bed back towards the monitoring site.
- Downstream Bed (DB) – Looking downstream from the centre of the creek bed.

Appendix A shows the 2019 diversion inspection photographic records of the creek alongside the photographic records from the 2018 inspection. The photographic records provide a comparison base for future diversion inspections of Two Mile Creek and a reference point to identify changes in diversion condition.

It was noted during the inspection that some of the physical markers for the monitoring sites installed prior to the 2016 inspection had been washed away during the Tropical Cyclone Debbie flow event and have not been reinstated. As a result, providing a photographic record at consistent locations was dependent upon utilising GPS coordinates and pre-existing landmarks captured in the previous photos (i.e. trees, pipelines, channel meanders, etc.). This was successful except for one monitoring point, which could not be definitively matched to the 2018 photos (TMC-Div3).

It is recommended that physical markers be installed where practical to facilitate the ongoing collection of a photographic record at consistent locations.

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5. CROSS SECTION SURVEY

Cross section surveys have been identified as an important part of the diversion monitoring program to monitor the stability of the diversion reach; however, an aerial survey has not been undertaken since 2014. It is recommended that cross section comparison be undertaken following the next site aerial survey capture.

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6. MONITORING OBSERVATIONS

The Two Mile Creek Diversion monitoring program (refer Table 2.3) does not require an Index of Diversion Condition (IDC) Assessment in Year 6 of operation (i.e. 2019). However, the IDC methodology has been used as a guide for the visual monitoring of the diversion.

IDC is a method described in the ACARP diversion monitoring guidelines (ID&A Pty Ltd, 2001) for recording and monitoring the condition of watercourse diversions and adjacent upstream and downstream reaches. The IDC provides a rapid assessment that is designed to flag potential management issues rather than provide a detailed scientific assessment of the waterway. It is an integrated suite of indicators that measures the geomorphic and riparian condition of a diversion and its upstream and downstream reaches. The indicators for the geomorphic index and riparian index are listed in Table 6.1 below.

Table 6.1 Geomorphic and Riparian Indicators used in IDC Method

Indicators for Geomorphic Index	Indicators for Riparian Index
Width of high flow channel, active channel and low flow channel	Width of riparian zone
Bank condition	Structural intactness
Piping of banks	Regeneration
Bed condition	Longitudinal continuity
Spoil piles	
Recovery	
In-stream structures	

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6.1 Upstream Reach

The waterway upstream of the diversion comprises two primary tributaries (northern and southern). Two monitoring sites were established in each of the upstream tributaries to give an accurate indication of stream condition.

Monitoring points TMC-US1 and TMC-US2 are located on the northern tributary while TMC-US3 and TMC-US4 are located on the southern tributary. The following key observations were made during the monitoring inspection:

- Northern Tributary (TMC-US1 and TMC-US2):

- The northern tributary is characterised by an incised channel with limited flow capacity and poorly defined low flow channel.
- Significant bank erosion and steepening with exposed roots is evident at a number of locations along the waterway, particularly on the outside of bends (Figure 6.1). This is generally consistent with previous inspections and the condition appears to be relatively stable.
- There is increased ground cover along the waterway including in the bed of the channel at some locations (Figure 6.2). This is despite the below average annual rainfall and is likely due to the late season rainfall in the months prior to the inspection.

- Southern Tributary (TMC-US3 and TMC-US4):
  - The southern tributary is generally in a similar condition to the northern reach.
  - As with the Northern Tributary, bank erosion and steepening were evident at a number of locations along the waterway (Figure 6.3 and Figure 6.4). This is generally consistent with previous inspections and the condition appears to be relatively stable.
  - Flood debris and fallen trees remained evident throughout the reach (Figure 6.5) and are attributed to the rainfall and strong winds during previous storm events (e.g. Tropical Cyclone Debbie).
  - Increased ground cover was observed along the waterway including on benches and some of the previous eroded batters (Figure 6.6).
  - Small residual pools were observed in several locations along the Southern Tributary (Figure 6.7).

Figure 6.1 Bank Erosion and Undercutting Downstream Of TMC-US1

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Figure 6.2 Grass Establishment in Channel At TMC-US2

Figure 6.3 Bank Erosion Upstream Of TMC-US4

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Figure 6.4 Bank Erosion Upstream Of TMC-US4

Figure 6.5 Flood Debris Upstream Of TMC-US4

Figure 6.6 Grass Establishment on Bench and Batters At TMC-US4

Figure 6.7 Small residual pool upstream of TMC-US4

6.2 Diversion Reach

The diversion experienced its first flow event since construction during the 2014/15 wet season; however, there were no further flows observed during the 2015/16 wet season. A significant flow occurred as a result of rainfall associated with Tropical Cyclone Debbie in late March 2017. This was the largest flow observed in the diversion since construction and has been estimated to exceed the 5 year ARI design flow (i.e. the flow event would be expected to occur less frequently than once every five years on average). As noted in Section 3.2, it is considered likely that any flow event in the Two Mile Creek Diversion during the period May 2018 to April 2019 would have been smaller than a 50% (1:2) AEP event.

Key observations from the inspection are:

- In general, it is noted that areas of damage observed during the 2019 inspection were also observed during the 2017 and 2018 inspections, indicating that the damage occurred as a result of the Tropical Cyclone Debbie flow event. As discussed in further detail below, these areas have generally remained stable over the previous 12 months.

- The trend towards better vegetation establishment within the diversion has increased. In particular, the good grass cover and increased understorey establishment previously observed upstream of the haul road has extended to downstream sections of the diversion reach (Figure 6.8 and Figure 6.9).

- The haul road crossing includes two banks of culverts: 5 x 1800 mm diameter corrugated metal pipes in the low flow channel and 8 x 1800 mm diameter corrugated metal pipes on the right bank of the high flow channel. During the 2017 inspection some damage to the upstream headwall was observed on the high flow channel culverts, including cracking of the concrete and scouring around the ends of the headwall (Figure 6.10 and Figure 6.11). The condition of this structure has remained stable but should continue to be monitored for signs of further deterioration.

- The Tropical Cyclone Debbie flow event resulted in a number of scour holes on the downstream side of the haul road that were observed during the 2017 inspection. The scour hole on the downstream side of the haul road at the low point on the right bank has not been filled in although it appears to be naturally filling with sediment (Figure 6.12). Large boulders have been placed on the roadside of the scour hole to provide a barrier for vehicles. A second scour hole remained evident at the outlet of the high flow channel culverts as well as undermining of the concrete apron (Figure 6.13). The scour holes appear to have remained stable since the previous inspection. However, management action will be required to ensure the physical integrity of the diversion and prevent the scour holes becoming a source of sediment to the downstream waterway in future streamflow events. It is recommended that one of the following management actions be implemented:

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- **Reinstatement:** Repairing the scour holes by ripping and placing compacted fill and reinstatement of rock protection for the scour hole at the outlet of the high flow channel culverts; or
- **Redesign:** Revisit the design of the haul road crossing scour protection to identify a solution that will perform better in future events. This may include stabilising the scour holes and using them as an energy dissipater until the haul road is decommissioned.

- No significant damage was observed at the outlet of the low flow channel culverts (Figure 6.14). Ground cover vegetation is establishing in this area and is expected to provide ongoing stability to the channel (Figure 6.15).

- As with previous inspections, areas of rilling erosion were observed along the left bank of the high flow channel in the vicinity of Sediment Dam 5 (SD5) (Figure 6.16). Additional areas of gully erosion associated with concentrated flows were observed in the vicinity of SD5 and on the right bank upstream of TMC-Div3. The erosion in these areas was considered to be of similar extent to that observed during the 2017 and 2018 inspections, indicating that these areas have not significantly worsened over the previous year. Recommended management actions to prevent ongoing damage to the diversion include:

  - Construction of dedicated drainage structures (e.g. rock chutes) to convey concentrated inflows to the low flow channel; and
  - Repairing existing rilling and gully erosion by ripping, re-compacting and re-seeding.

- During Tropical Cyclone Debbie, discharge from the SD5 gravity release pipe resulted in localised scouring and movement of the rock protection in the vicinity of the outlet. Additional pipework was subsequently installed, which is understood to transfer water from SD5 to the Return Water Dam for reuse in the CHPP circuit. Since the previous inspection, vegetation has continued to establish around the outlet (Figure 6.17). The SD5 outlet pipe has not been replaced on its pipe supports. Previous inspections determined that damage resulting from discharge of water from SD5 appears to have stabilised and stopped progressing. Recommended management actions to prevent ongoing damage to the diversion include:

  - Monitor future releases from the SD5 pipe outlet to ensure that the damage does not continue to progress.

- A number of erosion gullies were previously observed along the left bank of the high flow channel downstream of TMC-Div2 and SD5 (Figure 6.18 to Figure 6.20). These gullies had near vertical walls up to approximately 2 m high. The gullies appear to have remained stable since the previous inspection and grass has started to establish. A review of aerial survey data from July 2014 indicates the cause is runoff from an undisturbed catchment to the north and east of the Mine Infrastructure Area (MIA) that is draining into the diversion. Due to the lack of a formalised drain and rock chute in this area, it appears that this runoff has resulted in the gully erosion observed during

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the inspection. Recommended management actions to prevent ongoing damage to the diversion include:

- Review the upstream catchment runoff and provide a suitable drain to convey concentrated flows from this catchment to the diversion.
- Repairing existing gully erosion by battering back the steep gully batters, placing compacted fill and re-seeding.

- An area of scour was previously observed along the toe of the batter between the gullies identified above and the light vehicle road crossing (Figure 6.21). Minor erosion in this area appears to have remained stable since the 2018 inspection. Addressing the cause of the gully erosion is expected to prevent on-going progression of this scour.

- The light vehicle road low level crossing downstream of TMC-Div2 was washed away during the Tropical Cyclone Debbie flow event (Figure 6.22) and has not been reinstated. This outcome is expected for this type of crossing. Site personnel have advised that there is no immediate intention to reinstate the light vehicle road crossing.

- The 2017 inspection identified extensive areas of shallow scour on the bed of the high flow channel downstream of TMC-Div3. Establishment of ground cover in this area has continued to increase since the 2018 inspection (Figure 6.23) and will improve resistance to scour in future flow events. It is recommended that future inspections continue to monitor the establishment of ground cover in the downstream section of the diversion.

- The previous inspection observed extensive sediment deposition within the diversion channel as well as in the perimeter drainage system from TMC-Div3 to the end of the diversion. The establishment of ground cover has since increased in these areas (Figure 6.24). The downstream end of the diversion and transition to the downstream reach has very dense ground cover (Figure 6.25). Due to the lack of a defined channel at the transition (i.e. broad, flat floodplain), future deposition of sediment in this area is expected.
  - It is recommended that this section of the diversion continue to be monitored for the establishment of ground cover and to ensure that it does not become a source of sediment for the downstream reach.

- The diversion reach is considered to be in generally good geomorphic condition due to the presence of natural channel features as designed. Minor damage associated primarily with Tropical Cyclone Debbie in March 2017 was observed as described above but is generally consistent with previous inspections.

- The perimeter drainage system designed to manage lateral inflows and limit ponding on the floodplain generally appears to be working as designed. No evidence of ponding on the bank or piping of the low flow channel was observed during the 2019 inspection.

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- The Main Pit overburden dump and Sonoma B Pit overburden dump are greater than 50 m from the diversion high flow channel. The Main Pit overburden dump is showing signs of vegetation establishment, which will ultimately reduce the risk of oversupply of sediment to the diversion. The proximity of spoil piles will need to be monitored as part of the ongoing monitoring program to determine if these will be an ongoing management issue for the diversion.

- The riparian condition of the diversion reach is generally poor due to the lack of diversity of vegetation types and species, with the diversion reach dominated by ground covers (i.e. grasses). However, increased establishment of mid-storey and over-storey vegetation was observed, which is continuing to progress from upper portions to downstream portions of the diversion.

  - This observation is to be expected in the early years of establishment of the diversion (or rehabilitation in general). There continues to be signs of regeneration of trees and shrubs. The establishment of vegetation is inherently dependent upon rainfall.

- The diversity of species is limited; however, the diversity is expected to increase over time as other species return from existing seed stock in the topsoil. Although the diversity is currently limited to predominantly grass species, these plants are providing necessary stability to the topsoil structure during the establishment phase of the diversion.

Figure 6.8 Extensive Groundcover with Increased Understorey and Overstory at TMC-Div1

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Figure 6.9 Extensive Groundcover with Increased Understorey and Overstory Downstream of Haul Road

Figure 6.10 Damaged Headwall of High Level Culverts at Upstream Side of Haul Road

Figure 6.11 Low Flow Culverts at Upstream Side of Haul Road

Figure 6.12 Scour Hole Downstream of Haul Road Causeway

Figure 6.13 Scour Hole and Damaged Apron at Downstream Headwall of High Level Haul Road Culverts

Figure 6.14 Downstream Headwall of Low Level Haul Road Culverts

Figure 6.15 Grass Establishment in Low Flow Channel Downstream of Haul Road

Figure 6.16 Rilling In the Vicinity Of TMC-Div2

Figure 6.17 Vegetation Establishment at Location of Previous Scour at Outlet of SD5 Gravity Discharge Pipe

Figure 6.18 View Along Erosion Gully on Left Bank of Diversion Downstream Of TMC-Div2

Figure 6.19 Upstream Limit of Erosion Gully (View Towards SD5 and MIA)

Figure 6.20 Secondary Smaller Erosion Gully Near Light Vehicle Road Crossing

Figure 6.21 Scour at Toe of Embankment Upstream of Light Vehicle Road Crossing

Figure 6.22 View to North-West Across Light Vehicle Road Causeway Crossing

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Figure 6.23 Vegetation Establishment on Right Bank Downstream Of TMC-Div3

Figure 6.24 Vegetation Establishment in Bed of Channel At TMC-Div4

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Figure 6.25 Dense Ground Cover at Downstream End of Diversion

6.3 Downstream Reach

The downstream reach remains in a very similar state to the upstream reach. The creek consists of an incised channel with high sinuosity that sits within a large flat floodplain that is engaged frequently by stream flows. Immediately downstream of the diversion the floodplain widens with the majority of vegetation located in close proximity to the creek. Key observations from the inspection include:

- Immediately downstream of the diversion, Two Mile Creek is broad and flat with no clearly defined low flow channel and dense groundcover. As noted in previous inspections, sediment deposition appears to have been concentrated in the vicinity of this interface with no significant accretion evident at the downstream monitoring sites. The establishment of dense ground cover in this area was noted in Section 6.2 above (Figure 6.25)

- As with previous inspections, the downstream reach was considered to be in a moderate condition overall, with a clearly defined channel and good geomorphic diversity, with alternating benches, bars developing in relation to bends, and woody debris.

- As with other reaches, the trend towards increased extent of ground cover was observed to have continued since the previous inspection (Figure 6.26).

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- Flood debris was observed in the downstream reach but appeared to be old and is expected to be from the Tropical Cyclone Debbie flow event (Figure 6.27).
- Some pools of ponded water were evident in discreet locations throughout the downstream reach (Figure 6.28 and Figure 6.30).
- As with previous inspections, bank erosion was evident in a number of locations along the downstream reach. The erosion did not appear to have significantly changed since the previous inspection. The erosion becomes more significant in the lower portions of the downstream reach with gully erosion of the floodplain observed on the right bank (Figure 6.29) and significant bank steepening in the vicinity of TMC-DS4 (Figure 6.30). This increase in erosion corresponds to a reduction in riparian vegetation as well as evidence of increased access by livestock.
- A drainage channel has been constructed in the vicinity of Drake 1 Pit and Drake 2 Pit that joins Two Mile Creek along the downstream reach between TMC-DS3 and TMC-DS4. The trapezoidal earth-lined channel appears to have performed well and is in a stable condition.
- There was no observed evidence of the diversion negatively impacting the downstream reach at the time of the inspection.

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Figure 6.26 Dense Ground Cover At TMC-DS1

Figure 6.27 Flood Debris Downstream Of TMC-DS1

Figure 6.28 Ponding At TMC-DS3

Figure 6.29 Gully Erosion on Right Bank Downstream Of TMC-DS3

Figure 6.30 Ponding and Bank Steepening At TMC-DS4

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7. SUMMARY AND RECOMMENDATIONS

A monitoring program has previously been developed for the Two Mile Creek Diversion. The monitoring program has been developed in accordance with the ACARP Guideline *Monitoring and Evaluation Program for Bowen Basin River Diversions* (ID&A, 2001).

Engeny undertook the 2019 monitoring inspection of the Two Mile Creek Diversion on the 9th of April 2019. Based on the stream flow monitoring data for Pelican Creek, observed flood levels in the Two Mile Creek Diversion and site rainfall monitoring data, it is evident that any flow event in the Two Mile Creek Diversion during the period of interest would have been of small magnitude (i.e. less flow than a 50% (1:2) AEP event).

The diversion is generally considered to be in good condition and performing as per the design intent. However, several areas of flood damage remain since the 2017 inspection (caused during Tropical Cyclone Debbie in March 2017), which will require management action to prevent ongoing deterioration of the diversion.

From a geomorphic perspective, the diversion reach is in better condition than the upstream and downstream control reaches. The riparian vegetation condition of the diversion reach is limited due to the lack of diversity in plant type and relatively short establishment period since construction; however, vegetation establishment and diversity appears to be continuing to improve. Existing ground covers are performing the function of providing the stability as other species continue to establish in the future.

Recommended short–term management actions for the Two Mile Creek diversion are summarised below while recommended remedial actions are summarised in Table 7.1.

- Continue to monitor key areas for signs of deterioration, including:
  - The concrete headwall on the upstream side of the high flow channel culverts at the haul road crossing.
  - The downstream side of the haul road crossing on the high flow channel to identify any localised damage following high flow events.
  - The downstream side of the haul road crossing in the low flow channel following flow events to ensure that vegetation is continuing to establish and damage to the diversion does not occur.

- Implement one of the following management actions to ensure the physical integrity of the diversion and prevent the scour holes at the haul road becoming a source of sediment to the downstream waterway:
  - **Reinstatement:** Repairing the scour holes by ripping and placing compacted fill and reinstatement of rock protection for the scour hole at the outlet of the high flow channel culverts; or
  - **Redesign:** Revisit the design of the haul road crossing scour protection to identify a solution that will perform better in future events. This may include stabilising the

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scour holes and using them as an energy dissipater until the haul road is decommissioned.

- Management of the lateral inflows on the left bank adjacent to Sediment Dam 5 to prevent the progression of gully erosion. Recommended management strategies are:
  - Construction of dedicated drainage structures to convey concentrated inflows to the low flow channel; and
  - Repairing existing rilling and gully erosion by ripping, re-compacting and re-seeding.
- Continue to monitor previously identified rilling erosion for signs of deterioration.
- Monitor future releases from the SD5 pipe outlet to ensure that the damage does not continue to progress.
- Stabilise the erosion gullies downstream of SD5 and manage future flows by:
  - Review the upstream catchment runoff and provide a suitable drain to convey concentrated flows from this catchment to the diversion.
  - Repairing existing gully erosion by ripping, re-compacting and re-seeding.
- Monitor the establishment of ground cover in the downstream section of the diversion reach.
- Monitor the areas of sediment deposition between TMC-Div3 and the end of the diversion for establishment of ground cover and to ensure that it does not become a source of sediment for the downstream reach.
- Replace the eight (8) physical markers that have been washed away in order to maintain consistency in the photo reference point for the purpose of ongoing monitoring (TMC-US1, TMC-US2, TMC-US3, TMC-US4, TMC-Div3, TMC-DS1, TMC-DS2 and TMC-DS3).

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Table 7.1 Recommended Remedial Actions

ID	Description	Timeframe
1	Manage lateral inflows on left bank at SD5	Prior to 2019/20 wet season
2	Reinstate eight physical markers for ongoing photographic record	Prior to April 2020 monitoring inspection
3	Implement preferred management action to address scour holes at haul road crossing	Prior to 2019/20 wet season
4	Repair erosion gullies downstream of SD5 and implement a drainage solution for this catchment	Prior to 2019/20 wet season

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8. QUALIFICATIONS

a. In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

b. Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document are as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

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g. This report does not provide legal advice.

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APPENDIX A

Monitoring Site Photos

Two Mile Creek Diversion Inspection (2019 vs 2017 Photographic Record – 2018 location inconsistent)

Monitoring Point: TMC-US1 ***(no survey peg installed – meander provides fixed point)***

	Upstream	Cross stream	Downstream
2019			
2017			

Document Set ID: 4... Version: 1, Version Date: 2...

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Two Mile Creek Diversion Inspection (2019 vs 2017 Photographic Record – 2018 location inconsistent)

Monitoring Point: TMC-US1 ***(no survey peg installed – meander provides fixed point)***

	Upstream from bed	Cross Bed	Downstream from bed
2019			
2017			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-US2 *(no survey peg installed – trees provides fixed point)*

	Upstream	Cross stream	Downstream
2019			
2018			

Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-US2 *(no survey peg installed – trees provides fixed point)*

	Upstream from bed	Cross Bed	Downstream from bed
2019			
2018			

Received DES October 2019

Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-US3 ***(no survey peg installed – pipeline provides fixed point)***

	Upstream	Cross stream	Downstream
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-US3 *(no survey peg installed – pipeline provides fixed point)*

	Upstream from bed	Cross Bed	Downstream from bed
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-US4 ***(no survey peg installed – trees provides fixed point)***

	Upstream	Cross stream	Downstream
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-US4 *(no survey peg installed – trees provides fixed point)*

	Upstream from bed	Cross Bed	Downstream from bed
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-Div1

	Upstream	Cross stream	Downstream
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-Div1

	Upstream from bed	Cross Bed	Downstream from bed
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-Div2

	Upstream	Cross stream	Downstream
2019			
2018			

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EIP Act

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-Div2

	Upstream from bed	Cross Bed	Downstream from bed
2019			
2018			

Pending DEC Approval

Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-Div3 ***(no survey peg installed – 2019 photo location inconsistent)***

	Upstream	Cross stream	Downstream
2019			
2018			

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RTI Act

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-Div3 *(no survey peg installed – 2019 photo location inconsistent)*

	Upstream from bed	Cross Bed	Downstream from bed
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-Div4

	Upstream	Cross stream	Downstream
2019			
2018			

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RTI Act

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-Div4

	Upstream from bed	Cross Bed	Downstream from bed
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-DS1 *(no survey peg installed – windmill provides fixed point)*

	Upstream	Cross stream	Downstream
2019			
2018			

Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-DS1 *(no survey peg installed – windmill provides fixed point)*

	Upstream from bed	Cross Bed	Downstream from bed
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-DS2 ***(no survey peg installed – trees provides fixed point)***

	Upstream	Cross stream	Downstream
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-DS2 *(no survey peg installed – trees provides fixed point)*

	Upstream from bed	Cross Bed	Downstream from bed
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-DS3 ***(no survey peg installed – meander provides fixed point)***

	Upstream	Cross stream	Downstream
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-DS3 *(no survey peg installed – meander provides fixed point)*

	Upstream from bed	Cross Bed	Downstream from bed
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-DS4 *(no survey peg installed – tree provides fixed point)*

	Upstream	Cross stream	Downstream
2019			
2018			

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Two Mile Creek Diversion Inspection (2019 vs 2018 Photographic Record)

Monitoring Point: TMC-DS4 *(no survey peg installed – tree provides fixed point)*

	Upstream from bed	Cross Bed	Downstream from bed
2019			
2018			

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2019 Annual Regulated Structures Inspection Report

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Visual assessments are limited to accessibility and visibility at the time of the site visit. Certain restrictions including but not limited to accessibility, visibility due to vegetative cover, water levels (both inside and outside the dams), weather conditions such as rainfall, timing and once-off nature of visual inspections may prevent all issues from being identified.

A proper assessment of the condition of structures can only be gained over an extended period of data collection and interpretation and regular and more detailed field inspections.

The advice tendered in this report is not warranted with respect to any conditions that either reveal subsequent to this inspection or were not able to be observed during the inspection.

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1. INTRODUCTION

QCoal Sonoma Pty Ltd engaged Engeny Water Management (Engeny) to carry out the 2019 annual inspection of regulated structures at the Sonoma Coal Mine (SCM) which is part of the QCoal Northern Hub mining complex (QNH).

The annual inspection of the regulated structures at SCM was carried out on 17 October 2019 (the inspection) in accordance with the Queensland Government Department of Environment and Science (DES) requirements, as set out in the SCM Environmental Authority (EA) EPML00707713 (dated 3 October 2019).

The requirements of the EA relating to annual inspections of regulated structures at SCM are as follows:

- Condition I20: Each regulated structure must be inspected each calendar year by a suitably qualified and experienced person.
- Condition I21: At each annual inspection, the condition and adequacy of all components of the regulated structure must be assessed and a suitably qualified and experienced person must prepare an annual inspection report containing details of the assessment and include recommended actions to ensure the integrity of the regulated structure. Regulated structures must be assessed:
    - a) against the most recent hazard assessment report and design plan (or system design plan);
    - b) against recommendations contained in previous annual inspections reports;
    - c) against recognised dam safety deficiency indicators;
    - d) for changes in circumstances potentially leading to a change in hazard category;
    - e) for conformance with the conditions of this authority;
    - f) for conformance with the 'as constructed' drawings;
    - g) for the adequacy of the available storage in each regulated dam, based on an actual observation or observations taken after 31 May each year but prior to 1 November of that year, of accumulated sediment, state of the containment barrier and the level of liquids in the dam (or network of linked containment systems); and
    - h) for evidence of conformance with the current operational plan.

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- Condition I22: The suitably qualified and experienced person who prepared the annual inspection report must certify the report in accordance with the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (ESR/2016/1933).

At the time of the inspection the following were the regulated structures located on the SCM:

- Co-Disposal Area (CDA) Cells 1 and 2 (CDA1/2)
- Co-Disposal Area Cells 3 and 4 (CDA3/4)
- North Sonoma Creek Diversion (NSCD) Upstream Plug
- North Sonoma Creek Diversion (NSCD) Downstream Plug

The inspection of regulated structures at SCM was carried out by sch4p4(6) Person (Principal Engineer, RPEQ No. 21211) from Engeny under the supervision of sch4p4(6) Personal (Environmental Officer) from QCoal Pty Ltd (QCoal) and sch4p4(6) Personal inf of Sedgman Limited (Sedgman) on 17 October 2019. Weather conditions were fine on the day of the inspection, with no substantial rainfall occurring for a significant period prior to the inspection.

This report describes the observations and recommendations of the 2019 annual inspection of the SCM regulated structures.

A photographic record of the existing condition of each structure is provided in Appendix A (CDA Cells 1 and 2), Appendix B (CDA Cells 3 and 4), Appendix C (NSCD Upstream Plug) and Appendix D (NSCD Downstream Plug). RPEQ certification of the annual inspection by the inspecting engineer is provided in Appendix E.

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2. CO-DISPOSAL AREA CELLS 1/2

2.1 Description of Structure

Co-Disposal Cells 1 and 2 are collectively referred to as Co-Disposal Area 1/2 (CDA1/2), which was originally designed by Parsons Brinckerhoff (2007) and is operated by Sedgman in conjunction with the coal handling and preparation plant (CHPP). CDA1/2 has generally reached the end of its design storage capacity, with only minor future rejects deposition planned, to facilitate the final surface shaping and closure. At the time of this report, it is understood that QCoal has commenced construction of a ramp from the Drake pits to the top of CDA1/2 to allow final shaping and encapsulation of CDA1/2 with spoil material.

As at the time of the inspection the bulk of the CHPP reject material is deposited in Co-Disposal Cells 3 and 4, which are collectively referred to as Co-Disposal Area 3/4 (CDA3/4), as discussed in Section 3 of this report. As at the time of the inspection the CHPP at the SCM is processing Run-Of-Mine (ROM) coal mined from the SCM and the adjacent QNH mines comprising the Drake Coal Mine (DCM), the Cows Coal Mine (CCM) and the Jax Coal Mine (JCM). The location of the CDA1/2 and CDA3/4 are shown in Figure 2.1.

CDA1/2 comprises external clay starter walls with subsequent higher walls constructed from coarse reject material around the inside of the starter walls and finer reject material contained in the centre, within the external rejects walls. Five lifts of the external rejects walls above the starter bund have been completed.

Rainfall inflows to CDA1/2 can be temporarily stored on top of the rejects surface by inserting weir bars to block off the decant structure. The CDA1/2 decant structure discharges to the eastern solution trench (which flows to the non-regulated Return Water Dam) via three pipes.

The design of CDA1/2 did not require an emergency spillway during the operating phase of the facility, with the decant structure providing relief to water stored in the structure. Coarse reject material has previously been placed along the southern side of CDA1/2 to form an emergency overflow point from the top surface of CDA1/2 into Cell 3. Placing spoil material on CDA1/2 to allow final shaping and capping of CDA1/2 will reduce the storage capacity of CDA1/2. It is recommended that a plan for capping and closure of CDA1/2 is developed. This plan should assess stability impacts of placing spoil material on top of CDA1/2 and identify any drainage impacts on CDA3/4 so that sufficient accommodation can be made for additional freeboard in CDA3/4 if required.

Subsequent to the annual inspection, QCoal has constructed a ramp from the nearby Drake 2 pit to the top of CDA1/2 in readiness to stockpile overburden material on CDA1/2. It is understood that this ramp crosses the western solution trenches and incorporates culverts to facilitate drainage.

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Figure 2.1 Aerial Image of CDA1/2 and CDA3/4 (aerial photo taken June 2019)

2.2 Visual Inspection Observations

CDA1/2 appears to be generally structurally sound and suitable for ongoing use as a regulated structure, given that no further operational reject deposition is planned for the dam. A photographic record of the existing condition of the dam is provided in Appendix A. Key observations made on the current condition and structural integrity of the dam are as follows (refer Figure 2.2 for key observation locations):

1. CDA1/2 has reached the end of its operational life, with only minor future rejects deposition planned to facilitate final surface shaping and closure. No active rejects deposition has occurred in CDA1/2 for approximately 6 months sch4p4(6) Personal inf pers. comm.). At the time of this report, it is understood that QCoal has commenced construction of a ramp from the Drake pits to the top of CDA1/2 to allow final shaping and encapsulation of CDA1/2 with spoil material.
2. The CDA1/2 decant pond was dry as a result of the recent dry weather conditions and cessation of active rejects deposition (Photo 2 in Appendix A).

3. Rainfall falling onto CDA1/2 is directed into the eastern solution trench via a decant inlet structure and pipelines (Photo 3 in Appendix A). Two pipelines were discharging into the CDA1/2 decant inlet structure at the time of the inspection (Photo 17 in Appendix A). These pipelines were transferring water from the Cell 3 Decant Pond as discussed in Section 3. It is understood that prior to finalisation of the annual inspection report, the need for these pump transfer pipelines was resolved and they have now been removed from the CDA1/2 decant inlet structure.
4. The decant structure acts as the primary spillway but it is possible that in very large rainfall events the decant pond may spill over the edge of the perimeter reject wall. Shaping of the coarse reject material along the southern side of CDA1/2 has previously been undertaken to form an emergency overflow point from the top surface of CDA1/2 into Cell 3 (Photo 4 in Appendix A). Placing spoil material on CDA1/2 to allow final shaping and capping of CDA1/2 will reduce the storage capacity of CDA1/2. It is recommended that a plan for capping and closure of CDA1/2 is developed. This plan should define a staged drainage plan for the landform, include a hydrologic assessment and identify any drainage impacts on CDA3/4 so that sufficient accommodation can be made for additional freeboard in CDA3/4 if required.
5. The downstream embankments of the starter walls appeared to be in reasonable condition with moderate grass cover and generally no evidence of erosion of the batters from surface runoff (Photos 8, 9, 12 and 13 in Appendix A).
6. Numerous small to medium sized trees were observed to be growing on the downstream embankments of the starter walls on the northern, eastern and western sides of CDA1/2 (Photos 8, 12, 13 and 16 in Appendix A).
7. Large established trees are growing on the northern starter embankment adjacent to the Return Water Dam (Photo 1 and 5 in Appendix A).
8. Seepage expression through the first lift reject wall (first wall above the top of the starter bund) was observed at numerous locations along the northern and western sides of CDA1/2 (Photos 7, 8 and 10 in Appendix A). There were no visible signs of instability in the rejects wall or starter walls. The most significant seepage flows were observed at the toe of the first lift reject wall near the south-western corner of Cell 2 (Photos 8 and 10 in Appendix A) adjacent to Cell 3. Given the period of time since rejects were deposited in CDA1/2 and the proximity of the Cell 2 seepage flows to Cell 3, it is considered likely that water from Cell 3 may have seeped through the internal wall and into Cell 2 and expressed on the outer wall. The seepage flows along the western side of Cell 2 were expressing up to 1 m above the base of the drain on the inside of the starter bund and appeared to be consistent with what was observed in the 2018 annual inspection, despite the higher decant pond level in Cell 3. Given that the elevation of the Cell 3 water level will continue to increase with ongoing rejects deposition in CDA3/4, the elevated phreatic surface level along the western side of Cell 2 is a potential stability concern. It is recommended that a review of the original stability analyses for the dam be undertaken and additional stability analyses be performed if the current phreatic surface conditions in the dam differs significantly from that assumed in the original stability analyses.
9. Seepage collection pipes through the starter walls were observed to be flowing at the time of the inspection, indicative of continued dewatering of the CDA1/2 material expected after the cessation of active deposition (Photo 11 in Appendix A). The design

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of the co-disposal cells has allowed for seepage collection via these pipes. As such, this flow is expected.

10. A number of the seepage collection pipes on the western side of CDA1/2 discharge at an elevation close to the crest of the starter walls resulting in localised scouring of the downstream embankment slope of the starter walls around the pipes (Photo 11 in Appendix A). This scouring has not significantly changed for a number of years and is not expected to get any worse in the future especially as the rate of flow in these pipes is expected to decrease
11. Generally, drainage inside the starter bund around the three sides of CDA1/2 (between the toe of the first external coarse reject wall and the starter wall) is fair, with seepage flows and ponding observed in numerous places. Ponding is due to either high invert levels of seepage relief pipes, drain grade or blockage by reeds/sedimentation (Photo 7 in Appendix A).
12. Some maintenance clean-out of the western solution trench has occurred downstream of the CDA3/4 decant pipe outlet as a result of the discharge of fine rejects from that pipeline (discussed further in Section 3). These fines were contained in the solution trench and Return Water Dam, with no discharge to the environment. The clean-out has removed the reject material from the solution trench in addition to reed growth over this section (Photo 9 in Appendix A). In addition, the road crossing at the downstream end of the Eastern Solution Trench has been re-graded with the inclusion of safety bunds. The Eastern Solution Trench has also been de-silted in this location (Photo 14 and 15 in Appendix A). The drains generally appeared to be in fair condition with significant growth of tall reeds and some trees in the channel (Photos 13 to 15 in Appendix A). Reed growth in the solution trenches can reduce the flow capacity of the solution trenches during high flow (i.e. rainfall events) but is considered beneficial during periods of normal operation since it promotes the settlement of coal fines within the solution trench for subsequent management.
13. There are two western solution trenches along the south-western side of CDA1/2: an inner trench associated with the original CDA1/2 decant outlet and an outer trench which receives decant and seepage flows from CDA3/4 (Photo 9 in Appendix A). It is noted that the CDA3/4 decant is currently closed as discussed in Section 3.
14. The rock entry chute into the Return Water Dam at the downstream end of the eastern solution trench experienced some damage (movement of rock and erosion of channel banks) during the Cyclone Debbie rainfall event in late March 2017 but is still functional.
15. There are currently no piezometers installed in the CDA 1/2 starter walls or coarse rejects external walls. Piezometers are typically installed to validate the design assumptions regarding water table (phreatic surface) levels and associated landform stability. The need for installation of piezometers in the CDA1/2 external walls should be re-assessed following a review of the original stability analyses given that CDA1/2 has reached the end of its operational life.

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Figure 2.2 Location of Observations for CDA1/2

2.3 Regulatory Compliance

The regulatory requirements for regulated structures at SCM are specified in section I of the EA. Compliance against these requirements is summarised in the following sections.

2.3.1 Dam Documentation

The status of documentation required for the operation of CDA1/2 in accordance with the EA is summarised in Table 2.1. A System Design Plan is not required for CDA1/2 since the dam does not require a Design Storage Allowance (DSA) (refer Section 2.3.4).

Table 2.1 Required Documentation for CDA1/2

Documentation	Status
Design Plan	Documentation exists
As Constructed Drawings	Documentation exists

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Documentation	Status
Operational Plan	Documentation exists
Register of Regulated Dams	Documentation exists

2.3.2 Consequence Category

The consequence category of CDA1/2 was assessed in 2015 (Engeny, 2015a) in accordance with the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures. No changes to the dam configuration, purpose or the nature of the stored contents of the dam has occurred since then to require re-assessment of the consequence category. The consequence category assessment for CDA1/2 is summarised in Table 2.2.

Table 2.2 Summary of Consequence Category Assessment for CDA1/2

Failure Event Scenario	Consequence Category
Failure to contain - seepage	Not applicable[1]
Failure to contain - overtopping	Low
Dam break	Significant
Overall	Significant

Note 1: Consequence category for failure to contain - seepage scenario only required to be assessed for new structures.

2.3.3 Mandatory Reporting Level

Since the consequence category of CDA1/2 has been assessed as Low for the failure to contain – overtopping scenario, the Mandatory Reporting Level (MRL) requirements of the EA (i.e. Conditions I11 to I15) do not apply to this dam in accordance with Condition I11 of the EA.

2.3.4 Design Storage Allowance

Since the consequence category of CDA1/2 has been assessed as Low for the failure to contain – overtopping scenario, the Design Storage Allowance (DSA) requirements of the EA (i.e. Conditions I16 to I19) do not apply to this dam in accordance with Section 2.2.2 of the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures.

For information purposes the water level in the Return Water Dam (into which CDA1/2 decant and seepage reports) was surveyed on 28 October 2019 at 162.982 m AHD. The

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water volume in the dam at the end of October 2019 was approximately 72 ML, which is only 22% of the storage capacity of the dam. The Return Water Dam has a significant storage capacity available prior to the 2019/20 wet season.

2.3.5 Spillway Capacity

Surface runoff and seepage flows from the co-disposal facility are conveyed to the Return Water Dam via the decant inlet structure and pipeline, seepage collection pipes and solution trenches.

The decant inlet structure and pipeline act as the primary spillway for water that accumulates on the top surface of CDA1/2. The available water storage capacity on top of CDA1/2 has been significantly reduced by the final stages of rejects deposition in the facility.

Coarse reject material has previously been placed along the southern side of CDA1/2 to form an emergency overflow point from the top surface of CDA1/2 into Cell 3. Overflows from CDA1/2 into Cell 3 may cause some erosion as a result of the large elevation difference between CDA1/2 and Cell 3; however the intent of directing emergency overflows into CDA3 is to prevent overflows over the external walls of CDA1/2 which could cause a catastrophic failure of the structure

Placing spoil material on CDA1/2 to allow final shaping and capping of CDA1/2 will reduce the storage capacity of CDA1/2. It is recommended that a plan for capping and closure of CDA1/2 is developed. This plan should define a staged drainage plan for the landform, include a hydrologic assessment and identify any drainage impacts on CDA3/4 so that sufficient accommodation can be made for additional freeboard in CDA3/4 if required.

2.3.6 Conformance with Operational Plan

The operation of CDA1/2, CDA3/4 and the associated Return Water Dam, is addressed by an Operational Plan (Sedgman Limited, 2015). It is noted that the Operational Plan covers standard operations of CDA1/2 and as such may require a review given CDA1/2 is at the end of its operational life.

CDA1/2 appears to have been operated in accordance with the Operational Plan (Sedgman Limited, 2015) over the last 12 months since the previous inspection (October 2018). CDA1/2 was operated to prevent overfilling (and therefore any required releases) of the Return Water Dam during the 2018/19 wet season. Water level monitoring data indicates that the Return Water Dam water inventory did not exceed 41% of the storage capacity during the 2018/19 wet season.

The inspecting engineer viewed evidence of Return Water Dam water level and water quality monitoring in accordance with the Operational Plan.

It is recommended that the Operational Plan be updated to identify on-going management requirements for CDA1/2 now that this facility is at the end of its' operational life.

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2.4 Completion Status of 2018 Annual Inspection Recommendations

The status of the recommendations from the 2018 Annual Inspection Report (Engeny, 2018) are summarised in Table 2.3.

Table 2.3 Status of 2018 Annual Inspection Recommendations for CDA1/2

Recommendation	Status
The growth of trees on the starter walls poses a risk of dam failure and should be prevented by removing them while still small. Once trees become large and established they will continue to pose a risk, but their removal may then cause greater damage to the dam embankment. Existing trees that have exceeded either 2 m in height or with a trunk diameter greater than 100 mm should be left insitu but monitored for signs of distress.	Ongoing This recommendation has been carried forward to the 2019 annual inspection recommendations.
Clean out the reed growth in the eastern and western solution trenches where there are concerns that the blockage caused by the reeds could compromise the hydraulic capacity of the drainage system.	Partially Complete – desilting of western solution trench. This recommendation has been carried forward to the 2019 annual inspection recommendations.
Desilt culverts on eastern solution trench where the access road crosses the trench adjacent to the Return Water Dam.	Complete
Review the original stability analyses for the dam and perform additional stability analyses if the current phreatic surface conditions in the dam (i.e. significant seepage expression above the starter bund on the western wall of Cell 2) differs significantly from that assumed in the original stability analyses	Ongoing This recommendation has been carried forward to the 2019 annual inspection recommendations.
Undertake a hydrologic assessment to identify the likelihood of overflows from the top surface of CDA1/2 into Cell 3	Ongoing This recommendation has been carried forward to the 2019 annual inspection recommendations.
Update the Operational Plan to identify on-going management requirements for CDA1/2 now that this facility is at the end of its' operational life	Ongoing This recommendation has been carried forward to the 2019 annual inspection recommendations.
Develop a decommissioning strategy for CDA1/2 now that this facility is at the end of its' operational life	Ongoing This recommendation has been carried forward to the 2019 annual inspection recommendations.

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2.5 2019 Annual Inspection Recommendations

Recommendations from the 2019 annual inspection of CDA1/2 are provided in Table 2.4 below.

Table 2.4 Recommendations from the 2019 Annual Inspection of CDA1/2

Recommendation	Category of Recommendation	Suggested Implementation Timeframe
The growth of trees on the starter walls poses a risk of dam failure and should be prevented by removing them while still small. Once trees become large and established they will continue to pose a risk, but their removal may then cause greater damage to the dam embankment. Existing trees that have exceeded either 2 m in height or with a trunk diameter greater than 100 mm should be left insitu but monitored for signs of distress.	Dam safety improvement / Improved maintenance	Ongoing
Clean out the reed growth in the eastern and western solution trenches where there are concerns that the blockage caused by the reeds could compromise the hydraulic capacity of the drainage system.	Improved water management	Prior to 1 November 2020
Develop a plan for capping and closure of CDA1/2 including consideration of CDA3.4. As a minimum, this plan should include the following: • define a staged drainage plan for the combined CDA landform (i.e. CDA1/2 and CDA3/4) and undertake a hydrologic assessment to identify any hydrologic impacts on freeboard requirements for CDA3/4 • review and update the stability analyses for the dam including proposed stockpiling of capping material and the proposed final landform • review the operability of the solution trenches during capping and closure • develop a plan for decommissioning including a strategy for removal of the structure from the register of regulated structures	Dam safety improvement	As soon as possible
Update the Operational Plan to identify on-going management requirements for CDA1/2 now that this facility is at the end of its' operational life	Improved water management	As soon as possible

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3. CO-DISPOSAL AREA CELLS 3/4

3.1 Description of Structure

Co-Disposal Cells 3 and 4 are collectively referred to as Co-Disposal Area 3/4 (CDA3/4) and were designed by Golder Associates (2010). CDA3/4 is operated by Sedgman in conjunction with the CHPP. Rejects disposal into Cell 3 commenced in 2014, while rejects disposal into Cell 4 commenced in 2015. The location of the CDA1/2 and CDA3/4 are shown in Figure 3.1.

CDA3/4 comprises external earth starter walls with subsequent higher walls constructed from coarse rejects material around the inside of the starter walls and finer reject material contained in the centre of the dam within the external rejects walls. Four lifts of the external rejects walls above the starter bund have been completed around the perimeter of CDA3/4, with the fifth rejects wall lift in progress in several locations.

CDA 3/4 has a decant structure located centrally along the northern embankment of Cell 3. The decant structure comprises three inlet pipes which combine to discharge decant flows to the western solution trench (which flows to the Return Water Dam) at the north-western corner of Cell 3 via a single steel pipe.

Rainfall inflows to CDA 3/4 can be temporarily stored on top of the rejects surface within CDA 3/4 by inserting weir bars to block off the decant structure. The CDA3/4 design did not require an emergency spillway, with the decant structure providing relief to water stored in the structure.

Rejects from the CHPP are currently being deposited in CDA3/4; however, the storage is approaching the limit of its design rejects storage capacity. QCoal are currently working to develop an in-pit Co-Disposal in the non-operational Sonoma Main Pit. It is understood that this in-pit CDA will be available in the first half of 2020 and that CDA3/4 will generally have reached the end of its design storage capacity by mid-2020, with only minor further rejects deposition beyond that date, to facilitate the final surface shaping and closure.

Subsequent to the annual inspection, QCoal has constructed a ramp from the nearby Drake 2 pit to the top of CDA1/2 in readiness to stockpile overburden material on CDA1/2. It is understood that this ramp crosses the western solution trenches and incorporates culverts to facilitate drainage.

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Figure 3.1 Aerial image of CDA1/2 and CDA3/4 (aerial photo taken June 2019)

3.2 Visual Inspection Observations

The starter embankment and progressive rejects embankments constructed to date appear to be structurally sound and suitable for ongoing use as a regulated structure. A photographic record of the existing condition of the dam is provided in Appendix B. Key observations made on the current condition and structural integrity of the dam are as follows (refer Figure 3.2 for key observation locations):

1. Four lifts of the external rejects walls above the starter bund have been completed around the perimeter of CDA3/4, with the fifth rejects wall lift in progress in several locations.
2. Cells 3 and 4 act as a single co-disposal facility (CDA3/4), with the dividing embankment now completely submerged (Photo 2 in Appendix B).
3. The decant pond at the time of the inspection covered the majority of Cell 3 and Cell 4. Aerial imagery from June 2019 indicates more elevated beaching of fine rejects and less decant water ponded at the southern end of Cell 4 at that time (Photo 1 and 2 in

Appendix B). There is generally a significant freeboard (approximately 2 m) between the decant pond level and the top of the fourth lift of the external rejects wall (Photo 2 and 7 in Appendix B).

4. The water level in the northern parts of CDA3/4 is directly against the external coarse reject wall, which is not considered good operating practice and is not consistent with the operating conditions assumed for the stability analyses in the original design of the dam (Golder Associates, 2010). This is likely to affect stability of the CDA3/4 external walls and is also likely to compound the seepage flows through the internal wall into Cell 2 (expressing at the Cell 2 external wall). It is recommended that action be taken to reduce the area of the decant pond within Cell 3 so that water does not pond against the external rejects walls. It is also recommended that a review of the original stability analyses for the dam be undertaken and additional stability analyses be performed for the current decant pond configuration.
5. The decant structure (Photo 3 and 4 in Appendix B) is surrounded by an internal rejects wall which acts to filter out the fines from the decant water (decant water passes through the rejects walls). A lower weir in the decant walls surrounding the decant structure allows larger rainfall inflows to CDA3/4 to pass through to the decant structure at a faster rate (Photo 3 in Appendix B).
6. CDA3/4 does not have any external spillway structure, as the original spillway on the starter wall has been filled over. The flow relief from water stored in the dam is through the central decant structure and through external seepage relief pipes surrounding the starter embankment.
7. QCoal and Sedgman personnel reported that during the 2019 dry season, the decant inlet structure had sheared off from the decant outlet pipeline at the base of CDA3/4. It is understood that water was still able to flow through the decant inlet structure and discharge via the decant outlet pipe into the Western Solution Trench; however, it is reported that this flow had previously mobilised fine rejects into the Western Solution Trench and Return Water Dam. In order to prevent mobilisation of fine rejects, at the time of the inspection a gate valve had been installed on the decant pipe outlet, which was closed with the decant pond level above the weir bars on the decant inlet structure (Photo 4 in Appendix B). Two trailer mounted pumps were in place at the Cell 3 Decant Pond with the discharge lines directed into the CDA1/2 Decant Inlet Structure (Photo 4 and 5 in Appendix B). One of these pumps was in operation at the time of the inspection and was reported to be sufficient to keep up with process inflows. The second pump was available for redundancy and for increased discharge during wet weather events. It is understood that prior to finalisation of the annual inspection report, the decant inlet structure has been rectified with its full use reinstated. Operation of the decant is reported to be functioning normally with clean water decanting into the Western Solution Trench and no apparent reduction in hydraulic capacity of the decant structure (i.e. no blockage or reduced flow). Rectification works involved:
    a. draining the inner decant pond formed by the rejects filter wall around the Cell 3 decant inlet structure
    b. excavating reject material from around the decant inlet structure
    c. sinking a geotextile sheet around the decant inlet structure and back filling around it with coarse rejects

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8. The starter walls of Cells 3 and 4 appeared to be in reasonable condition with moderate grass cover and generally no evidence of erosion on the downstream batters (Photos 11, ,12, 14, 17 and 18 in Appendix B).
9. A number of trees of varying sizes were observed to be growing on the downstream embankments of the starter walls around Cells 3 and 4 (Photos 11, 12 and 17 in Appendix B).
10. Seepage collection pipes through the starter walls were observed to be flowing (Photo 14 in Appendix B). The design of the co-disposal cells has allowed for seepage through the external coarse rejects walls to be collected via these pipes. As such, this flow is expected.
11. The seepage collection pipes typically discharge through the top section of the starter walls resulting in some localised scouring of the downstream embankment slope of the starter walls around the pipes (Photo 14 in Appendix B). This scouring is not expected to pose a risk to the structural integrity of the starter walls.
12. Generally drainage inside the starter bund is fair, with seepage flows and ponding observed around the majority of the perimeter of Cells 3 and 4. Ponding is due to either high invert levels of seepage relief pipes, poor drain grade or blockage by reeds/ sedimentation. (Photos 10, 13, 15, 16 and 19 in Appendix B). Seepage expression through the base of the first rejects wall above the starter bund was observed to be consistent with that observed in the 2018 annual inspection (Engeny, 2017a).
13. The solution trenches around Cell 3 are only required to convey the flows from the seepage collection pipes through the starter walls (the CDA3/4 decant pipes discharge into the upstream end of the CDA1/2 western solution trench). The solution trenches appeared to be in reasonable condition, however some reed and tree growth has established in the solution trenches (Photos 11, 17, 18, 20 and 21 in Appendix B).
14. The solution trench along the western side of Cell 3 is shallow and narrow, with an adequate capacity and freeboard under dry weather operational flows (Photo 11 and 14 in Appendix B). The flow capacity of this section of the western solution trench has been reduced by the installation of an access road crossing of the solution trench (Photo 12 in Appendix B). It is considered likely that the solution trench will overflow during significant rainfall events; however, any overflows from the solution trench will drain into the sedimentation dams to the west of Cell 3 (Borrow Pit 1 and 2 dams) where it is contained.
15. A clean water drain is located on the outer side of the solution trench along the north-eastern side of Cell 3. The main access road into the co-disposal area crosses both the eastern solution trench and the clean water drain near the junction of Cells 1 and 3 (Photo 20 and 21 in Appendix B). A water pipeline is partially blocking the entrance to the culvert on the clean water drain. The clean water drain overflowed the road crossing and spilled into the eastern solution trench during the Tropical Cyclone Debbie rainfall event in March 2017, which flows to the Return Water Dam. As such the containment of increased flow in the eastern solution trench resulting from the clean water drain overflow during extreme rainfall events (such as Tropical Cyclone Debbie) has been proven.
16. There are currently no piezometers installed in the CDA 3/4. It is considered best practise to install piezometers in the co-disposal landform to allow validation of design

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assumptions regarding water table (phreatic surface) levels and associated landform stability as per the original design report (Golder Associates, 2010).

Figure 3.2 Location of Observations for CDA3/4

3.3 Regulatory Compliance

The regulatory requirements for regulated structures at SCM are specified in section I of the EA. Compliance against these requirements is summarised in the following sections.

3.3.1 Dam Documentation

The status of documentation required for the operation of CDA3/4 in accordance with the EA is summarised in Table 3.1. A System Design Plan is not required for CDA3/4 since the dam does not require a Design Storage Allowance (DSA) (refer Section 3.3.4).

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Table 3.1 Required Documentation for CDA3/4

Documentation	Status
Design Plan	Documentation exists
As Constructed Drawings	Documentation exists
Operational Plan	Documentation exists
Register of Regulated Dams	Documentation exists

3.3.2 Consequence Category

The consequence category of CDA3/4 has been assessed (Engeny, 2015a and 2015b) in accordance with the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures. No changes to the dam configuration, purpose or the nature of the stored contents of the dam has occurred since then to require re-assessment of the consequence category. The consequence category assessment for CDA3/4 is summarised in Table 3.2.

Table 3.2 Summary of Consequence Category Assessment for CDA3/4

Failure Event Scenario	Consequence Category
Failure to contain - seepage	Not applicable[1]
Failure to contain - overtopping	Low
Dam break	Significant
Overall	Significant

Note 1: Consequence category for failure to contain - seepage scenario only required to be assessed for new structures.

3.3.3 Mandatory Reporting Level

Since the consequence category of CDA3/4 has been assessed as Low for the failure to contain – overtopping scenario, the Mandatory Reporting Level (MRL) requirements of the EA (i.e. Conditions I11 to I15) do not apply to this dam in accordance with Condition I11 of the EA.

3.3.4 Design Storage Allowance

Since the consequence category of CDA3/4 has been assessed as Low for the failure to contain – overtopping scenario, the Design Storage Allowance (DSA) requirements of the EA (i.e. Conditions I16 to I19) do not apply to this dam in accordance with Section 2.2.2 of

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the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures.

For information purposes the water level in the Return Water Dam (into which CDA3/4 decant and seepage reports) was surveyed on 28 October 2019. The water volume in the dam at the end of October 2019 was approximately 72 ML, which is only 22% of the storage capacity of the dam. The Return Water Dam has a significant storage capacity available prior to the 2019/20 wet season.

3.3.5 Spillway Capacity

CDA3/4 does not have an external spillway. Flows are conveyed to the Return Water Dam via the decant inlet structure and pipeline, seepage collection pipes and solution trenches.

The decant inlet structure and pipeline act as the primary spillway for water that accumulates within CDA3/4. At the time of the inspection there was a significant freeboard (approximately 2 m) between the decant pond level and the top of the fourth lift of the external rejects wall crest (Photo 2 and 7 in Appendix B). The potential for overflows from the top surface of CDA1/2 into CDA3/4 may also increase the volume of water that needs to be discharged from CDA3/4 in a large rainfall event.

A hydrologic assessment of CDA3/4 would identify the minimum operating freeboard within CDA3/4 to provide adequate storm event containment and discharge capacity, taking into account the potential overflows from the top surface of CDA1/2 into CDA3/4.

3.3.6 Conformance with Operational Plan

The operation of CDA1/2, CDA3/4 and the associated Return Water Dam, is addressed by an Operational Plan (Sedgman Limited, 2015).

CDA3/4 appears to have been operated in accordance with the Operational Plan (Sedgman Limited, 2015) over the last 12 months since the previous inspection (October 2018). CDA3/4 was operated to prevent overfilling (and therefore any requires releases) of the Return Water Dam during the 2018/19 wet season. Water level monitoring data indicates that the Return Water Dam water inventory did not exceed 41% of the storage capacity during the 2018/19 wet season.

The inspecting engineer viewed evidence of Return Water Dam level and water quality monitoring in accordance with the Operational Plan.

3.4 Completion Status of 2018 Annual Inspection Recommendations

The status of the recommendations from the 2018 Annual Inspection Report (Engeny, 2017a) are summarised in Table 3.3.

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Table 3.3 Status of 2018 Annual Inspection Recommendations for CDA3/4

Recommendation	Status
The growth of trees on the starter walls poses a risk of dam failure and should be prevented by removing them while still small. Once trees become large and established they will continue to pose a risk, but their removal may then cause greater damage to the dam embankment. Existing trees that have exceeded either 2m in height or with a trunk diameter greater than 100mm should be left insitu but monitored for signs of distress.	Ongoing This recommendation has been carried forward to the 2019 annual inspection recommendations.
Clean out the reed growth in the eastern and western solution trenches where there are concerns that the blockage caused by the reeds could compromise the containment capacity of the drainage system.	Ongoing This recommendation has been carried forward to the 2019 annual inspection recommendations.
Investigate options to improve the flow capacity of the western solution trench around Cell 3 (in particular around the pipe culvert/crossing) to ensure that the drainage system provides sufficient containment capacity during large rainfall events.	Ongoing This recommendation has been carried forward to the 2019 annual inspection recommendations.
Take action to reduce the extent of standing water within Cell 3 and Cell 4 so that water does not pond against the external rejects walls.	Ongoing This recommendation has been carried forward to the 2019 annual inspection recommendations.
Review the original stability analyses for the dam and perform additional stability analyses for the current decant pond configuration.	Ongoing This recommendation has been carried forward to the 2019 annual inspection recommendations.
Undertake a hydrologic assessment to identify the minimum operating freeboard within CDA3/4 to provide adequate storm event containment and discharge capacity, taking into account the potential overflows from the top surface of CDA1/2 into CDA3/4.	Ongoing This recommendation has been carried forward to the 2019 annual inspection recommendations.
Update the Operational Plan in accordance with the hydrologic assessment (above) to identify the minimum operating freeboard required within CDA3/4 to provide adequate storm event containment and discharge capacity.	Ongoing This recommendation has been carried forward to the 2019 annual inspection recommendations.
Develop a plan for installation of piezometers in CDA3/4 as part of the on-going development of the co-disposal facility. This plan should identify piezometer trigger levels, based on stability analysis, and associated action plans.	Ongoing This recommendation has been carried forward to the 2019 annual inspection recommendations.

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3.5 2019 Annual Inspection Recommendations

Recommendations from the 2019 annual inspection of CDA3/4 are provided in Table 3.4.

Table 3.4 Recommendations from the 2019 Annual Inspection of CDA3/4

Recommendation	Category of Recommendation	Suggested Implementation Timeframe
The growth of trees on the starter walls poses a risk of dam failure and should be prevented by removing them while still small. Once trees become large and established they will continue to pose a risk, but their removal may then cause greater damage to the dam embankment. Existing trees that have exceeded either 2m in height or with a trunk diameter greater than 100mm should be left insitu but monitored for signs of distress.	Dam safety improvement/ Improved maintenance	Ongoing
Clean out the reed growth in the eastern and western solution trenches where there are concerns that the blockage caused by the reeds could compromise the containment capacity of the drainage system.	Improved water management	Prior to 1 November 2020
Take action to reduce the extent of standing water within Cell 3 and Cell 4 so that water does not pond against the external rejects walls.	Dam safety improvement/ Improved water management	As soon as possible
Develop a plan for capping and closure of CDA3/4 and to manage impacts associated with capping activities on CDA1/2. This plan should include the following: • define a staged drainage plan for the combined CDA landform (i.e. CDA1/2 and CDA3/4) and undertake a hydrologic assessment to identify the minimum operating freeboard to provide adequate storm event containment and discharge capacity • review and update the stability analyses for the dam including the current decant pond configuration and the proposed final landform • review the operability of the solution trenches during capping and closure including the impact of the recently constructed CDA1/2 ramp • develop a decommissioning strategy	Dam safety improvement	As soon as possible
Update the Operational Plan in accordance with the hydrologic assessment (above) to identify the minimum operating freeboard	Dam safety improvement/	As soon as possible

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Recommendation	Category of Recommendation	Suggested Implementation Timeframe
required within CDA3/4 to provide adequate storm event containment and discharge capacity.	Improved water management	
Develop a plan for installation of piezometers as part of the on-going development of the co-disposal facility. This plan should identify piezometer trigger levels, based on stability analysis, and associated action plans.	Dam safety improvement	Prior to 1 July 2020

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4. NSCD UPSTREAM PLUG

4.1 Description of Structure

The detailed design of the North Sonoma Creek Diversion (NSCD) was undertaken by Engeny in the first half of 2018 (Engeny, 2018c). Construction of the NSCD occurred in the second half of 2018 during the 2018 dry season (Engeny 2018b). The NSCD incorporates two plugs across the original creek alignment at the upstream and downstream end of the diversion. The plugs act as flood protection levees for the North Pit and direct creek flows into the diversion. The locations of the NSCD Upstream Plug and NSCD Downstream Plug are shown in Figure 4.1.

Figure 4.1 Aerial image of NSCD including Upstream and Downstream Plugs (aerial photo taken June 2019)

4.2 Visual Inspection Observations

The NSCD Upstream Plug appears to be structurally sound and suitable for ongoing use as a regulated structure. A photographic record of the existing condition of the plug is provided in Appendix A. Key observations made on the current condition and structural integrity of the plug are as follows:

1. No changes have been made to the NSCD Upstream Plug since construction was completed.
2. There was no water flowing through or ponded in the NSCD adjacent to the Upstream Plug at the time of the inspection (Photo 3, 8 and 9 in Appendix C).
3. The plug has only experienced relatively small rainfall events since construction was completed.
4. The NSCD Upstream Plug crest was in good condition at the time of the inspection (Photo 2 and 3 in Appendix C). Vehicle access is available along the crest and no safety bunds have been constructed due to the flat slope of the upstream embankment batter.
5. The downstream batter of the plug has been dumped out by the North Pit spoil dump, which is acting to buttress the plug and provide additional flood protection to North Pit (i.e. the dump crest levels are above the crest of the plug) (Photo 1 to 4 in Appendix C). A shallow drain has been formed between the downstream batter of the NSCD Upstream Plug and the batter of the North Pit Dump with flow directed along the plug to a settling area located at the south-eastern end of the plug (Photo 2 and 4 in Appendix C). This settling area is acting as a form of sediment control for the unrehabilitated dump batter. There was no water ponding in the settling area at the time of the inspection. It is noted that the NSCD Upstream Plug was not designed with the intention to act as a drain for runoff from the dump or to act as a water retaining embankment. Furthermore, in a large rainfall event, this settling area could fill and spill into the NSCD over the Upstream Plug. It is recommended that QCoal review the Sonoma North Pit spoil dump design and operations along the southern bank of the NSCD in consideration of drainage and develop a plan to convey runoff to designated water management structures or into the NSCD via a designated flow path.
6. The upstream batter of the NSCD Upstream Plug is entirely rock lined to provide scour protection for flows in Coral Creek (Photo 3, 6, 7 and 8 in Appendix C). The dumped rock is in good condition and in accordance with the Design Plan (Engeny, 2018c). Grasses are beginning to establish within the extent of the dumped rock and will provide further stabilisation to the plug. The transition between the dumped rock and vegetated batters of the NSCD are in good condition (Photo 9 in Appendix C).
7. The invert of the NSCD is rock lined adjacent to the Upstream Plug and there is limited establishment of grass vegetation within the channel. It is understood that the NSCD has only experienced relatively minor flows since construction was completed.

4.3 Regulatory Compliance

The regulatory requirements for regulated structures at SCM are specified in section I of the EA. Compliance against these requirements is summarised in the following sections.

4.3.1 Levee Documentation

The status of documentation required for the operation of NSCD Upstream Plug in accordance with the EA is summarised in Table 4.1. A System Design Plan is not required for NSCD Upstream Plug since the levee does not require a Design Storage Allowance (DSA) (refer Section 4.3.4).

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Table 4.1 Required Documentation for NSCD Upstream Plug

Documentation	Status
Design Plan	Documentation exists (Engeny 2018c)
As Constructed Drawings	Documentation exists (Engeny 2018b)
Operational Plan	Documentation exists (Engeny 2018d) [1]
Register of Regulated Dams	Documentation exists

Note 1: The annual review and update of the Water Management Plan is currently in progress and will incorporate the operational plan for levee structures (as described in Section 4.3.7).

4.3.2 Consequence Category

The consequence category of NSCD Upstream Plug was assessed as part of the Design Plan (Engeny, 2018c) in accordance with the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures. No changes to the levee configuration, purpose or the nature of the stored contents of the structure has occurred since then to require re-assessment of the consequence category. The consequence category assessment for NSCD Upstream Plug is summarised in Table 4.2.

Table 4.2 Summary of Consequence Category Assessment for NSCD Upstream Plug

Failure Event Scenario	Consequence Category
Failure to contain - seepage	Low
Failure to contain - overtopping	Low
Dam break	Significant
Overall	Significant

4.3.3 Mandatory Reporting Level

Mandatory Reporting Level requirements do not apply for levee structures.

4.3.4 Design Storage Allowance

Design Storage Allowance requirements do not apply for levee structures.

4.3.5 Spillway Capacity

Spillway capacity requirements do not apply for levee structures.

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4.3.6 Design Flood Level for Levee Embankment Crest

Table 7 of the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (DEHP, 2016) requires that levees determined to be regulated structures must be designed with an embankment crest level above the 1:1,000 Annual Exceedance Probability (AEP) design flood level. The levee embankment crest was designed to be 0.5 m higher than the 1:1,000 AEP design flood level (Engeny, 2018c). The levee complies with the hydraulic performance requirements for regulated levee structures.

4.3.7 Conformance with Operational Plan

The annual review and update of the Water Management Plan is currently in progress and will incorporate the Operational Plan for levee structures including the NSCD Upstream Plug (Engeny 2018d). Since the levee does not require any specific operational actions, the Operational Plan focuses on maintenance and inspection/monitoring requirements and planning for emergency events. The Operational Plan meets the requirements of Condition I10 of the EA for a levee structure.

4.4 Completion Status of 2018 Annual Inspection Recommendations

The 2019 annual inspection of the NSCD Upstream Plug is the first annual inspection since the construction of the levee was completed in 2018. No previous annual inspections have been performed for the levee.

4.5 2019 Annual Inspection Recommendations

Recommendations from the 2019 annual inspection of NSCD Upstream Plug are provided in Table 4.3 below.

Table 4.3 Recommendations from the 2019 Annual Inspection of NSCD Upstream Plug

Recommendation	Category of Recommendation	Suggested Implementation Timeframe
Review the Sonoma North Pit spoil dump design and operations along the southern bank of the NSCD in consideration of drainage and develop a plan to convey runoff to designated water management structures or into the NSCD via a designated flow path.	Improved maintenance / Improved water management	Prior to 1 November 2020

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5. NSCD DOWNSTREAM PLUG

5.1 Description of Structure

The detailed design of the North Sonoma Creek Diversion (NSCD was undertaken by Engeny in the first half of 2018 (Engeny, 2018c). Construction of the NSCD occurred in the second half of 2018 during the 2018 dry season (Engeny 2018b). The NSCD incorporates two plugs across the original creek alignment at the upstream and downstream end of the diversion. The plugs act as flood protection levees for the North Pit and direct creek flows into the diversion. The locations of the NSCD Upstream Plug and NSCD Downstream Plug are shown in Figure 5.1.

Figure 5.1 Aerial image of NSCD including Upstream and Downstream Plugs (aerial photo taken June 2019)

5.2 Visual Inspection Observations

The NSCD Downstream Plug appears to be structurally sound and suitable for ongoing use as a regulated structure. A photographic record of the existing condition of the plug is provided in Appendix A. Key observations made on the current condition and structural integrity of the plug are as follows:

1. No changes have been made to the NSCD Downstream Plug since construction was completed.
2. There was no water flowing through or ponded in the NSCD adjacent to the Downstream Plug at the time of the inspection (Photo 3 and 7 in Appendix D).
3. The plug has only experienced relatively small rainfall events since construction was completed.
4. The NSCD Downstream Plug crest was in good condition at the time of the inspection (Photo 7 and 9 to 12 in Appendix C). Vehicle access is available along the crest and no safety bunds have been constructed due to the flat slope of the upstream embankment batter.
5. The downstream batter of the plug has been dumped out by the North Pit spoil dump, which is acting to buttress the plug and provide additional flood protection to North Pit (i.e. the dump crest levels are above the crest of the plug) (Photo 1 to 4, 7 and 9 to 12 in Appendix C). A shallow drain has been formed between the downstream batter of the NSCD Downstream Plug and the batter of the North Pit Dump with flow directed along the plug to the southern end of the plug (Photo 8 to 12 in Appendix C). At the southern end of the plug, the dump batter directs this flow onto the access road with no formal drainage path defined. There was no water evident in the drain at the time of the inspection. It is noted that the NSCD Downstream Plug was not designed with the intention to act as a drain for runoff from the dump. It is recommended that QCoal review the Sonoma North Pit spoil dump design and operations along the southern bank of the NSCD in consideration of drainage and develop a plan to convey runoff to designated water management structures or into the NSCD via a designated flow path.
6. The upstream batter of the NSCD Downstream Plug is entirely rock lined to provide scour protection for flows in Coral Creek (Photo 2 to 7 in Appendix C). The dumped rock is in good condition and in accordance with the Design Plan (Engeny, 2018c). Grasses are beginning to establish within the extent of the dumped rock and will provide further stabilisation to the plug. The transition between the dumped rock and vegetated batters of the NSCD are in good condition (Photo 6 in Appendix C).
7. The invert of the NSCD is rock lined adjacent to the Downstream Plug and there is limited establishment of grass vegetation within the channel. It is understood that the NSCD has only experienced relatively minor flows since construction was completed.

5.3 Regulatory Compliance

The regulatory requirements for regulated structures at SCM are specified in section I of the EA. Compliance against these requirements is summarised in the following sections.

5.3.1 Levee Documentation

The status of documentation required for the operation of NSCD Downstream Plug in accordance with the EA is summarised in Table 4.1. A System Design Plan is not required for NSCD Downstream Plug since the levee does not require a Design Storage Allowance (DSA) (refer Section 4.3.4).

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Table 5.1 Required Documentation for NSCD Downstream Plug

Documentation	Status
Design Plan	Documentation exists (Engeny 2018c)
As Constructed Drawings	Documentation exists (Engeny 2018b)
Operational Plan	Documentation exists (Engeny 2018d) [1]
Register of Regulated Dams	Documentation exists

Note 1: The annual review and update of the Water Management Plan is currently in progress and will incorporate the operational plan for levee structures (as described in Section 4.3.7).

5.3.2 Consequence Category

The consequence category of NSCD Downstream Plug was assessed as part of the Design Plan (Engeny, 2018c) in accordance with the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures. No changes to the levee configuration, purpose or the nature of the stored contents of the structure has occurred since then to require re-assessment of the consequence category. The consequence category assessment for NSCD Downstream Plug is summarised in Table 4.2.

Table 5.2 Summary of Consequence Category Assessment for NSCD Downstream Plug

Failure Event Scenario	Consequence Category
Failure to contain - seepage	Low
Failure to contain - overtopping	Low
Dam break	Significant
Overall	Significant

5.3.3 Mandatory Reporting Level

Mandatory Reporting Level requirements do not apply for levee structures.

5.3.4 Design Storage Allowance

Design Storage Allowance requirements do not apply for levee structures.

5.3.5 Spillway Capacity

Spillway capacity requirements do not apply for levee structures.

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5.3.6 Design Flood Level for Levee Embankment Crest

Table 7 of the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (DEHP, 2016) requires that levees determined to be regulated structures must be designed with an embankment crest level above the 1:1,000 Annual Exceedance Probability (AEP) design flood level. The levee embankment crest was designed to be 0.5 m higher than the 1:1,000 AEP design flood level (Engeny, 2018c). The vegetation associated with early establishment of the NSCD Diversion means that the flow capacity of the diversion drain is maximised and does not currently affect the flood immunity of the levee. The levee complies with the hydraulic performance requirements for regulated levee structures.

5.3.7 Conformance with Operational Plan

The annual review and update of the Water Management Plan is currently in progress and will incorporate the Operational Plan for levee structures including the NSCD Downstream Plug (Engeny 2018d). Since the levee does not require any specific operational actions, the Operational Plan focuses on maintenance and inspection/monitoring requirements and planning for emergency events. The Operational Plan meets the requirements of Condition I10 of the EA for a levee structure.

5.4 Completion Status of 2018 Annual Inspection Recommendations

The 2019 annual inspection of the NSCD Downstream Plug is the first annual inspection since the construction of the levee was completed in 2018. No previous annual inspections have been performed for the levee.

5.5 2019 Annual Inspection Recommendations

Recommendations from the 2019 annual inspection of NSCD Downstream Plug are provided in Table 4.3 below.

Table 5.3 Recommendations from the 2019 Annual Inspection of NSCD Downstream Plug

Recommendation	Category of Recommendation	Suggested Implementation Timeframe
Review the Sonoma North Pit spoil dump design and operations along the southern bank of the NSCD in consideration of drainage and develop a plan to convey runoff to designated water management structures or into the NSCD via a designated flow path.	Improved maintenance / Improved water management	Prior to 1 November 2020

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6. QUALIFICATIONS

a. In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

b. Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

c. Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

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   (ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

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g. This report does not provide legal advice.

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7. REFERENCES

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APPENDIX A

Inspection Photographs – Co-Disposal Cells 1 and 2

Photo 1 June 2019 Aerial Imagery

Photo 2 Decant pond

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Photo 3 Decant Inlet Structure

Photo 4 Re-shaping of Southern End of CDA1/2 to Form Overflow to Cell 3

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Photo 5 Return Water Dam and Trees Growing on Return Water Dam Batter and Northern Starter Bund

Photo 6 Return Water Dam Pump Suction Line

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Photo 7 Ponding in Drain above Starter Bund - Northern Side of Cells 1 and 2

Photo 8 Western Wall of Cell 2 and Seepage Flows in Drain above Starter Bund (View to north)

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Photo 9 Western Solution Trench

Photo 10 Seepage at toe of First Rejects Wall Lift above Starter Bund - Western Side of Cell 2 Near with Cell 3

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Photo 11 Discharge from Drainage Pipe Outlet into Western Solution Trench

Photo 12 Eastern Solution Trench and Eastern Wall of Cell 1

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Photo 13 Trees On Starter Bund – Western Side of Cell 1

Photo 14 De-silted Channel at Downstream End of Eastern Solution Trench

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Photo 15 Eastern Solution Trench Upstream of Outlet into Return Water Dam

Photo 16 Western wall of Cell 2 Viewed from Top of Cell ¾

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Photo 17 Pump Discharge Lines from Cell 3 Decant Pond into Decant Inlet of CDA1/2

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APPENDIX B

Inspection Photographs – Co-Disposal Cells 3 and 4

Photo 1 June 2019 Aerial Imagery

Photo 2 CDA3/4 Reservoir Area Viewed from Southern Wall of Cell 1

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Photo 3 Decant Pond in Cell 3

Photo 4 Decant Inlet Structure and Two Trailer Mounted Pumps Located at Cell 3 Decant Pond

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Photo 5 Pump Discharge Lines from Cell 3 Decant Pond into Decant Inlet of CDA1/2

Photo 6 Decant Pipe Outlet into Western Solution Trench Adjacent to Cell 3 with Valve Closed

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Photo 7 Western Side of Cell3/4 Viewed from the Top of Partially Constructed Fifth Wall Raise

Photo 8 Rejects Deposition on Eastern Side of Cell 4

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Photo 9 Western Side of Cell 3 Viewed from Top of Cell 3/4

Photo 10 Western Side of Cell 3 Including Seepage Flows in Drain above Starter Bund

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Photo 11 Western Solution Trench Adjacent to Cell 3

Photo 12 Access Track Crossing of Western Solution Trench - North-Western Corner of Cell 3

Photo 13 Seepage Expression Above Starter Bund – Western Side of Cell 3

Photo 14 Discharge from Drainage Pipe Outlet into Western Solution Trench – Western Side of Cell 3

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Photo 15 Reeds Growing in Drain above Starter Bund - Western Side of Cell 3

Photo 16 Eastern Side of Cell 4

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Photo 17 Trees Growing on Outside Face of Starter Bund - Eastern Side of Cell 4

Photo 18 Eastern Solution Trench Adjacent to Cell 3

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Photo 19 Seepage Expression Above Starter Bund – Eastern Side of Cell 4 near Cell 3

Photo 20 View Upstream Along Eastern Solution Trench from Road Crossing of Clean Water Drain and Eastern Solution Trench at North-Eastern Corner of Cell 3

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Photo 21 View Downstream Along Eastern Solution Trench and Clean Water Drain from Road Crossing at North-Eastern Corner of Cell 3

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APPENDIX C

Inspection Photographs – NSCD Upstream Plug

Photo 1 June 2019 Aerial Imagery

Photo 2 Crest and Downstream Side of Plug (View from North-West End)

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Photo 3 Crest and Upstream Side of Plug (View from North-West End)

Photo 4 Downstream Side of Plug with Buttressing by North Pit Spoil Dump

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Photo 5 Settling Area on Downstream Side of Plug Formed by North Pit Dump

Photo 6 Rock Surface Treatment on Upstream Side of Plug

Photo 7 Upstream Side of Plug Viewed from Bench at Upstream End of Plug

Photo 8 Upstream Side of Plug Viewed from Bench at Downstream End of Plug

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Photo 9 Interface Between Dumped Rock and Vegetation at Upstream End of Plug

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APPENDIX D

Inspection Photographs – NSCD Downstream Plug

Photo 1 June 2019 aerial imagery

Photo 2 Upstream Side of Plug at Downstream End of Plug

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Photo 3 Upstream Side of Plug Viewed from Bench at Downstream End of Plug

Photo 4 Upstream Side of Plug Viewed from Bench at Upstream End of Plug

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Photo 5 Rock Surface Treatment on Upstream Side of Plug

Photo 6 Interface Between Dumped Rock and Vegetation at Upstream End of Plug

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Photo 7 Crest and Upstream Side of Plug (View from North-East End)

Photo 8 Insitu Creek Bank and North Pit Dump at Upstream End of Plug

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Photo 9 Crest and Downstream Side of Plug (View from North-East End)

Photo 10 Crest and Downstream Side of Plug (Approximate Chainage 100m)

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Photo 11 Crest and Downstream Side of Plug (Approximate Chainage 140m)

Photo 12 Crest and Downstream Side of Plug (Approximate Chainage 170m)

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APPENDIX E

Certification Statement

ENGENY
WATER MANAGEMENT

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4 February 2020

Form of certification
2019 Annual Inspection of Regulated Dams at Sonoma Coal Mine

Name of Registered Professional Engineer providing certification:
sch4p4(6) Personal informati

Address of Registered Professional Engineer providing certification:
Level 7, 500 Queen Street, Brisbane, Qld, 4000

Statement of relevant experience
I hereby state that I am a Registered Professional Engineer of Queensland and meet the requirements of the definition of 'suitably qualified and experienced person'.

Statement of certification
All relevant material relied upon by me, where required by Environmental Authority No. EPML00707713, is provided in the attached report *2019 Annual Regulated Structures Inspection Report – Sonoma Coal Mine* dated 4 February 2020.

I hereby certify that the report entitled *2019 Annual Regulated Structures Inspection Report – Sonoma Coal Mine* dated 4 February 2020 documents the annual inspection of the regulated structures at the Sonoma Coal Mine which was completed in accordance with Conditions I20 to I22 of Environmental Authority No. EPML00707713 and the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures published by the administering authority. The report;

1. Identifies which regulated structure(s) is the subject of the certification;
2. Identifies the relevant environmental authority condition which is the subject of the certification;
3. Identifies details of the inspection of the current condition of the facility;
4. Provides an assessment of the hydraulic capacity of the facility;
5. Provides an assessment of the physical condition and performance with respect to design intent;
6. Identifies whether operation has been undertaken in accordance with the operational plan;
7. References the operational plan on which a regulated structure performance relies, together with information about the extent to which the regulated structure has been operated in accordance with the operational plan over the last year;
8. Includes any potential implications of non-conformance with the operational plan;
9. Identifies, where appropriate, what is not included in the certification – including information about any limitations, restrictions or exclusions that apply to the certification;
10. Identifies where the certification relates to an inspection or design;
11. Identifies if the certification was under supervision, the extent of the supervision.

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I sch4p4(6) Personal inform declare that the information provided as part of this certification is true to the best of my knowledge. I acknowledge that it is an offence under section 480 of the *Environmental Protection Act 1994* to give the administering authority a document containing information that I know is false, misleading or incomplete in a material particular.

sch4p4(6) Personal infor

Signed: _ _____

sch4p4(6) Personal informati **RPEQ No. 21211**

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SONOMA MINE MANAGEMENT PTY LTD

Two Mile Creek Diversion Operations Monitoring 2018

Sonoma Coal Mine

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June 2018

M4100_029

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M4100_029 Two Mile Creek Diversion Operations Monitoring 2018					
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REV	**DESCRIPTION**	**AUTHOR**	**REVIEWER**	**APPROVED BY**	**DATE**
Rev 0	Client Issue Draft	sch4p4(6) Personal information			22 June 2018
Signatures					

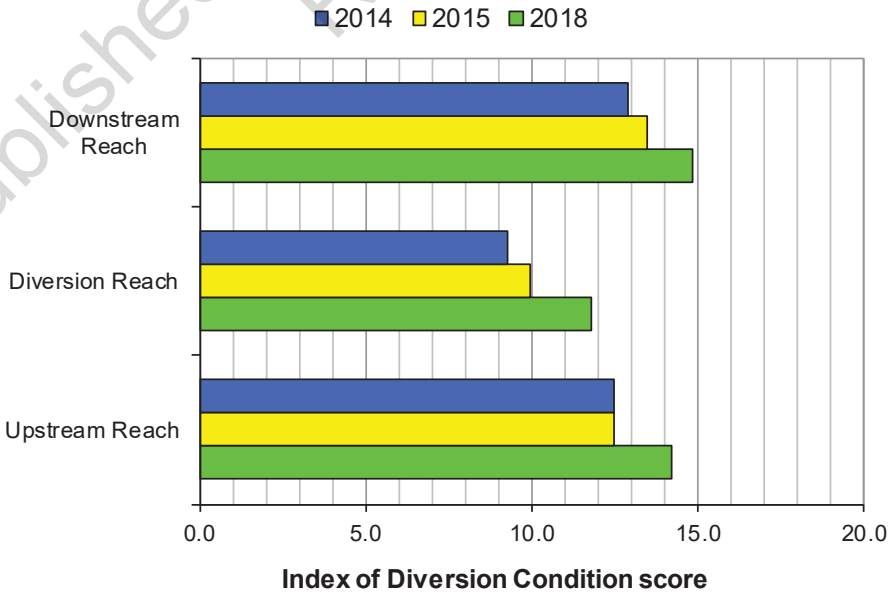
EXECUTIVE SUMMARY

Annual operations monitoring of Two Mile Creek Diversion, at Sonoma Mine, was performed by Engeny Water Management (Engeny) on the 23rd of April 2018. This was the fifth year of operations monitoring since the diversion was constructed and became operational in 2013. Monitoring was undertaken in accordance with the program established for the Two Mile Creek Diversion (Engeny, 2014).

Three assessment reaches were established within Two Mile Creek at the time of the initial inspection in 2014. The monitoring program (Engeny, 2014) to be undertaken during the fifth year of operation requires the full range of monitoring activities (i.e. flow events, Index of Diversion Conditions (IDC), photographs, survival of works and cross section survey).

There was minimal rainfall in the weeks preceding the 2018 diversion inspection. Based on the stream flow monitoring data for Pelican Creek, observed flood levels in the Two Mile Creek Diversion and site rainfall monitoring data, it is considered likely that any flow event in the Two Mile Creek Diversion during the period May 2017 to April 2018 would have been smaller than a 20% (1:5) AEP event.

The 2018 IDC scores are summarised in the figure below and compared against previous assessments. The figure indicates improvement across all three reaches with the greatest improvement in the diversion reach. This is largely due to the improved vegetation structure as a result of two consecutive years of median annual rainfall. The difference in the scores from previous years for all three reaches is small, and will need to be monitored over a longer period to determine any underlying trend in the condition of the waterway as it experiences a range of flow events.



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The diversion is generally considered to be in good condition and performing as per the design intent. However, several areas of flood damage remain since the previous inspection (caused during Tropical Cyclone Debbie in March 2017), which will require management action to prevent ongoing deterioration of the diversion.

The visual inspection and comparison against the photographic record indicates that the upstream and downstream reaches have remained in a stable condition over the previous year. The extent of riparian ground cover has increased across all reaches.

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1. INTRODUCTION

1.1 Overview

QCoal Sonoma Pty Ltd (Sonoma) is required to monitor the performance of the Two Mile Creek Diversion as a condition of the Sonoma Coal Mine (SCM) Environmental Authority (EA) EPML00707713 (take effect date 14/9/2017). Engeny Water Management (Engeny) was commissioned by Sonoma to conduct annual operations monitoring of the Two Mile Creek Diversion in April 2018 following the 2017/18 wet season (i.e. the fifth year of diversion operation).

The monitoring program for the Two Mile Creek Diversion has been established in accordance with the Australian Coal Association Research Program (ACARP) guidelines for *Monitoring and Evaluation Program for Bowen Basin River Diversions* (ID&A Pty Ltd, 2001). This guideline sets the standard for monitoring of watercourse diversions within the Bowen Basin and the criteria for assessment.

1.2 Two Mile Creek Diversion

Two Mile Creek is an ephemeral tributary of the Bowen River, which is a major tributary in the Burdekin River catchment. The catchment area upstream of the diversion is approximately 30 km^2. Two Mile Creek flows from east to west through the centre of the SCM. Downstream of the SCM lease, Two Mile Creek flows into Pelican Creek, which discharges into the Bowen River some 28 km north west of the mining lease.

The catchment upstream of the SCM open cut mining operations maintains open woodland cover. The waterway reaches immediately upstream of the diversion are typically low capacity incised channels in broad valley floor floodplains, which would be regularly engaged by flood flows. There are two tributaries in the upstream catchment that cross under road and rail infrastructure before entering the diversion.

Prior to mining and diversion construction, Two Mile Creek flowed through an area now occupied by the SCM Main Pit. The diversion was constructed during 2012/13 with completion in August 2013. The diversion comprises a constructed meandering low flow channel within a high flow channel to match the sinuosity of the existing creek. The low flow channel is rock lined for the length of the diversion with an average depth of 1.5 m and 1V:4H batters to convey the 2 year average recurrence interval (ARI) peak flow. The high flow channel comprises a wide channel with benches grading towards the low flow channel. A rock lined perimeter drain and chutes were constructed to convey runoff from the high flow benches to the low flow channel. The high flow channel benches were designed to be planted with grasses and the embankments of the high flow channel with trees and shrubs. Design details for the diversions are contained in the design report prepared by Brisbane Stormwater Management (BSM, 2012).

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1.3 Regulatory Requirements

The Two Mile Creek Diversion Water Licence was granted in October 2012 under the Water Act 2000. The Queensland Government approval for the operation of the Two Mile Creek Diversion (including approval conditions and referenced certified designs), was subsequently transferred from the Water Act 2000 licence, into the SCM EA EPML00707713 (take effect date 14/9/2017), which is administered under the Environmental Protection Act 1994 (EP Act 1994). Accordingly, Water Licence Number 607384 was surrendered by QCoal Sonoma Pty Ltd (notice dated 6/12/2017).

Key EA conditions relevant to the diversion inspection are presented below:

- **Condition I7**: The holder of this authority is required to monitor the performance of all diversions by way of a performance report prepared for each diversion by a registered professional engineer (RPEQ) at the following times:
  - April of each year; and at any time when poor performance and/or potential failure of the diversion are observed.
  - Monitoring of the works must include recommendations as per ACARP Project C9068 "Monitoring and Evaluation Program for Bowen Basin River Diversions". Two (2) hard copies and an electronic copy shall be furnished to the Chief Executive by the 30 June each year.

- **Condition I8**: The performance report must detail the following:
  - (a) The performance of the diversion by way of comparison with the relevant approved Design Plans, specifications and monitoring/maintenance strategies therein;
  - (b) Surveys to identify and quantify any changes to the channel bed and permanent corridor width subjected to settlement;
  - (c) Detail any remedial works to be undertaken including a timetable for completion of proposed works; and
  - (d) Any recommendations on measures to be taken to ensure the physical integrity of the works.

1.4 Scope of Work for Operations Diversion Monitoring

A formal operations monitoring program for the Two Mile Creek diversion was initiated in 2014 (the first full year in which the diversion was operational). This report documents the fifth monitoring inspection undertaken since completion of construction of the diversion.

The 2018 diversion monitoring assessment included the following activities in accordance with the monitoring program for the diversion (Engeny, 2014), with field inspections undertaken on the 23rd of April 2018:

- Index of Diversion Condition (IDC) assessments of monitoring sites and reaches.

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- Establishment of photographic records of the condition of the waterway at the monitoring sites.
- Review of rainfall and stream flow monitoring data for the 2017/18 wet season to provide context to the diversion monitoring assessment.
- Survival of works assessment including assessment of flood damage and maintenance/management intervention requirements.

A cross-section survey comparison was not able to be undertaken due to the lack of a recent aerial survey capture. It is recommended that this activity is undertaken following the next aerial survey capture of the site.

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2. MONITORING PROGRAM

A monitoring program for the Two Mile Creek Diversion was developed as part of the diversion design and approval process in 2012. The proposed program included IDC assessment, fixed photo points, aerial photography analysis, cross section survey, flow event analysis, vegetation assessment and event-based damage assessment. This original monitoring program was reviewed and revised at the time of the 2014 inspection (Engeny, 2014) to better align with the ACARP diversion monitoring standards and current industry standards.

2.1 Monitoring Reaches

The monitoring program for the Two Mile Creek diversion has been structured to assess and compare the condition of the diversion reach against the upstream and downstream reaches of Two Mile Creek.

The Two Mile Creek diversion has two distinct upstream reaches that flow from the east and discharge into the diversion after crossing the Bowen Developmental Road and Collinsville Newlands Branch Railway. The diversion reach is defined as the approximately 5,700 m length of the constructed diversion between the Bowen Developmental Road and the downstream limit of construction. The downstream reach is defined as the natural reach of Two Mile Creek between the limit of the constructed diversion and point at which the creek crosses the southern boundary of the Cows Coal Mine (CCM) mining lease (ML10345) boundary. The reach was limited to the mining lease boundary due to access constraints. The locations of the upstream, diversion and downstream reaches are listed in Table 2.1.

Table 2.1 Location of Two Mile Creek Diversion and control reaches

Reach	Upstream Limit (m GDA94)		Downstream Limit (m GDA94)	
	Easting	Northing	Easting	Northing
Upstream Reach (TMC US1, TMC US2)	590,708	7,719,266	590,066	7,719,708
Upstream Reach (TMC US3, TMC US4)	590,598	7,718,049	589,923	7,718,636
Diversion Reach	590,066 589,923	7,719,708 7,718,636	587,100	7,718,317
Downstream Reach	587,100	7,718,317	585,821	7,717,891

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2.2 Monitoring Sites

Monitoring sites have been established to provide reasonable representations of the geomorphic and riparian vegetation characteristics and condition within each of the reaches. Monitoring locations were initially determined through inspection of aerial photography with sites located in areas with different observable features within each reach. This included straight sections of low flow channel, low flow channel meanders and deeply incised sections. Monitoring sites have been located at relatively uniform intervals.

During the initial field investigation in 2014, a number of monitoring locations were altered based on access and observed ground conditions at each location. GPS coordinates were recorded at each monitoring site to ensure consistency as part of the ongoing monitoring program. Physical markers were installed at the monitoring sites prior to the 2016 inspection. These markers help to ensure consistency in location and provide a photo reference point for the purpose of ongoing monitoring. Several of the markers were washed away during the Tropical Cyclone Debbie flow event in March 2017 (TMC-US2, TMC-US3, TMC-US4, TMC-Div3 and TMC-DS2), and have not been reinstated. It is recommended that these physical markers be replaced in order to maintain consistency in the photo locations.

A total of 12 monitoring sites have been established along Two Mile Creek for the diversion monitoring which include:

- Four sites in the upstream reach (TMC-U1 to TMC-U4) with two sites on each of the main tributaries of Two Mile Creek upstream of the diversion.
- Four sites in the diversion reach (TMC-Div1 to TMC-Div4).
- Four sites in the downstream reach (TMC-D1 to TMC-D4).

The locations of the monitoring sites are shown in Figure 2.1 while the coordinates of the monitoring sites are provided in Table 2.2.

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Figure 2.1 Diversion Monitoring Site Locations

Table 2.2 Monitoring site locations

Site ID	Creek Bank Location	Easting (m GDA94)	Northing (m GDA94)
Two Mile Creek Upstream Reach			
TMC-US1	Left	590,606	7,719,248
TMC-US2	Left	590,223	7,719,627

Site ID	Creek Bank Location	Easting (m GDA94)	Northing (m GDA94)
TMC-US3	Left	590,578	7,718,098
TMC-US4	Left	590,102	7,718,493
Two Mile Creek Diversion Reach			
TMC-Div1	Left	589,834	7,718,817
TMC-Div2	Left	588,903	7718641
TMC-Div3	Right	588,000	7,719,197
TMC-Div4	Right	587,556	7,718,327
Two Mile Creek Downstream Reach			
TMC-DS1	Right	586,996	7,718,228
TMC-DS2	Right	586,565	7,717,975
TMC-DS3	Left	586,502	7,717,849
TMC-DS4	Right	585,821	7,717,891

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2.3 Monitoring Frequency

The recommended frequency of monitoring is provided in the *Monitoring and Evaluation Program for Bowen Basin River Diversions* (ID&A Pty Ltd, 2001). The monitoring should be undertaken annually in April with a report submitted to the Department of Environment and Science (DES) prior to 30 June each year to satisfy the conditions of the EA. The activities proposed as part of the annual monitoring are outlined in Table 2.3.

Table 2.3 Diversion monitoring activities and frequency

Monitoring Activity	Year of Diversion Operation (Year 1 = 2014)									
	1	2	3	4	5	6	7	8	9	10
Flow Events	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Index of Diversion Condition (IDC)	✓	✓			✓			✓		✓

Monitoring Activity	Year of Diversion Operation (Year 1 = 2014)									
	1	2	3	4	5	6	7	8	9	10
Photographs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Survival of Works	✓	✓			✓			✓		✓
Cross Section Survey	✓				✓					✓

Additional monitoring is recommended following flow events of a magnitude sufficient to potentially cause damage to the diversion reach or seriously affect the survival or establishment process of constructed diversion works. The trigger for this event-based monitoring is a 5 year Average Recurrence Interval (ARI) flood event or greater as defined by the *Two Mile Creek Diversion Design Report* (BSM, 2012). It is recommended that this monitoring include a visual inspection of the diversion reach with recommendations to rectify any areas of damage that could trigger on-going deterioration of the diversion.

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3. RAINFALL AND STREAM FLOW MONITORING

3.1 Stream Flow Monitoring

There is currently no stream flow monitoring being conducted on Two Mile Creek. Sonoma Mine maintains a water quality and stream flow gauging station on Pelican Creek (BG1), which flows to the north of the SCM. The recorded levels and estimated flows at BG1 over the twelve month period since the previous diversion inspection are presented in Figure 3.1.

The figure indicates a number of stream flow events during the period of interest. The largest of these occurred in mid-May 2017 with a peak flow of approximately 200 m^3/s. By comparison, the peak flow in this event was less than half the peak flow that occurred at the end of March 2017 as a result of Tropical Cyclone Debbie. The performance of the diversion during the March 2017 event is document in the previous diversion monitoring report (Engeny 2017).

The remaining flows over the period of interest are relatively minor events. The most recent occurred in late-February and early-March with a peak flow of approximately 100 m^3/s.

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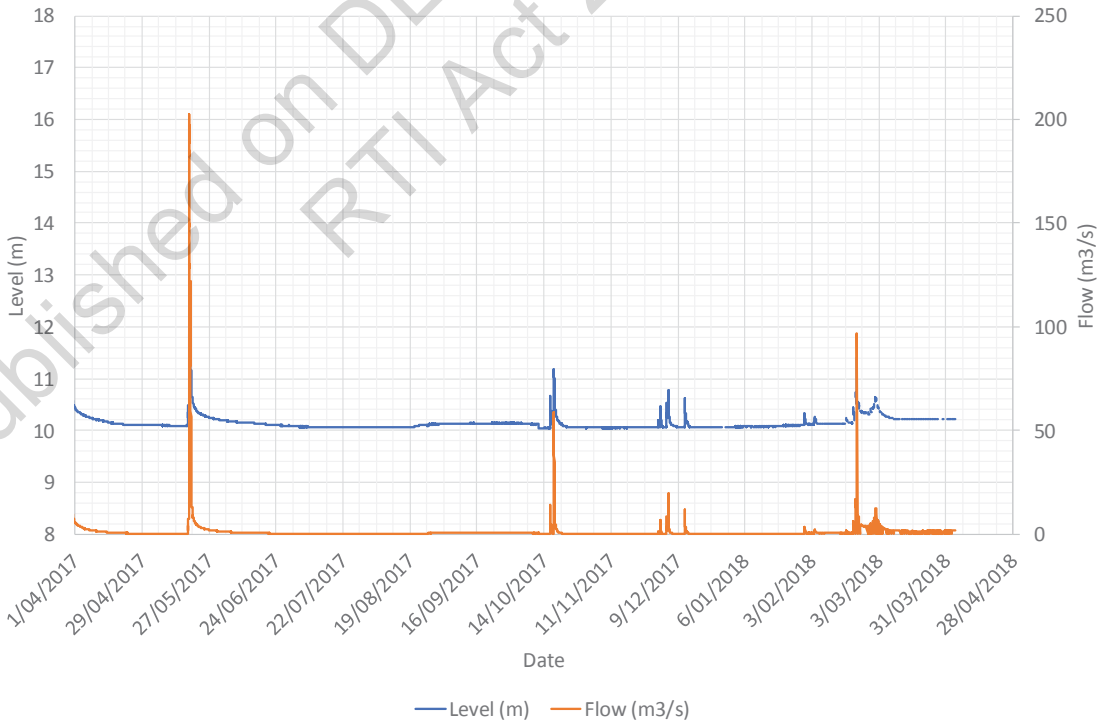

Figure 3.1 Stream Flow In Pelican Creek Upstream Of Coral Creek (Bg1)

3.2 Rainfall Monitoring

Sonoma Mine maintains a site rainfall monitoring station. Recorded rainfall at the station for the period from May 2017 to March 2018 has been obtained and assessed for the purpose of inferring the magnitude of flow events during the 2017/18 wet season.

3.2.1 Monthly Rainfall

The site monthly rainfall totals for the 2017/18 wet season were compared to the average rainfall recorded at site (2008 – current) and the long-term average rainfall for the Bureau of Meteorology Collinsville Post Office rainfall station (Station No. 330013) (1940 to 2018). These results are presented in Table 3.1 and Figure 3.2.

A comparison between average rainfall and recorded rainfall shows that significantly higher than average monthly rainfalls were recorded in May and October 2017. However, the annual total rainfall during 2017/18 was slightly below the long term average.

Table 3.1 Monthly rainfall comparison

Month	Site Rainfall 2017/18 (mm)	Site Average (2008 – current) (mm)	Long-Term Average Rainfall for Collinsville (mm)
May 2017	180	36	33
Jun 2017	1	25	27
Jul 2017	0	22	20
Aug 2017	10	24	17
Sep 2017	0	11	12
Oct 2017	68	23	22
Nov 2017	39	92	50
Dec 2017	109	117	94
Jan 2018	26	131	134
Feb 2018	158	100	157
Mar 2018	23	99	98
Apr 2018	34 [1]	28	42

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Month	Site Rainfall 2017/18 (mm)	Site Average (2008 – current) (mm)	Long-Term Average Rainfall for Collinsville (mm)
Annual Total	647	754	707

Note 1: Obtained from BOM Collinsville Post Office station (33013)

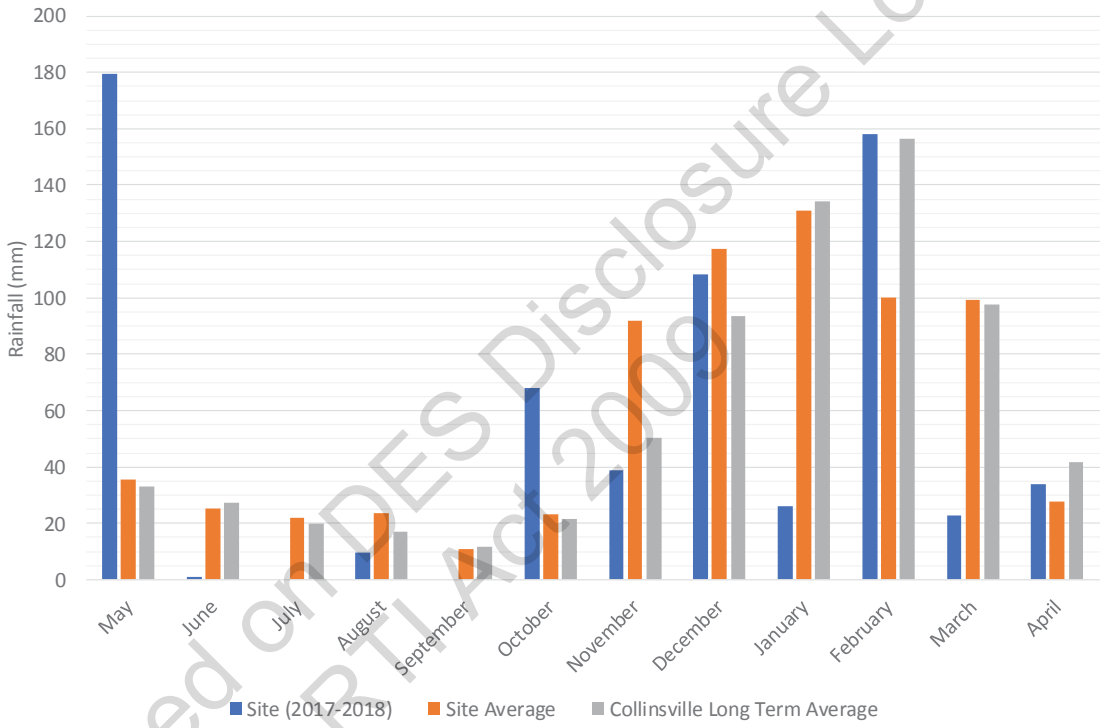

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Figure 3.2 Monthly Rainfall Comparison

3.2.2 Daily Rainfall

Daily rainfall recorded at SCM between May 2017 and early April 2018 is summarised in Figure 3.3. Significant daily rainfall totals were recorded on 18th May 2017 (144.5 mm) and 3rd December 2017 (49 mm). The May event followed a relatively dry three week period (<10 mm cumulative rainfall); however, it was only approximately six weeks after Tropical Cyclone Debbie. The December event followed two smaller rainfall events that occurred over a two week period (55 mm cumulative rainfall).

There was negligible rainfall in the weeks preceding the 2018 diversion inspection.

3.2.3 Pluviographic Rainfall

Site pluviographic rainfall data between May 2017 and early April 2018 are compared to design event rainfall totals (2016 revision of Australian Rainfall and Runoff) in Figure 3.4

below. The most intense rainfall over this period was the 24 hr event commencing on 18th May 2017, which was approximately a 20% (1:5) Annual Exceedance Probability (AEP) event. The 1 hr duration rainfall on the evening of the 3rd December 2017 was approximately a 30% (1:3.4) AEP event. The maximum intensity for all recorded rainfall durations at the SCM rainfall station were as generally between 50% (1:2) and 20% (1:5) AEP for rainfall durations ranging from 10 minutes to 7 days.

Anecdotal information from site indicates that the diversion did not experience any flows comparable to the Tropical Cyclone Debbie event from the previous investigation. On the basis of the stream flow monitoring data for Pelican Creek, observed flood levels in the Two Mile Creek Diversion and site rainfall monitoring data, it is considered likely that any flow event in the Two Mile Creek Diversion during the period of interest would have been smaller than a 20% (1:5) AEP event.

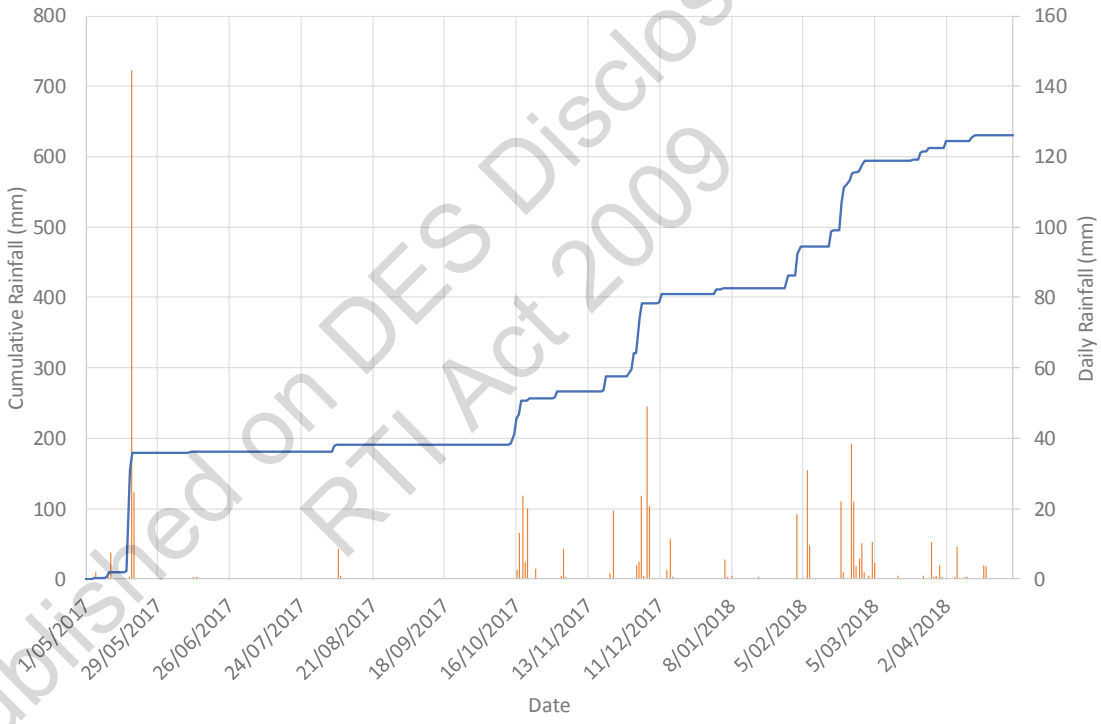

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Figure 3.3 2017/18 Recorded Daily Rainfall Data At Sonoma Mine

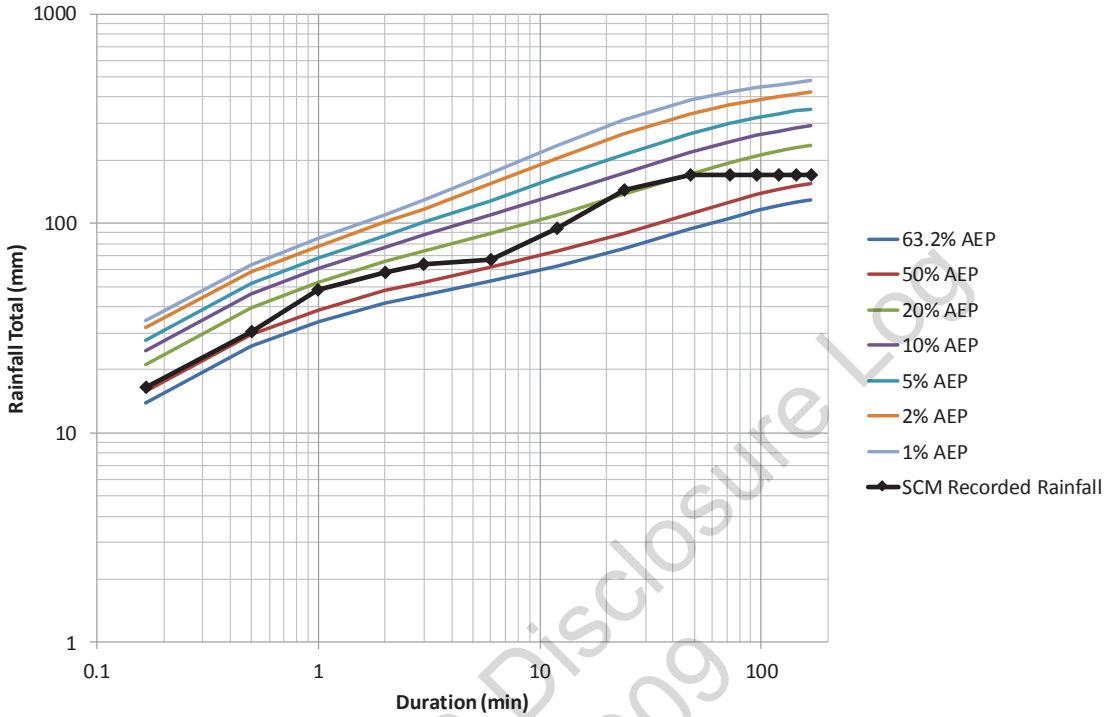

Figure 3.4 Comparison Of Recorded And Design Event Rainfall Totals

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4. PHOTOGRAPHIC RECORD OF CREEK CONDITION

Photographs were taken of Two Mile Creek at the monitoring sites on 23rd of April 2018 to provide a record of the current condition of the creek at these locations. A minimum of 6 photos were taken at each location. Photos taken include:

- Upstream (US) – Looking upstream from the monitoring site.
- Cross Stream (CS) – Looking across to the opposite bank from the monitoring site.
- Downstream (DS) – Looking downstream from the monitoring site.
- Upstream Bed (UB) – Looking upstream from the centre of the creek bed.
- Cross Bed (CB) – Looking from the centre of the creek bed back towards the monitoring site.
- Downstream Bed (DB) – Looking downstream from the centre of the creek bed.

Appendix A shows the 2018 diversion inspection photographic records of the creek alongside the photographic records from the 2017 inspection. The photographic records provide a comparison base for future diversion inspections of Two Mile Creek and a reference point to identify changes in diversion condition.

It was noted during the inspection that some of the physical markers for the monitoring sites installed prior to the 2016 inspection had been washed away during the Tropical Cyclone Debbie flow event and have not been reinstated. As a result, providing a photographic record at consistent locations was dependent upon utilising GPS coordinates and pre-existing landmarks captured in the previous photos (i.e. trees, pipelines, channel meanders, etc.). This was successful except for one monitoring point, which could not be definitively matched to the 2017 photos (TMC-US1). This location is not within the diversion reach and the landmarks are subject to natural and/or third party impacts.

It is recommended that physical markers be installed where practical to facilitate the ongoing collection of a photographic record at consistent locations.

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5. CROSS SECTION SURVEY

Cross section surveys have been identified as an important part of the diversion monitoring program to monitor the stability of the diversion reach; however, an aerial survey has not been undertaken since 2014. It is recommended that cross section comparison be undertaken following the next site aerial survey capture.

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6. INDEX OF DIVERSION CONDITION ASSESSMENT

6.1 Index of Diversion Condition Methodology

IDC is a method described in the ACARP diversion monitoring guidelines (ID&A Pty Ltd, 2001) for recording and monitoring the condition of watercourse diversions and adjacent upstream and downstream reaches. The IDC provides a rapid assessment that is designed to flag potential management issues rather than provide a detailed scientific assessment of the waterway. It is an integrated suite of indicators that measures the geomorphic and riparian condition of a diversion and its' upstream and downstream reaches. The indicators for the geomorphic index and riparian index are listed in Table 6.1 below.

Table 6.1 Geomorphic and riparian indicators used in IDC method

Indicators for Geomorphic Index	Indicators for Riparian Index
Width of high flow channel, active channel and low flow channel	Width of riparian zone
Bank condition	Structural intactness
Piping of banks	Regeneration
Bed condition	Longitudinal continuity
Spoil piles	
Recovery	
In-stream structures	

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The IDC method is applied to four monitoring sites (approximately 50 m long) defined in each of the upstream, diversion and downstream reaches. Each indicator is assigned a score within each site. The average scores for each indicator from the four sites are then used to calculate the overall score for the geomorphic index (maximum score is 10) and riparian index in each reach (maximum score is 10). The sum of the geomorphic and riparian index is then calculated to determine the overall IDC score (maximum score is 20) for each reach. A low IDC score indicates an overall poor waterway condition.

The IDC method was applied to the 12 monitoring sites described in Section 2 on the 23rd of April 2018.

6.2 Upstream Reach Observations

The waterway upstream of the diversion comprises two primary tributaries (northern and southern). Two monitoring sites were established in each of the upstream tributaries to give an accurate indication of stream condition.

Monitoring points TMC-US1 and TMC-US2 are located on the northern tributary while TMC-US3 and TMC-US4 are located on the southern tributary. The following key observations were made during the monitoring inspection:

- Northern Tributary (TMC-US1 and TMC-US2):
  - The northern tributary is characterised by an incised channel with limited flow capacity and poorly defined low flow channel.
  - Continuing the trend from the 2017 inspection, there was less evidence of stock accessing the creek bed compared to previous inspections. This may be the result of water availability in other locations.
  - Significant bank erosion and steepening with exposed roots is evident at a number of locations along the waterway, particularly on the outside of bends (Figure 6.1). This is generally consistent with previous inspections and the condition appears to be relatively stable.
  - There is increased ground cover along the waterway including in the bed of the channel at some locations (Figure 6.2). This is evidence of a successful wet season with average rainfall.
- Southern Tributary (TMC-US3 and TMC-US4):
  - The southern tributary is generally in a similar condition to the northern reach.
  - As with the Northern Tributary, bank erosion and steepening were evident at a number of locations along the waterway (Figure 6.3 and Figure 6.4). This is generally consistent with previous inspections and the condition appears to be relatively stable.
  - Flood debris and fallen trees remained evident throughout the reach (Figure 6.5) and are attributed to the rainfall and strong winds experienced during Tropical Cyclone Debbie.
  - Increased ground cover was observed along the waterway including on benches and some of the previous eroded batters (Figure 6.6).
  - Minimal ponded water was observed in either tributary.

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Figure 6.1 Bank Erosion And Undercutting Downstream Of TMC-US1

Figure 6.2 Grass Establishment In Channel At TMC-US2

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Figure 6.3 Bank Erosion Upstream Of TMC-US4

Figure 6.4 Bank Erosion Upstream Of TMC-US4

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Figure 6.5 Flood Debris Upstream Of TMC-US4

Figure 6.6 Grass Establishment On Bench And Batters At TMC-US4

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6.3 Diversion Reach

As noted in previous inspection reports, the Two Mile Creek diversion reach appears to have been constructed as per the approved design. The diversion experienced its first flow event since construction during the 2014/15 wet season; however, there were no further flows observed during the 2015/16 wet season. A significant flow occurred as a result of rainfall associated with Tropical Cyclone Debbie in late March 2017. This was the largest flow observed in the diversion since construction and has been estimated to exceed the 5 year ARI design flow (i.e. the flow event would be expected to occur less frequently than once every five years on average). As noted in Section 3.2, it is considered likely that any flow event in the Two Mile Creek Diversion during the period May 2017 to April 2018 would have been smaller than a 20% (1:5) AEP event.

Key observations from the inspection are:

- In general, it is noted that areas of damage observed during the 2018 inspection were also observed during the 2017 inspection, indicating that the damage occurred as a result of the Tropical Cyclone Debbie flow event. As discussed in further detail below, these areas have generally remained stable over the previous 12 months.

- The trend towards better vegetation establishment within the diversion has increased. In particular, the upstream portions of the diversion from the vicinity of the haul road crossing have good grass cover and increased understorey and overstory establishment (Figure 6.7 and Figure 6.8).

- The haul road crossing includes two banks of culverts: 5 x 1800 mm diameter corrugated metal pipes in the low flow channel and 8 x 1800 mm diameter corrugated metal pipes on the right bank of the high flow channel. During the 2017 inspection some damage to the upstream headwall was observed on the high flow channel culverts, including cracking of the concrete and scouring around the ends of the headwall (Figure 6.9 and Figure 6.10). It is recommended that the condition of the headwall be monitored for signs of further deterioration.

- The Tropical Cyclone Debbie flow event resulted in a number of scour holes on the downstream side of the haul road that were observed during the 2017 inspection. The scour hole on the downstream side of the haul road at the low point on the right bank has not been filled in (Figure 6.11). Large boulders have been placed on the road side of the scour hole to provide a barrier for vehicles. A second scour hole remained evident at the outlet of the high flow channel culverts as well as undermining of the concrete apron (Figure 6.12). The scour holes appear to have remained stable since the previous inspection. However, management action will be required to ensure the physical integrity of the diversion and prevent the scour holes becoming a source of sediment to the downstream waterway in future streamflow events. It is recommended that one of the following management actions be implemented:

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- **Reinstatement:** Repairing the scour holes by ripping and placing compacted fill and reinstatement of rock protection for the scour hole at the outlet of the high flow channel culverts; or
- **Redesign:** Revisit the design of the haul road crossing scour protection to identify a solution that will perform better in future events. This may include stabilising the scour holes and using them as an energy dissipater until the haul road is decommissioned.

- No significant damage was observed at the outlet of the low flow channel culverts (Figure 6.13). Ground cover vegetation is establishing in this area and is expected to provide ongoing stability to the channel (Figure 6.14).

- As with previous inspections, areas of rilling erosion were observed along the left bank of the high flow channel in the vicinity of Sediment Dam 5 (SD5) (Figure 6.15). Additional areas of gully erosion associated with concentrated flows were observed in the vicinity of SD5 and on the right bank upstream of TMC-Div3 (Figure 6.16 and Figure 6.17). The erosion in these areas was considered to be of similar extent to that observed during the 2017 inspection, indicating that these areas have not significantly worsened over the previous year. Recommended management actions to prevent ongoing damage to the diversion include:

  - Construction of dedicated drainage structures (e.g. rock chutes) to convey concentrated inflows to the low flow channel; and
  - Repairing existing rilling and gully erosion by ripping, re-compacting and re-seeding.

- During Tropical Cyclone Debbie, discharge from the SD5 gravity release pipe resulted in localised scouring and movement of the rock protection in the vicinity of the outlet. Since the previous inspection, vegetation has begun to establish around the outlet and additional pipework has been installed, which is understood to transfer water from SD5 to the Return Water Dam for reuse in the CHPP circuit (Figure 6.18). The SD5 outlet pipe has not been replaced on its pipe supports (Figure 6.19). Previous inspections determined that damage resulting from discharge of water from SD5 appears to have stabilised and stopped progressing. Recommended management actions to prevent ongoing damage to the diversion include:

  - Monitor future releases from the SD5 pipe outlet to ensure that the damage does not continue to progress.

- A number of erosion gullies were previously observed along the left bank of the high flow channel downstream of TMC-Div2 and SD5 (Figure 6.20 to Figure 6.22). These gullies had near vertical walls up to approximately 2 m high. The gullies appear to have remained stable since the previous inspection and grass has started to establish. A review of aerial survey data from July 2014 indicates the cause is runoff from an undisturbed catchment to the north and east of the MIA that is draining into the diversion. Due to the lack of a formalised drain and rock chute in this area, it appears that this runoff has resulted in the gully erosion observed during the inspection.

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Recommended management actions to prevent ongoing damage to the diversion include:

- Review the upstream catchment runoff and provide a suitable drain to convey concentrated flows from this catchment to the diversion.
- Repairing existing gully erosion by battering back the steep gully batters, placing compacted fill and re-seeding.

- An area of scour was previously observed along the toe of the batter between the gullies identified above and the light vehicle road crossing (Figure 6.23). Minor erosion in this area appears to have progressed since the previous inspection as a result of local runoff and a small area of ponded water was evident. Addressing the cause of the gully erosion is expected to prevent on-going progression of this scour.

- The light vehicle road low level crossing downstream of TMC-Div2 was washed away during the Tropical Cyclone Debbie flow event (Figure 6.24) and has not been reinstated. This outcome is expected for this type of crossing. Site personnel have advised that there is no immediate intention to reinstate the light vehicle crossing.

- The 2017 inspection identified extensive areas of shallow scour on the bed of the high flow channel downstream of TMC-Div3. Establishment of ground cover in this area has increased since the previous inspection (Figure 6.25) and will improve resistance to scour in future flow events. Recommended management actions to prevent ongoing damage to the diversion include:

  - Monitor the establishment of ground cover in the downstream section of the diversion.
  - Consider undertaking additional seeding of this section of the diversion to encourage establishment of ground cover.

- The previous inspection observed extensive sediment deposition within the diversion channel as well as in the perimeter drainage system from TMC-Div3 to the end of the diversion. The establishment of ground cover has since increased in these areas (Figure 6.26). The downstream end of the diversion and transition to the downstream reach has very dense ground cover (Figure 6.27). Due to the lack of a defined channel at the transition (i.e. broad, flat floodplain), future deposition of sediment in this area is expected.

  - It is recommended that this section of the diversion continue to be monitored for the establishment of ground cover and to ensure that it does not become a source of sediment for the downstream reach.

- The diversion reach is considered to be in generally good geomorphic condition due to the presence of natural channel features as designed. Minor damage associated primarily with Tropical Cyclone Debbie in March 2017 was observed as described above, but is generally consistent with previous inspections.

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- The perimeter drainage system designed to manage lateral inflows and limit ponding on the floodplain generally appears to be working as designed. No evidence of ponding on the bank or piping of the low flow channel was observed during the 2018 inspection.

- The Main Pit overburden dump and Sonoma B Pit overburden dump are greater than 50 m from the diversion high flow channel. The Main Pit overburden dump is showing signs of vegetation establishment, which will ultimately reduce the risk of oversupply of sediment to the diversion. The proximity of spoil piles will need to be monitored as part of the ongoing monitoring program to determine if these will be an ongoing management issue for the diversion.

- The riparian condition of the diversion reach is generally poor due to the lack of diversity of vegetation types and species, with the diversion reach dominated by ground covers (i.e. grasses). However, increased establishment of mid-storey and over-storey vegetation was observed, particularly in the upper portion of the diversion.

  - This observation is to be expected in the early years of establishment of the diversion (or rehabilitation in general). There continues to be signs of regeneration of trees and shrubs. The establishment of vegetation is inherently dependent upon rainfall.

- The diversity of species is limited; however, the diversity is expected to increase over time as other species return from existing seed stock in the topsoil. Although the diversity is currently limited to predominantly grass species, these plants are providing necessary stability to the topsoil structure during the establishment phase of the diversion.

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Figure 6.7 Extensive Groundcover With Increased Understorey And Overstory At TMC-Div1

Figure 6.8 Extensive Groundcover With Increased Understorey And Overstory Downstream Of Haul Road

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Figure 6.9 High Level Culverts At Upstream Side Of Haul Road

Figure 6.10 Low Flow Culverts At Upstream Side Of Haul Road

Figure 6.11 Scour Hole Downstream Of Haul Road Causeway

Figure 6.12 Scour Hole And Damaged Apron At Downstream Headwall Of High Level Haul Road Culverts

Figure 6.13 Downstream Headwall Of Low Level Haul Road Culverts

Figure 6.14 Grass Establishment In Low Flow Channel Downstream Of Haul Road

Figure 6.15 Rilling In The Vicinity Of TMC-Div2

Figure 6.16 Gully Erosion Downstream Of TMC-Div2

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Figure 6.17 Gully Erosion Of Right Bank Upstream Of TMC-Div3

Figure 6.18 Vegetation Establishment At Location Of Previous Scour At Outlet Of Sd5 Gravity Discharge Pipe

Figure 6.19 Sd5 Release Pipeline Off Mounting Blocks

Figure 6.20 View Along Erosion Gully On Left Bank Of Diversion Downstream Of TMC-Div2

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Figure 6.21 Upstream Limit Of Erosion Gully (View Towards SD5 And MIA)

Figure 6.22 Secondary Smaller Erosion Gully Near Light Vehicle Road Crossing

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Figure 6.23 Scour At Toe Of Embankment Upstream Of Light Vehicle Road Crossing

Figure 6.24 View To North-West Across Light Vehicle Road Causeway Crossing

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Figure 6.25 Vegetation Establishment On Right Bank Downstream Of TMC-Div3

Figure 6.26 Vegetation Establishment In Bed Of Channel At TMC-Div4

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Figure 6.27 Dense Ground Cover At Downstream End Of Diversion

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6.4 Downstream Reach

The downstream reach remains in a very similar state to the upstream reach. The creek consists of an incised channel with high sinuosity that sits within a large flat floodplain that is engaged frequently by stream flows. Immediately downstream of the diversion the floodplain widens with the majority of vegetation located in close proximity to the creek. Key observations from the inspection include:

- Immediately downstream of the diversion, Two Mile Creek is broad and flat with no clearly defined low flow channel and dense groundcover. As noted in previous inspections, sediment deposition appears to have been concentrated in the vicinity of this interface with no significant accretion evident at the downstream monitoring sites. The establishment of dense ground cover in this area was noted in Section 6.3 above (Figure 6.27)

- As with previous inspections, the downstream reach was considered to be in a moderate condition overall, with a clearly defined channel and good geomorphic diversity, with alternating benches, bars developing in relation to bends, and woody debris.

- As with other reaches, the extent of ground cover was observed to have increased relative to the previous inspection (Figure 6.28).

- Flood debris was observed in the downstream reach but appeared to be old and is understood to be from the Tropical Cyclone Debbie flow event (Figure 6.29).
- Some pools of ponded water were evident in discreet locations throughout the downstream reach with some evidence of access by stock (Figure 6.30 and Figure 6.32).
- As with previous inspections, bank erosion was evident in a number of locations along the downstream reach. The erosion did not appear to have significantly changed since the previous inspection. The erosion becomes more significant in the lower portions of the downstream reach with gully erosion of the floodplain observed on the right bank (Figure 6.31) and significant bank steepening in the vicinity of TMC-DS4 (Figure 6.32). This increase in erosion corresponds to a reduction in riparian vegetation as well as evidence of increased access by livestock.
- A drainage channel has been constructed in the vicinity of Drake 1 Pit and Drake 2 Pit that joins Two Mile Creek along the downstream reach between TMC-DS3 and TMC-DS4. The trapezoidal earth-lined channel appears to have performed well with only minor erosion of the toe of the left bank observed (Figure 6.33).
- There was no observed evidence of the diversion negatively impacting the downstream reach at the time of the inspection.

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Figure 6.28 Dense Ground Cover At TMC-DS1

Figure 6.29 Flood Debris Downstream Of TMC-DS1

Figure 6.30 Ponding And Evidence Of Stock Access At TMC-DS3

Figure 6.31 Gully Erosion On Right Bank Downstream Of TMC-DS3

Figure 6.32 Ponding And Bank Steepening At TMC-DS4

Figure 6.33 Erosion At Toe Of Left Bank Of Drain Downstream Of Drake 1 Pit And Drake 2 Pit

6.5 Index of Diversion Condition Results

The maximum possible score for any reach using the IDC assessment is 20. If a reach were to achieve this score, it would be in a stable geomorphic condition with minimal erosion or accelerated rate of sedimentation. It would also have continuous and dense vegetative ground, mid-storey and over-storey riparian vegetation. However, even outside of mining areas this score would be rare because most streams in central Queensland, as elsewhere, are subject to pressures of human use including grazing, infrastructure and other activities. Accordingly, the successful establishment of the diversion must be considered in the context of the upstream (i.e. control) reach and downstream reach.

6.5.1 2018 IDC Assessment

A summary of the overall 2018 IDC assessment scores for the three reaches is shown in Table 6.2 and Figure 6.34. Detailed IDC assessment sheets for each monitoring station location are provided in Appendix B.

Table 6.2 2018 Condition Scores

Index	Upstream Reach	Diversion Reach	Downstream Reach
Geomorphic Index	7.9	8.5	8.2
Riparian Index	6.4	3.3	6.7
Index of Diversion Condition	14.3	11.8	14.9

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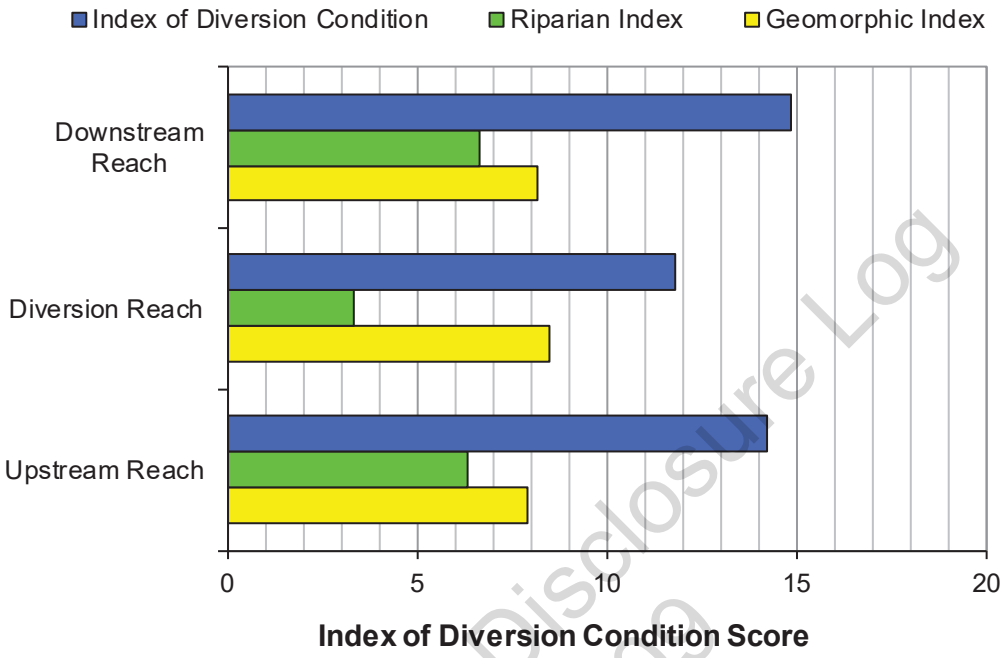

Figure 6.34 2018 Index Of Diversion Condition Results

The 2018 IDC scores indicate:

- The geomorphic condition of the diversion reach is comparable to the control (i.e. upstream) reach but scored considerably lower for the Riparian Index due to the limited variation in vegetation structure.
- Once vegetation establishment advances in the diversion reach it is expected that the score for the diversion reach will be similar to that of the control (i.e. upstream) reach.
- The condition of the downstream reach is similar to the upstream reach, with slightly higher scores for both the Riparian and Geomorphic Index. This indicates negligible impacts from the diversion on the downstream reach as a result of flow events in recent wet seasons.

6.5.2 Comparison of Previous IDC Assessments

Figure 6.35 compares the overall 2018 IDC scores for the three reaches against the corresponding scores from the 2014 and 2015 monitoring assessment. The 2018 IDC scores indicate improvement across all three reaches with the greatest improvement in the diversion reach. This is largely due to the improved vegetation structure as a result of two consecutive years of median annual rainfall and the increased establishment time since completion of the diversion construction. The difference in the scores for the three reaches is small and will need to be monitored over a longer period to determine any underlying trend in the condition of the waterway as it experiences a range of flow events.

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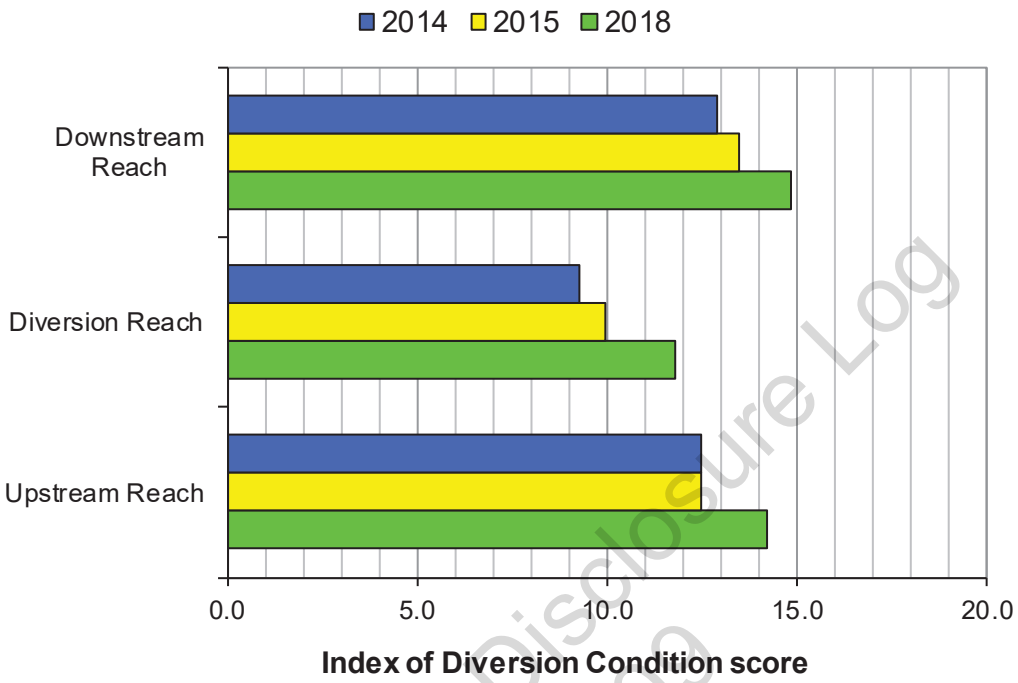

Figure 6.35 IDC Assessment Comparison Of 2014, 2015 And 2018 Results

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7. SUMMARY AND RECOMMENDATIONS

A monitoring program has previously been developed for the Two Mile Creek Diversion. The monitoring program has been developed in accordance with the ACARP Guideline *Monitoring and Evaluation Program for Bowen Basin River Diversions* (ID&A, 2001).

Engeny undertook the 2018 monitoring inspection of the Two Mile Creek Diversion on the 23rd of April 2018. Based on the stream flow monitoring data for Pelican Creek, observed flood levels in the Two Mile Creek Diversion and site rainfall monitoring data, it is considered likely that any flow event in the Two Mile Creek Diversion during the period of interest would have been smaller than a 20% (1:5) AEP event.

The diversion is generally considered to be in good condition and performing as per the design intent. However, several areas of flood damage remain since the previous inspection (caused during Tropical Cyclone Debbie in March 2017), which will require management action to prevent ongoing deterioration of the diversion.

From a geomorphic perspective, the diversion reach is in better condition than the upstream and downstream control reaches. The riparian vegetation condition of the diversion reach is limited due to the lack of diversity in plant type and relatively short establishment period since construction and below-average rainfall conditions. However, the ground covers are performing the function of providing the initial stability as other species continue to establish in the future.

Recommended short–term management actions for the Two Mile Creek diversion are summarised below while recommended remedial actions are summarised in Table 7.1.

- Continue to monitor key areas for signs of deterioration, including:
  - The concrete headwall on the upstream side of the high flow channel culverts at the haul road crossing.
  - The downstream side of the haul road crossing on the high flow channel to identify any localised damage following high flow events.
  - The downstream side of the haul road crossing in the low flow channel following flow events to ensure that vegetation is continuing to establish and damage to the diversion does not occur.
  - The area of ponding on the right bank of the high flow channel upstream of TMC-Div3 (observed in 2017 but not in 2018).

- Implement one of the following management actions to ensure the physical integrity of the diversion and prevent the scour holes at the haul road becoming a source of sediment to the downstream waterway:
  - **Reinstatement:** Repairing the scour holes by ripping and placing compacted fill and reinstatement of rock protection for the scour hole at the outlet of the high flow channel culverts; or

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- **Redesign:** Revisit the design of the haul road crossing scour protection to identify a solution that will perform better in future events. This may include stabilising the scour holes and using them as an energy dissipater until the haul road is decommissioned.

- Management of the lateral inflows on the left bank adjacent to Sediment Dam 5 and upstream of TMC-Div3 to prevent the progression of gully erosion. Recommended management strategies are:
  - Construction of dedicated drainage structures to convey concentrated inflows to the low flow channel; and
  - Repairing existing rilling and gully erosion by ripping, re-compacting and re-seeding.

- Continue to monitor previously identified rilling erosion for signs of deterioration.

- Monitor future releases from the SD5 pipe outlet to ensure that the damage does not continue to progress.

- Stabilise the erosion gullies downstream of SD5 and manage future flows by:
  - Review the upstream catchment runoff and provide a suitable drain to convey concentrated flows from this catchment to the diversion.
  - Repairing existing gully erosion by ripping, re-compacting and re-seeding.

- Monitor the establishment of ground cover in the downstream section of the diversion reach and consider undertaking additional seeding of this section to encourage establishment of ground cover if required.

- Monitor the areas of sediment deposition between TMC-Div3 and the end of the diversion for establishment of ground cover and to ensure that it does not become a source of sediment for the downstream reach.

- Replace the nine (9) physical markers that have been washed away in order to maintain consistency in the photo reference point for the purpose of ongoing monitoring (TMC-US1, TMC-US2, TMC-US3, TMC-US4, TMC-Div2, TMC-Div3, TMC-Div4 and TMC-DS2, TMC-DS3).

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Table 7.1 Recommended Remedial Actions

ID	Description	Timeframe
1	Manage lateral inflows on left bank at SD5 and on right bank upstream of TMC-Div3	Prior to 2018/19 wet season
2	Reinstate nine physical markers for ongoing photographic record	Prior to April 2019 monitoring inspection
3	Implement preferred management action to address scour holes at haul road crossing	Prior to 2018/19 wet season
4	Repair erosion gullies downstream of SD5 and implement a drainage solution for this catchment	Prior to 2018/19 wet season

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8. QUALIFICATIONS

a. In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

b. Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document are as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

c. Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

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   (ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

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g. This report does not provide legal advice.

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APPENDIX A

Monitoring Site Photos

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-US1

	Upstream	Cross stream	Downstream
2018			
2017			

Section 22 Document Disclosure Log

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-US1

	Upstream from bed	Cross Bed	Downstream from bed
2018			
2017			

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Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-US2

	Upstream	Cross stream	Downstream
2018			
2017			

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-US2

	Upstream from bed	Cross Bed	Downstream from bed
2018			
2017			

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-US3

	Upstream	Cross stream	Downstream
2018			
2017			

Submitted to eLog

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-US3

	Upstream from bed	Cross Bed	Downstream from bed
2018			
2017			

Published in FES Discussion Paper 2018 Hearing

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-US4

	Upstream	Cross stream	Downstream
2018			
2017			

Released under FOI Act

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-US4

	Upstream from bed	Cross Bed	Downstream from bed
2018			
2017			

Public Submission

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-Div1

	Upstream	Cross stream	Downstream
2018			
2017			

Section 22 of the FOI Act
Exempt Document Log

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-Div1

	Upstream from bed	Cross Bed	Downstream from bed
2018			
2017			

Released under the Freedom of Information Act 2000

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-Div2

	Upstream	Cross stream	Downstream
2018			
2017			

Section 22 of the Act - Private Log

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-Div2

	Upstream from bed	Cross Bed	Downstream from bed
2018			
2017			

Received by DES

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-Div3

	Upstream	Cross stream	Downstream
2018			
2017			

Scan DFO Act Issue Log

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-Div3

	Upstream from bed	Cross Bed	Downstream from bed
2018			
2017			

Published with DES Permit 20 Fire Log

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-Div4

	Upstream	Cross stream	Downstream
2018			
2017			

Publication on DLI Act Disclosure Log

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-Div4

	Upstream from bed	Cross Bed	Downstream from bed
2018			
2017			

Published by DES under the Public Records Act 2

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-DS1

	Upstream	Cross stream	Downstream
2018			
2017			

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Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-DS1

	Upstream from bed	Cross Bed	Downstream from bed
2018			
2017			

Public Inspection DES Act 20

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-DS2

	Upstream	Cross stream	Downstream
2018			
2017			

Published by DES Electronic Document Log

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-DS2

	Upstream from bed	Cross Bed	Downstream from bed
2018			
2017			

Published Reports 2018

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-DS3

	Upstream	Cross stream	Downstream
2018			
2017			

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-DS3

	Upstream from bed	Cross Bed	Downstream from bed
2018			
2017			

PUBLIC SUPPORT DISCLOSURE

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-DS4 *(no survey peg installed – tree provides fixed point)*

	Upstream	Cross stream	Downstream
2018			
2017			

Public Consultation Draft – Closure Log

Two Mile Creek Diversion Inspection (2018 vs 2017 Photographic Record)

Monitoring Point: TMC-DS4 *(no survey peg installed – tree provides fixed point)*

	Upstream from bed	Cross Bed	Downstream from bed
2018			
2017			

Published DES Disclosure Log
RTI 2009

Published on DES Disclosure Log
RTI Act 2009

APPENDIX B

IDC Assessment Field Sheets

INDEX OF DIVERSION CONDITION

Spreadsheet template for processing data

Reach information

Date:	23/04/2018
Collected by:	sch/
Diversion name:	Two Mile Creek
Location:	Sonoma Mine

AMG co-ordinates	*U1*	*U2*	*U3*	*U4*
Eastings	590606	590223	590578	590102
Nothings	7719248	7719627	7718098	7718493

Photographs Photo number	*U1*	*U2*	*U3*	*U4*

Summary of sub-index values

Geomorphic sub-index	7.9
Riparian sub-index	6.4
Index of Diversion Condition	**14.3**

Evaluation of sub-index values

Geomorphic sub-index

Stream width	*U1*	*U2*	*U3*	*U4*
Width of high flow channel (m)	12	15	17	15
Width of active channel (m)	7	5	5	5
Width of low flow channel (m)	1	1	1	1

Bank condition erosion = 2, extensive instability = 1, extreme instability = 0	*U1*	*U2*	*U3*	*U4*
	1	3	3	3

Embankment condition Nil piping of embankments = 4, moderate piping = 2, extensive piping = 0	*U1*	*U2*	*U3*	*U4*
	4	4	4	4

Bed condition	*U1*	*U2*	*U3*	*U4*
Nil bed aggradation or degradation = 4, moderate bed aggradation or degradation = 2, extreme bed aggradation or degradation = 0	3	2	4	4
Define whether aggradation (a) or degradation (d)	d	a		

Spoil Piles No spoil piles within 50 m of diversion = 4, Vegetated spoil piles within 50 m of diversion = 2, Unvegetated spoil piles within 50 m of diversion = 0	*U1*	*U2*	*U3*	*U4*
	4	4	4	4

Recovery Presence of vegetated benches = 4, Presence of unvegetated benches = 2, Absence of benches = 0	*U1*	*U2*	*U3*	*U4*
	0	3	3	2

Instream Structures	*Reach*
Absence of instream structures = 1, Presence of instream structures = 0	0
Stable structure - minor scouring only = 0, Moderately unstable - minor erosion requires maintenance = 1, Unstable - extensive scouring or undermining of structure = 2	0

Geomorphic sub-index value 7.9

Riparian sub-index

Width of streamside zone	*U1*	*U2*	*U3*	*U4*
Width of high flow channel	12	15	17	15
Width of riparian zone	13	30	40	50

Structural intactness (continuous = 4, patchy = 2, sparse = 0)	*U1*	*U2*	*U3*	*U4*
Overstorey	0	2	2	0
Understorey	4	2	2	1
Ground cover	4	4	4	4

Regeneration (presence = 1, absence = 0)	*U1*	*U2*	*U3*	*U4*
	1	1	1	1

Longitudinal continuity

	Running distance (m)	Mark by 'X' if vegetation is continuous
Start Northern Reach	0	
	576	x
	797	
	896	x
	1564	
	1690	x
	2093	
End Northern Reach	2150	
Start Southern Reach	2151	x
	2520	
	2590	x
	2950	
End Southern Reach	3660	

Length of bank (m)	3660
Length of bank with streamside vegetation width greater than 5 m (m)	2019
Number of discontinuities in representative site	6
Proportion of vegetated bank length	55%
Number of significant discontinuities per km	1.639344262

Riparian sub-index value 6.4

Comments

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RTI Act 2009

INDEX OF DIVERSION CONDITION

Spreadsheet template for processing data

Reach information

Date: 23/04/2018

Collected by: [redacted]

Diversion name: Two Mile Creek

Location: Sonoma Mine

AMG co-ordinates	*Div1*	*Div2*	*Div3*	*Div4*
Eastings	589834	588903	588200	587556
Nothings	7718817	7718641	7719197	7718327

Photographs	*Div1*	*Div2*	*Div3*	*Div4*
Photo number				

Summary of sub-index values

Geomorphic sub-index	8.5
Riparian sub-index	3.3
Index of Diversion Condition	**11.8**

Evaluation of sub-index values

Geomorphic sub-index

Stream width	*Div1*	*Div2*	*Div3*	*Div4*
Width of high flow channel (m)	70	90	180	160
Width of active channel (m)	13	22	22	18
Width of low flow channel (m)	5	10	10	9

Bank condition erosion = 2, extensive instability = 1, extreme instability = 0	*Div1*	*Div2*	*Div3*	*Div4*
	4	3	4	4

Embankment condition Nil piping of embankments = 4, moderate piping = 2, extensive piping = 0	*Div1*	*Div2*	*Div3*	*Div4*
	4	3	4	4

Bed condition	*Div1*	*Div2*	*Div3*	*Div4*
Nil bed aggradation or degradation = 4, moderate bed aggradation or degradation = 2, extreme bed aggradation or degradation = 0	4	4	4	4
Define whether aggradation (a) or degradation (d)				

Spoil Piles No spoil piles within 50 m of diversion = 4, Vegetated spoil piles within 50 m of diversion = 2, Unvegetated spoil piles within 50 m of diversion = 0	*Div1*	*Div2*	*Div3*	*Div4*
	4	3	4	4

Recovery Presence of vegetated benches = 4, Presence of unvegetated benches = 2, Absence of benches = 0	*Div1*	*Div2*	*Div3*	*Div4*
	2	2	2	2

Instream Structures	*Reach*
Absence of instream structures = 1, Presence of instream structures = 0	0
Stable structure - minor scouring only = 0, Moderately unstable - minor erosion requires maintenance = 1, Unstable - extensive scouring or undermining of structure = 2	0

Geomorphic sub-index value 8.5

Riparian sub-index

Width of streamside zone	*Div1*	*Div2*	*Div3*	*Div4*
Width of high flow channel	70	90	180	160
Width of riparian zone	0	0	0	0

Structural intactness (continuous = 4, patchy = 2, sparse = 0)	*Div1*	*Div2*	*Div3*	*Div4*
Overstorey	0	0	0	0
Understorey	0	0	0	0
Ground cover	4	4	4	4

Regeneration (presence = 1, absence = 0)	*Div1*	*Div2*	*Div3*	*Div4*
	1	1	1	1

Longitudinal continuity

Running distance (m)	**Mark by 'X' if vegetation is continuous**
0	
4830	

Length of bank (m)	4830
Length of bank with streamside vegetation width greater than 5 m (m)	0
Number of discontinuities in representative site	1
Proportion of vegetated bank length	0%
Number of significant discontinuities per km	0.207039337

Riparian sub-index value 3.3

Comments

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INDEX OF DIVERSION CONDITION

Spreadsheet template for processing data

Reach information

Date: 23/04/2018

Collected by: sch4r

Diversion name: Two Mile Creek

Location: Sonoma Mine

AMG co-ordinates	D1	D2	D3	D4
Eastings	586996	586565	586502	585821
Nothings	7718228	7717975	7717849	7717891

Photographs	D1	D2	D3	D4
Photo number				

Summary of sub-index values

Geomorphic sub-index	8.2
Riparian sub-index	6.7
Index of Diversion Condition	**14.9**

Evaluation of sub-index values

Geomorphic sub-index

Stream width	D1	D2	D3	D4
Width of high flow channel (m)	20	15	13	19
Width of active channel (m)	6	5	6	10
Width of low flow channel (m)	1	1	1	2

Bank condition erosion = 2, extensive instability = 1, extreme instability = 0	D1	D2	D3	D4
	3	4	2	0

Embankment condition Nil piping of embankments = 4, moderate piping = 2, extensive piping = 0	D1	D2	D3	D4
	4	4	4	4

Bed condition	D1	D2	D3	D4
Nil bed aggradation or degradation = 4, moderate bed aggradation or degradation = 2, extreme bed aggradation or degradation = 0	4	4	4	1
Define whether aggradation (a) or degradation (d)				d

Spoil Piles No spoil piles within 50 m of diversion = 4, Vegetated spoil piles within 50 m of diversion = 2, Unvegetated spoil piles within 50 m of diversion = 0	D1	D2	D3	D4
	4	4	4	4

Recovery Presence of vegetated benches = 4, Presence of unvegetated benches = 2, Absence of benches = 0	D1	D2	D3	D4
	2	4	2	4

Instream Structures	Reach
Absence of instream structures = 1, Presence of instream structures = 0	0
Stable structure - minor scouring only = 0, Moderately unstable - minor erosion requires maintenance = 1, Unstable - extensive scouring or undermining of structure = 2	0

Geomorphic sub-index value 8.2

Riparian sub-index

Width of streamside zone	D1	D2	D3	D4
Width of high flow channel	20	15	13	19
Width of riparian zone	20	30	25	20

Structural intactness (continuous = 4, patchy = 2, sparse = 0)	D1	D2	D3	D4
Overstorey	0	4	2	2
Understorey	2	0	2	0
Ground cover	4	4	3	4

Regeneration (presence = 1, absence = 0)	D1	D2	D3	D4
	1	1	1	1

Longitudinal continuity

Running distance (m)	Mark by 'X' if vegetation is continuous
0	
1170	x
1320	
1690	x
1850	
2340	x
2560	
2910	x

Length of bank (m)	2910
Length of bank with streamside vegetation width greater than 5 m (m)	2380
Number of discontinuities in representative site	3
Proportion of vegetated bank length	82%
Number of significant discontinuities per km	1.030927835

Riparian sub-index value 6.7

Comments

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RTI Act 2009