Government of Western Australia
Department of Environment Regulation

# Decision Document

## *Environmental Protection Act 1986,* Part V

## Licensee: Talison Lithium Australia Pty Ltd

## Licence: L4247/1991/13

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|---|---|
| **Registered office:** | Level 4<br>37 St Georges Terrace<br>PERTH WA 6000 |
| **ACN:** | 139 401 308 |
| **Premises address:** | Talison Lithium Mine<br>Mining Tenements M01/3, M10/6, M01/7, M01/16, G01/1 and G01/02<br>Maranup Ford Road<br>GREENBUSHES WA 6254 |
| **Issue date:** | Thursday, 12 December 2013 |
| **Commencement date:** | Saturday, 14 December 2013 |
| **Expiry date:** | Sunday, 13 December 2026 |

**Decision**

Based on the assessment detailed in this document the Department of Environment Regulation (DER), has decided to issue an amended licence. DER considers that in reaching this decision, it has taken into account all relevant considerations and legal requirements.

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| Decision Document prepared by: | Louise Lavery<br>Licensing Officer |
| Decision Document authorised by: | Tim Gentle<br>Delegated Officer |

# Contents



# 1 Purpose of this Document

This decision document explains how DER has assessed and determined the application and provides a record of DER's decision-making process and how relevant factors have been taken into account. Stakeholders should note that this document is limited to DER's assessment and decision making under Part V of the *Environmental Protection Act 1986.* Other approvals may be required for the proposal, and it is the proponent's responsibility to ensure they have all relevant approvals for their Premises.

# 2 Administrative summary

| **Administrative details** | | | |
|---|---|---|---|
| Application type | Works Approval ☐<br>New Licence ☐<br>Licence amendment ☒<br>Works Approval amendment ☐ | | |
| Activities that cause the premises to become prescribed premises | **Category number(s)** | **Assessed design capacity** | |
| | 5 | 2 300 000 tonnes beneficiated | |
| | | 5 000 000 tonnes tailings deposited | |
| Application verified<br>Application fee paid | Date: N/A<br>Date: N/A | | |
| Works Approval has been complied with<br>Compliance Certificate received | Yes☐ No☐ N/A☒<br>Yes☐ No☐ N/A☒ | | |
| Commercial-in-confidence claim | Yes☐ No☒ | | |
| Commercial-in-confidence claim outcome | N/A | | |
| Is the proposal a Major Resource Project? | Yes☒ No☐ | | |
| Was the proposal referred to the Environmental | Yes☐ No☒ | Referral decision No: | |

| | | |
|---|---|---|
| Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986*? | | Managed under Part V ☐<br>Assessed under Part IV ☐ |
| Is the proposal subject to Ministerial Conditions? | Yes☐ No☒ | Ministerial statement No:<br>EPA Report No: |
| Does the proposal involve a discharge of waste into a designated area (as defined in section 57 of the *Environmental Protection Act 1986*)? | Yes☒ No☐<br>Department of Water consulted Yes ☒ No ☐ | |
| Is the Premises within an Environmental Protection Policy (EPP) Area Yes☐ No☒ | | |
| Is the Premises subject to any EPP requirements? Yes☐ No☒<br>. | | |

# 3 Executive summary of proposal and assessment

Talison Lithium Australia Pty Ltd (Talison) operates a lithium mine (a series of open cut and underground operations) and processing plants at Greenbushes, WA. Lithium has been mined since 1983, however historical mining operations at the Premises date back to tin mining in 1888 and tantalum mining in the 1940s. Spodumene ore is mined and processed in one of two processing plants (the Technical Grade Processing Plant (TG) and the Chemical Grade (CG) Processing Plant) to recover lithium concentrate. Processing involves separation techniques analogous to those used in the mineral sands industry. The CG Processing Plant underwent an expansion in 2012/2013, under Works Approval W4927/2011/1. The total processing capacity is currently 1,750,000 tonnes. Planned debottlenecking in the two processing plants will allow processing capacity to increase to 2,300,000 tonnes per annum with no change to the tailings deposition rate.

Tailings are generated from processing and currently discharged to Tailings Storage Facility 2 (TSF 2). TSF2 was commissioned in 2006 and currently the height of the embankments is at RL 1260 m. There is an older Tailings Storage Facility 1 (TSF1) which is on care and maintenance.

Tantalum concentrates and tin metal are also recovered from the ore deposits at Greenbushes, through a Primary Tantalum Processing Plant and a Secondary Tantalum Processing Plant. Prior to 2010 these plants and related infrastructure were part of the Talison operations; however these assets are now owned and operated by a separate company Global Advanced Metals Greenbushes Pty Ltd and are subject to a separate Premises Licence L8501/2010/2. This Licence L4247/1991/13 has excised areas subject to the Licence L8501/2010/2 (refer to Figure 1: Premises Map for further detail).

Tailings are also generated from the tantalum process and are discharged to the Talison's TSF 1 via a contractual arrangement between the two companies. Currently the Tantalum Primary Processing Plant is not operating and hence no tailings are being generated.

Processing of lithium ores requires a significant water supply which is primarily recovered by the Licensee via a network of surface water storages (dams) located within the Premises (refer to Figure 2). As the mine and processing plants are located at the top of a catchment, surface water storages are located lower in the landscape and to the west of the Premises, collecting all surface water flows

from the western half of the Premises, where the Processing Plants and TSF2 are located. Surface water flows are also augmented by a shallow groundwater aquifer which is thought to have surface expression in the Premises' dams. The water storages do not just collect uncontaminated surface water however; the tailings at TSF2 generate large seepage flows of which a significant component is allowed to flow via gravity through to the Austins Dam, which can then overflow to the Southampton Dam. From Southhampton the water is then recovered into the Lithium and/or Tantalum Processing Plants. Other contaminated surface water is also allowed to overflow to Austins Dam including overflows from the Processing Plant sumps, Processing water tanks and overflows from the Clear Water Pond, which collects TSF decant and seepage.

Periodically during winter and high rainfall events all storages overflow and contaminated water is released from the Premises, either from the Southampton or Cowan Brook Dams. This water discharge has resulted in lithium and trace metals/metalloids (including arsenic) contamination of the Norilup Brook. Norilup Brook is a tributary of the Blackwood River and represents 3% of the average total surface water flows into the Blackwood River within the mid-lower third of the Blackwood River catchment. Contaminated surface water from the mining operations in the eastern half of the Premises is also released off the Premises, with flows from the mining operations eventually flowing to Hester Brook, also a tributary of the Blackwood River. The contribution of Hester Brook flow to the Blackwood River has not been modelled to date by Talison, however data from 1999 from Floyds Gully (upstream discharge from mine to Hester Brook) determined that the flow from Floyds Gully contributed 1% of the flow from Hester Brook to the Blackwood River in that year (Talison Lithium Australia 2015).

The key environmental impact of the existing Talison operations is the contamination of the Norilup Brook and Hester Brook and the risk of downstream ecological impacts. There also exists the risk of human health impacts to third party users of this water. Potential impacts to the deeper groundwater aquifer at the Premises are also present due to TSF seepage and seepage from the water storage dams themselves.

Lithium is soluble and concentrations have built up in the Premises' water circuit over time due to increased processing rates and recirculation of contaminated water, including tailings seepage, within the water circuit. No treatment of the Premises water supply currently occurs to reduce the lithium concentrations but investigations and pilot plant trials have occurred within the last few years with the expectation that water treatment will occur. The Premises also has legacy issues as a result of historical tin mining, exacerbated by current mining operations which has resulted in the concentration of arsenic and other metals and metalloids being elevated in surface water and sediments within the dams. Three arsenic treatment plants are in use to reduce arsenic concentrations, two on the Clear Water Pond within Tailson Lithium's Premises and the third at the neighbouring Global Advanced Metals Greenbushes water storage, Tin Shed Dam.

In 2015 the Premises was classified under the *Contaminated Sites Act 2003* as 'contaminated – restricted use'. The classification required Talison to undertake further soil and groundwater investigations, to validate existing remediation works and also to implement plans for future investigations and remediation through the Premises' Mine Closure Plan.

A further discussion of these impacts and risks is attached in Appendices A – D to this Decision Document.

**July 2016 Amendment**

This amendment is sought by the Licensee to construct, commission and operate a series of embankment raises to a total height of 1280 m AHD (20 m in excess of the current embankment height of 1260m AHD) and to construct a buttress and other supporting infrastructure such that the TSF2 facility can comply with the safety guidelines in ANCOLD's 2012 Guidelines on Tailings Dams: Planning, Design, Construction, Operation and Closure.

As part of these works, infrastructure will be constructed to improve seepage recovery from the western and southern walls of TSF2. Additionally, underdrainage pipework will be installed as part of each lift to recover seepage and to manage the phreatic surface (water saturation) within the embankments.

The footprint of the TSF2 will extend to the west and south and result in the destruction of a number of existing groundwater monitoring bores surrounding the TSF. These bores are being replaced by a series of new bores.

The Licence has also been amended to impose controls on surface water discharges from the Premises.

# 4 Decision table

All applications are assessed in line with the *Environmental Protection Act 1986*, the *Environmental Protection Regulations 1987* and DER's Operational Procedure on Assessing Emissions and Discharges from Prescribed Premises. Where other references have been used in making the decision they are detailed in the decision document.

| DECISION TABLE | | | |
|---|---|---|---|
| **Works Approval / Licence section** | **Condition number W = Works Approval L= Licence** | **Justification (including risk description & decision methodology where relevant)** | **Reference documents** |
| **General conditions** | L.1.2.1 | Generic changes have been made to the General Conditions of this Licence as part of Departmental reform and updates to licence templates. These changes include removing conditions referencing the Code of Practice for the Storage and handling of dangerous goods (previous Licence condition W4(a). Previous draft 1.1.5 (general) and 1.2.1 (pollution control and monitoring equipment) have been removed from the final amended licence as DER has subsequently determined that these conditions are not enforceable and do not meet the intent of DER's *Guidance Statement: Setting Conditions.* | DER (2015) *Guidance Statement: Setting Conditions,* October 2015 |
| **Premises operation - Tailings Storage Facility 2** | L1.3.1<br>L1.3.2<br>L1.3.3 | DER's assessment and decision making are detailed in Appendix B. | Refer Appendix B |
| | L1.3.2<br>L1.3.6<br>L1.3.7 | DER's assessment and decision making are detailed in Appendix B. | Refer Appendix B |
| **Premises Operation – Technical Grade Lithium Process Plant and Chemical Grade Lithium Process Plant** | L3.3.1<br>L4.1.1 (IR4) | DER's assessment and decision making are detailed in Appendix C. | Refer Appendix C |
| | L1.3.5 | The requirement to monitor discharges from heavy vehicle refuelling areas and the light and heavy vehicle wash down bays (part of previous condition W6(a)) has been removed from the licence due to the low oil and grease results recorded for discharges for the heavy vehicle refuelling area (>5 - 9 mg/L in 2014/15) and light vehicle washdown area (>5 mg/L to 17 mg/L in 2014/15). Whilst the discharges from the heavy vehicle washdown pad have the larger oil and grease | General provisions of the *Environmental Protection Act 1986*<br><br>Section 7.10 of Talison Lithium |

| DECISION TABLE | | | |
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| **Works Approval / Licence section** | **Condition number W = Works Approval L= Licence** | **Justification (including risk description & decision methodology where relevant)** | **Reference documents** |
| | | concentrations (17 – 40 mg/L in 2014/15) it is noted that this facility is located at the top of a waste rock dump and hence these discharges no not enter downstream waterways. The Licensee should note general condition 1.2.2 in that all spills of environmentally hazardous materials should be immediately cleaned up. Condition 1.3.5 replaces previous condition W5(a). | Australia Annual Monitoring Report 2014-15. |
| **Premises Operation – Water Storages/Dams** | L1.3.1<br>L1.3.7<br>L2.2.1, L2.2.2<br>L3.2.1, L3.3.1<br>L3.4.1 (Tables 3.4.2, 3.4.3)<br>L4.1.1 (IR5, IR6) | DER's assessment and decision making are detailed in Appendix D. | Refer Appendix D. |
| **Premises Operation – Waste** | L1.3.8 – L1.3.10 | Premises operation conditions have been applied to the amended Licence to allow disposal of a small amount of inert waste and used tyres to the waste rock dump. The permitted amount of 200 tonnes per year is below the category threshold of 500 tonnes or more for category 63.<br><br>These conditions include requirements for the types of waste permitted, trench size and location, covering regularity, and security. These conditions mirror the requirements of the *Environmental Protection (Rural Landfill) Regulations 2002*. | Application supporting documentation<br><br>*Environmental Protection (Rural Landfill) Regulations 2002*.<br><br>General provisions of the *Environmental Protection Act 1986*. |
| **Emissions general** | L2.1.1 | Descriptive limits will be set through condition 2.2.3 of the licence and therefore the condition regarding recording and investigation of exceedances of limits has been included. | N/A |
| **Point source emissions to** | L2.2.1, L2.2.2, L2.2.3 | Discharge off the Premises is authorised from Cowan Brook Dam for the period of the Licence. Discharges are also authorised from the locations Carters Farm, | ANZECC & ARMCANZ (2000) |

| DECISION TABLE | | | |
|---|---|---|---|
| **Works Approval / Licence section** | **Condition number W = Works Approval L= Licence** | **Justification (including risk description & decision methodology where relevant)** | **Reference documents** |
| **surface water including monitoring** | | Floyds North,Floyds South, Cemetery (refer to Figure 2 in the Licence).<br>No discharge off the Premises is permitted from Southhampton Dam due to the increased concentration of contaminants present in this dam (as compared to Cowan Brook Dam) and the ability for the Licensee to control flows into Southampton Dam from Austins Dam.<br><br>Limits have been imposed on the lithium concentration in the receiving water body, Norilup Dam. The allowable lithium concentrations are reduced over the life of the Licence, requiring improvements in water quality discharged to this receptor.<br>Refer to the DER's assessment and decision making in Appendices A and B. | Australian and New Zealand Guidelines for Fresh and Marine Water<br><br>NHMRC & ARMCANZ (2011) Australian Drinking Water Guidelines |
| **Fugitive Emissions** | L3.4.1 | Previous licence condition A1 has been removed from the licence following Departmental changes to the management of fugitive dust emissions. Existing monitoring requirements have not been reassessed and are included on the licence under condition 3.4.1, Table 3.4.1 (refer to Ambient Quality Monitoring for further detail). | N/A |
| **Monitoring general** | L3.1.1 – L3.1.5 | General monitoring conditions are specified to detail the standards required for sample collection and analysis, quality control and timeframes for monitoring. Calibration and maintenance requirements of monitoring equipment are also specified. | General provisions of the *Environmental Protection Act 1986* |
| **Monitoring of point source emissions to surface water** | L3.2.1 | Monitoring of the duration and frequency of surface water discharges off the Premises is required to allow the extent of these discharges to be assessed. | Surface Water Management Plan |
| **Process monitoring** | L3.3.1 | Monitoring of the duration and frequency of contaminated surface water overflows to Austins Dam is specified to allow the extent of these overflows to be assessed. Each of the overflows are currently recorded internally but have not been part of the Licence conditions. | Surface Water Management Plan |
| **Ambient quality monitoring** | L3.4.1, Table 3.4.1 | Fugitive dust emissions have not been reassessed as part of this Licence amendment. Condition 3.4.1, Table 3.4.1 replaces previous licence conditions A2(a), A3, and A4. | N/A |

| DECISION TABLE | | | |
|---|---|---|---|
| **Works Approval / Licence section** | **Condition number W = Works Approval L= Licence** | **Justification (including risk description & decision methodology where relevant)** | **Reference documents** |
| | L3.4.1, Table 3.4.2 L3.4.2 | Refer to the DER's assessment and decision making in Appendices A, B and C. | Refer to Appendices A, B and C |
| | L3.4.1, Table 3.4.3 | Refer to the DER's assessment and decision making in Appendices A, B and D. | Refer to Appendices A, B and D |
| | No noise conditions | As noise and blasting are regulated through an approval under Regulation 17 of the *Environmental Protection (Noise) Regulations 1997*, previous noise conditions N1(a) and N1(b) have been removed from the Licence. | *Environmental Protection (Talison Lithium Australia Greenbushes Operations Noise Emissions) Approval 2015* |
| **Improvements** | L4.1.1 | A number of improvement conditions have been listed on the licence in response to the risk assessment in relation to:<br>• current operation of the TSF2 and the proposed embankment raise;<br>• poor integrity of water containment infrastructure; and<br>• current management of surface water and infrastructure within the lithium processing plants and the surrounding catchments within the Premises.<br><br>The application and rationale behind these improvement conditions is discussed in Appendices A, B, C and D. | Surface Water Management Plan, Version 5 |
| **Information** | Previous draft L5.1.2 | Previous draft condition 5.1.2 (knowledge of licence conditions) has been removed from the final amended licence as DER has subsequently determined that this condition is not enforceable and does not meet the intent of DER's *Guidance Statement: Setting Conditions.* | DER (2015) *Guidance Statement: Setting Conditions,* October 2015 |
| | L5.2.1, L5.2.2 | Changes have been made to the requirements for the Annual Environmental Report as listed in Table 5.2.1 consistent with the changes made as a result of this amendment. This condition replaces previous conditions G1, A2(b) and N1(b).<br><br>Other administrative changes have been made to condition 5.2.2 consistent with | |

| DECISION TABLE | | | |
|---|---|---|---|
| **Works Approval / Licence section** | **Condition number W = Works Approval L= Licence** | **Justification (including risk description & decision methodology where relevant)** | **Reference documents** |
| | | current DER licence templates. | |
| | L5.2.3 | Requirement to supply monitoring reports on request is standard.<br>A requirement to provide quarterly reports on surface water discharges in accord with conditions 3.2.1 and 3.3.1 has been placed on the Licence in response to risk assessments for surface water quality impacts associated with tailings seepage overflows to Cowan Brook Dam, process water overflows to Austins Dam and discharges from the eastern side of the Premises towards Hester Brook. Refer to the risk assessment in Appendices A, B and C for further detail. | Refer to Appendices A, B and C |
| | L5.2.4, L5.2.5 | These new conditions are associated with submission of a compliance certificate for works authorised by condition 1.3.5 and reporting requirements associated with these works. | General provisions of the *Environmental Protection Act 1986* |
| | L5.3.1 | This condition replaces previous conditions G2(a), G2(b) and G2(c) in part. | |
| **Licence Duration** | N/A | The licence expiry date has been extended to 2026 to give effect to the improvement programs required to be implemented to effect progressive reduction in lithium concentrations at Norilup Dam. The extension to the expiry date is also consistent with the Amendment by Notice of 29 April 2016. | N/A |

# 5 Advertisement and consultation table

| Date | Event | Comments received/Notes | How comments were taken into consideration |
|---|---|---|---|
| 30/11/2015 | Application referred to interested parties listed - Department of Mines and Petroleum | Comments discussed at meeting held 11/12/2015. Representatives of Department of Parks and Wildlife and Department of Water also attended. | Comments incorporated into decision document. |
| 12/02/2016 | Proponent sent a copy of draft instrument | Comments received in regard to :<br>• administrative errors;<br>• Clarification of use of the surface water management plan in Table 1.3.3;<br>• Clarification of use of arsenic remediation units in condition 1.3.4;<br>• Correction to mine waste rock dump sources in Table 3.2.1;<br>• Flow monitoring absent in some sites in Table 3.2.1;<br>• Reference to the dust management plan in Table 3.4.1 requested;<br>• Clarification on timing of reporting from new groundwater bores; and<br>• Comments on the Improvement Programs.<br><br>Proponent provided additional information on historical lithium discharges to Cowan Brook Dam from Austin's overflow and the recovery sump 2 for the period 2009 – 2015. | Comments adopted. Changes were made to the expiry date of the licence and also then to scheduling of ambient surface water limits for lithium as measured at Norilup Dam.<br><br>Historical information on discharges used to develop condition 1.3.7. |
| 24/03/2016 | Proponent sent a second copy of draft instrument | Comments received in regard to<br>• condition 1.3.7;<br>• pit storage to be added to containment infrastructure in Table 1.3.1;<br>• flow loggers removed from Carters Farm and | Comments adopted with the exception of changes to ambient surface water quality lithium limits. |

| Date | Event | Comments received/Notes | How comments were taken into consideration |
|---|---|---|---|
| | | Cemetery as not present;<br>• Request to define 'event' in Table 3.2.1;<br>• lithium limits in Table 3.4.2; and<br>• request for landfill inert waste and used tyres. | |
| 12/04/2016 | Draft instrument referred to interested parties listed<br>- Department of Mines and Petroleum<br>- Water Corporation<br>- Shire of Greenbushes-Bridgetown | No comments received. | N/A |
| | Draft instrument referred to interested parties listed<br>- Department of Water (DOW) | Comments received 29/04/2016.<br>• Condition 2.2.1 – DOW note that a number of the emission points designated in Table 2.2.1 are outside the TLA Premise boundary (as per Figure 2); would expect that these nominated 'point source emission' points (as per Table 3.2.1) should be located within the premise boundary. DOW also note that none of the eastern point source emission locations have any storage capacity for containment and/or treatment of surface water prior to discharge from the premises, given flows are identified from mine dumps and tailings storage areas.<br>• Condition 3.4.1/ Table 3.4.2 – There is no monitoring of ambient surface water quality (beyond pH/EC) of any of the eastern point source emission locations. Furthermore, there exists no tolerance criteria for these eastern sites (as there is for the balance – pH limit of 6-9) which may trigger further investigation or response. This table also schedules a reduction in Lithium concentrations from 7mg/L in 2015-2017 to 2mg/L by 2022-2026. While it is acknowledged that this is a significant improvement in onsite performance, concentrations are still well in excess of background lithium concentrations in the external environment (mean of 0.03mg/L). | In response to comment on condition 2.2.1, DER has amended Figure 2 to indicate the discharge points at the Premises boundary as opposed to sampling point locations. There is an expectation that provision of additional emergency storage capacity within the Premises will be considered under improvement condition IR5.<br><br>In response to DOW comment on condition 3.4.1, at this point in time there is no data on the water quality of the discharges from the eastern side of the Premises and hence it is the expectation that data recorded during the forthcoming annual period will be collected, analysed and dependent on results limits imposed in a future amendment if required. Additional parameters have been added to the monitoring required for these discharges under Table 3.2.1.<br><br>IR2 – Adopted.<br><br>IR5 – Noted. |

| Date | Event | Comments received/Notes | How comments were taken into consideration |
|---|---|---|---|
| | | Notwithstanding, the reduction in Lithium proposed is a significant decline in existing site concentrations identified (Austin's Dam 12 mg/L, Cowan Brook 5.7mg/L) and further investigation of the Water Improvement Program Options Study proposed by Talison in 2015 will determine the feasibility of meeting and exceeding these targets. An assessment of these options may conclude that targets can be achieved before time and the licence schedule should ultimately reflect the most efficient and timely outcome for lithium reduction.<br>• IR2 – DOW has previously recommended annual bioaccumulation assessment as part of ecological impact assessment and defining a more robust lithium trigger, rather than the proposed assessment every 2 years in the draft condition. Provision should also be considered within the Ecological assessment program to be expanded beyond up- and down-stream of Norilup Dam, given the number of other point source emission points and unquantified risk to the external environment, as part of establishing a localised baseline.<br>• IR5 – DOW recommend that all options for treatment and negating environmental impact should be exhausted before any approval for further impact on the external environment or water resources.<br>• IR6 - Consideration should be given as to the timing of the 'consecutive three month period' as it is likely that water levels/quality will be influenced by seasonal impacts. It may be considered that this period could be over summer when the dilution effect of rainfall will have the least influence on results, or have sampling undertaken over various periods to represent seasonal change. The report itself should identify contingency management options should adverse findings be made. | IR6 – Adopted. |

| Date | Event | Comments received/Notes | How comments were taken into consideration |
|---|---|---|---|
| | Draft instrument referred to interested parties listed - Department of Parks and Wildlife | Letter and comments received 11/05/2016. Parks and Wildlife recommendations as follows:<br>1: Review whether the setting of monitoring and limit conditions for this premises outside the Premises is legally tenable.<br>2:Treat the Cowan Brook Dam discharge as both a discharge and sampling point and transfer the lithium and arsenic limits proposed for Norilup Dam to this discharge point.<br>3. Treat Norilup Dam as a sampling point for the same analytes in Table 3.4.2 and Cowan Brook Dam if not legally untenable.<br>4. For Table 3.2.1 and the Cowan Brook Dam point source discharge sampling point, include in addition to the flow rate the same analytes as prescribed for the 'Cemetery' discharge – in pH, EC and lithium.<br>5. For Table 3.2.1 and the Cowan Brook Dam point source sampling point, consider prescribing additional metal analytes, such as Cadmium.<br>6. Reduce the discharge limits for lithium set in Table 3.4.2. | 1. These conditions are consistent with s62A, subsections 1 (d), (e) and (g) of the Act.<br>2. Adopted in part – sampling is now required at the discharge point as per Table 3.2.1. Impractical to place limits at the discharge due to the variability in flow and concentration, the engineering design of the storages with spillways and also the existence of diffuse surficial groundwater flows adding to off site contamination.<br>3. Cowan Brook Dam and Norilup Dam already have prescribed the same sampling analytes so unclear what is requested here.<br>4. Adopted.<br>5. Adopted.<br>6. Not adopted. Proposed limits are based on possible remediation works that could be practically implemented during the life of the Licence. If the technology proves more effective then these limits will be reduced. |
| | Draft instrument referred to interested parties listed - Department of Health (DOH) | Comments received 20/05/2016. DOH response:<br>• DOH supports the proposed engineering controls and changes to the licence conditions that are designed to stop the contamination;<br>• DOH requires a timely assessment of the extent of the contamination so that appropriate health warnings can be issued if necessary; and<br>• DOH requires that it be notified immediately if substances in the Norilup Dam conditioned by the Licence exceed the Australian Drinking Water Guidelines (ADWG). | In response the parameters for analysis in Norilup Dam in Table 3.4.2 have been expanded and include ADWG limits where available.<br>IR7 has been added to the Licence to require monitoring of the water quality in Swenkies and Mt Jones Reservoir.<br>DER has requested further advice from DOH in relation to lithium concentration limits to protect human health for water storages within and off the Premises. |

| Date | Event | Comments received/Notes | How comments were taken into consideration |
|---|---|---|---|
| 12/04/2016 | Draft instrument issued to Licensee for 21 day consultation period | Comments received in regard to<br>• request for increase in category 5 capacity to 2,300,000 tpa; no change to tailings deposition amount;<br>• addition of process water to authorised use of Cornwall Pit (Table 1.3.2);<br>• correction to title of secondary recovery sump in Table 3.3.1;<br>• correction to page 24 of decision document; and<br>• increase to due dates for IR1,3,4 due to extended time for signing instrument. | Comments adopted. |

# 6 Risk Assessment

*Note: This matrix is taken from the DER Corporate Policy Statement No. 07 - Operational Risk Management*

### Table 1: Emissions Risk Matrix

| Likelihood | Consequence | | | | |
|---|---|---|---|---|---|
| | Insignificant | Minor | Moderate | Major | Severe |
| Almost Certain | Moderate | High | High | Extreme | Extreme |
| Likely | Moderate | Moderate | High | High | Extreme |
| Possible | Low | Moderate | Moderate | High | Extreme |
| Unlikely | Low | Moderate | Moderate | Moderate | High |
| Rare | Low | Low | Moderate | Moderate | High |

# Appendix A

## Overview of Premises Water Systems and Water Discharges

Processing of lithium at Talison Lithium Australia's (Talison) operations is currently configured to connect a series of water storages (large dams), process water, contaminated and non-contaminated surface water and shallow groundwater flows into one interdependent circuit with the net goal to harvest as much water as possible for processing use, whilst providing flexibility in terms of supply (refer Figure 5 for detail).

Talison's process depends on a reliable water source in order to separate the lithium ore from the waste using processes similar to those used in the mineral sands industry. The processing of lithium generates large tailings flows, of low density, which are currently deposited to TSF2. In 2013 approximately 8.8 GL was used in the Lithium Chemical Grade (CG) and Technical Grade (TG) processing plants, of which 6.0 GL was deposited to tailings (refer to Figure 6 for flows recorded in 2013). TSF2 generates large seepage flows of which a component is returned to the process water circuit; some overflows to onsite water storages, transported over land through wetlands feeding the water storages and also transported via the shallow aquifer. Refer to Appendix B for further detail on TSF 2 construction and operation and environmental risks present from current operations and the proposed expansion.

The mine and processing plants are located within the mid – lower catchment of the Blackwood River. The site is located at the top of the catchment on a north - south topographic divide. Drainage from the processing side and TSF2 flows to the west to Premises water storages Cowan Brook Dam and Austins Dam and south off the Premises to neighbouring GAMG's Tin Shed Dam water storage. Drainage from the mine site, waste rock dump and TSF1 flows to the east of the site, off the Premises to Floyds Gully and Salt Water Gully and then to Hester Brook, a tributary of the Blackwood River.

During the winter wet season the water circuit experiences a positive water balance. This means that all water storages are filled to capacity (typically by October of each year) and during subsequent high rainfall events unmanaged overflow discharges are released from Cowan Brook Dam, flowing off the Premises to Norilup Dam. Unmanaged overflow discharges are occasionally released from the Southampton Dam, overflowing off the Premises to Spring Gully and then to Schwenkies Dam (also referred to as Swenkies Dam). Schwenkies Dam flows into Mt Jones Dam and from there into Norilup Dam. (Refer to Figure 2 in the Licence for an aerial image of the locations of these water storage dams in relation to the Premises).

Norilup Dam then releases flows to Norilup Brook, a tributary of the Blackwood River. The Norilup Brook subcatchment comprises an area of 67 ha. Norilup Brook represents approximately 3% of total flows that make up the Blackwood River in the mid – lower catchment (Talison Lithium Australia 2015).

**Impacts to Downstream Users and Sensitive Receptors from Premises Surface Water Discharges**

Overflows from Cowan Brook Dam into Norilup Dam and Norilup Brook have resulted in elevated lithium and trace metals and metalloids including arsenic concentrations in Norilup Brook. Current lithium concentrations downstream of the discharge point in Norilup Brook are between 5 – 6 mg/L, whereas upstream concentrations are of the order of 0.03 mg/L or less.

Elevated metals/metalloids have also been detected in sediments at the near downstream locations. Sediments in these near downstream locations of the discharge point recorded elevated concentrations of magnesium, potassium, aluminium, sulfates, copper and lithium as compared to upstream sampling locations (CENRM 2014). Arsenic and cadmium concentrations in sediments

were detected at levels above the ANZECC/ARMCANZ (2000) In-term Sediment Quality Guidelines-Low trigger values; that is above a concentration at which biological effects would possibly occur.

This lithium contamination represents a risk to the receiving environment (freshwater aquatic ecosystem) and also to users of this water. A census of downstream users of Norilup Brook by the Licensee as part of the Surface Water Management Plan, determined that out of 5 landowners, 3 drew water from the Brook for irrigation or livestock use (Talison Lithium Australia 2015).

A similar census has not been conducted for the Hester Brook sub-catchment, however it is known that there are more landowners present than at Norilup Brook. Land uses in the Hester Brook sub-catchment include grazing, perennial horticulture (mainly tree farms) and rural residential. Salinity in the Hester Brook catchment is elevated (electrical conductivity of 1000 – 5000 µs/cm) and it is thought that this salinity precludes usage for drinking water, however this is not confirmed (Talison Lithium Australia 2015).

Further, Section 4.7 of the Surface Water Management Plan Version 5 notes that Norilup Dam and Mt Jones Dam are currently configured so as to allow water to be pumped to the augment the Water Corporation supply to the Town of Greenbushes. Norilup Dam, Schwenkies Dam and Mt Jones Dams, whilst outside the Premises boundary, are all located on mining tenements owned by Talison and are managed by Talison.

It is expected that once a pipeline from Water Corporation's Millstream Dam to supply the Town of Greenbushes in completed that Mt Jones Dam will no longer act as a supplementary water supply but at present this pipeline is not completed.

A literature review of available scientific literature on lithium toxicity in freshwater aquatic ecosystems has indicated that:

- A 2008 review of human and environmental toxicity concludes that lithium displays generally low toxicity although numerous articles cited in the review demonstrate observable effects (Aral H., Vecchio-Sadus A., 2008). It is also noted that the presence of sodium reduces lithium toxicity to aquatic organisms (Kszos *et al.,* 2003).
- More recent studies showed lithium had observable effects on aquatic snails at concentrations as low as 200 µg/L (Sawasdee,B., *et al.,* 2011) and that lithium can disrupt biological function in rainbow trout (Tkatcheva, *et al.,* 2015)
- The available literature focuses on acute effects of lithium and there does not appear to be any information on the long term effects of lithium on ecosystem health and function. There is also little information on human health toxicity.

The Licensee has completed two studies of the impact of the discharge in the receiving environment; one on aquatic fauna present in Norilup Brook, where a direct toxicity assessment of the effluent on three local aquatic species was completed to determine an EC50 for each. EC50 represents the effective concentration at which a particular effect (immobility in this case) is observed in 50% of the organisms tested. The lowest 96 hour EC50 of the three species sampled was recorded for Pygmy Perch at a lithium concentration of 42 mg/L. As the EC50 value does not account for long-term or non-lethal effects of lithium, an attenuation factor was applied in order to derive a recommended trigger value of 0.42 mg/L (CENRM 2013). This value was determined using an Assessment Factor method, as described in section 3.2.3 of Schedule B5b of the National Environment Protection (Assessment of Site Contamination) Measure 1999 (the NEPM). The trigger value is conservative, given the lack of data on chronic effects.

The second study, analysed water quality, sediments and macrofaunal species diversity, abundance and bioaccumulation at sites upstream and downstream of the discharge point. Metals in sediments at the near downstream location were elevated as discussed above, and some evidence of bioaccumulation of arsenic and lithium in the flesh of fish and crayfish sampled at the location downstream of Cowan Brook Dam was recorded. It is not clear at this time whether this represents a

potential risk to human health, dependent on access of these species to recreational users. The majority of other ecological indicators were not significantly different from upstream to downstream (CENRM 2014).

DER notes the second report's conclusion that the proposed trigger value of a lithium concentration of 0.42 mg/L is too conservative and should not be adopted for regulation. DER considers that whilst this conclusion may be appropriate in relation to acute toxicity effects, the available information is too limited to enable an adequate assessment of potential effects on factors such as reproductive function of freshwater organisms, or the long term consequences of elevated lithium on ecosystem function. Accordingly DER will apply a progressive series of limits on lithium concentration in the receiving surface water as measured at Norilup Dam in order to require the Licensee to reduce the impact of discharges to this receiving environment. Refer to the following risk assessments in Appendices B- D for detail on the specific risks that contribute to the current offsite discharge, in terms of flow and water quality.

**References**

ANZECC & ARMCANZ (2000) *The Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, October 2000.

Aral H., Vecchio-Sadus A., (2008) 'Toxicology of lithium to humans and the environment – a literature review', *Ecotoxicology and Environmental Safety*, Vol 70 pp. 349 -356.

Centre of Excellence in Natural Resource Management, UWA (CERNM) (2013) *Ecotoxicology of lithium*, August 2013.

Centre of Excellence in Natural Resource Management, UWA (CERNM) (2014) *Surveys of aquatic flora and fauna in Norilup Brook to determine the presence and health thereof and any evidence of bioaccumulation of heavy metals from the Talison Lithium Mine, Greenbushes, Western Australia,* February 2014.

Ksvos, Lynn Adams, Beauchamp, John. J., Stewart, Arthur J., (2003) "Toxicity of Lithium to Three Freshwater Organisms and the Antagonistic Effect of Sodium*" Ecotoxicology* Vol 12 pp 427 - 427.

National Environment Protection (Assessment of Site Contamination) Measure 1999, Schedule B5b, 'Methodology for Deriving EILs (Ecological Investigation Levels)'.

Sawasdee B., Kohler H-R., Triebskor R., (2011) "Histopathological effects of copper and lithium in the Ramshorn snail, Marisa cornuarietis (Gastropoda, Prosbranchia)", *Chemosphere* Vol 85 pp. 1033 - 1039.

Tkatcheva *et al*., (2015) "Lithium an emerging contaminant: Bioavailability, effect on protein expression, and homeostasis disruption in short-term exposure of rainbow trout", *Aquatic Toxicology* Vol 161 pp. 85 – 93.

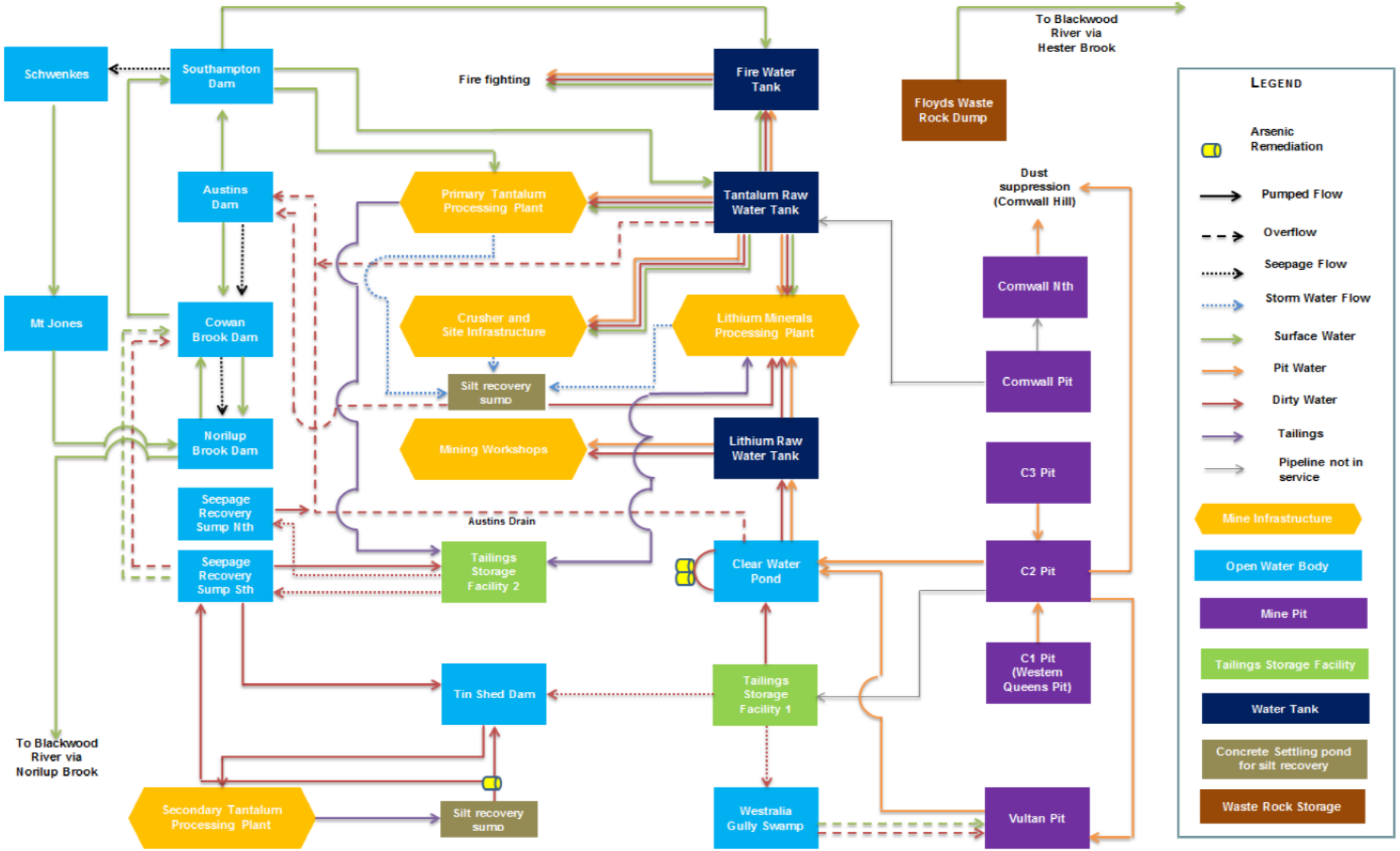


**Figure 5: Talison Lithium Premises water flows (includes infrastructure and contributions from neighbouring Premises Global Advanced Metals Greenbushes)**

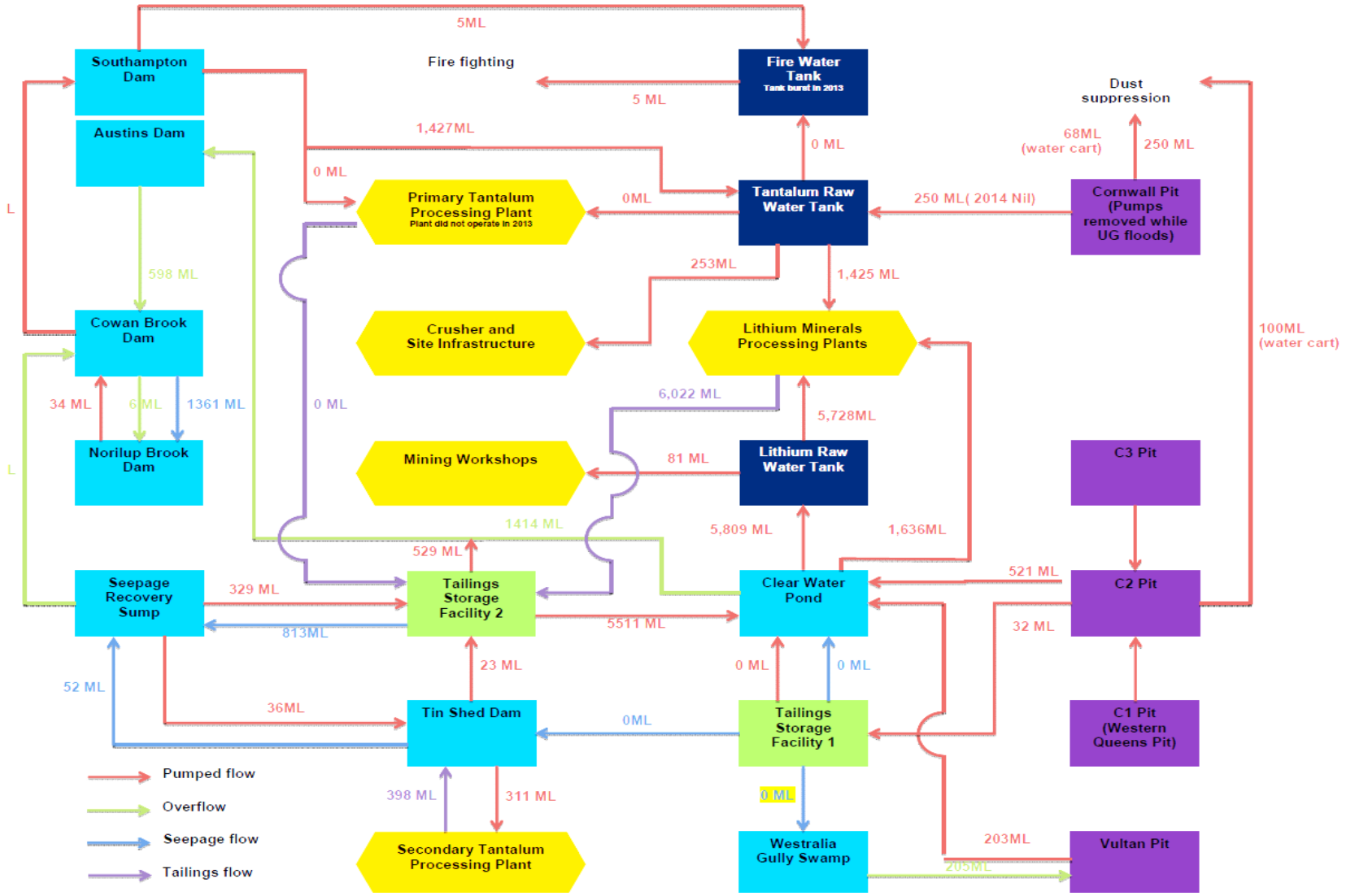


**Figure 6: 2013 Water Balance (Talison Lithium & Global Advanced Metals Greenbushes)**

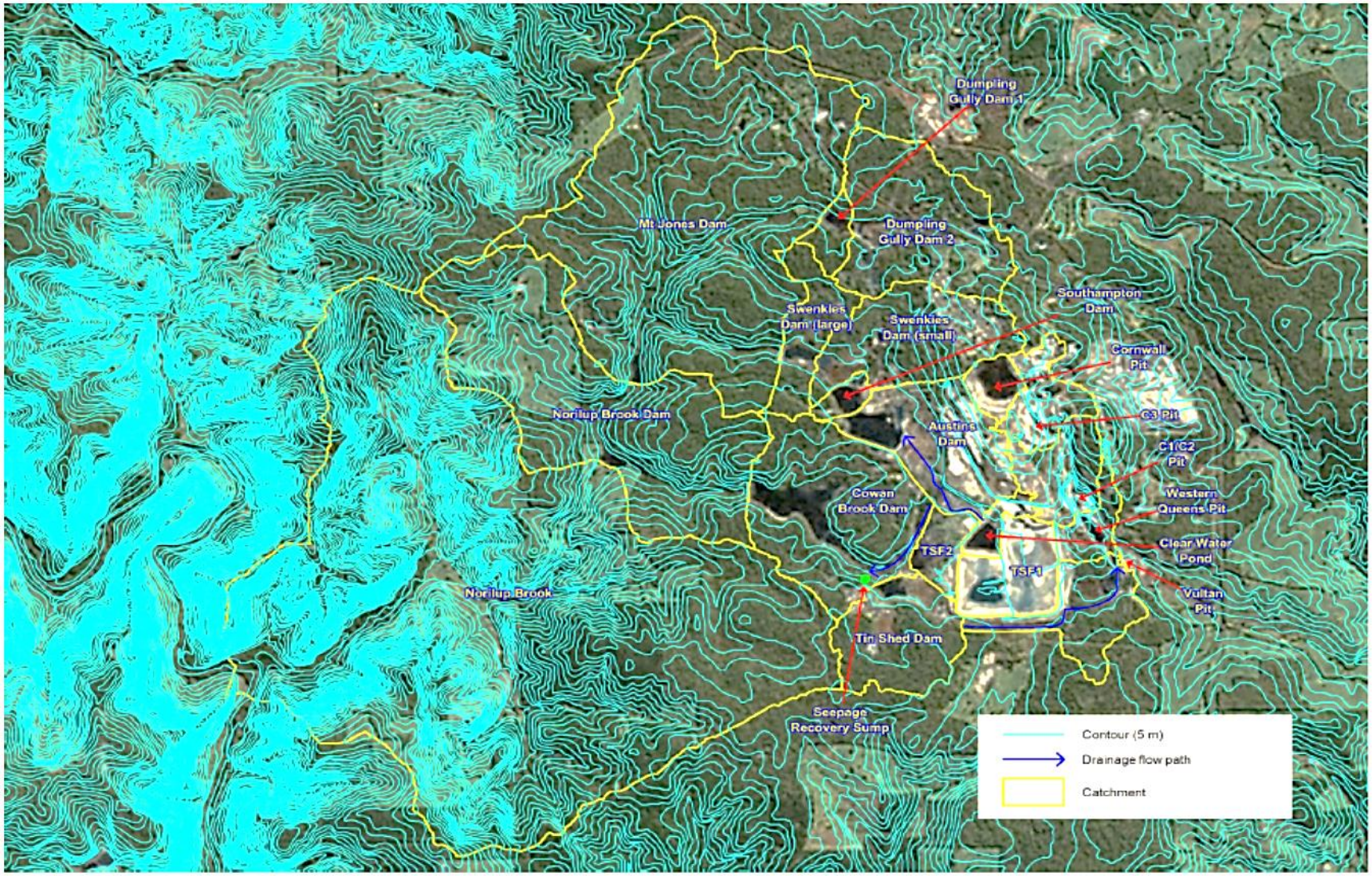


**Figure 7: Receiving surface water catchments for discharge from Premises**

# Appendix B

## Premises Operation - Tailings Storage Facility 2 Operation & Embankment Raise to RL 1265 m

TSF 2 and adjacent TSF1 (currently not in operation) receive tailings from the lithium process (spodumene ore) and the tin and tantalum process (adjacent Licensee Global Advanced Minerals; previously one entity with Talison Lithium Australia).

TSF1 was established in 1970. Currently the surface area of TSF1 is 110 ha and the crest of the embankment height is at RL 1280 m.

TSF2 was constructed in 2006 with a starter embankment at RL 1240 m. It incorporated clayey embankments of the former slimes dam known as 3Cs, which had been in operation since the 1970s. TSF2 was commissioned as a conventional facility with a perimeter tailings discharge to form a beach towards a decant point. Tailings had been discharged into TSF2 via two deposition pipes with single outlet points (single spigots) moved manually along the perimeter wall from the south west to the north west.

Significant seepage flows have been observed at the western embankment of TSF2 since its commissioning (GHD 2015a).

The TSFs are sited over historical mining dredge channels. Two aquifers underlie the TSFs, a shallow aquifer and a deeper aquifer within weathered basement/ clays. Recent hydrogeological and geophysical investigations into potential groundwater impacts (GHD 2014a; GHD 2014b) have indicated that the shallow aquifer has been impacted from tailings seepage but it appears that the deeper aquifer has not been impacted. This is only a preliminary conclusion, given the lack of consistent monitoring data for the existing monitoring bores surrounding the TSF, the lack of monitoring wells within the shallow aquifer and that the groundwater migration direction of the shallow aquifer is not confirmed (GHD 2014b).

The shallow aquifer is inferred as hydraulically connected to surface water features (swamps/dams, and toe drains surrounding the TSFs) (GHD 2014b). Consequently the shallow aquifer acts as a preferential pathway for tailings seepage flows. Field mapping of the shallow aquifer appears to be coincident with the historic mining dredge channels and water courses (refer Figure 9 below). The deposition of mining material has resulted in locally variable lithology observed at the surface (i.e variable clays, quartz and sands: disturbed soils) and it is assumed that the surface variability will occur in the vertical geological profile.

The shallow groundwater flow is inferred towards the Premises' water storages: Southampton/Austins Dam, Cowan Brook Dam and Schwenkies Dam.

Permeability of TSF 2 is as listed in Table 1 below and the location of the materials in the TSF is shown graphically in Figure 8 (numbers in the table correspond to those in the Figure).

**Table 1 Material Properties**

| Material No. | Description | Permeability, k (m/sec) |
|---|---|---|
| 1 | Mine waste (embankments) | 4.00E-06 |
| 2 | Clay face | 1.00E-09 |
| 3 | Deposited tailings | 4.00E-05 |
| 4 | Slimes | 1.00E-06 |
| 5 | Old slimes | 1.00E-06 |
| 6 | Residual soil | 1.00E-07 |
| 7 | Mine waste (existing embankments) | 4.00E-06 |
| 8 | Soft weathered rock | 1.00E-08 |
| 9 | Starter embankment (clay) | 1.00E-09 |
| 10 | New rock buttress RL1259 | 1.00E-02 |

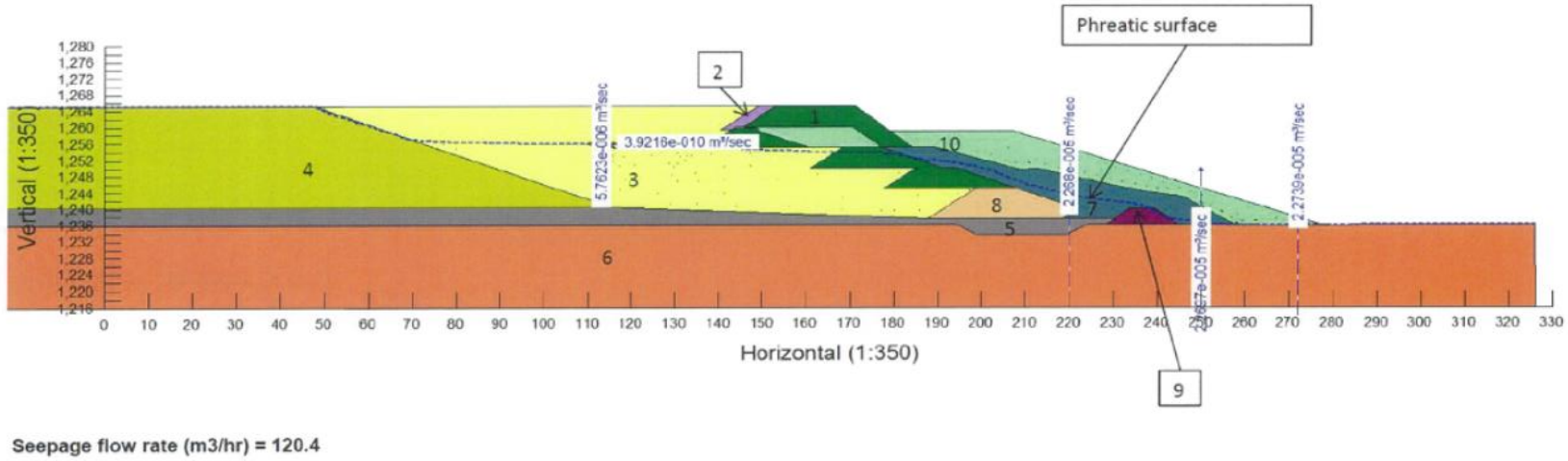


**Figure 8: Cross section of the TSF2 embankment at RL 1265m and expected seepage flows (GHD 2015c)**


**Figure 9: Inferred shallow aquifer flow direction and distribution (GHD 2014b)**

Key risks associated with the operation of TSF2 and proposed embankment raise are as follows:

- B1: Normal Operation – TSF2 seepage impact to deeper aquifer
- B2: Normal Operation – Overflow and release of water from Clear Water Pond to Austins Drain
- B3: Abnormal Operation – TSF2 seepage sump 02 overflow to Cowan Brook Dam
- B4: Emergency Operation – TSF2 overtopping
- B5: Emergency Operation – TSF2 structural failure (Note DER is not able to risk assess the likelihood of this event as it is reliant on geotechnical expertise so is not included in this risk assessment. This is regulated by the Department of Mines and Petroleum (DMP) under the *Mines Safety and Inspection Act 1994* and Regulations)

These risks are described individually in further detail below.

## B1 Normal Operations – Impacts to groundwater from TSF 2 Seepage

Emission Description

*Emission:* Seepage impacts to deeper groundwater aquifer.

*Impact:* Alteration of groundwater quality from seepage. Seepage is expected to be similar in water quality to that of the TSF2 decant water. Laboratory results of the TSF2 decant from June 2013 – October 2015 indicate pH of approximately 7.5 – 8.3, TDS (total dissolved solids) 810 – 1300 mg/L, arsenic concentrations of 0.08- 0.60 mg/L and lithium concentrations between 8.9 – 18 mg/L, amongst other trace metals. Radionuclides (uranium, thorium and radium) may also be present in seepage at trace amounts, but were not detected at the level of detection utilised by site analyses (being 0.1 mg/L for uranium and 0.05 mg/L for thorium).

Radionuclide activity has also been detected in all current groundwater bores during the 2014/15 annual period. The highest radioactivities for Radium 226 of 1.608 Bq/L and Radium 228 of 1.118 Bq/L have been recorded in groundwater bore M97/4, located near the seepage sumps.

The ADWG (Australian Drinking Water Guideline) for arsenic is 0.01 mg/L and the WA Department of Health (DOH) 2014 recommended criteria for arsenic for non-potable groundwater use is 0.1 mg/L. Arsenic levels are above both of these criteria.

There is no specified lithium limit for non-potable groundwater use. ANZECC (2000) guidelines prescribe an irrigation value of 2.5mg/L.

Average TSF2 seepage flows are estimated to currently be 119$m^3$/hr. With the completion of the embankment raise to RL 1280 m seepage is expected to increase to 180$m^3$/hr approximately (GHD 2015c).

*Controls:* ***Current controls***

Four dewatering bores were installed in 2014 within TSF2 to pump water from TSF2 to discharge into Austins drain, which flows to Southampton/Austins Dam (refer Figure 2 for locations). These bores have proved to have minimal effect in recovering seepage water (6 ML recovered in 2014/15) and no further dewatering bores are planned (Section 5.2.3 of Talison Lithium Australia 2015).

Currently seepage and runoff from the TSF2 embankment slopes is collected in two seepage collection sumps (southern and northern seepage collection sumps). Seepage from the northern sump is pumped to the Austins drain. Seepage from the southern sump is either pumped to Austins

drain, Tin Shed Dam (on the neighbouring Global Advanced Minerals Premises) or TSF2. Overflow from the sump flows to Cowan Brook Dam.

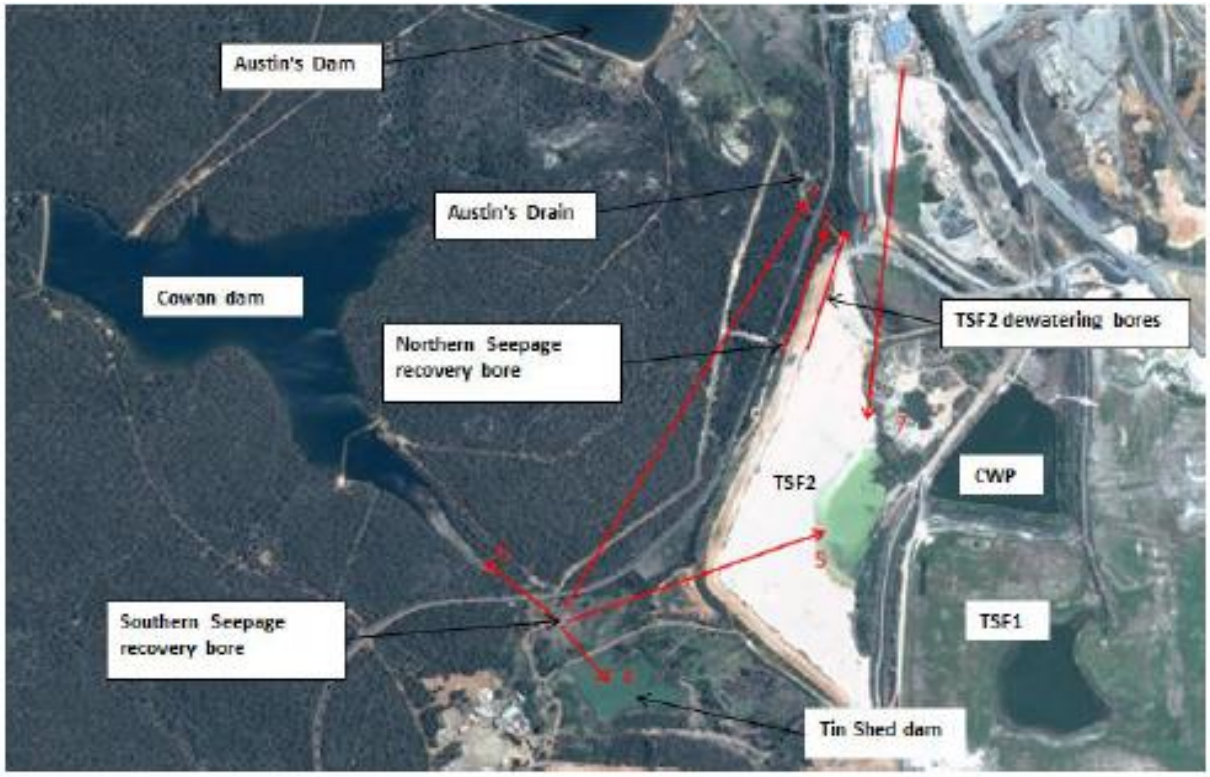


**Figure 10: Current TSF2 drainage management plan**

Three arsenic stabilisation units have been installed on process water flows either feeding TSF 2 (Tin Shed Dam) or on the decant storage to reduce the concentration of arsenic in process water and consequently in site surface water storages:

- at the Tin Shed Dam located within the neighbouring Global Advanced Minerals Lease – source of tantalum tailings feeding TSF2; and
- two at the Clear Water Pond.

***Proposed controls – TSF 2 embankment raise***

The proposed works to increase the TSF2 embankment height to RL1280 m will include two new seepage trenches at the toe of the western side of TSF2, within the new buttress structure (refer to Figures 4- 7 for further detail). Seepage trench 01 contains twin draincoil pipelines to collect foundation seepage and direct flow to sump 01, in a similar location to the existing northern sump.The trenches will be backfilled with coarse tailings sand and clayey cap. Similar trench 02 will comprise of two drainage pipelines (one for redundancy) and will feed sump 02. A surplus pipeline will also convey overflows from sump 01 to sump 02 in the event of a failure of the twin pipelines or pump at sump 01. No contingency is in place for sump 02.

A new network of groundwater monitoring bores will be installed as part of the works for the TSF2 embankment raise, including bores slotted to measure the shallow aquifer, intermediate depth between the aquifers and the deeper aquifer (GHD 2015b). Current monitoring does not measure the shallow aquifer and an audit of the existing monitoring network found that some bores have poor casing integrity (GHD 2014a). Additionally a number of existing bores will be destroyed by the civil

works to construct the embankment raise and the supporting buttress, and hence new bores to measure the deeper aquifer are required.

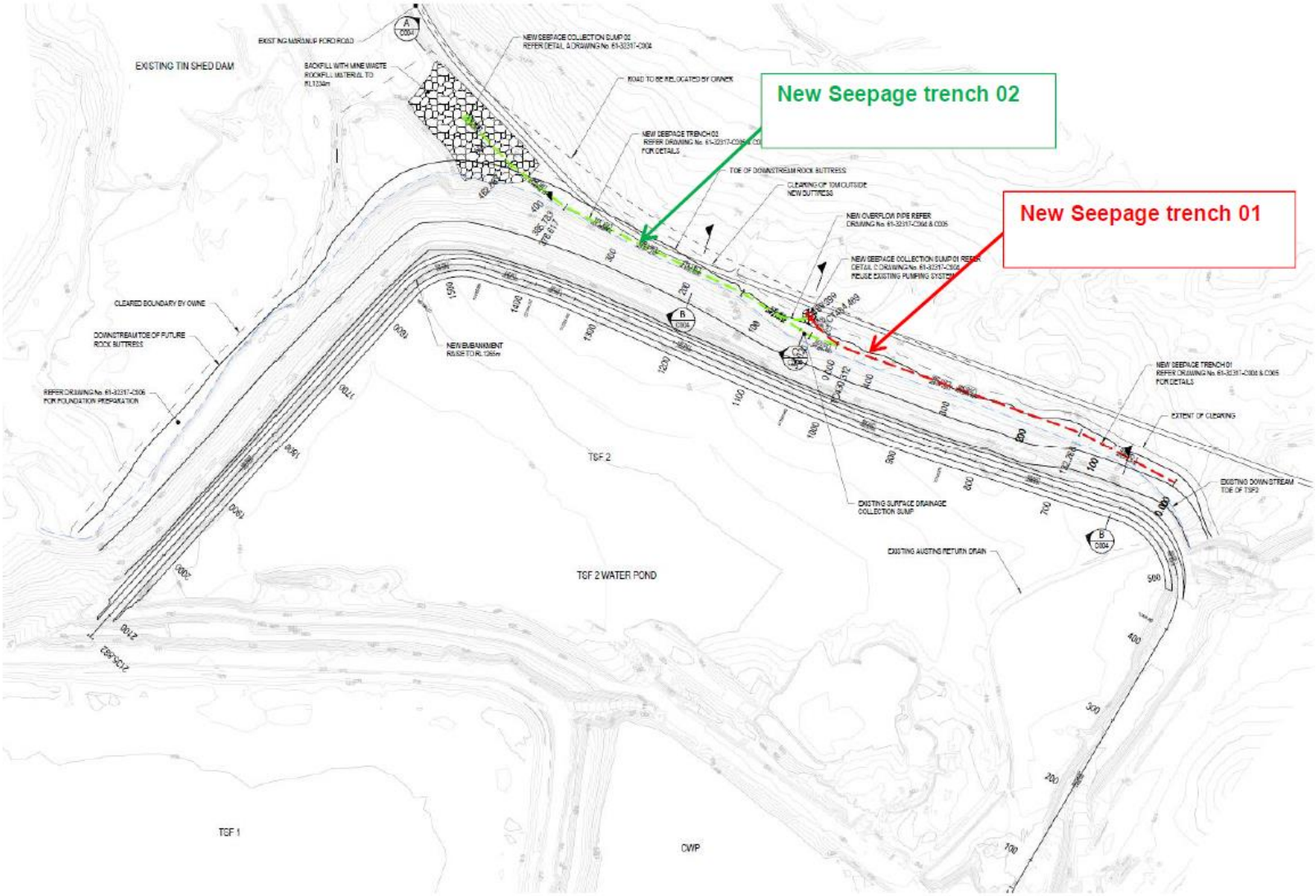


**Figure 11: TSF 2 Proposed foundation drainage system (GHD 2015a)**

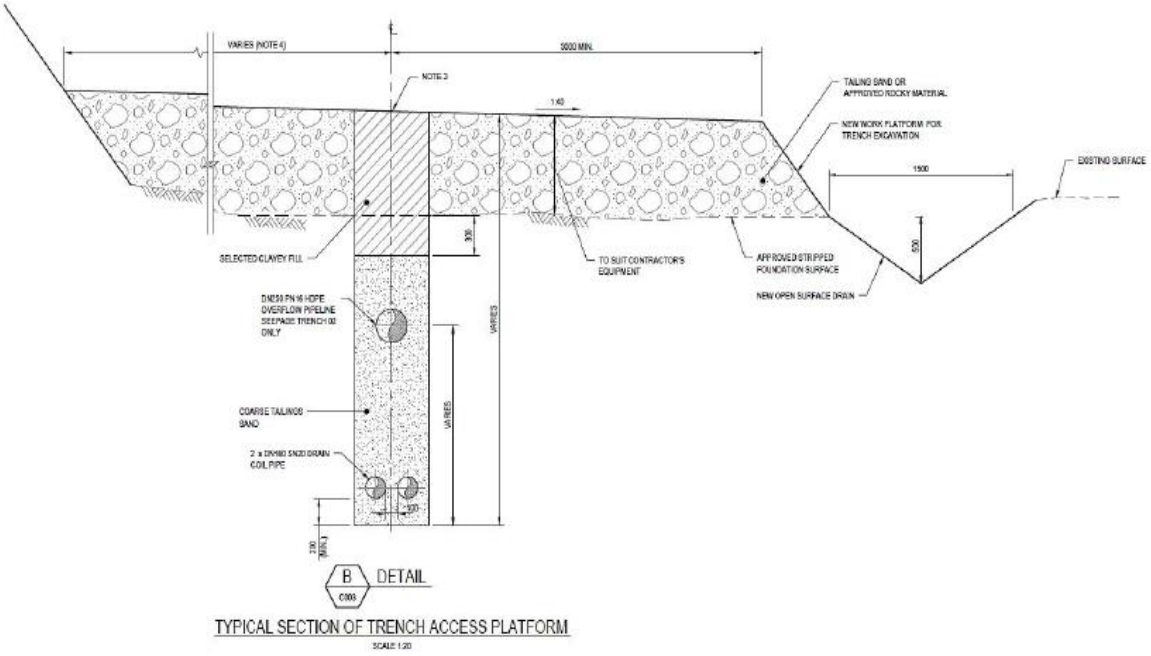


**Figure 12: TSF 2 Proposed foundation drainage system (GHD 2015a)**

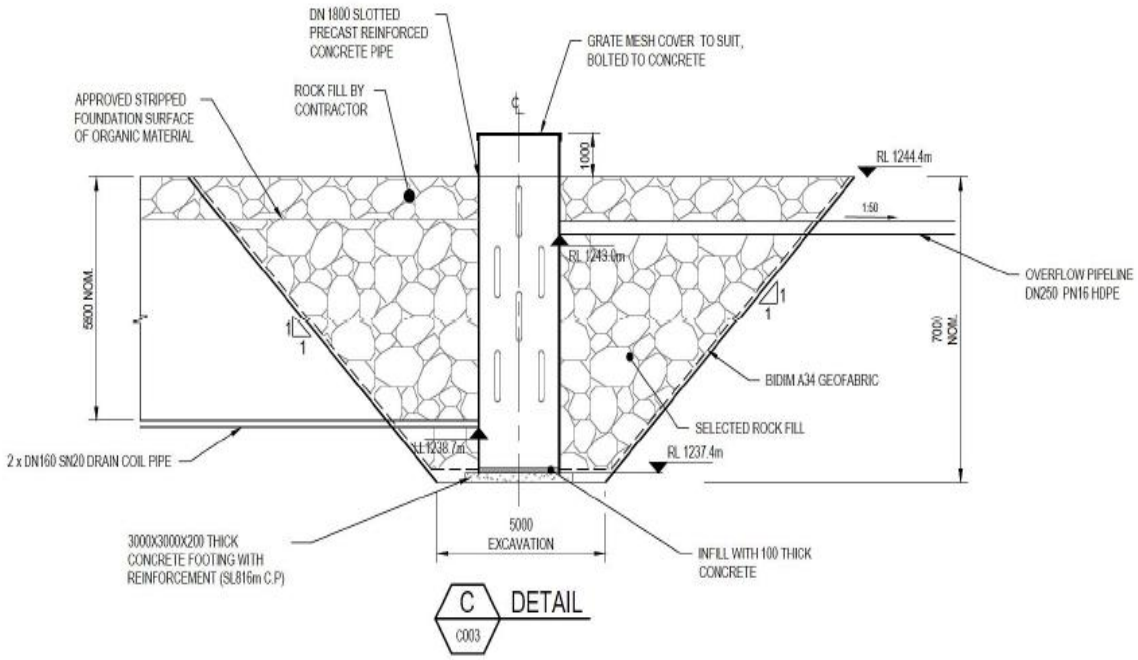


**Figure 13: Cross section of Proposed TSF 2 Seepage Sump 01 showing overflow pipeline to Sump 02 (GHD 2015a)**

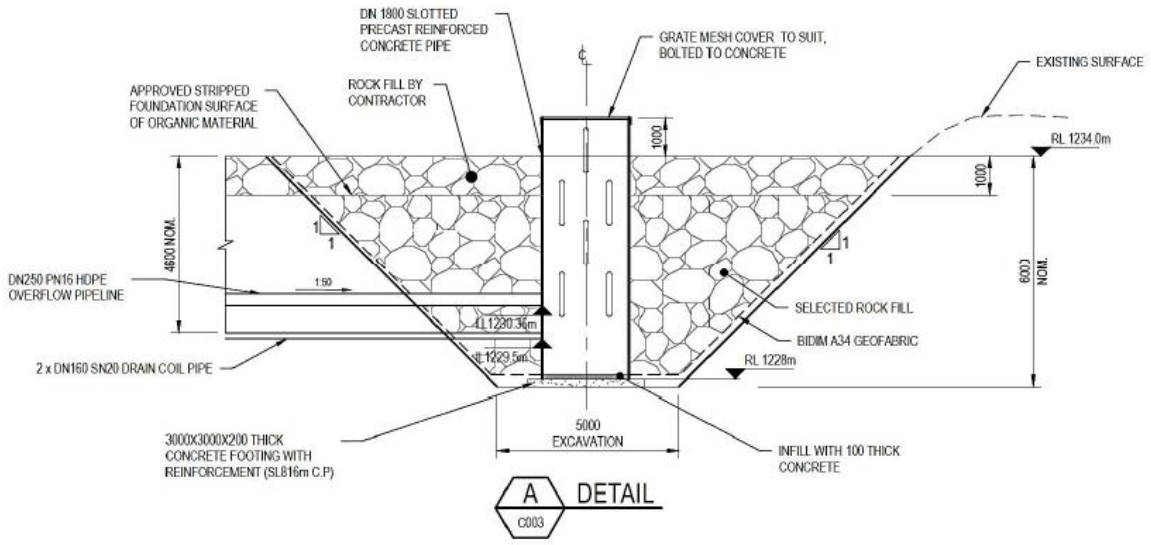


**Figure 7: Cross section of Proposed TSF 2 Seepage Sump 02 (GHD 2015a)**

Drainage interceptor pipes will also be built into the tailings beach for each 5m lift of the embankment. These pipelines will assist in controlling the phreatic line (seepage presence in the embankment) such that the increasing head of the TSF will not increase the seepage proportionally. Seepage flows expected to be recovered from these pipelines are 23 $m^3$/hr at the first lift of RL 1265 m to 30 $m^3$/hr at completion of the embankment raise to RL 1280 m. These pipelines will assist in recovery of seepage.

Risk Assessment

*Consequence:* Major; due to the Lithium concentration of seepage expected to be at least 9 mg/L. Whilst there is no ecological level is specified for Lithium, the ANZECC guideline for irrigation is 2.5 mg/L.

*Likelihood*: Possible; GHD 2014a review of groundwater monitoring results stated that groundwater data for two existing bores indicated the presence of seepage, possibly due to migration into the deep aquifer or due to poor well integrity. To date GHD has surmised that the weathered clays above the deeper aquifer had protected the deeper aquifer from impact but this is only a hypothesis at present.

*Risk Rating:* High

Regulatory Controls

A monitoring program of the shallow and deeper aquifers is required by Licence condition 3.4.1. Bores slotted at intermediate depths between the two aquifers have also been included to assist in determining impacts.

Residual Risk

*Consequence:* Major

*Likelihood*: Possible

*Risk Rating:* High

It is should be noted that the risk assessment results have been determined in the absence of adequate groundwater monitoring data and should be considered preliminary. Pending the monitoring results, further regulatory controls may be imposed to reduce the risk if necessary, and/or the residual risk revised.

**References**

GHD (2014a*) Talison Lithium Australia Pty Ltd: Stage 3 Integrated Geophysics and Hydrogeological Investigation. Interpretation of Geochemical Data*, February 2014.

GHD (2014b*) Talison Lithium: Mapping of shallow aquifer, letter report prepared for Talison Lithium Australia*, 17 September 2014.

GHD (2015a) *Talison Lithium Australia Pty Ltd: TSF2 Raise to RL 1280m Design Report*, Revision B October 2015.

GHD (2015b) *Talison Lithium Mine, Greenbushes WA: Design of new groundwater monitoring network TSF2, letter report prepared for Talison Lithium Australia*, 23 November 2015.

GHD (2015c) *TSF2 to RL 1280m: Response to DER queries, letter prepared for Talison Lithium*, 30 November 2015.

Significant Environmental Services (2015) *Water Monitoring Review 2014/15 Greenbushes Mine*, 17 August 2015.

Talison Lithium Australia (2015) *Surface Water Management Plan*, Version 5, 23 September 2015

## B2 Normal Operation: Overflows from Clear Water Pond

Emission Description
*Emission:* Overflow and release of water from Clear Water Pond to Austins Drain. The 2013 Mine Water Circuit water balance (refer Figure 6) indicates out of a total inflow of 6235 ML (comprising 5511 ML from decant water seepage from the north west corner of TSF1 and incident rainfall and 724 ML from mine pits) 1414 ML is allowed to be directly released as an overflow from the Clear Water Pond to the open Austins Drain, to flow to Austins Dam.

*Impact*: The water quality of the Clear Water Pond would be similar to that of the TSF2 decant water quality being pH of approximately 7.5 – 8.3, TDS 810 – 1300 mg/L, arsenic concentrations of 0.08-0.60 mg/L and lithium concentrations between 8.9 – 18 mg/L. Two arsenic remediation units operate at the Clear Water Pond which treat both the decant from TSF2 and recirculating water.

The overflow using the open Austins Drain contributes also to the increased lithium, arsenic and total dissolved solids concentrations in the shallow aquifer, given that the shallow aquifer and surface water flows are inferred to be hydraulically connected (GHD 2014b). The net impact of the discharge is increased concentrations of lithium and arsenic in Austins Dam and then Southampton Dam, and contamination of wetlands surrounding and feeding Austins Dam, with potential ecological impacts to aquatic species (refer Appendix A for more detail).

Risk Assessment
*Consequence:* Moderate, as there is localised, actual alteration of the environment.
*Likelihood*: Almost Certain, as it is current practice.
*Risk Rating:* High

Regulatory Controls
IR5 of licence condition 4.1.1 required the Licensee to provide a scope and schedule for works including replacement of overland conveyance of flows from the Clear Water Pond (amongst other sources) with bunded pipelines or equivalent.

Licence condition 3.3.1 requires the Licensee to record the frequency and volume of all overflows from the Clear Water Pond, so that the extent of the overflows can be monitored and reported to DER.

A monitoring program of the shallow aquifer is required by Licence condition 3.4.1.

Residual Risk
*Consequence:* Moderate
*Likelihood*: Likely
*Risk Rating:* High

**References**

GHD (2014b*) Talison Lithium: Mapping of shallow aquifer, letter report prepared for Talison Lithium Australia*, 17 September 2014.

GHD (2015c) *TSF2 to RL 1280m: Response to DER queries, letter prepared for Talison Lithium*, 30 November 2015.

Talison Lithium Australia (2015) *Surface Water Management Plan*, Version 5, 23 September 2015, Section 4.6

## B3 Abnormal Operation: TSF2 tailings seepage release from pump failure at sump 02

Emission Description
*Emission:* Release of tailings seepage to Cowan Brook Dam from pump failure at sump 02 or power outage.

*Impact*: Overflow of TSF2 seepage directly to Cowan Brook Dam, increasing lithium, arsenic, other trace metals and salts concentration in Cowan Brook Dam. TSF 2 seepage is currently estimated at a rate of 119 $m^3$/hr, increasing to 120 $m^3$/hr at completion of the first 5 m lift to RL 1265 m. At the completion of all the proposed lifts to RL 1280 m, seepage is estimated to be generated at a rate of 180 $m^3$/hr (GHD 2015c).

Water quality in TSF2 seepage is similar to that measured in the TSF 2 decant (pH of approximately 7.5 – 8.3, TDS 810 – 1300 mg/L, Arsenic concentrations of 0.08- 0.60 mg/L and Lithium concentrations between 8.9 – 18 mg/L, amongst other trace metals.) Radionuclides (uranium, thorium and radium) may also be present in seepage at trace amounts. Current onsite monitoring of decant liquor is unable to analyse these elements at the lower level of detection to detect ecological impacts.

In times of high rainfall Cowan Brook Dam overflows and the discharge leaves the Premises, contaminating water quality in Norilup Dam and Norilup Brook, a tributary of the Blackwood River. Norilup Brook is estimated to contribute approximately 3% of the total flows to the Blackwood River in mid – lower catchment (Talison Lithium Australia 2015).

Ecological study into impacts on aquatic species present in Norilup Brook and downstream of the discharge point at Norilup Dam has determined that bioaccumulation of lithium and arsenic in the flesh of tested aquatic species present in Norilup Dam and Norilup Brook has occurred (CNERM 2014).

Some downstream landowners access Norilup Brook water for livestock and irrigation purposes (Talison Lithium Australia 2015).

Norilup Dam also forms part of the Water Corporation's emergency water supply for the Town of Greenbushes through ability to pump back to Mt Jones Reservoir, and hence the Cowan Brook Dam discharge may contaminate drinking water supplies.

*Controls:* Process controls only. An additional overflow pipe serves to direct flow from the sump 01 (new northern sump) to the sump 02 (new southern sump), however no additional redundancy is planned to be installed for the failure of the pump itself. No emergency storages or additional back up pumping capacity is planned to be installed.

Risk Assessment
*Consequence:* Major, due to the Lithium concentration of seepage expected to be at least 9 mg/L. Whilst there is no ecological level specified for Lithium, the ANZECC guideline for irrigation is 2.5 mg/L. Refer also to Appendix A for further detail.
*Likelihood*: Likely
*Risk Rating:* High

Regulatory Controls
Ambient surface water quality limits have been imposed for the receiving environment for the discharge as part of licence condition 3.4.1.

Improvement condition 4.1.1, IR 1 of Table 4.1.1 has been imposed on the licence for the Licensee to develop an emergency response plan and provide either emergency containment, and/ or additional redundancy in the form of a back up pumping system or equivalent to reduce the impact of emergency failure due to pumping failure or power failure.

Improvement condition 4.1.1, IR5 of Table 4.1.1 has been placed on the licence to require the Licensee to submit a plan to replace open conveying of process water overflows to Austins Dam with bunded pipelines or equivalent and to evaluate the need for additional emergency storage to capture overflows. These requirements are a subset of an overall plan to either isolate contaminated process water flows from clean stormwater or to improve the water quality of the discharge from Cowan Brook Dam by other means.

Residual Risk
*Consequence:* Moderate
*Likelihood*: Possible
*Risk Rating:* Moderate

**References**

GHD (2015a) *Talison Lithium Australia Pty Ltd: TSF2 Raise to RL 1280m Design Report,* Revision B October 2015.

GHD (2015c) *TSF2 to RL 1280m: Response to DER queries, letter prepared for Talison Lithium*, 30 November 2015.

Talison Lithium Australia (2015) *Surface Water Management Plan*, Version 5, 23 September 2015, Sections 4.7, 5.2.5, 5.2.7.

## B4 Emergency Operation: Overtopping of TSF2

Emission Description
*Emission:* Overtopping of TSF2 following the embankment raise to RL 1265 m and future 5 m lifts to RL 1280 m.

*Impact:* Release of tailings decant water to land and then to surrounding water storages (on and off the Premises); potential to impact tributaries of Blackwood River (including Norilup Brook). Laboratory results from June 2013 – October 2015 of the TSF 2 decant indicates pH of approximately 7.5 – 8.3, TDS 810 – 1300 mg/L, Arsenic concentrations of 0.08- 0.60 mg/L and Lithium concentrations between 8.9 – 18 mg/L, amongst other trace metals. Radionuclides (uranium, thorium and radium) may also be present in seepage at trace amounts.

*Controls*: Design of the embankment raise to RL 1265 m has confirmed that providing the maximum operating pond level during the wet season is maintained at or below RL 1264.02 m, compliance with ANCOLD 2012 and DMP 1999 guidance for freeboard can be achieved, allowing for a 1 in 100 year, 72 hour event, 0.5 m contingency storage and a 1:10 wave run up capacity of 0.1m.

The Surface Water Management Plan details the inspection schedule for all tailings and water storages.

Risk Assessment
*Consequence:* Major
*Likelihood*: Unlikely
*Risk Rating:* Moderate

Regulatory Controls
Condition 1.3.4 has been placed on the Licence to ensure that the specified freeboard for TSF2 is maintained. Condition 1.3.6 requires the embankment raise to be constructed as per the submitted application documents. Conditions 5.2.4 and 5.2.5 require compliance documents to be submitted following the TSF 2 embankment construction works and prior to commissioning.

Residual Risk
*Consequence:* Major
*Likelihood*: Rare; compliance with licence conditions should reduce the frequency.
*Risk Rating:* Moderate

**References**

ANCOLD (2012) *Guidelines on Tailings Dams Planning, Design, Construction, Operation and Closure*, May 2012

Department of Mines and Petroleum (1999) *Safe Design and Operating Standards for Tailings Storage Facilities*

GHD (2015a) *Talison Lithium Australia Pty Ltd: TSF2 Raise to RL 1280m Design Report*, Revision B October 2015.

GHD (2015c) *TSF2 to RL 1280m: Response to DER queries, letter prepared for Talison Lithium*, 30 November 2015.

# Appendix C

## Premises Operation – Lithium Technical Grade Processing Plant and Lithium Chemical Grade Processing Plant

Key risks for the Processing Plant are:

C1: Abnormal Operation - Overflow or release of process water from process/raw water tanks to ground and to surface water channels within the Premises and eventual flow to Austins Dam via Austins Drain or wetland upstream of Austins Dam; and

C2: Abnormal/Emergency Operation - Overflow of contaminated stormwater from the Lithium Processing Plant's siltation trap.

Both of these overflows would contribute in part to the contaminated water quality in Cowan Brook Dam, and eventual poor water quality in Norilup Brook via wet season discharges from Cowan Brook Dam.

### C1 Abnormal Operation: Overflow from Process Water Tanks

Emission Description

*Emission:* Overflow from process water feed tanks to ground due to failure of process control. These tanks being the:

- Lithium TG Raw Water Tank (supplied from Clear Water Pond; i.e. combination of TSF 2 decant, TSF 2 seepage, TSF 2 embankment runoff and mine dewater from C1, C2, C3 and Vultan pits)
- Fire Water Tank (supplied from Southampton Dam)

*Impact:* Contamination of surrounding land and surface water drainage systems.
Overflows from the Lithium CG Raw Water Tank discharge to land to an adjacent sand tails area. Clear Water Pond liquor in the period from June 2013 to October 2015 recorded a pH of approximately 7.5 – 8.3, TDS 810 – 1300 mg/L, Arsenic concentrations of 0.08- 0.60 mg/L and Lithium concentrations between 8.9 – 18 mg/L. Water quality in Southampton dam typically records Lithium concentrations of 10 - 12mg/L.

*Controls:* Water level control is in place on the Raw Water tanks. There is no secondary containment bunding to collect overflows.

Risk Assessment

*Consequence*: Moderate; localised, actual alteration of the environment.
*Likelihood:* Possible; overflows from these tanks have occurred in recent past.
*Risk Rating:* Moderate

Regulatory Controls

Improvement condition 4.1.1, IR 4 has been added to the licence to require the Licensee to submit and implement a plan to capture and/or reduce overflows from the Lithium TG Raw Water Tank such that the overflow is not released to the siltation trap.

Residual Risk

*Consequence*: Moderate
*Likelihood:* Unlikely
*Risk Rating:* Moderate

**Reference**

Talison Lithium Australia (2015) *Surface Water Management Plan*, Version 5, 23 September 2015, Sections 4.7, 5.2.5, 5.2.7.

## C2 Abnormal/Emergency Operation: Overflow from Lithium Processing Plant's Siltation Trap

Emission Description
*Emission*: Overflow from Lithium Processing Plants Siltation Trap released to Austins wetland/drain and flowing to Austins Dam, due to a sump pump failure from a power outage or due to a heavy rainfall event exceeding the capacity of the trap.

*Impact:* Contamination of surrounding land and surface water drainage systems. Overflows from the Siltation Trap discharge to the land upstream of Austins Dam, resulting in a contributory impact to poor local surface water quality in Austins Dam from the addition of metals and metalloids (particularly lithium and arsenic) and salts (sodium and sulfate).

*Controls*: No emergency controls are in place for these events.

Risk Assessment
*Consequence:* Moderate; localised, actual alteration of the environment.
*Likelihood*: Possible; overflows of the sump have been recorded in recent past.
*Risk Rating:* Moderate

Regulatory Controls
Condition 3.3.1 requires the Licensee to monitor these events and record their duration and frequency. A quarterly report containing this information must be submitted to DER according to condition 5.2.2.

Improvement condition 4.1.1, IR 5 of Table 4.1.1 has been placed on licence to require the Licensee to submit a plan to replace open conveying of process water overflows to Austins Dam with bunded pipelines or equivalent and to evaluate the need for additional emergency storage to capture overflows. These requirements are a subset of an overall plan to either isolate contaminated process water flows from clean stormwater or to improve the water quality of the discharge from Cowan brook Dam by other means.

Dependent on the results of incident reporting, additional conditions may be required in a future amendment of this Licence.

Residual Risk
*Consequence:* Moderate
*Likelihood*: Possible
*Risk Rating:* Moderate

**Reference**
Significant Environmental Services (2015) *Water Monitoring Review 2014/15 Greenbushes Mine*, 17 August 2015.

Talison Lithium Australia (2015) *Surface Water Management Plan*, Version 5, 23 September 2015, Sections 4.7, 5.3.

# Appendix D

## Premises Operation – Premises Water Storages: Austins Dam, Southampton Dam, Cowan Brook Dam

Key risks for the water storages are:

- D1: Normal Operation - Seepage from Austins Dam, Southhampton Dam and Cowan Brook Dam impacting on surface water quality
- D2: Normal Operation - Seepage from Austins Dam, Southhampton Dam and Cowan Brook Dam impacting on deeper groundwater aquifer
- D3 Abnormal Operation – Overflows from Austins Dam and Cowan Brook Dam released off the Premises to receiving downstream freshwater catchments
- D4: Emergency Operation – Overflows from Southhampton Dam released off the Premises to receiving downstream freshwater catchments

### D1 Normal Operation: Impacts to surface water from seepage from Premises' water storages

Emission Description

*Emission:* Seepage from the Southampton, Austins or Cowan Brook Dams contributing to adverse water quality in Norilup Brook and upstream catchment. Talison's Surface Water Management Plan notes that both Austins Dam and Southampton Dam are seeping at the toe of the walls.

*Impact*: Lithium concentration in Austins Dam recorded to 12 mg/L, arsenic approximately 0.16 mg/L (above recommended threshold level of 0.1 mg/L Australian Drinking Water Guidelines), TDS at 900 mg/L. In 2014/15 Southampton Dam recorded lithium concentrations of 7.9 – 10.7 mg/L, arsenic at 0.043 – 0.128 mg/L and TDS at 850 – 1000 mg/L. Water quality in Cowan Brook Dam over 2014/15 recorded lithium concentrations of 6.6 – 7.3 mg/L, arsenic at 0.004 -0.018 mg/L and TDS between 839 – 1020 mg/L (Significant Environmental Services 2015).

*Controls*: Currently seepage from Austins Dam is collected in toe drains and directed to borrow pits to the southwest of the Dam. A solar pump is installed to return seepage from the seepage pits to the Austins Dam, however in winter the pits overflow to Cowan Brook Dam and contribute to elevated lithium and arsenic concentrations in the Cowan Brook Dam.

Seepage from Southhampton dam is directed to a small wetland south east of the dam, managed by Blackwood Basin Group. It is not clear whether this wetland is within the Premises boundary, nor its water quality.

Risk Assessment

*Consequence:* Moderate; localised, actual alteration of the environment.
*Likelihood*: Almost Certain; as it is currently occurring with seepage overflowing in winter to Cowan Brook Dam and being released to a small wetland from Southampton Dam.
*Risk Rating:* High

Regulatory Controls

IR5 of licence condition 4.1.1 includes the requirement for the Licensee to review the need to provide additional storage capacity within the Premises for emergency overflows. This additional storage should also be considered for toe seepage from Austins Dam to prevent overflows to Cowan Brook Dam.

IR6 of licence condition 4.1.1 requires the Licensee to sample water quality of the receiving wetland for seepage from Southampton Dam, clarify its location with regard to the Premises boundary and characterise the contribution of seepage flows to this wetland to determine the extent of this impact.

Residual Risk
*Consequence:* Moderate
*Likelihood*: Almost Certain
*Risk Rating:* High

**References**

Significant Environmental Services (2015) *Water Monitoring Review 2014/15 Greenbushes Mine*, 17 August 2015

Talison Lithium Australia (2015) *Surface Water Management Plan*, Version 5, 23 September 2015.

## D2 Normal Operation: Impacts to groundwater from seepage from Premises' water storages

Emission Description
*Emission:* Seepage from the Southampton, Austins or Cowan Brook Dams to the deeper groundwater aquifer. Talison's Surface Water Management Plan notes that both Austins Dam and Southampton Dam are seeping at the toe of the walls.

*Impact*: Lithium and arsenic concentrations in all dams as listed in risk assessment above.

GHD (2014a) noted that there is limited understanding of the impacts to the groundwater system from the water storage dams. However in one bore, MB97/1, there were impacts on groundwater interpreted as derived from Austins Dam. MB97/1 is installed into the deeper level of the shallow aquifer (~20m below ground level). GHD (2014a) noted that the monitoring data to 2013 indicated that the groundwater quality was consistent with tailings water and circuit water quality, considered to be sourced from the adjacent and up-gradient Austins Dam. The shallow aquifer is inferred to be in hydraulic connection with the Dam. GHD concluded that where hydraulic connectivity between the shallow aquifer and water storage is inferred, discharges and impacts on the groundwater system are likely.

In a supplementary report, GHD (2014b) surmised that as it is likely the dams have been excavated into weathered basement material and the presence of predominately weathered material is likely to limit the transport of groundwater seepage. However this has not been confirmed or investigated.

*Controls*: Some existing groundwater monitoring bores are located in the adjacent area between Austins and Cowan Brook Dam. In 2015 a Dams Handbook was developed to ensure that the weekly inspections of the dam walls and seepage collection structures were completed. A seepage collection drain was installed at the Cowan Brook Dam wall.

Risk Assessment
*Consequence:* Moderate; localised, actual alteration of the environment.
*Likelihood*: Possible; no monitoring of deeper groundwater aquifer is occurring in this area.
*Risk Rating:* Moderate

Regulatory Controls
Licence condition 3.4.1 requires monitoring in existing groundwater bores MB97/1, MB97/2 and MB01/11 to be reported to DER as indicators of local impacts to the deeper groundwater aquifer in the area between the Austins Dam and Cowan Brook Dam (refer to Figure 2 for locations). Dependent on these results and the results of implementation of the improvement condition 4.1.1, further regulatory control may be required.

Residual Risk
*Consequence:* Moderate
*Likelihood*: Possible
*Risk Rating:* Moderate

**References**

GHD (2014a*) Talison Lithium Australia Pty Ltd: Stage 3 Integrated Geophysics and Hydrogeological Investigation. Interpretation of Geochemical Data*, February 2014.

GHD (2014b*) Talison Lithium: Mapping of shallow aquifer, letter report prepared for Talison Lithium Australia*, 17 September 2014.

Significant Environmental Services (2015) Water Monitoring Review 2014/15 Greenbushes Mine, 17 August 2015

Talison Lithium Australia (2015) Surface Water Management Plan, Version 5, 23 September 2015.

## D3 Abnormal Operation: Impacts to surface water from overflows from Austins Dam and/or Cowan Brook Dam

Emission Description
*Emission:* Overflows from either Austins Dam, or Cowan Brook Dam to the downstream environment. Overflows from Austins Dam occur regularly during winter and are released from a spillway to flow via surface wetlands south west to Cowan Brook Dam. Cowan Brook Dam overflows periodically during winter to release off the Premises to Norilup Dam and Norilup Brook.

*Impact*: Impacts to downstream irrigation/livestock users, potential health impacts if Norilup Dam water is used in the augmented Water Corporation water supply to Town of Greenbushes. Potential chronic impacts to downstream freshwater aquatic ecosystem in Norilup Brook. Refer to Appendix A for detail.

*Controls*: Flowmeters are installed on Austins Dam and Cowan Brook Dam spillways. Section 10.1 of the Surface Water Management Plan requires inspections of dam infrastructure integrity and monitoring of discharges.

Risk Assessment
*Consequence:* Major; refer Appendix A for further detail.
*Likelihood*: Likely, potential chronic ecosystem effects and impacts to third party users.
*Risk Rating:* High

Regulatory Controls
Licence condition 1.3.3 requires the Licensee to complete the inspection schedule as per the Premises' Surface Water Management Plan.

Licence condition 3.2.1 requires the Licensee to monitor all overflow events from Cowan Brook Dam discharged to Norilup Dam, while condition 3.3.1 requires that all overflow events from Austins Dam to Cowan Brook Dam be recorded. This data must be reported as part of the Annual Environmental Report for the Premises (condition 5.2.1).

IR3 of licence condition 4.1.1 requires the Licensee to install a flowmeter on the discharge point from Norilup Dam to Norilup Brook so downstream flows and releases can be monitored in future by the Licensee.

IR5 of licence condition requires the Licensee to provide a scope of works for implementing improvements to reduce the concentration of contaminants in the offsite discharge from Cowan Brook Dam and/or reduce the frequency of discharges. Ambient surface water quality limits as measured at Norilup Dam have been imposed on the licence in Table 3.4.2 of condition 3.4.1. These progressively reduce the concentration for lithium over the life of the licence.

Residual Risk
*Consequence:* Major
*Likelihood*: Likely
*Risk Rating:* High

**References**

ANZECC & ARMCANZ (2000) *The Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, October 2000.

Aral H., Vecchio-Sadus A., (2008) 'Toxicology of lithium to humans and the environment – a literature review', *Ecotoxicology and Environmental Safety*, Vol 70 pp. 349-356.

Centre of Excellence in Natural Resource Management, UWA (CERNM) (2013) *Ecotoxicology of lithium*, August 2013.

Centre of Excellence in Natural Resource Management, UWA (CERNM) (2014) *Surveys of aquatic flora and fauna in Norilup Brook to determine the presence and health thereof and any evidence of bioaccumulation of heavy metals from the Talison Lithium Mine, Greenbushes, Western Australia,* February 2014.

GHD (2014a*) Talison Lithium Australia Pty Ltd: Stage 3 Integrated Geophysics and Hydrogeological Investigation. Interpretation of Geochemical Data*, February 2014.

GHD (2014b*) Talison Lithium: Mapping of shallow aquifer, letter report prepared for Talison Lithium Australia*, 17 September 2014.

Significant Environmental Services (2015) *Water Monitoring Review 2014/15 Greenbushes Mine*, 17 August 2015

Talison Lithium Australia (2015) *Surface Water Management Plan*, Version 5, 23 September 2015.

## D4 Emergency Operation: Impacts to surface water from overflows from Southampton Dam

Emission Description
*Emission:* Overflows from Southampton Dam, released to downstream water catchment.

*Impact*: In 2014/15 Southampton Dam recorded lithium concentrations of 7.9 – 10.7 mg/L, arsenic at 0.043 – 0.128 mg/L and TDS at 850 – 1000 mg/L. Overflows from this dam will impact on downstream water quality in Schwenkies Dam. Impacts to downstream irrigation/livestock users, potential health impacts if Schwenkies Dam water is used in the augmented Water Corporation water supply to Town of Greenbushes. Potential chronic impacts to downstream freshwater aquatic ecosystem. Refer to Appendix A for detail.

*Controls*: Water flow to Southampton Dam is controlled via manual valve from Austins Dam. Flows to this dam are managed solely by the Licensee and no other inflows occur. Inspections of the dam are carried out in accord with the frequency and parameters listed in Section 10.1 of the Surface water Management Plan. The Licensee has not permitted managed overflows from this Dam since 2005 (Talison Lithium 2015).

Risk Assessment
*Consequence:* Major; refer Appendix A for further detail.
*Likelihood*: Possible, potential chronic ecosystem effects and impacts to third party users, potential for the dam to overflow.
*Risk Rating:* High

Regulatory Controls
Due to the ability for flows into this Dam to be managed by the Licensee, and the increased concentrations of lithium and other contaminants in this Dam as compared to Cowan Brook Dam, Licence condition 2.2.2 does not permit discharges from Southampton Dam off the Premises.

Residual Risk
*Consequence:* Major
*Likelihood*: Unlikely
*Risk Rating:* Moderate

**References**

ANZECC & ARMCANZ (2000*) The Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, October 2000.

Significant Environmental Services (2015) *Water Monitoring Review 2014/15 Greenbushes Mine*, 17 August 2015

Talison Lithium Australia (2015) *Surface Water Management Plan*, Version 5, 23 September 2015.