



FLY-BY-NIGHT MINE - WATER QUALITY INVESTIGATION

REPORT FOR MINERAL RESOURCES TASMANIA

18 June 2013 - Final - Project No: 2821.004

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1. INTRODUCTION

1.1 GENERAL

The historic Fly-By-Night tin / gold mine site is located south of Gladstone in North-Eastern Tasmania (Figure 1). The Fly-By-Night Creek (FBNC), which collects runoff from historic tin workings in the area, has been flagged by the Tasmanian Public and Environment Health Network (TPEHN) as an area potentially contaminated by heavy metals. The site is also included in the Mineral Resources Tasmania (MRT) schedule of sites earmarked for rehabilitation.

During May 2013, Mineral Resources Tasmania (MRT) engaged SEMF Pty. Ltd. (SEMF) to conduct a preliminary surface water quality investigation (general water quality parameters and metals/metalloids) in drainage lines within the FBNC sub-catchment and the adjacent Mt. Cameron Creek sub-catchment (Figure 1).

Project components integrated into SEMF's assessment included:

- Determination of site drainage in the FBNC and Mt. Cameron Creek sub-catchments;
- Assessment of the locations of potential contamination sources using aerial photographs, maps and existing databases;
- A site visit to assess the FBNC mine and collect water samples;
- Collect samples from and provide a visual assessment of an artificial impoundment, located just downstream of the historic FBNC mine workings to assess its potential impacts on downstream surface water quality;
- Examine the dam wall on the impoundment for any obvious signs of structural weakness (refer to Figure 2 and Figure 3); and
- Provide a qualitative assessment of potential contaminant impacts on flora and fauna around the sampled waterways.

Following the site visit, water samples were analysed at a NATA accredited laboratory (ALS) in order to:

- Establish general surface water quality trends within the FBNC and adjacent catchments; and
- Assess potential surface water quality impacts (through comparison with relevant guideline levels).

1.2 SCOPE OF WORKS

The investigation aimed to provide MRT with information:

- To determine the nature and magnitude of potential metal contamination in the drainage lines;
- To assist in narrowing down the approximate location(s) of possible metal contaminant sources in the FBNC and Mt. Cameron Creek sub-catchments;
- To broadly characterise surface water quality trends throughout the catchment and provide an indication of its suitability for various uses, via comparison with appropriate screening levels; and
- To document qualitative flora/fauna health which had been opportunistically observed during the site assessment.





Fly-By-Night Mine Water Quality Investigation

Figure 1: Location of Mt Cameron Creek and Fly-By-Night Creek Sub-Catchments

- Ringarooma River
- Fly-By-Night Sub-Catchment
- Mt Cameron Creek Sub-Catchment

Base data by TASMAR. © State of Tasmania
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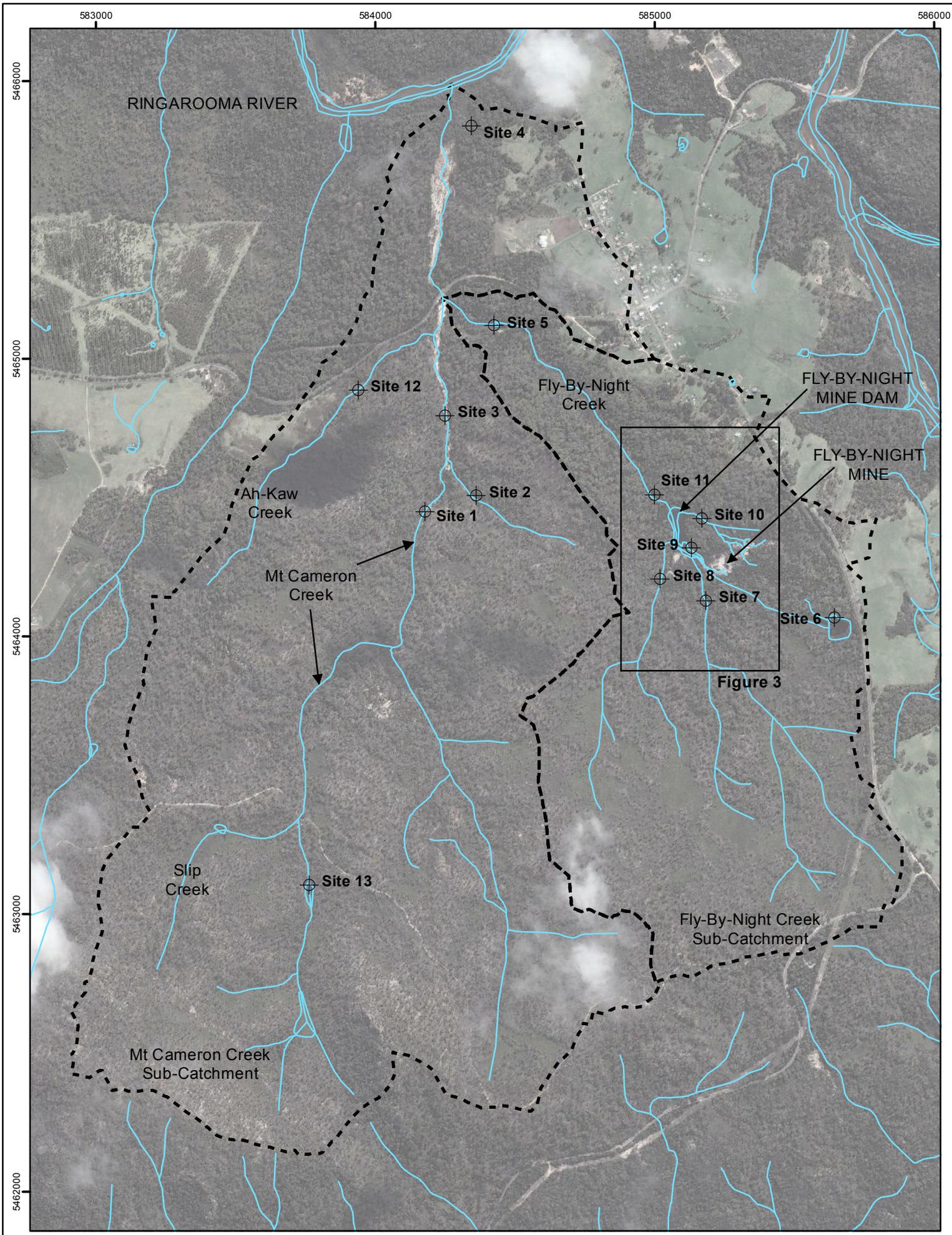


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0 500 1,000
Meters





Fly-By-Night Mine Water Quality Investigation

Figure 2: Location of Water Sampling Sites in the Mt Cameron and Fly-By-Night Sub-Catchments

Water Sampling Locations



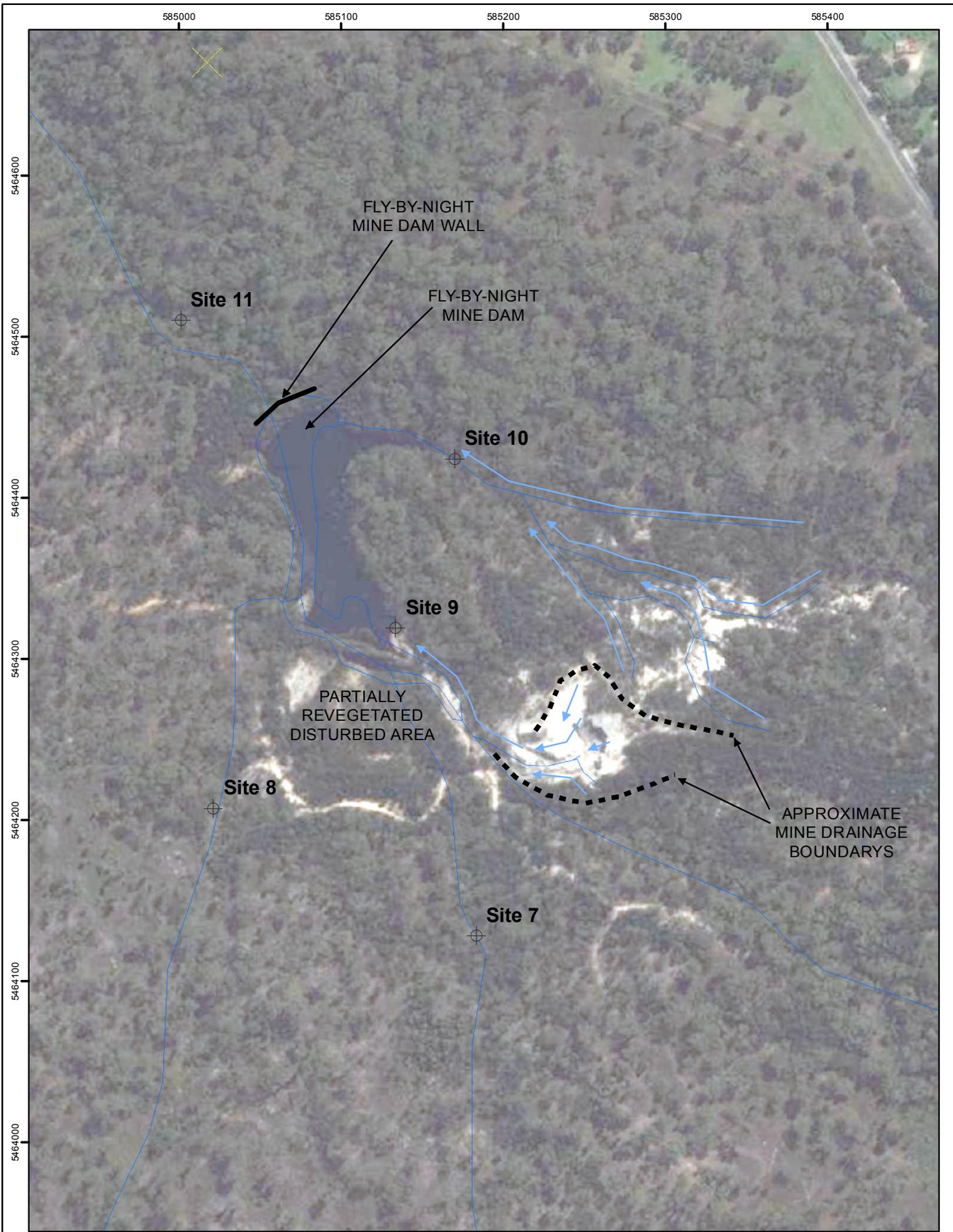
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0 125 250 Meters

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Fly-By-Night Mine Water Quality Investigation

Figure 3: Fly-By-Night Mine

-  Water Sampling Locations
-  Water Movement



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2. METHODS

2.1 DESKTOP ANALYSIS

Available contour information and elevation models, mineral deposits records (from MRT) and Google Earth imagery were reviewed to delineate catchment boundaries and to determine the location of various features including: historic mine workings, dams and drainage lines, etc. (refer to to Geological mapping (MRT 1:25,000 scale) information was also used to examine the extent of regional scale geological units across the site.

2.2 ONSITE ASSESSMENT

Mr. Anthony Williams and Dr. Colin McCoull (SEMF) conducted the site assessment on the 7th to 8th of May 2013, in conjunction with Mr. Andrew Wakefield (MRT) on the 7th of May.

The onsite assessment was divided into four components comprising:

- 1) verifying (ground-truthing) the locations of topographic features identified during the desktop assessment such as historic mine workings, dams and drainage lines,
- 2) surface water sampling,
- 3) visual assessment of flora and fauna health, and
- 4) a visual qualitative assessment of the FBNC dam wall.

2.2.1 Ground-truthing

The location of the FBNC mine, other mineral deposit points identified on the MRT database, downstream dam, drainage lines, catchment boundaries and general site geology were initially determined via desktop analysis (in ArcGIS) and were verified in the field during an initial short site inspection and subsequent site sampling. Additional mine working areas were noted during the field assessment. Those of relevance to the investigation (i.e. in close proximity to sampling locations, and with potential to impact surface water quality results) were noted (Figure 4).

2.2.2 Surface water quality assessment

Sampling locations

Whilst desktop analysis was used to determine appropriate areas for surface water sampling, locations were ultimately selected in an opportunistic fashion (sampling could only occur where surface water was present).

Photographs for each of the sampling locations shown in

Figure 2 (excluding FBNC-12) are included as a series of Plates (Appendix D).

Plates references are also referred to in Table 1, which summarises each sampling site in terms of its location, relevant field comments and rationale for the site's inclusion in the investigation.

Sample sites were selected to characterise surface water quality in the following drainage lines:

- Drainage lines above the primary mine workings on FBNC (Samples 6, 7 and 8);
- A drainage line between the primary mine workings on FBNC and the downstream surface water dam (sample 10 and samples 9 + duplicate);
- FBNC below the primary surface water dam (samples 4, 5 and 11); and
- Adjacent creek lines including; Mt. Cameron Creek (samples 1, 2, 3, 13) and – Ah Kaw Creek (sample 12).

Background sampling locations used for this assessment included; Site 12 (Ah-Kaw Creek), Site 6 (FBNC Sub-Catchment) and Site 13 (Mt. Cameron Creek Sub-Catchment) Figure 2 and Table 1. These are considered to be 'background' samples in the context of the FBNC catchment area, however they may not be necessarily representative of totally undisturbed waters.

In-field monitoring

A calibrated water quality meter (Aqua meter) was used to determine general water quality parameters in the field. Parameters included: temperature, oxidation reduction potential (ORP), pH, dissolved oxygen (percentage saturation), electrical conductivity ($\mu\text{S}/\text{cm}^3$), total dissolved solids (TDS), salinity and turbidity (NTU). A copy of the Aqua meter calibration certificate is attached as Appendix A.

Sample collection for laboratory analysis

Collection of surface water samples for analysis at a NATA accredited laboratory ALS also occurred. Samples were collected from various locations in an opportunistic fashion (where water was available) in accordance with:

AS/NZS 5667.1:1998 Water quality – Sampling, Part 1: 'Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples', Standards Australia, 1998.

Adopted surface water guidelines

In-field and laboratory analysis results were compared with a number of appropriate guideline levels, including:

- Australian Drinking Water Guidelines (ADWG 2004)– Health and Aesthetics;
- Aquatic ecosystems levels for protection of 95% of species - commonly applied to slightly disturbed aquatic ecosystems (ANZECC & ARMCANZ 2000);
- Default trigger values for conductivity (EC, salinity), total suspended solids (TSS) and pH indicative of slightly disturbed lowland rivers in south-east Australia (ANZECC & ARMCANZ 2000); and
- Livestock drinking water guidelines (ANZECC & ARMCANZ 2000).

Quality assurance

One blind duplicate sample was taken, DUP, of sample FBNC-09. Analytical results for both samples are provided in the summary tables in Appendix C. Repeatability of the results between both samples for all analytes is excellent and shows the reliability of the laboratory results. Laboratory supplied bottles were used for all samples and the samples were sent to the laboratory in cool-boxes, under chain of custody documentation. The condition and preservation of the samples on receipt was appropriate to the analytes tested.

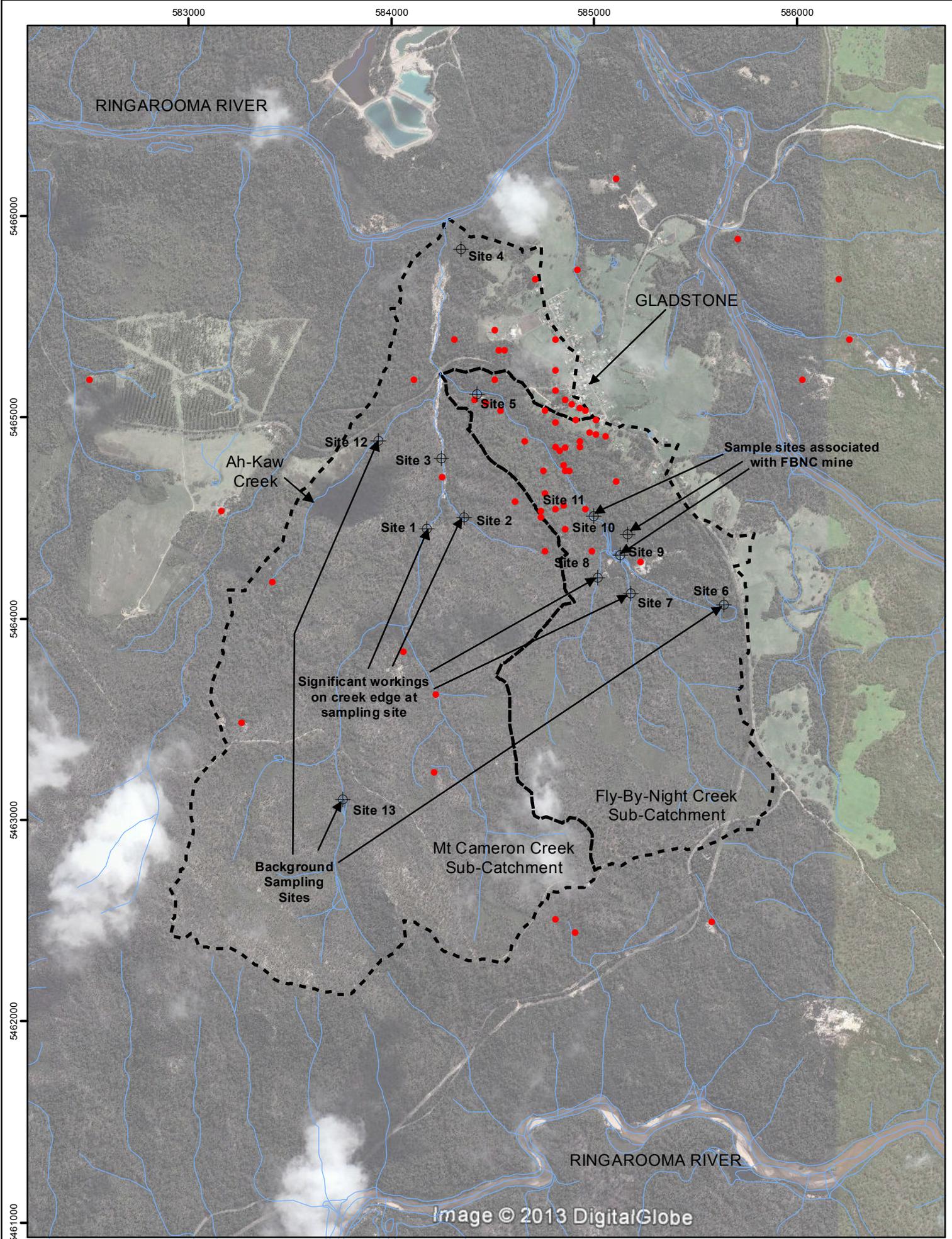
Comparison of water quality indicators determined via laboratory analysis showed strong correlation with in-field water quality meter results.

2.2.3 Assessment of in-stream flora and fauna impacts

A qualitative visual assessment of in-channel vegetation structure, site disturbance and general stream health was also undertaken during the water sampling event. Assessment results have been integrated into this report (Section 3.2).

2.2.4 Visual assessment of dam integrity

A visual inspection of the surface water dam, located below historic mine workings on FBNC was completed during the site assessment. The location of various erosion features were noted and photographed, with results integrated into Section 3.5 of the report.



Fly-By-Night Mine Water Quality Investigation

Figure 4: Location of Fly-By-Night Mine and other workings within the sub-catchments

-  Water Sampling Locations
-  Mineral Deposits (MRT)



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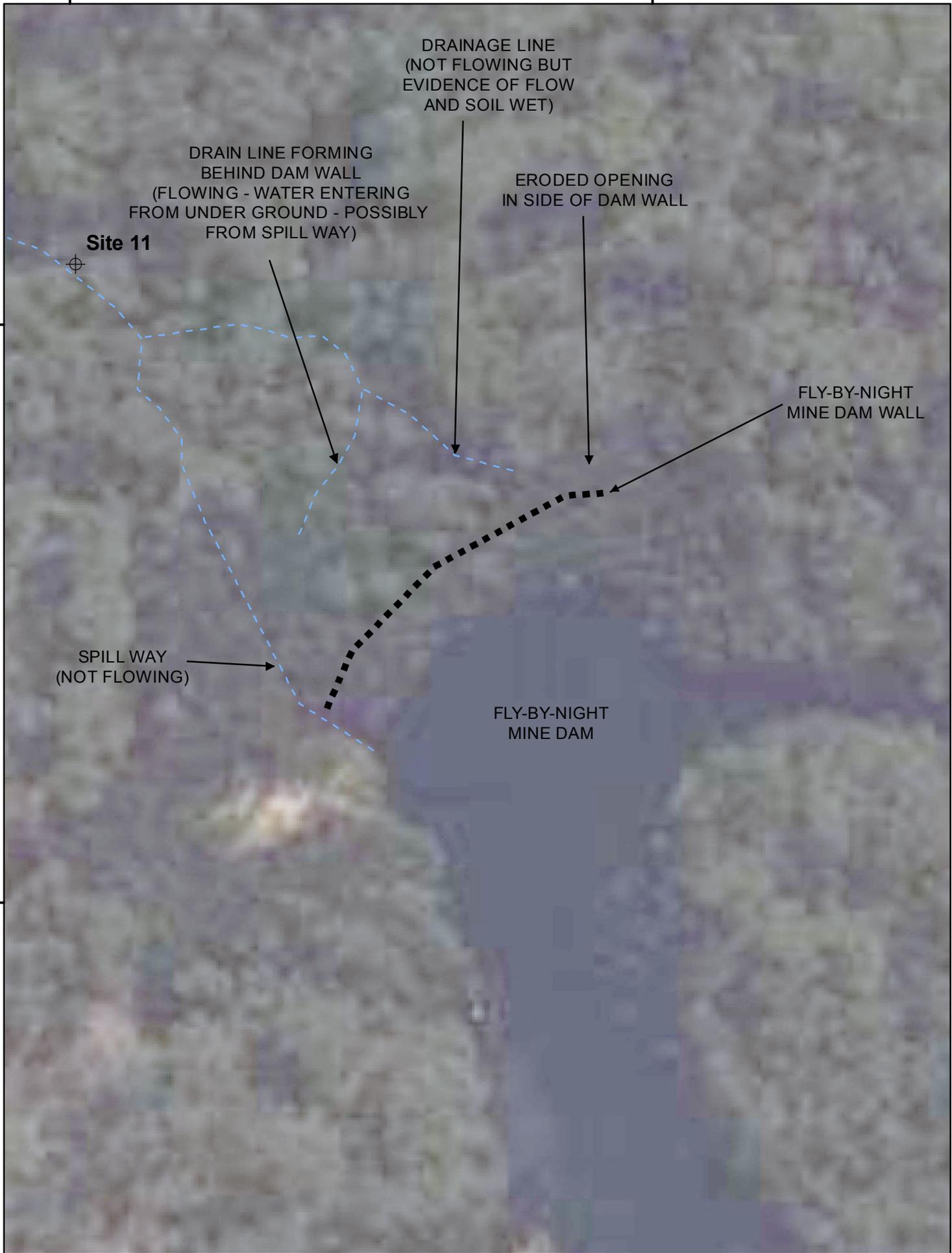


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**Fly-By-Night Mine
Water Quality Investigation**

Figure 5: Fly-By-Night Mine Dam



Water Sampling Locations



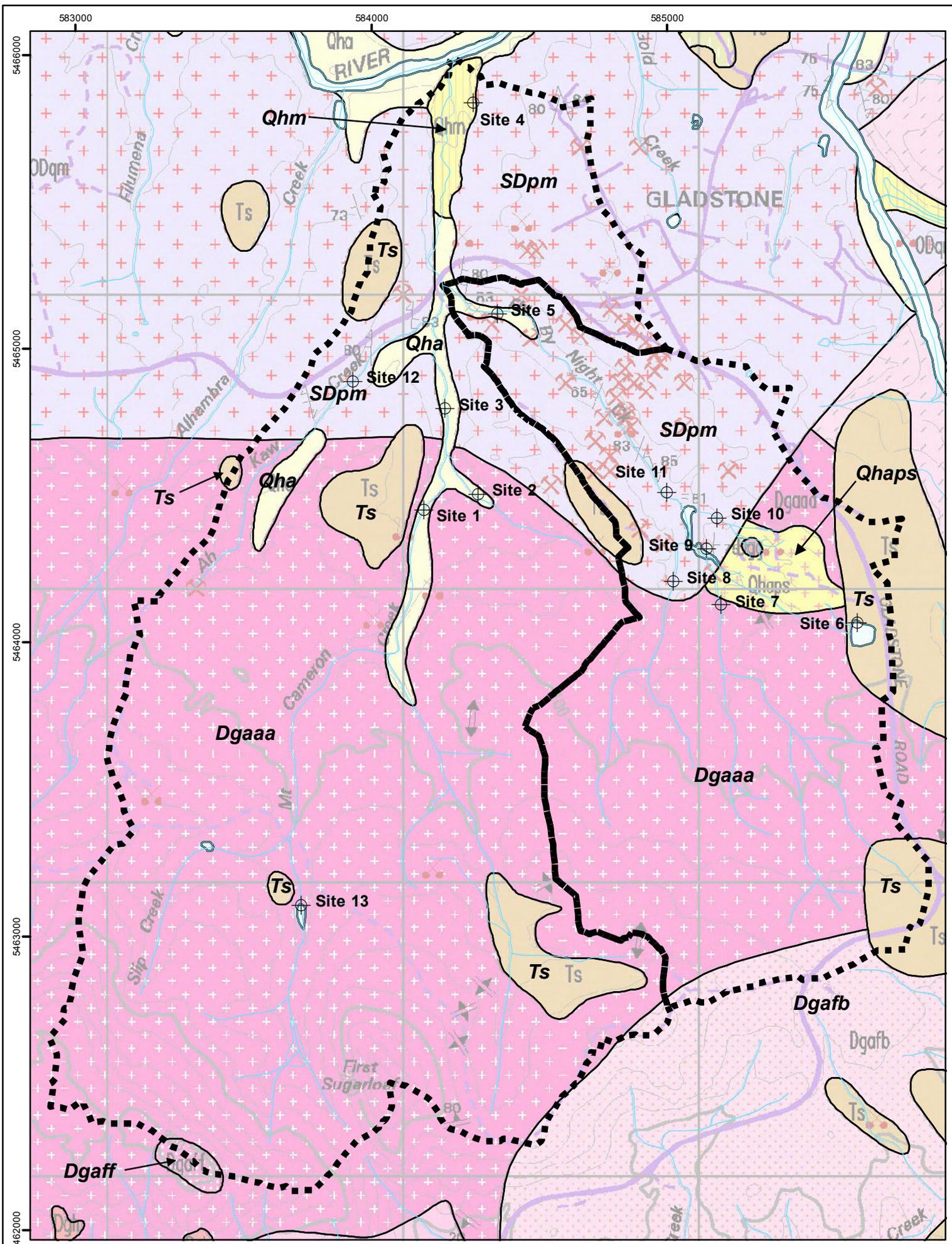
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0 10 20 Meters





Fly-By-Night Mine Water Quality Investigation

Figure 6: Geology (MRT - 1:25,000) of the Mt Cameron and Fly-By-Night Creek Catchments

⊕ Water Sampling Locations



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Meters

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3. DISCUSSION OF RESULTS

Each sampling location was described and photographed in the field. Figure 4 shows the location of each sample site relative to known mineral deposits and mine sites workings in the sub-catchments. Photographs of all sampling sites, as well as other important features are included as a series of plates in Appendix D. Photographs illustrating other site features are also included in Appendix D and referred to as appropriate.

Observations of general mining workings at each sampling location, information regarding in-stream flora and fauna, and important water quality results are integrated into Table 1, and are discussed as appropriate below.

3.1 GENERAL GEOMORPHOLOGY AND STREAM SEDIMENTS OBSERVATIONS

The catchment was dominated by medium to coarse grained potassium feldspar monzo-granites in the upper catchment reaches and turbidity (sedimentary) sequences in the lower catchment. Both these lithologies are interspersed with non-marine Tertiary sedimentary sequences and Quaternary Holocene alluvium and swamp deposits (Figure 6).

With the exception of the swamp deposits (site 4), the mineralogical composition of rock units within the catchment have little potential to contribute to surface water acidification. As such the presence of mildly acidic surface waters is likely a consequence of decomposition of the significant amounts of organic material present at the site and the slightly acidic nature of rainwater.

3.2 FLORA AND IN-STREAM FAUNA HABITAT

Aspects of flora and fauna common to all sites (generally) are provided below, with site-specific characteristics integrated into Table 2.

Excluding site 4 (which was a disturbed swamp forest), vegetation surrounding sampling locations was generally dominated by *Eucalyptus amygdalina* (black peppermint). Forested banks tended to have an open mid-storey dominated by *Allocasuarina littoralis*, *Acacia dealbata* and *Leptospermum scoparium* with occasional *Banksia marginata* and *Allocasuarina verticillata*. *Lomandra longifolia* and *Pteridium esculentum* often dominated the understorey, with occasional open patches of leaf litter and dry forest herbs and shrubs. A number of sites (i.e. FBNC-01, 02, 07 and 08) showed significant disturbance to the river banks, attributable to old mining-related works. However, in all cases the river banks were covered in regenerating native vegetation, indicating that mining disturbance was relatively old.

Aquatic macro-invertebrates were not observed at any in-creek sampling site (decomposing leaf litter was hand searched). Aquatic macro-invertebrates were however, observed in all dam sampling locations. Of the creek sampling sites, Site 8 did have a large number of burrowing crayfish holes on its banks (probably *Engaeus mairene*). With the exception of Site 3 (which was covered in deposited sand and gravel and had little organic material, decomposing leaf litter) the majority of the remaining in-stream sampling sites had a thin covering of decomposing litter and filamentous algae.

Table 1 – Sample location summary

Sample location	Location	Comments	Purpose
Samples collected from Mt.Cameron Creek and associated feeder tributaries (includes background location)			
FBNC-01	600m upstream of Mt. Cameron Creek and Fly-By-Night confluence.	Site 1 (Plate A) was on Mt Cameron Creek at the point where significant deposition of river sediment started, above the FBNC confluence. Two goldfish (<i>Carassius auratus</i>), one of which was dead, were observed.	To characterise surface water in Mt. Cameron Creek and associated feeder tributaries, above the confluence with the FBNC
FBNC-02	600m upstream of Mt. Cameron Creek and Fly-By-Night confluence on minor eastern drainage line.	Site 2 (Plate B) on Mt Cameron Creek sub-catchment, was characterised by significant evidence of in-stream mining disturbance (i.e. mine workings on the bank edges).	
FBNC-03	300m upstream of Mt. Cameron Creek and Fly-By-Night confluence.	Site 3 (Plate C) was further down stream (but still above the FBNC confluence) at a point where deposition of fine sands and small rocks was more pronounced. Covered in deposited sand and gravel and had little organic material (decomposing leaf litter).	
FBNC-13	Approximately 1.5Km upstream of Mt. Cameron Creek and Fly-By-Night confluence.	A relatively undisturbed background surface water monitoring location (impounded water body – Plate L), located in the upper Mt. Cameron Sub-Catchment. Terrestrial vegetation was present almost to the dam edge in some areas which provided some shade. This site was characterised by a more closed mid story dominated by <i>Leptospermum</i> sp.. Cutting grass and sedges were present. The dam appeared clean and contained submerged aquatic macrophytes and emergent aquatic and semi aquatic vegetation around its edges. A number of frogs were heard calling in vegetation around the dam (mostly <i>Litoria ewingi</i>) and aquatic macro-invertebrates were also observed during water sampling (including <i>Hemiptera</i> and <i>Coleoptera</i> spp).	<u>Background surface water monitoring location</u>
Samples collected from Ak-Kaw Creek			
FBNC-12	250m upstream of confluence with Mt. Cameron Creek.	Likely had some mining activities within main channel, it had been roughly cleared to the stream centre and was covered in short regenerating vegetation (i.e. ferns, bracken and short shrubs).	To characterise surface in Ah-Kaw Creek above the confluence with Mt. Cameron Creek. <u>Considered a background surface water monitoring location for Ah-Kaw Creek.</u>

Samples collected from above Primary Mine Site Workings in FBNC			
FBNC-06	Impoundment on eastern drainage line above primary FBNC Mine Workings.	<p>Impounded water body (Plate F). This site was considered a background surface water sampling location (also an impoundment) for this catchment, with little evidence of mining impacts.</p> <p>This site had tannin affected water present in a small open area and some emergent vegetation. No macro-invertebrates were observed at this site.</p>	To characterise surface water quality above primary mine workings on FBNC.
FBNC-07	Drainage line to south above primary FBNC Mine workings	Sites 7 and 8 (Plates G and H) in the Fly-By-Night Creek sub-catchment were both sites with significant evidence of in-stream mining disturbance (i.e. mine workings on the bank edges).	
FBNC-08	Drainage line to west above primary FBNC Mine Workings	<p>Sites 7 and 8 (Plates G and H) in the Fly-By-Night Creek sub-catchment were both sites with significant evidence of in-stream mining disturbance (i.e. mine workings on the bank edges).</p> <p>A large number of burrowing crayfish holes were noted on the banks (probably <i>Engaeus mairene</i>).</p>	
Samples collected from drainage lines and dam below primary FBNC Mine workings			
FBNC-09	Dam collecting flow from primary FBNC Mine workings and other upstream drainage lines within the FBNC Catchment.	<p>This sampling site (Plate I) was an impoundment located directly below the primary mine workings / significant mining disturbance located in FBNC.</p> <p>Contained brown water (tannin affected) and emergent aquatic and semi aquatic vegetation around their edges.</p> <p>Very sandy / gravelly dam environment with emergent dead woody vegetation and few submerged aquatic macrophytes</p> <p>Aquatic macro-invertebrates were observed during water sampling.</p>	To characterise surface water directly downstream of primary mine workings in the FBNC.
FBNC-10	Drainage line collecting surface water from FBNC Mine Workings (just above confluence with dam – very small pool of water only).	<p>Site 10 (Plate J) was in a small channel that drained the majority of the disturbed area in Fly-By-Night mine. During flow events, the channel would discharge into the impoundment located below the primary mine workings.</p> <p>At the time of sampling only a small residual puddle was present.</p>	
Dup	Duplicate of FBNC-09		To characterise surface water directly downstream of primary mine workings and provide a duplicate sample for quality assurance purposes.

Samples collected downstream of FBNC Dam			
FBNC-04	Swampland 150m upstream of FBNC confluence with Ringarooma River	<p>Site 4 (Plate D) was below the confluence of FBNC and Mt. Cameron Creek in swamp forest. This swamp area collected water from both drainage systems and from some cleared land to the west of Gladstone.</p> <p>Water at this site was brown (tannin affected) and stagnant. No macro invertebrates were observed at the site.</p> <p>The forest was dominated by an open canopy formed by <i>Melaleuca sp</i>, <i>Leptospermum sp</i> <i>Acacia melanoxylon</i>, and <i>Acacia dealbata</i>. As is typical in this type of community, the ground layer had a think covering of ferns, cutting grass, litle and other organic material.</p>	To characterise surface water in FBNC downstream of mine workings and dam but above confluence with Ringarooma River
FBNC-05	Small dam on FBNC above confluence with Mt. Cameron Creek (about 200m above road)	<p>This surface water sampling site (Plate E) was an impoundment located below areas of significant mining disturbance.</p> <p>Contained brown water (tannin affected) and emergent aquatic and semi aquatic vegetation around their edges.</p> <p>The site had a significant cover of submerged aquatic macrophytes. Aquatic macro-invertebrates were observed during water sampling and a number of frogs were also heard calling in vegetation (<i>Litoria ewingi</i>).</p>	
FBNC-11	FBNC directly below dam (collecting flow from various dam wall erosion features and spillway).	Site 11 (Plate K) was located just below the Fly-By-Night mine dam.	

3.3 GENERAL WATER QUALITY INDICATORS

In addition to affecting suitability of water for human and stock water consumption, human induced water quality impacts (as determined via general water quality characteristics) can lead to a number of in-stream issues (ANZECC & ARMCANZ 2000) including:

- Nuisance growth of aquatic plants and algae (eutrophication);
- Lack of dissolved oxygen (DO; asphyxiation of respiring organisms);
- Excess suspended particulate matter (SPM; smothering of benthic organisms), inhibition of primary production;
- Unnatural change in salinity (change in biological diversity);
- Unnatural change in temperature (change in biological diversity);
- Unnatural change in pH (change in biological diversity);
- Poor optical properties of water bodies (reduction in photosynthesis; change in predator–prey relationships); and
- Unnatural flow (inhibition of migration; associated temperature modification of spawning; changes in estuarine productivity).

In-field and laboratory assessment of general water quality indicators such as: temperature, oxidation reduction potential (ORP), pH, dissolved oxygen (percentage saturation), electrical conductivity ($\mu\text{S}/\text{cm}^3$), total dissolved solids (TDS), salinity and turbidity (NTU) thus provide information useful in the assessment of general surface water quality.

Water quality indicators monitored during the field assessment (See Appendix C – Table 1) show that:

- pH levels across the sub-catchments were mildly acidic (ranged from 5.3 to 6.6) but within the range specified for humic-rich Tasmanian lakes and rivers (4.0-6.5) (ANZECC & ARMCANZ 2000).
- pH levels were however predominantly (only exception being site FBNC-05 located downstream of the FBNC Dam) slightly lower than ADWG (2004) guideline of 6.5, potentially limiting the waters usefulness as a potable water source.
- EC results ranged from 196 to 649 $\mu\text{S}/\text{cm}^3$ being in the lower end of the range specified for slightly disturbed lowland rivers in south-east Australia (125 to 2200 $\mu\text{S}/\text{cm}^3$) (ANZECC & ARMCANZ 2000).
- DO levels were highly variable ranging from 40.4 to 105.3% saturation; with 10 of the 13 sample locations (including the background surface water monitoring location FBNC-06) recording DO

concentrations lower than default trigger values typical of lowland rivers in south-east Australia (ANZECC & ARMCANZ 2000).

- DO levels in the Cameron Creek and Ah Kaw Creek sub-catchments were typically within, or just below the normal range. In contrast, DO levels at surface water sampling locations in the FBNC sub-catchment were commonly much lower than the default trigger values typical of lowland rivers in south-east Australia (ANZECC & ARMCANZ 2000).
- However, those sampling sites with very low DO concentrations within the FBNC sub-catchment (sites FBNC—04, 09, Dup and 10) were all characterised by significant levels of organic material, that when decomposed likely consumed significant amounts of oxygen. Additionally, little or no water flow was evident at these sites (FBNC—04, 09, Dup and 10) at the time of sampling, limiting the ability for surface waters to replenish oxygen supplies via normal flow processes.
- No guidelines were available for other water quality indicators, though values for TDS, temperature and redox potential were within the ranges commonly encountered in freshwater systems.

Water quality indicators determined via laboratory analysis (Appendix C – Table 2) largely mimicked in-field results, with all pH and EC levels being within adopted guidelines.

Suspended solids (SS) were also determined via laboratory analysis and generally followed the spatial patterns highlighted for turbidity. Only 1 of the 13 sample sites (site FBNC-10) had an exceedance of ANZECC & ARMCANZ 2000 range (6 to 50 mg/L). Site number 10 was in fact a small puddle with significant sediment and organic debris, located between the primary mine workings and the surface water dam on FBNC.

3.4 TOXICANTS

The presence of metals/metalloids and other toxicants at sufficiently high concentrations can compromise the use of surface water for consumption by humans and stock, or for the support of aquatic ecosystems. The following sub-headings assess surface water suitability for a range of potential uses.

3.4.1 Human consumption (Health)

Appendix C - Table 3 shows that from a **human health** perspective metal / metalloid concentrations in water across all sites were generally satisfactory (below ADWG 2004 levels). The following exceptions were however noted:

Arsenic: Sample site FBNC-05 (located in the lower portion of the Fly-By-Night catchment below the dam) was characterised by very slightly elevated total arsenic concentrations, relative to other sites and ADWG's (0.009 mg/L against guideline level of 0.007mg/L). Dissolved arsenic concentrations at this site, were however well below ADWG's and laboratory detection limits, suggesting that the arsenic is being carried by the particulates in the water.

Cadmium: Total and dissolved cadmium concentrations were approximately 5 times higher than ADWG's (2004) (0.011 and 0.010 mg/L against the guideline of 0.002mg/L) at site FBNC-02 in the Mt. Cameron Creek

sub-catchment. The presence of dissolved cadmium concentrations at these concentrations indicates surface waters may be inappropriate for human consumption at this location. However, the cadmium concentration is still relatively low and no elevated cadmium concentrations were noted downstream (sites FBN-03 and 04) suggesting only localised impacts.

3.4.2 Human Use (Aesthetics)

For completeness, we also discuss here the comparison to water quality guidelines that have been developed for aesthetic criteria, i.e. potential for visual impacts on the water and impacts on water storage infrastructure (e.g. tanks, pools, sinks, etc.).

Appendix C - Table 4 shows numerous exceedances of ADWG (2004) **aesthetic** guidelines for iron and aluminium (both total and dissolved concentrations) however these guidelines are set relative to waters which may appear coloured or may cause staining or marking on infrastructure and water containing equipment.

It is also noted that the dissolved concentrations are typically lower than total concentrations, suggesting that portions of the metals are bound to the suspended material in the water.

Background sites FBNC-06 and FBNC-12 both had alumina exceedances, and FBNC-12 also had iron exceedances of the aesthetic guideline levels for those analytes. However, FBNC-13 sample concentrations were all below the aesthetic guideline limits.

Given the presence of both alumina and iron at relatively similar concentrations to those in the downstream samples, in what are considered to be background samples from the mining works perspective, it is considered likely that these compounds are sourced from the primary lithologies (granitoids and sediments) and not necessarily only due to mining disturbance.

3.4.3 Stock consumption

Appendix C - Table 5 shows that from a livestock supply perspective metal / metalloid concentrations in water across all sites were largely satisfactory (below ANZECC and ARMCANZ 2000 concentrations), with the following exception:

Cadmium: Very minor exceedances of stock watering guidelines for cadmium (total and dissolved) occurred at site FBNC-02. Dissolved cadmium concentrations were marginally in excess of guideline values (0.0114 and 0.0107 mg/L respectively against the guideline of 0.01mg/L) and may suggest bio-availability and limit suitability for stock watering purposes. It must however be noted that the exceedance was very minor and localised in nature, with no elevated cadmium concentrations noted at downstream sites (FBNC-03 and 04).

3.4.4 Aquatic ecosystems

Appendix C - Table 6 shows that a significant number of sample sites exceeded aquatic ecosystems levels for the protection of 95% of species - commonly applied to slightly disturbed aquatic ecosystems (ANZECC & ARMCANZ 2000). Exceedances were primarily associated with:

- Aluminium (total and dissolved) at all sites, including background;



- Cadmium (total and dissolved concentrations) at two sites, FBNC-02 and FBNC-10.
- Zinc (total and dissolved concentrations), at several sites, including background site FBNC-13;
- Copper (total and dissolved concentrations), at several sites, including background site FBNC-13.

Aluminium concentrations are fairly consistent throughout the catchment and are considered to be at close to natural concentrations for this catchment throughout all sampling locations.

Cadmium concentrations at FBNC-10 and FBNC-2 are the only anomalous locations for this metal, and at FBNC-10 the exceedance is only minor, 0.0004 and 0.0007mg/L against the guideline of 0.0002mg/L. However the exceedance at FBNC-2 is more significant, of the order of 60 times greater than the guideline limit and significantly above background.

Zinc exceedances are at fairly elevated concentrations in the exceedances, and even though some zinc is reported from the background site FBNC-13, suggesting primary lithological chemical input, the other sites have much more elevated concentrations, suggesting potential concentrating impact from the mining workings at locations: FBNC- 2, 5, 7, 11.

Copper exceedances are at very low concentrations, and also occur in background site samples FBNC-13, and only marginally above the guideline level of 0.0014mg/L. When comparing to background, the only site that may have some potential copper concentrating impact from mining workings is FBNC-10.

3.5 VISUAL INSPECTION OF DAM

Plates related to the site inspections are provided in Appendix D.

A visual inspection of the dam wall on FBNC, below the primary FBNC Mine Workings, showed the presence of extensive *Allocasuarina* regrowth (Plate Q) growing on a substrate of gravelly clay on the dam wall. In addition there was obvious tunnel erosion in the north-eastern section of the dam wall (Plate S) and emergent seeps (Plates R and T).

Sandstone, siltstone and mudstones all outcrop in this vicinity. Regional geological mapping of the area highlights the presence of Siluro-Devonian sediments (primarily turbidite sequences) that have undergone some level of contact metamorphism as a result of granitoid intrusions during the Devonian.

It is likely that the sediments were used to construct the dam wall and Siluro-Devonian sediments of this type in Tasmania are commonly dispersive. This likely explains the presence of:

1. tunnel erosion features located on the north-eastern section of the dam wall (approximately a one meter opening) (Plate S); and
2. emergent seeps (Plates R and T) behind the dam wall (potentially capturing water from the dam, or spillway located to the north-west of the dam.

Whilst no detailed geomorphologic assessment of the dam wall was completed, the presence of intact sandstone bedrock at depth, overlain by less resistant sediments suggests that water from the dam likely permeates down to the sandstone layers at depth and then flows across the hard interface, removing the less cohesive overlying sediments and promoting the development of tunnel erosion.

4. CONCLUSIONS

The majority of sampling sites were characterised by slightly acidic (though in specified range for rivers of this type) commonly oxygen deficient surface waters with variable turbidity and suspended sediment concentrations (waters ranging from very clear to highly turbid).

No clear trends relating presence of mining activities and poor **water quality indicator** results was evident. However, sites with low DO and elevated turbidity readings / suspended sediment loads seemed to be those with an absence of flow and high levels of organic material present.

pH levels were typically lower than ADWQ (2004) guideline of 6.5, limiting the waters usefulness as a potable water source and potentially assisting some toxicants (metals / metalloids) to be more readily dissolved, and increasing the potential for bioavailability and organism uptake (aquatic organisms, stock and humans).

From a **human health** perspective, the majority of metal / metalloid concentrations were satisfactory, however the following localised impacts were noted (impacts were spatially restricted with no downstream impacts noted) and may preclude water use for human consumption at the sites concerned:

- Slightly elevated **cadmium** concentrations (total and dissolved) at site **FBNC-02** in the Mount Cameron Creek, where the concentration was 5 times above the guideline limit of 0.002mg/L;
- **Slightly** elevated **arsenic** concentration was noted well downstream of the primary workings in FBNC (sample site **FBNC-05**), the dissolved metal concentration at that location was below guideline value, suggesting that the arsenic is bound to the suspended material; the concentration was only 0.009mg/L against the guideline of 0.007mg/L.

Levels of **iron and aluminium** in surface waters throughout the catchment may render the **visual** appearance of water displeasing and thus unsuitable for human infrastructure use; however this may not be relevant in this assessment as it is unlikely that these considerations would be required in this location. Concentrations of these elements were generally acceptable at background impoundment sites (FBNC-06 and 13) where potential for colloidal settling was greatest. However, it should be noted that iron and aluminium levels were still elevated in internal impoundment sites (FBNC-05 and 08).

When comparing to ANZECC guidelines for the **protection of aquatic ecosystems**, and against background concentrations within the catchment, only a few locations showed potential impact to water quality from the mining workings and at levels that may affect ecosystems:

- Copper and Cadmium at FBNC-10;
- Cadmium and Zinc at FBNC-2; and
- Zinc at FBNC-5, 7 and 11.

These exceedances have the potential to adversely affect the local aquatic ecosystems. All these sites, except for site FBNC-5, are located within the FBNC mine catchment. From an aquatic ecosystem perspective FBNC-02 and 10 were both of slightly lower quality than many other sites (no evidence of aquatic macro-invertebrates and significant coverage of filamentous algae (especially at FBNC-10).



Surface water throughout both catchments appeared to be generally of a quality suitable for **stock consumption** with only one minor exceedance for cadmium at site FBNC-02 in the Mt. Cameron Creek sub-catchment.

Whilst the presence of large scale tunnel erosion features and downstream seepages within / below the **dam wall** calls into question the structural integrity of that structure, this does not appear to have resulted in considerably elevated downstream toxicant concentrations, relative to other sites.

The presence of widespread mine workings throughout both the FBNC and Mt. Cameron Sub-catchments is likely contributing to reduced water quality, however no single contaminant input source was clearly evident.

That being said, it is likely that any appropriate rehabilitation works completed within the catchment would contribute to an improvement in water quality, and the repair or appropriate modification of the dam wall may need to be carried out as a matter of priority, to avoid a sudden flood release of water and sediment as a result of a potential breach of this structure.

5. REFERENCES

AS 5667:1998 Part 1: *'Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples'*, Standards Australia, 1998.

ANZECC & ARMCANZ 2000, *'National Water Quality Management Strategy, Australian and New Zealand Guidelines for Fresh and Marine Water Quality'*,

NHMRC 2004, *'Australian Drinking Water Guidelines'* (Health and Aesthetics).

NEPC, 1999, *'Guideline on Data Collection, Sample Design and Reporting Schedule B (2), National Environmental Protection Measure (Assessment of Site Contamination)'*.

APPENDICES



Appendix A – AquaMeter Calibration Certificate



RENTALS

Equipment Report – Aquameter- Water Quality Meter

This Aquameter Water Quality Instrument has been performance checked / calibrated* as follows:

Electrodes cleaned/checked

pH (Acidity/Alkalinity) pH 7.00 pH4.00

Electrical Conductivity 1413uS/cm 2570uS/cm 12880uS/cm

ORP 281 mV 250mV

Dissolved Oxygen 0.00ppm in Sodium Sulphite 100% Saturation in moist Air

Turbidity 0.00 NTU 1000NTU Temperature

Batteries (x 5 AA) 100 %

Aquameter S/N 122622327

Probe S/N 126120420

* Calibration solution traceability information is available upon request.

Date: 3rd May 2013 Checked by: PETER

Signed: 

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum \$20 cleaning / service / repair charge may be applied to any unclean or damaged items. Items not returned will be billed for at the full replacement cost.

Sent	Received	Returned	Item
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Aquameter unit
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Aquameter Ops check / Batteries <u>100</u> %.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Instruction Manual / Quick use guide
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Protective sleeve cap
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Spare Batteries x 5 (Alkaline / Rechargeable <u>7.5</u> volts)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Aquameter flow cell (AQR200_____)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cross Head screw driver
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Software & USB cable
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Quick release lanyard (Blue shoulder strap)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ph/ORP cap (with red strap)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Carry case
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Processors Signature/ Initials



Quote Reference	<u>35297</u>	Condition on return
Customer Ref	<u>T12638</u>	
Equipment ID	<u>AQR200 2000MB</u>	
Equipment serial no.		
Return Date	<u> / /</u>	
Return Time		

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Appendix B – Laboratory Results



Environmental Division

CERTIFICATE OF ANALYSIS

<p>Work Order : EM1304874</p> <p>Client : SEMF PTY LTD</p> <p>Contact : MR ANTHONY WILLIAMS</p> <p>Address : LEVEL 2 162 MACQUARIE STREET HOBART TAS, AUSTRALIA 7001</p> <p>E-mail : anthony.williams@semf.com.au</p> <p>Telephone : +61 03 6212 4400</p> <p>Facsimile : +61 03 6212 4475</p> <p>Project : Mineral Resources Tasmania - Fly By Night Creek Water Quality Assessment</p> <p>Order number : ----</p> <p>C-O-C number : ----</p> <p>Sampler : AW</p> <p>Site : ----</p> <p>Quote number : EN/040/12</p>	<p>Page : 1 of 8</p> <p>Laboratory : Environmental Division Melbourne</p> <p>Contact : Client Services</p> <p>Address : 4 Westall Rd Springvale VIC Australia 3171</p> <p>E-mail : Melbourne.Enviro.Services@alsglobal.com</p> <p>Telephone : +61-3-8549 9600</p> <p>Facsimile : +61-3-8549 9601</p> <p>QC Level : NEPM 1999 Schedule B(3) and ALS QCS3 requirement</p> <p>Date Samples Received : 10-MAY-2013</p> <p>Issue Date : 17-MAY-2013</p> <p>No. of samples received : 28</p> <p>No. of samples analysed : 14</p>
---	--

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics
Varsha Ho Wing	Non-Metals Team Leader	Melbourne Inorganics
Varsha Ho Wing	Non-Metals Team Leader	Melbourne Inorganics



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

- All Metals from waters is conducted by ALS Sydney, NATA accreditation no. 825, site no 10911.
- EA010: EM1304874 #5, insufficient sample volume has been provided for analysis.
- EG020: It is recognised that total concentration is less than dissolved for some analytes. However, the difference is within experimental variation of the methods.
- Selected samples were filtered through a 0.45um filter prior to the dissolved metals analysis.



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Client sample ID

Client sampling date / time

				FBNC-01	FBNC-02	FBNC-03	FBNC-04	FBNC-05
				07-MAY-2013 13:45	07-MAY-2013 14:41	07-MAY-2013 15:27	07-MAY-2013 16:20	07-MAY-2013 17:00
Compound	CAS Number	LOR	Unit	EM1304874-001	EM1304874-002	EM1304874-003	EM1304874-004	EM1304874-005
EA005: pH								
pH Value	----	0.01	pH Unit	6.29	5.69	6.17	6.21	6.55
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	311	774	315	296	----
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	14	<5
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.14	0.31	0.20	0.11	0.14
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	0.002	0.006
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0114	0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.004	0.002	<0.001	0.001	0.002
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	0.002	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	0.092	<0.005	<0.005	0.018
Manganese	7439-96-5	0.001	mg/L	0.009	0.035	0.010	0.073	0.004
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	0.29	0.09	0.35	2.61	1.46
Gold	7440-57-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.22	0.34	0.32	0.41	0.18
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	0.004	0.009
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0107	0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.002	0.008	0.002	0.003	0.002
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	0.002	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	0.100	0.006	0.010	0.012
Manganese	7439-96-5	0.001	mg/L	0.012	0.036	0.010	0.085	0.006
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	0.70	0.10	0.41	8.01	2.43
Gold	7440-57-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Client sample ID

				FBNC-01	FBNC-02	FBNC-03	FBNC-04	FBNC-05
				07-MAY-2013 13:45	07-MAY-2013 14:41	07-MAY-2013 15:27	07-MAY-2013 16:20	07-MAY-2013 17:00
				EM1304874-001	EM1304874-002	EM1304874-003	EM1304874-004	EM1304874-005
Compound	CAS Number	LOR	Unit					
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Client sample ID

Client sampling date / time

				FBNC-06	FBNC-07	FBNC-08	FBNC-09	FBNC-10
				08-MAY-2013 08:28	08-MAY-2013 10:25	08-MAY-2013 08:20	08-MAY-2013 09:48	08-MAY-2013 12:02
Compound	CAS Number	LOR	Unit	EM1304874-006	EM1304874-007	EM1304874-008	EM1304874-009	EM1304874-010
EA005: pH								
pH Value	----	0.01	pH Unit	5.62	5.25	5.52	5.74	5.27
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	297	567	456	317	384
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	<5	131
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.24	0.35	0.27	0.37	0.30
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.0004
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.001	<0.001	0.003	0.002	0.011
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	0.004
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	0.027
Manganese	7439-96-5	0.001	mg/L	0.040	0.030	0.013	0.017	0.085
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	0.21	0.13	0.30	0.73	0.81
Gold	7440-57-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.23	0.39	0.34	0.55	0.72
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.0007
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	0.005	<0.001	0.004	0.025
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	0.003
Zinc	7440-66-6	0.005	mg/L	<0.005	0.015	<0.005	0.005	0.026
Manganese	7439-96-5	0.001	mg/L	0.042	0.033	0.014	0.019	0.090
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	0.22	0.16	0.38	1.35	1.96
Gold	7440-57-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Client sample ID

Client sampling date / time

				FBNC-06	FBNC-07	FBNC-08	FBNC-09	FBNC-10
				08-MAY-2013 08:28	08-MAY-2013 10:25	08-MAY-2013 08:20	08-MAY-2013 09:48	08-MAY-2013 12:02
				EM1304874-006	EM1304874-007	EM1304874-008	EM1304874-009	EM1304874-010
Compound	CAS Number	LOR	Unit					
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Client sample ID

Client sampling date / time

				FBNC-11	FBNC-12	FBNC-13	Dup	----
				08-MAY-2013 12:33	08-MAY-2013 14:07	08-MAY-2013 15:22	08-MAY-2013 15:00	----
Compound	CAS Number	LOR	Unit	EM1304874-011	EM1304874-012	EM1304874-013	EM1304874-014	----
EA005: pH								
pH Value	----	0.01	pH Unit	5.80	5.98	6.05	5.78	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	318	342	290	309	----
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	18	14	<5	<5	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.36	0.15	0.18	0.38	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	0.001	<0.001	0.002	0.002	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Zinc	7440-66-6	0.005	mg/L	0.010	<0.005	0.008	<0.005	----
Manganese	7439-96-5	0.001	mg/L	0.036	0.009	0.003	0.017	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Iron	7439-89-6	0.05	mg/L	1.59	0.34	0.15	0.71	----
Gold	7440-57-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.38	0.29	0.17	0.56	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	0.001	<0.001	<0.001	0.004	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Zinc	7440-66-6	0.005	mg/L	0.006	0.006	0.011	0.021	----
Manganese	7439-96-5	0.001	mg/L	0.037	0.020	0.003	0.018	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Iron	7439-89-6	0.05	mg/L	2.19	1.67	0.20	1.33	----
Gold	7440-57-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Client sample ID

FBNC-11	FBNC-12	FBNC-13	Dup	----
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Client sampling date / time

08-MAY-2013 12:33	08-MAY-2013 14:07	08-MAY-2013 15:22	08-MAY-2013 15:00	----
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Compound	CAS Number	LOR	Unit	EM1304874-011	EM1304874-012	EM1304874-013	EM1304874-014	----
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EG035F: Dissolved Mercury by FIMS

Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
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EG035T: Total Recoverable Mercury by FIMS

Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
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Appendix C – Comparison Of Results (Field and Laboratory) With Adopted Screening Levels



Table 1 - Water Quality Field Monitoring Results - Comparison against ANZECC & ARMCANZ (2000)

Parameter	Guideline value	FBNC-01	FBNC-02	FBNC-03	FBNC-13	FBNC-04	FBNC-05	FBNC-11	FBNC-06	FBNC-07	FBNC-08	FBNC-09	Dup	FBNC-10	FBNC-12
		Mt. Cameron Creek				Downstream of FBNC Dam			Above primary mine workings in FBNC sub-catchment			Direrctly below primary mine workings in FBNC sub-catchment		Ah Kaw Creek	
pH	4.0-6.5*	5.51	4.46	5.28	6.14	5.58	5.8	5.81	5.69	5.1	5.55	5.85	5.85	5.04	6
EC (uS/Cm3)	125 to 2200**	235	649	242	196	213	305	231	208	453	356	226	226	296	212
DO (% saturation)	85-110****	83.3	94.2	105.3	83.5	40.4	89	71.8	62.9	75.4	63.4	57.7	57.7	46.7	85.9
Turb (NTU)	6 to 50***	81.3	0	0	0	75.2	22	24.3	0	0	0	0	0	135	73.8
TDS (mg/L)		152	422	156	128	139	198	150	134	294	231	146	146	193	134
Temp (degrees C)		10.4	8.5	12.1	13.1	16.3	10.3	10.8	8.4	9.9	8.6	9.8	9.8	12.7	10
ORP (mV) +ive unless otherwise stated		196	371	251	303	164	253	189	327	303	270	247	247	180	210
Notes	* ANZECC & ARMCANZ (2000) Default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems. Specified pH value is for humic rich Tasmanian lakes and rivers 4.0-6.5.														
	** ANZECC & ARMCANZ (2000) Default trigger values for conductivity (EC, salinity) indicative of slightly disturbed lowland rivers in south-east Australia.														
	*** ANZECC & ARMCANZ (2000) Default trigger values for NTU (Table 3.3.3 of the guidelines state that TSS and NTU values are typically the same) indicative of lowland rivers in south-east Australia. Turbidity in lowland rivers can be extremely variable. Values at the low end of the range would be found in rivers flowing through well vegetated catchments and at low flows. Values at the high end of the range would be found in rivers drainingslightly disturbed catchments and in many rivers at high flows.														
	**** ANZECC & ARMCANZ (2000) Default trigger values for dissolved oxygen (DO) indicative of lowland rivers in south-east Australia. DO measurements specified are daytime values and significant diurnal variation may occur.														
Color Key:	Within Guideline	Exceeds Guideline													

Appendix D – Plates



Plates

- A Sample site 1 (FBNC-01) (viewed from up stream) in Mt Cameron Creek Catchment.
- B Sample site 2 (FBNC-02) in Mt Cameron Creek Catchment.
- C Sample site 3 (FBNC-03) in Mt Cameron Creek Catchment.
- D Sample site 4 (FBNC-04) in Mt Cameron Creek Catchment.
- E Sample site 5 (FBNC-05) in Fly-By-Night Creek Catchment.
- F Sample site 6 (FBNC-06) in Fly-By-Night Creek Catchment.
- G Sample site 7 (FBNC-07) in Fly-By-Night Creek Catchment.
- H Sample site 8 (FBNC-08) in Fly-By-Night Creek Catchment.
- I Sample site 9 (FBNC-09 and Duplicate) in Fly-By-Night Creek Catchment.
- J Sample site 10 (FBNC-10) in Fly-By-Night Creek Catchment.
- K Sample site 11 (FBNC-11) in Fly-By-Night Creek Catchment.
- L Sample site 13 (FBNC-13) in Mt Cameron Creek Catchment.
- M Fly-By-Night mine. This area of the mine drains into Fly-By-Night dam from the south (see Figure 5).
- N The main drain that exits Fly-By-Night mine and enters the Fly-By-Night dam to the south.
- O Fly-By-Night mine. This area of the mine drains into Fly-By-Night dam from the east just above the dam wall (see Figure 5).
- P Fly-By-Night mine. This area of the mine drains into Fly-By-Night dam from the east just above the dam wall (see Figure 5).
- Q Back side of Fly-By-Night dam wall. The dam wall is covered with tall thick *Allocasuarina* re-growth.
- R Point at which water appears and forms a new channel on the back site of Fly-By-Night dam wall. The water may come from the nearby spill way (moving underground rather than over the spill way).
- S Large eroded opening on the north eastern end of the Fly-By-Night dam wall (Figure 6)
- T A damp area behind (and at the base of) Fly-By-Night dam wall.









