Government of Western Australia
Department of Water and Environmental Regulation

Works Approval

Works Approval Number	W6125/2018/1
Works Approval Holder	Northern Star (Kanowna) Pty Limited
ACN	010 511 789
Registered business address	Level 1 388 Hay Street SUBIACO WA 6008
File Number	DER2018/000241
Duration	15 May 2018 to 14 May 2021
Date of issue	15 May 2018
Prescribed Premises	Category 5 – Processing or beneficiation of ore
Premises	Kanowna Belle Gold Mine Mining tenements M27/18, 22, 23, 37, 49, 57, 92, 103, 122, 123, 127, 159, 164, 232, 245, 287, 420 and L27/87, 83, 62 KANOWNA WA 6431

This Works Approval is granted to the Works Approval Holder, subject to the following conditions, on 15 May 2018, by:

Date signed: 15 May 2018
Caron Goodbourn
A/Manager Licensing (Process Industries)
an officer delegated under section 20 of the *Environmental Protection Act 1986* (WA)

Explanatory notes

These explanatory notes do not form part of this Works Approval.

Defined terms

Definition of terms used in this Works Approval can be found at the start of this Works Approval. Terms which are defined have the first letter of each word capitalised throughout this Works Approval.

Department of Water and Environmental Regulation

The Department of Water and Environmental Regulation (DWER) is established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V, Division 3 of the *Environmental Protection Act 1986* (WA) (EP Act). The Department also monitors and audits compliance with licences and works approvals, takes enforcement action and develops and implements licensing and industry regulation policy.

Works Approval

Section 52 of the EP Act provides that an occupier of any premises commits an offence if any work is undertaken on, or in relation to, the premises which causes the premises to become, or to become capable of being, Prescribed Premises, except in accordance with a works approval.

Section 56 of the EP Act provides that an occupier of Prescribed Premises commits an offence if Emissions are caused or increased or permitted to be caused or increased, or Waste, noise, odour or electromagnetic radiation is altered or permitted to be altered from Prescribed Premises, except in accordance with a works approval or licence.

Categories of Prescribed Premises are defined in Schedule 1 of the *Environment Protection Regulations 1987* (WA) (EP Regulations).

This Works Approval does not authorise any activity which may be a breach of the requirements of another statutory authority including, but not limited to, the following:

- conditions imposed by the Minister for Environment under Part IV of the EP Act;
- conditions imposed by DWER for the clearing of native vegetation under Part V, Division 2 of the EP Act;
- any requirements under the *Waste Avoidance and Resource Recovery Act 2007;*
- any requirements under the *Environmental Protection (Controlled Waste) Regulations 2004*; and
- any other requirements specified through State legislation.

It is the responsibility of the Works Approval Holder to ensure that any action or activity referred to in this Works Approval is permitted by, and is carried out in compliance with, statutory requirements.

The Works Approval Holder must comply with the Works Approval. Contravening a Works Approval Condition is an offence under s.55 of the EP Act.

Responsibilities of Works Approval Holder

Separate to the requirements of this Works Approval, general obligations of Works Approval Holders are set out in the EP Act and the regulations made under the EP Act. For example, the Works Approval Holder must comply with the following provisions of the EP Act:

- the duties of an occupier under s.61; and

- restrictions on making certain changes to Prescribed Premises unless the changes are in accordance with a Works Approval, Licence, closure notice or environmental protection notice (s.53).

Strict penalties apply for offences under the EP Act.

Reporting of incidents

The Works Approval Holder has a duty to report to the Department all Discharges of Waste that have caused or are likely to cause Pollution, Material Environmental Harm or Serious Environmental Harm, in accordance with s.72 of the EP Act.

Offences and defences

The EP Act and its regulations set out a number of offences including:

- Offence of emitting an Unreasonable Emission from any Premises under s.49.
- Offence of causing Pollution under s.49.
- Offence of dumping Waste under s.49A.
- Offence of discharging Waste in circumstances likely to cause Pollution under s.50.
- Offence of causing Serious Environmental Harm (s.50A) or Material Environmental Harm (s.50B).
- Offence of causing Emissions which do not comply with prescribed standards (s.51).
- Offences relating to Emissions or Discharges under regulations prescribed under the EP Act, including materials discharged under the *Environmental Protection (Unauthorised Discharges) Regulations 2004 (WA).*
- Offences relating to noise under the *Environmental Protection (Noise) Regulations 1997 (WA).*

Section 53 of the EP Act provides that a Works Approval Holder commits an offence if Emissions are caused, or altered, from a Prescribed Premises unless done in accordance with a Works Approval, Licence or the requirements of a closure notice or an environmental protection notice.

Defences to certain offences may be available to a Works Approval Holder and these are set out in the EP Act. Section 74A(b)(iii) provides that it is a defence to an offence for causing Pollution, in respect of an Emission, or for causing Serious Environmental Harm or Material Environmental Harm, or for discharging or abandoning Waste in water to which the public has access, if the Works Approval Holder can prove that an Emission or Discharge occurred in accordance with a Works Approval.

This Works Approval specifies the Emissions and Discharges, and the limits and Conditions which must be satisfied in respect of specified Emissions and Discharges, in order for the defence to offence provision to be available.

Authorised Emissions and Discharges

The specified and general Emissions and Discharges from the Works authorised through this Works Approval are authorised to be conducted in accordance with the Conditions of this Works Approval.

Amendment of Works Approval

The Works Approval Holder can apply to amend the Conditions of this Works Approval under s.59 of the EP Act. An application form for this purpose is available from DWER.

The CEO may also amend the Conditions of this Works Approval at any time on the initiative of the CEO without an application being made.

Duration of Works Approval

The Works Approval will remain in force for the duration set out on the first page of this Works Approval or until it is surrendered, suspended or revoked in accordance with s.59A of the EP Act.

Suspension or revocation

The CEO may suspend or revoke this Works Approval in accordance with s.59A of the EP Act.

Definitions and interpretation

Definitions

In this Works Approval, the terms in Table 1 have the meanings defined.

Table 1: Definitions

Term	Definition
AS1726	means the Australian Standard AS1762 Geotechnical site investigations, as amended from time to time
ASTM D5092/D5092M-16	Standard Practice for Design and Installation of Groundwater Monitoring Wells, as amended from time to time
ASTM D5299/D5299M-17	Standard Guide for Decommissioning of Groundwater Well, Vadose zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities, as amended from time to time.
Books	has the same meaning given to that term under the EP Act.
CEO	means Chief Executive Officer. CEO for the purposes of notification means: Director General Department Administering the *Environmental Protection Act 1986* Locked Bag 33 Cloisters Square PERTH WA 6850 info@dwer.wa.gov.au
Condition	means a condition to which this Works Approval is subject under s.62 of the EP Act.
Department	means the department established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V, Division 3 of the EP Act.
Department Request	means a request for Books or other sources of information to be produced, made by an Inspector or the CEO to the Works Approval Holder in writing and sent to the Works Approval's address for notifications, as described at the front of this Works Approval, in relation to: (a) compliance with the EP Act or this Works Approval; (b) the Books or other sources of information maintained in accordance with this Works Approval; or (c) the Books or other sources of information relating to Emissions from the Premises.
Discharge	has the same meaning given to that term under the EP Act.
DWER	Department of Water and Environmental Regulation
Emission	has the same meaning given to that term under the EP Act.

Environmental Harm	has the same meaning given to that term under the EP Act.
EP Act	means the *Environmental Protection Act 1986* (WA).
EP Regulations	means the *Environmental Protection Regulations 1987* (WA).
Implementation Agreement or Decision	has the same meaning given to that term under the EP Act.
Inspector	means an inspector appointed by the CEO in accordance with s.88 of the EP Act.
Material Environmental Harm	has the same meaning given to that term under the EP Act.
Pollution	has the same meaning given to that term under the EP Act.
Premises	refers to the premises to which this Works Approval applies, as specified at the front of this Works Approval and as shown on the map in Schedule 1 to this Works Approval.
Prescribed Premises	has the same meaning given to that term under the EP Act.
Reportable Event	means an exceedance above the target limit specified in Column 4 of Table 6, in Schedule 3.
Serious Environmental Harm	has the same meaning given to that term under the EP Act.
TSF	means Tailings Storage Facility
Unreasonable Emission	has the same meaning given to that term under the EP Act.
Waste	has the same meaning given to that term under the EP Act.
Works	refers to the Works described in Schedule 2, at the locations shown in Schedule 1 of this Works Approval to be carried out at the Premises, subject to the Conditions.
Works Approval	refers to this document, which evidences the grant of the works approval by the CEO under s.54 of the EP Act, subject to the Conditions.
Works Approval Holder	refers to the occupier of the Premises being the person to whom this Works Approval has been granted, as specified at the front of this Works Approval.

Interpretation

In this Works Approval:

(a) the words ‘including’, ‘includes’ and ‘include’ will be read as if followed by the words ‘without limitation’;

(b) where any word or phrase is given a defined meaning, any other part of speech or other grammatical form of that word or phrase has a corresponding meaning;

(c) where tables are used in a Condition, each row in a table constitutes a separate Condition;

(d) any reference to an Australian or other standard, guideline or code of practice in this Works Approval means the version of the standard, guideline or code of practice in force at the time of granting of this Works Approval and includes any amendments to the standard, guideline or code of practice which may occur from time to time during the course of the Works Approval; and

(e) unless specified otherwise, any reference to a section of an Act refers to that section of the EP Act.

Conditions

Infrastructure and equipment

1. The Works Approval Holder must install and undertake the Works for the infrastructure and equipment:

(a) specified in Column 1;

(b) to the requirements specified in Column 2;

of Table 2 below.

Table 2: Infrastructure and equipment requirements table

Column 1	Column 2
Infrastructure/Equipment	**Requirements (design and construction)**
TSF 2	To be located adjacent to and north of TSF1: <u>Embankments</u> • Cell 1 and Cell 2 starter embankment built to 355m AHD (Reduced Level (RL) 355m). • A 4m(width) x 1m (depth) cut off trench constructed through the centreline of perimeter embankment; • A toe drain along the entire perimeter of the external embankment draining to designated under drainage and toe drain sumps; • Constructed to allow for a minimum total freeboard of 500mm; • Piezometers placed in eight array locations around the external perimeter embankment. Three piezometers will be placed at each location upstream, downstream and within each starter embankment to monitor the phreatic surface. • Constructed using in-situ soils and mine waste from a nearby waste rock landform, rolled and compacted to a minimum 95% of Standard Maximum Dry Density and placed within a moisture content tolerance of within 2% (+/-) of its optimum moisture content. <u>TSF base</u> • Permeability of at least 1 x 10^{-6}m/s (permeability of in-situ clay soils) <u>Underdrainage system</u> • 6.3km of Megaflo (or similar) 300mm slotted drain pipes with geotextile wrap to be placed on top of compacted clay base across both TSF 2 Cells 1 and Cell 2. • Underdrainage pipes that drain to the underdrainage pipes that drain to the return water pond, via the connected outfall pipe. <u>Tailings deposition</u> • Embankment perimeter will be fitted with a tailings deposition pipeline that contains multiple discharge spigot attachment valves, located at nominal 20m intervals; • Multiple spigots used to discharge tailings sub-aerially on the upstream edge of the perimeter embankment; • Tailings discharge at low velocity and spigot locations changed periodically to maximise tailings beach consolidation around the edge of the TSF and minimise the size and location of the decant pond towards the centre of each cell; • Tailings deposition will be managed to contain rainfall associated with a 1 in 100 year, 72- hour duration Average Recurrence Interval rainfall event. <u>Decant tower</u> • Each TSF cell will have a centrally located decant tower and access causeway; • Recovered decant water will be recycled back into processing plant via a return water pond and cyanide destruction plant. <u>Pipelines</u> • Will be contained within bunded open trenches to contain leaks and spillages from pipe burst events; • Will be fitted with automatic leak detection and shut off systems to minimise discharge and allow for maintenance and recovery of materials.

Column 1	Column 2
Infrastructure/Equipment	**Requirements (design and construction)**
	Return water pond and cyanide destruction plant • HDPE lined pond • Approximately 2.8m deep • 50m x 50m • Fenced compound • Pumping station • Hydrogen peroxide dosing unit
Storm water Diversion drainage system	Includes: • Extension and straightening of western diversion drain 280m to the north of the existing end point; • Existing draining structures to be repaired so they are in good working order; and • Culverts and drains to be cleared of debris.
Decommissioning of monitoring, seepage management and other historical bores encountered within the TSF 2 footprint area as depicted in Schedule 2: Site Plan 1 and Site Plan 2	Includes: • 10 monitoring bores; • 7 seepage management bores; • Any other historical exploration bores holes encountered within the TSF2 footprint area Resealed: Decommissioning of bores according ASTM D5299/D5299-17 to prevent water moving vertically in the bore: • including the annular space surrounding the casing; • using grout, bentonite or concrete at concentrations adequate to seal the bore above and below each aquifer that is intersected; • to prevent flow of groundwater flow to the surface; and • to a minimum depth of 5m below the surface

Column 1	Column 2
Infrastructure/Equipment	**Requirements (design and construction)**
New monitoring bores as depicted in Schedule 2, Site Plan 3*	<u>Groundwater monitoring bores</u> • 15 groundwater monitoring bores constructed and sampled in accordance with the application at the following locations prior to deposition: GWMB12: 362054E 6615268N GWMB13: 362054E 6615505N GWMB14: 362303E 6615787N GWMB15: 362513E 6615787N GWMB16: 362932E 6615787N GWMB17: 363141E 6615787N GWMB18: 363391E 6615504N GWMB19: 363391E 6615268N GWMB20: 363537E 6614670N GWMB21: 361900E 6614704N GWMB22: 362390E 6613915N GWMB23: 363119E 6616005N GWMB24: 362366E 6616740N GWMB25: 362366E 6616101N GWMB26: 361928E 6615350N • Constructed according to: ASTM D5092/D5092M-16; • Well construction details shall be documented to demonstrate compliance with ASTM D5092/D5092M16; and • Logged as per AS1726 for the unified classification system for soils • Top of casing elevations surveyed to millimeter accuracy • The results from the construction activity shall be reported in accordance with the requirements of ASTM D5092/D5092M-16

*Bore location to be confirmed post commissioning

2. The Works Approval Holder must not depart from the requirements specified in Column 2 of Table 2 except:

(a) where such departure does not increase risks to public health, public amenity or the environment; and

(b) all other Conditions in this Works Approval are still satisfied.

3. Subject to Condition 1, within 60 days of the completion of the Works specified in Column 1 of Table 2, the Works Approval Holder must provide to the CEO a report/engineering/building certification from a suitably qualified professional confirming each item of infrastructure or component of infrastructure specified in Column 1 above has been constructed with no material defects and to the requirements specified in Column 2.

4. Where a departure from the requirements specified in Column 2 of Table 2 occurs and is of a type allowed by Condition 2, the Works Approval Holder must provide to the CEO a description of, and explanation for, the departure along with the certification required by Condition 3.

5. The Works Approval Holder is authorised to construct the starter embankment raise at the Kanowna Belle Gold Mine TSF2 to the height listed in Table 3 below:

Table 3: TSF2 embankment rise levels approved by this works approval

Kanowna Belle Gold Mine TSF2 Construction Heights		
Embankment raise levels	**Construction Height (mAHD)**	**Construction status**
Starter embankment	355.0	Authorised by this approval
Stage 1	357.5	Construction not authorised under this works approval.
Stage 2	360.0	
Stage 3	362.5	
Stage 4	365.0	
Stage 5	367.5	
Stage 6	370.0	

Emissions

6. The Works Approval Holder must not cause any Emissions from the Works authorised through this Works Approval except for specified Emissions and general Emissions described in Column 1 of Table 4, subject to the exclusions, limitations or requirements specified in Column 2, of Table 4.

Table 4: Authorised emissions table

Column 1	**Column 2**
Emission type	**Exclusions/Limitations/Requirements**
General Emissions (excluding Specified Emissions)	
Emissions which arise from undertaking the Works set out in Schedule 2.	Emissions excluded from General Emissions are: • Unreasonable Emissions; or • Emissions that result in, or are likely to result in, Pollution, Material Environmental Harm or Serious Environmental Harm; or • Discharges of Waste in circumstances likely to cause Pollution; or • Emissions that result, or are likely to result in, the Discharge or abandonment of Waste in water to which the public has access; or • Emissions or Discharges which do not comply with an Approved Policy; or • Emissions or Discharges which do not comply with prescribed standard; or • Emissions or Discharges which do not comply with the conditions in an Implementation Agreement or Decision; or • Emissions or Discharges the subject of offences under regulations prescribed under the EP Act, including materials discharged under the Environmental P*rotection (Unauthorised Discharges) Regulations 2004*.

Record-keeping

7. The Works Approval Holder must maintain accurate Books including information, reports and data in relation to the Works and the Books must:

(a) be legible;

(b) if amended, be amended in such a way that the original and subsequent amendments remain legible or are capable of retrieval;

(c) be retained for at least 3 years from the date the Books were made;

(d) be available to be produced to an Inspector or the CEO.

8. The Works Approval Holder must comply with a Department Request within 14 days from the date of the Department Request or such other period as agreed to by the Inspector or the CEO.

Seepage Management Plan

9. The Works Approval Holder must prepare a Seepage Management Plan for Tailings Storage Facility 1 and Tailings Storage Facility 2, covering the management of seepage that may potentially cause a risk to the environment. As a minimum the Seepage Management Plan shall include:

(a) the extent of existing groundwater mounding;

(b) detail of shallow geology and groundwater chemistry;

(c) depth to groundwater contour map;

(d) a predictive groundwater contour map during operation when both Tailings Storage Facilities 1 and Tailings Storage Facility 2 are operational;

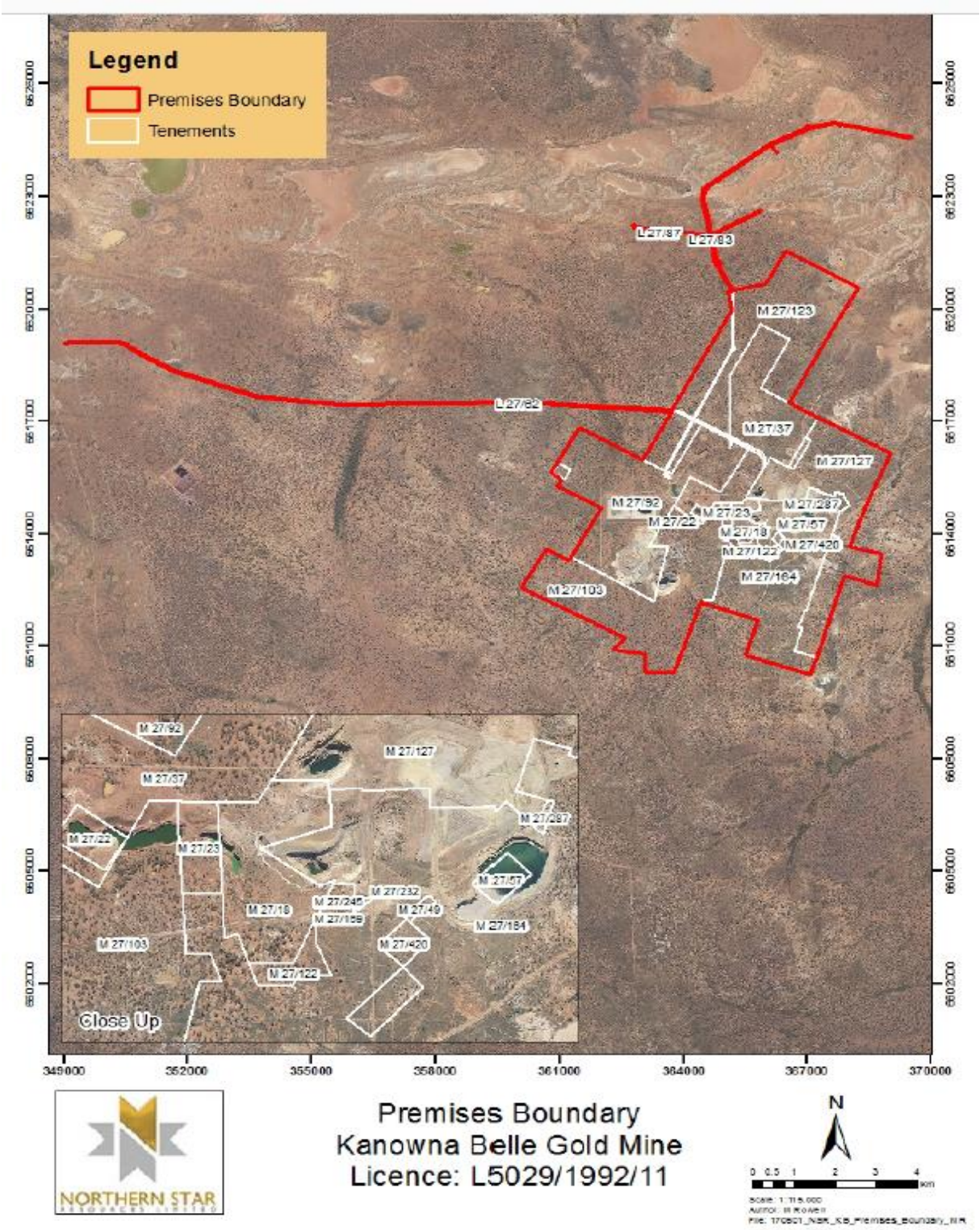
(e) the proposed location of any seepage recovery bores

(f) timeframe for installation of seepage recovery bores

10. The Works Approval Holder Holder must submit to the CEO, the seepage Management Plan in Condition 9 within 180 days of the completion of the Works specified in Column 1 of Table 2 in Condition 1 and prior to the commissioning of Tailings Storage Facility 2.

Schedule 1: Maps

Schedule 1 Map 1: Premises map
The Premises boundary is depicted in the map below by the red line.



Schedule 2: Works

At the time of assessment, Emissions and Discharges from the Works listed in Table 5 were considered in the determination of the risk and related Conditions for the Works Approval.

Table 5: Authorised Works

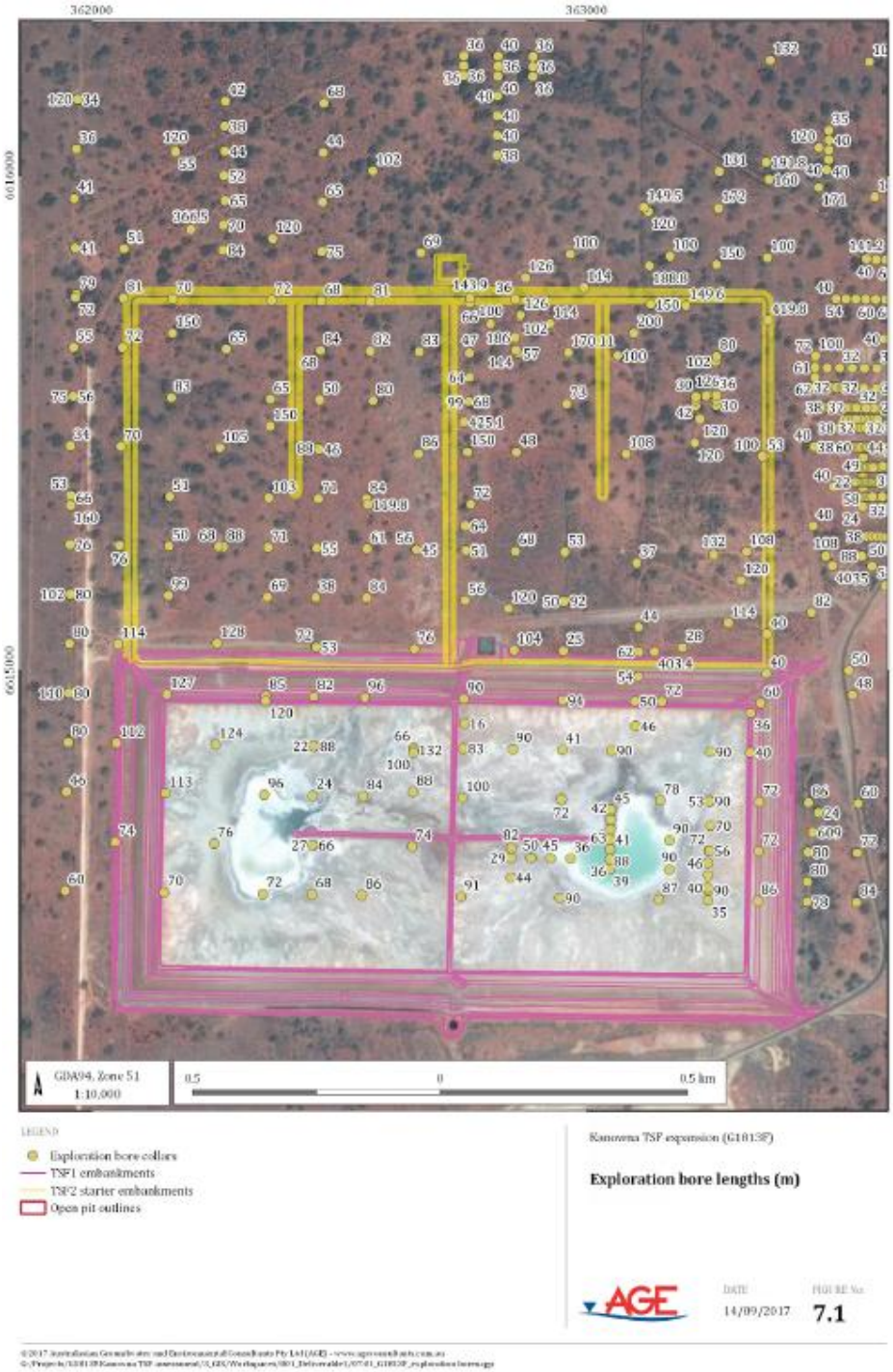
Works	Specifications/Drawings
Decommissioning of exploration, monitoring and seepage management bores	Schedule 2 Site Plans 1 and 2:
Construction of new monitoring and seepage management bores	Schedule 2 Site Plan 3
Tailings Storage Facility 2- Starter embankment	Schedule 2 Site Plans 4,5,6 and 7

Site layout

The infrastructure and equipment are set out on the Premises in accordance with the site layout specified on the Premises map in Schedule 1.

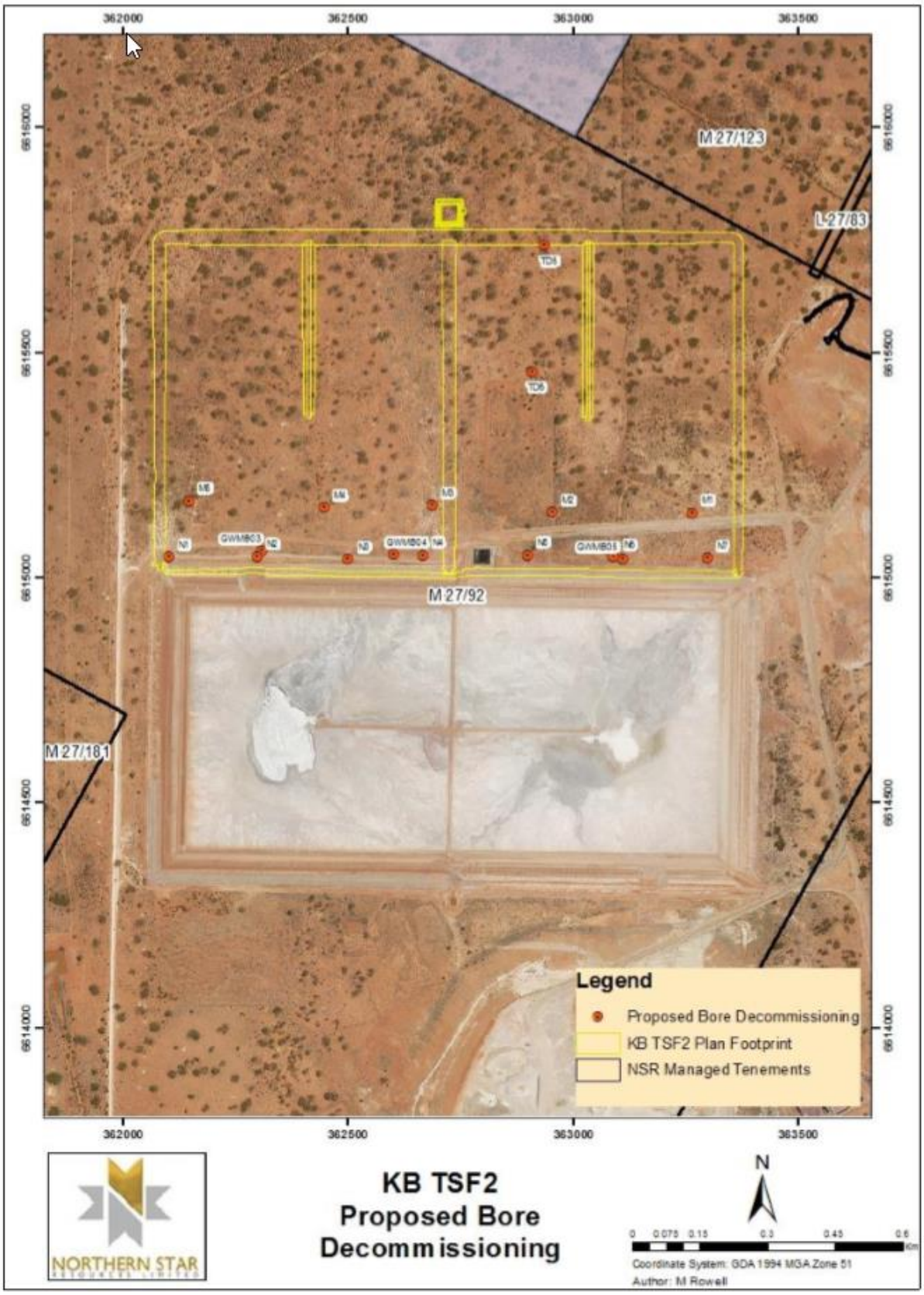
Site Plan 1: Potential locations of the historical bores within TSF 2 footprint area

Source Figure 7.1 Report on Kanowna Belle TSF Expansion Groundwater Review (AGE, 2017)

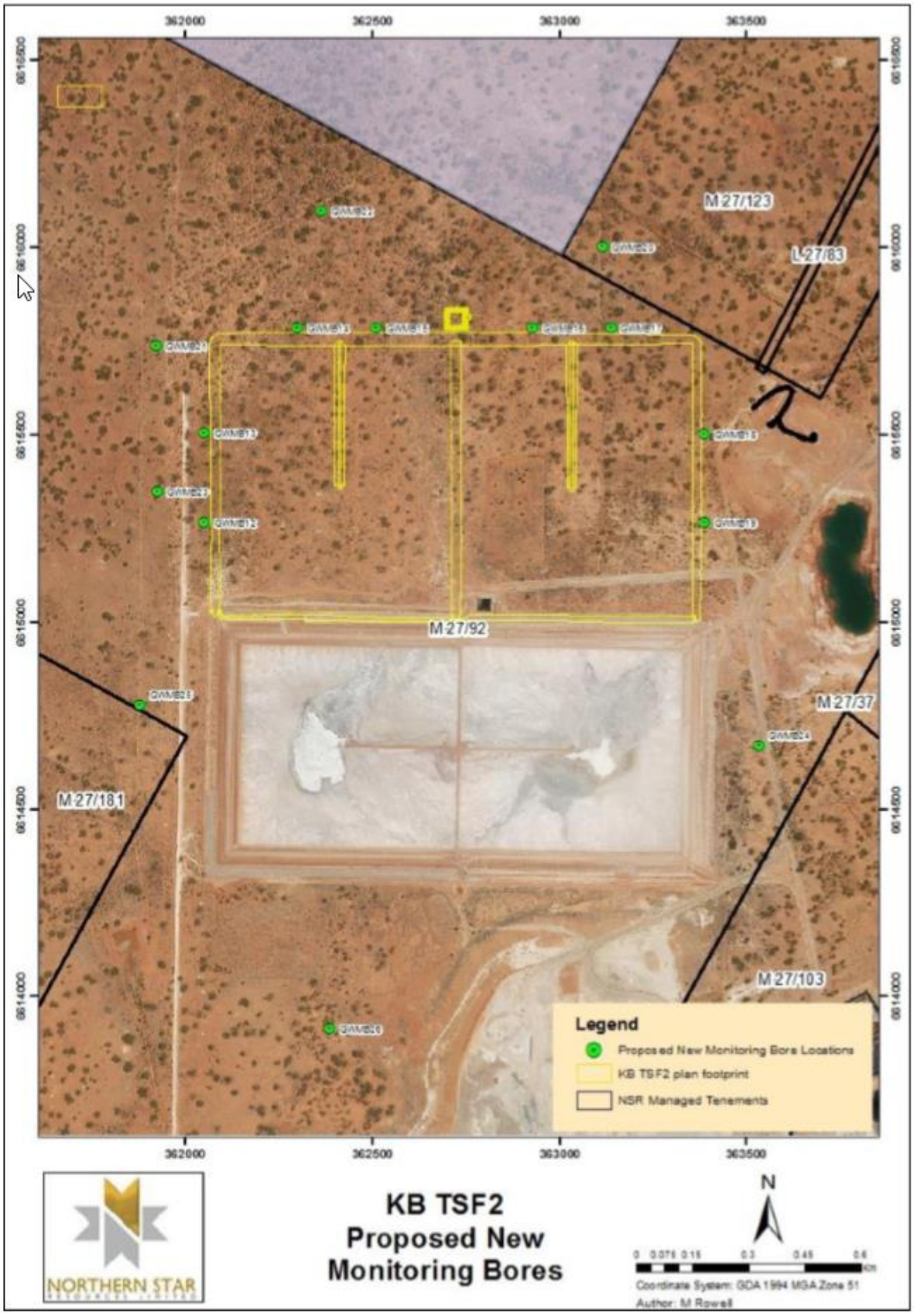


Site Plan 2: Monitoring and seepage recovery bores to be decommissioned within TSF 2 footprint area

Source Figure 7 Licence Amendment Supporting Document – Kanowna Belle Tailings Storage facility 2 (TSF2) (Northern Star (Kanowna) Pty Ltd, 2017)



Site Plan 3: Monitoring bores to be constructed as part of this works approval

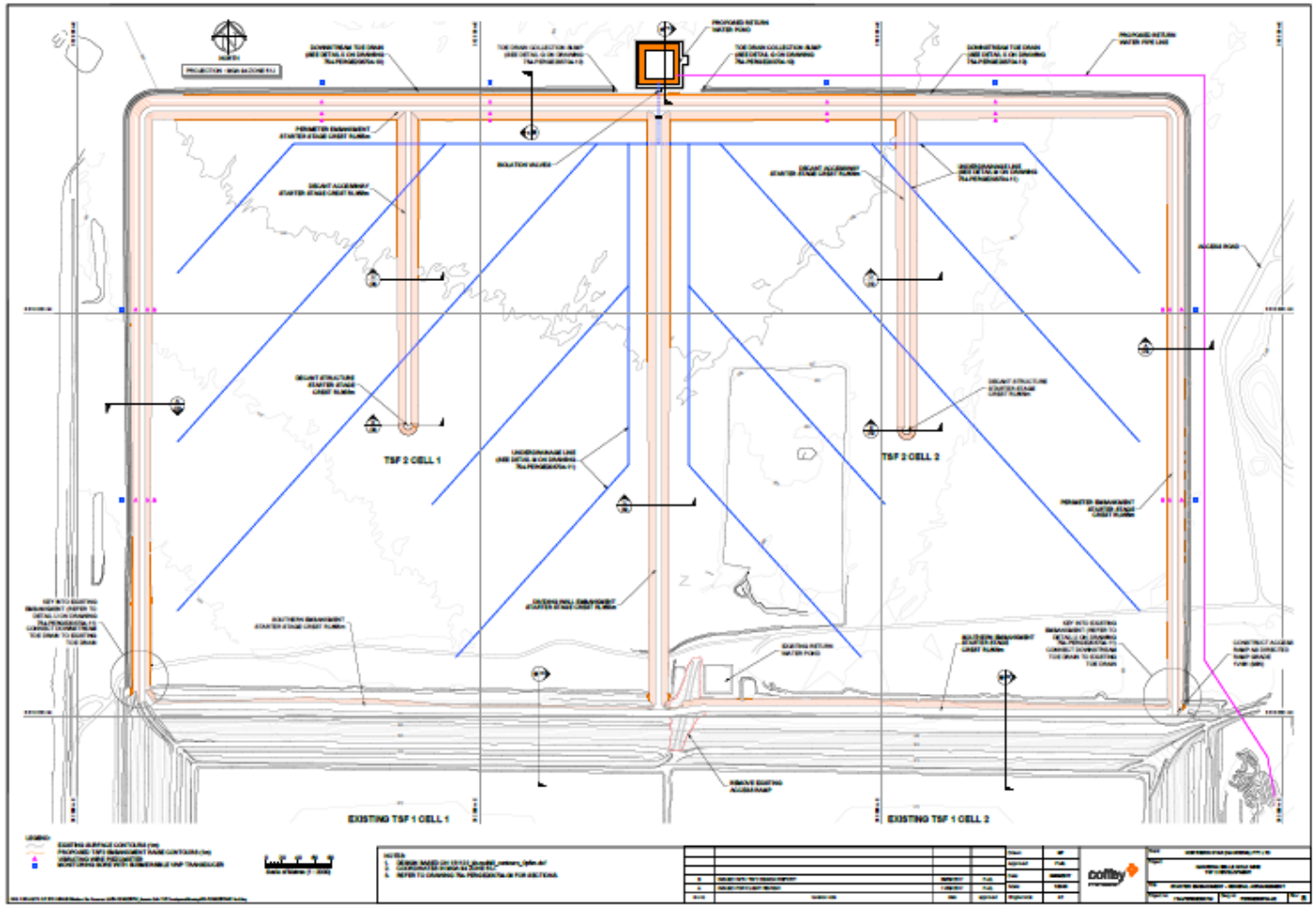


Source Figure 8 Licence Amendment Supporting Document – Kanowna Belle Tailings Storage facility 2 (TSF2) (Northern Star (Kanowna) Pty Ltd, 2017)

Schedule 2: Key Infrastructure

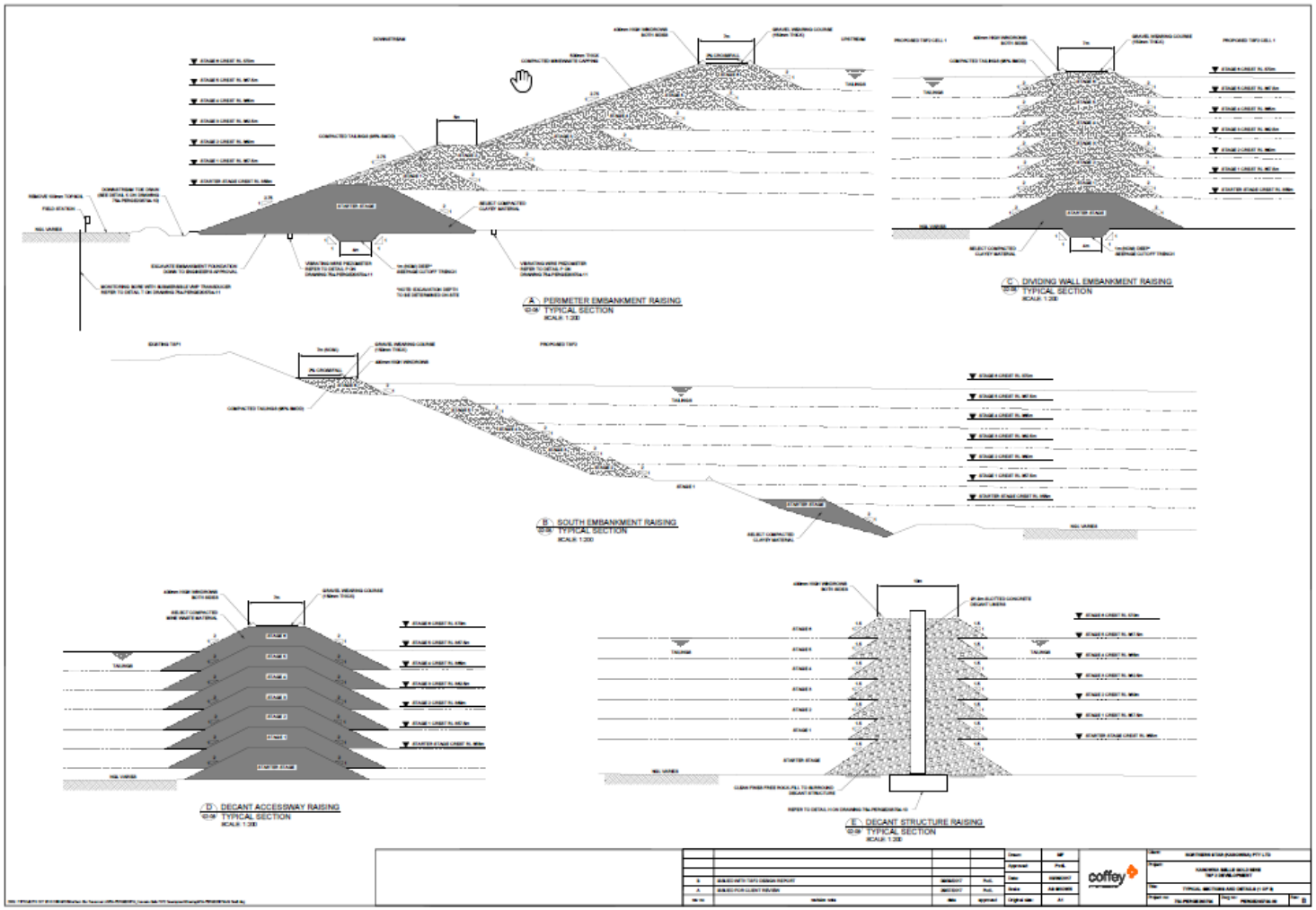
Site Plan 4: TSF 2 starter embankment- general arrangement

Source: Northern Star (Knowna) Pty Ltd - Kanowna Gold Mine Tailings Storage Facility No.2 – Design Report (Coffey, 2017)



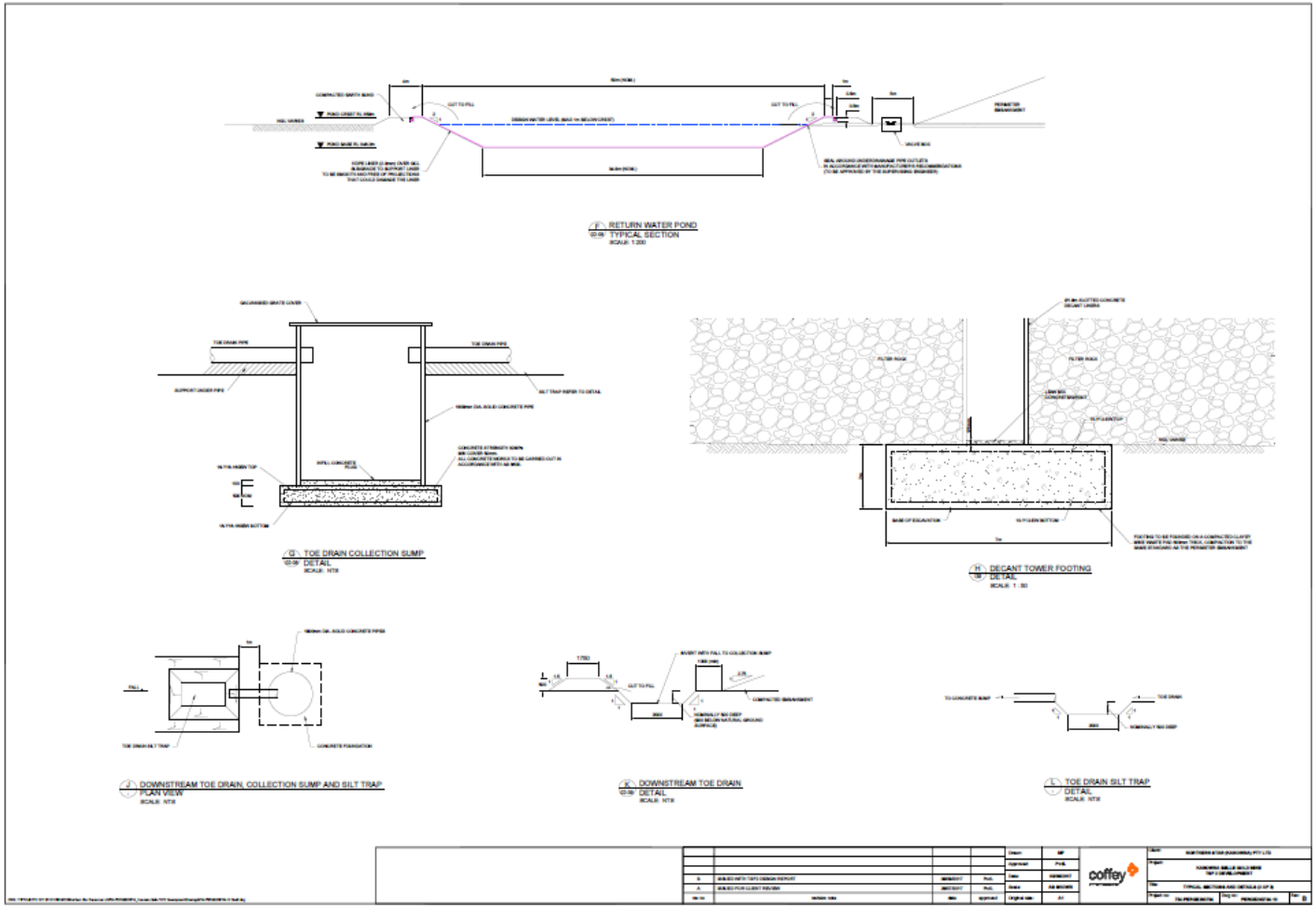
Site Plan 5: TSF 2 Typical Sections and Details (1 of 3)

Source: Northern Star (Knowna) Pty Ltd - Kanowna Gold Mine Tailings Storage Facility No.2 – Design Report (Coffey, 2017)



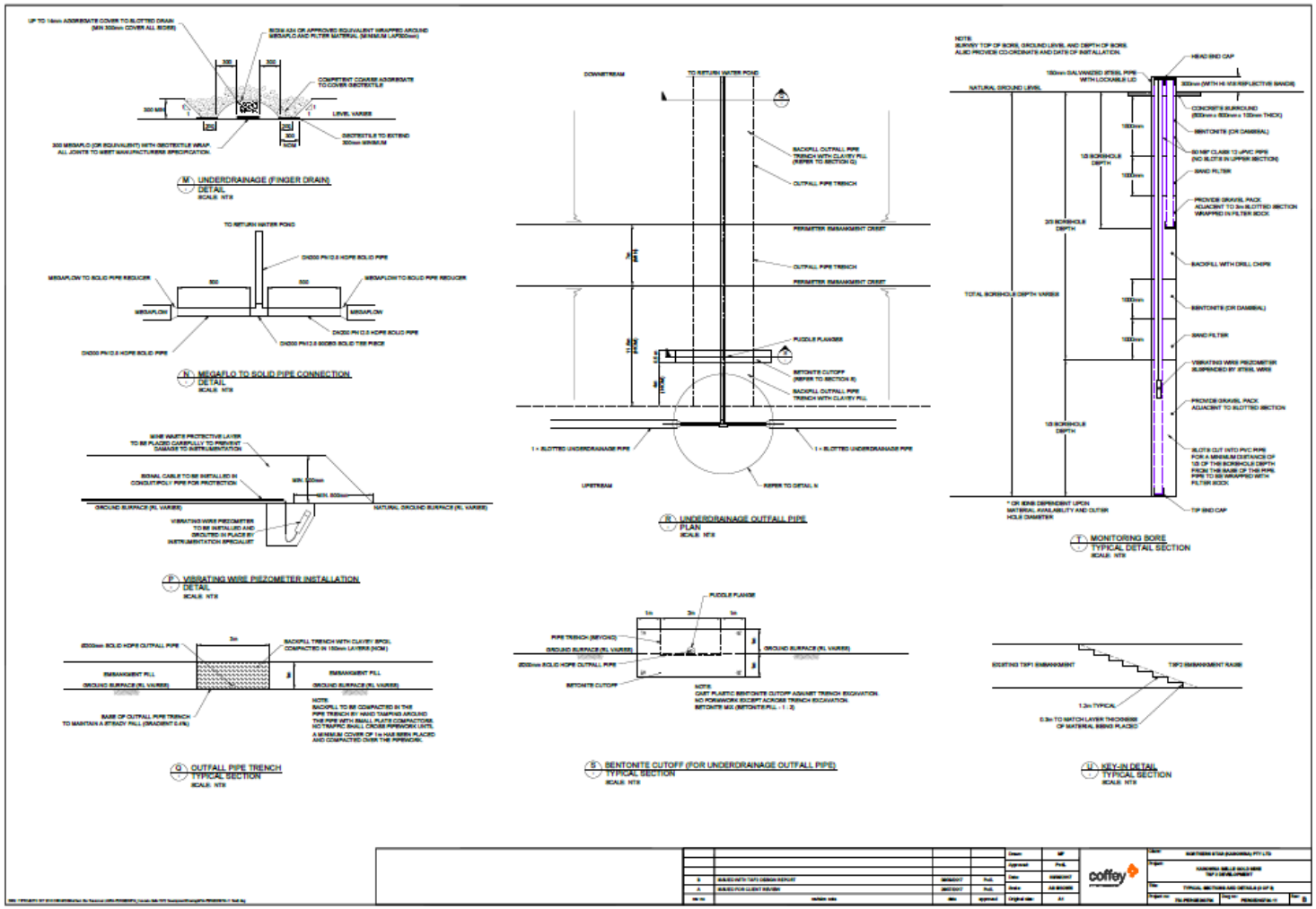
Site Plan 6: TSF 2 Typical Sections and Details (2 of 3)

Source: Northern Star (Knowna) Pty Ltd -Kanowna Gold Mine Tailings Storage Facility No.2 – Design Report (Coffey, 2017)



Site Plan 7: TSF 2 Typical Sections and Details (3 of 3)

Source: Northern Star (Knowna) Pty Ltd -Kanowna Gold Mine Tailings Storage Facility No.2 – Design Report (Coffey, 2017)



Government of Western Australia
Department of Water and Environmental Regulation

Decision Report

Application for Works Approval

Division 3, Part V *Environmental Protection Act 1986*

Works Approval Number	W6125/2018/1
Works Approval Holder	Northern Star (Kanowna) Pty Limited
ACN	010 511 789
File Number	DER2018/000241
Premises	Kanowna Belle Gold Mine Mining tenements: M27/18, 22, 23, 37, 49, 57, 92, 103, 122, 12 127, 159, 164, 232, 245, 287, 420 and L27/87, 83, 62 KANOWNA WA 6431
Date of Report	14 May 2018
Status of Report	Final

Table of Contents

1. Definitions of terms and acronyms

In this Decision Report, the terms in Table 1 have the meanings defined.

Table 1: Definitions

Term	Definition
ACN	Australian Company Number
AHD	Australian Height Datum
ANCOLD	Australian National Committee on Large Dams Incorporated
ANZECC	Australia and New Zealand Environment and Conservation Council
ARI	Average Recurrence Interval is the occurrence of total rainfall exceeding a value over a given time period
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
CS Act	*Contaminated Sites Act 2003* (WA)
Decision Report	refers to this document.
Delegated Officer	an officer under section 20 of the EP Act.
Department	means the department established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V, Division 3 of the EP Act.
DWER	Department of Water and Environmental Regulation
EP Act	*Environmental Protection Act 1986* (WA)
Existing Licence	L5029/1992/11
Licence Holder	Northern Star (Kanowna) Pty Ltd
m^3	cubic metres
mbgl	Meters below ground level
MS	Ministerial Statement
mRL	Reduced Level is the lateral elevation height in meters. In the current report this value is equivalent to height above mean sea level.
mtpa	million tonnes per annum
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
Occupier	has the same meaning given to that term under the EP Act.
Prescribed Premises	has the same meaning given to that term under the EP Act.

Premises	refers to the premises to which this Decision Report applies, as specified at the front of this Decision Report
TSF	Tailings Storage Facility

2. Purpose and scope of assessment

The purpose of this assessment is for the issue of a Works Approval for the construction of a new Tailings Storage Facility (TSF2) at the Kanowna Belle Gold Mine (Premises).

This Decision Report assesses emissions and discharges associated with the construction and operation of the TSF2 starter embankment raise to a final height of 355mAHD. TSF2 is a two celled paddock style compound with a footprint of approximately 100Ha. The risk of emissions and discharges from the broader Kanowna Belle Gold Mine are not within the scope of this assessment and are subject to the conditions of the Existing Licence.

This assessment has resulted in the Department of Water and Environmental Regulation (DWER) issuing Works Approval 6125/2018/1 (Issued Works Approval) which is contained in Attachment 1. The decision to grant this Works Approval is consistent with the following Department of Water and Environmental Regulation's (DWER) Guidance Statement: Risk Assessment (DER,2017) and Guidance Statement: Decision Making (DER,2017)

2.1 Application details

Table 2 lists the documents submitted during the assessment process.

Table 2: Documents and information submitted during the assessment process

Document/information description	Date received
Application form dated 1/12/2017; including: • Licence Amendment Supporting Document - Kanowna Belle Tailings Storage Facility 2 (TSF2): Kanowna Belle Gold Mine L5029/1992/11 (, Northern Star Resources Limited, November 2017. • Cover letter	4 December 2017
Supporting documentation: • Appendix A: Kanowna Belle Gold Mine: Tailing Storage Facility 2 – Design Report, Coffey Mining Pty Ltd, September 2017[1] • Appendix B: Kanowna Belle TSF Expansion – Groundwater Review, Australasian Groundwater and Environmental Consultants Pty Ltd, September 2017; • Appendix C: Flood Modelling for Kanowna Belle Mine: Preliminary High-Level Assessment, Eco Logical Australia, September 2017; • Appendix D: Kanowna Belle Tailings Storage Facility Expansion – Flora and Fauna Reconnaissance Survey, Botanica Consulting, October 2017	19 December 2017

Note 1: Appendix I to Appendix A of the Application contains the TSF2 Operating Manual that is referred to in this document

3. Background

The Premises is situated approximately 18km northeast of Kalgoorlie and covers an area of approximately 27,712Ha. The processing facility processes both sulphide rich refractory ore and free milling ore from regional mines. The processing plant utilises the carbon-in-pulp process for ore from the Kundana Gold Mine, while ore produced from the Premises requires roasting.

In December 2017 Northern Star (Kanowna) Pty Ltd (the Applicant), also referred to as Northern Star) obtained an approval to expand the existing gold mining operations at the premises to allow for the processing of up to processing of up to 2,5000,000 tonnes of ore per annum, an increase of 500,000 tonnes per annum. The increased tailings generated through this activity will bring forward the end of life of the existing TSF's and a new facility will be required to accommodate tailings by the beginning of 2019. The construction of TSF2 directly north and adjacent to the existing TSF 1 will allow for the storage of approximately 20 million tonnes of tailing and extend the life-of-mine by approximately 10 years.

4. Overview of Premises

4.1 Operational aspects

The tailings from the Kanowna Belle processing plant are pumped, via the tailings delivery line to one of four existing TSF's at the premises. While the Waldon In-pit TSF is the primary tailings deposition compound, decant water may be directed between TSF1, Waldon In-pit and Red Hill in-pit TSF for the management of process water. The Calcine TSF and TSF1 are currently inactive.

TSF2 will be located on the northern side and adjacent to TSF1. It will comprise approximately 100Ha of land and native vegetation is required to be cleared to allow for the construction of the two-celled paddock facility and associated infrastructure, including a vegetation and topsoil stockpiling area, transport and service infrastructure corridor. This will include a new HDPE lined return water pond with a cyanide destruction unit, electrical infrastructure, tailings delivery and decant water return pipelines.

The land on which TSF2 will be situated also contains the TSF1 process water return pond and a number of exploration, monitoring and seepage management bores which will require decommission prior to commencement of construction works. New monitoring and seepage management bores will be constructed in key areas surrounding TSF2 prior to deposition of tailings into the facility.

Tailing will be disposed along the perimeter embankments through sub-aerially rotating spigots, situated approximately 20m apart. Deposition will be managed to form a beach and a natural decline towards the center of each cell and a central decant tower which will pump and transfer the decant water to the return water pond via the causeway situated along the northern side of each cell. A total (operational and beach) freeboard of 500mm will be maintained at all times while allowing for a 1 in 100-year annual recurrence interval (ARI) rainfall event of 178mm over a 72 hour period.

TSF2 starter embankment and base will be designed using a clay liner derived from the naturally low permeability *insitu* clays overlaid with 6.3km of slotted under drainage network to limit the movement of decant water trapped in the consolidated tailings mass and mounding beneath the TSF. The starter embankment will be built to 355m RL (Reduced Level) and each subsequent 2.5m embankment lift will be constructed using the upstream method of construction for a total 6 stages to a final height of 370mRL. The embankments will be constructed using borrow material and mine waste that is tested to meet specified performance criteria. Eight piezometer arrays will be used to monitor the phreatic surface within the perimeter embankments, and a system of seepage interception trenches, cut off trenches will be used to further limit the movement of seepage into groundwater where it may impact on vegetation within proximity to TSF2. Groundwater monitoring from newly constructed bores will be undertaken to inform a Seepage Management Plan which is required to be submitted as part of the works approval prior to commissioning of TSF2.

4.2 Infrastructure

The TSF2 infrastructure, as it relates to Category 5 activities, is detailed in Table 3 and with reference to the Site Plan (attached in Attachment 1).

Table 3: Tailings Storage facility 2 Category 5 infrastructure

	Infrastructure
	Prescribed Activity Category 5
Gold is extracted from refractory (sulphur rich) and free milling ore at the Kanowna Belle Gold Mine. The refractory ore require roasting prior to leaching. A carbon-in-pulp leaching process is used whereby finely ground ore is passed through a series of agitator tanks containing a cyanide solution, making the gold water soluble. The gold cyanide complex is then recovered by adsorption onto activated carbon. The gold rich carbon is then separated from the slurry waste which is disposed of as tailings in TSF2. The loaded carbon goes through a cold and hot washing process, and pure gold is recovered from the solution using electrolysis.	
1	Tailings Storage Facility 2 (TSF2) including: To be located adjacent to and north of TSF1: <u>TSF embankments</u> • Cell 1 and Cell 2 starter embankment and stage 1 built to 355m AHD (Reduced Level (RL) 355tm). • A 4m(width) x 1m (depth) cut off trench constructed through the centreline of perimeter embankment; • A toe drain along the eternal perimeter of the external embankment draining to designated under drainage and toe drain sumps; • Constructed to allow for a minimum total freeboard of 500mm; • Piezometers placed in eight array locations around the external perimeter embankment. Three piezometers will be placed at each location upstream, downstream and within each starter embankment to monitor the phreatic surface. • Constructed using in-situ soils and mine waste from a nearby waste rock landform, rolled and compacted to a minimum 95% of Standard Maximum Dry Density and placed within a moisture content tolerance of within 2% (+/-) of its optimum moisture. <u>TSF base</u> • Permeability of at least 1 x 10^{-6}m/s (permeability of in-situ clay soils) <u>TSF underdrainage system</u> • 6.3km of Megaflo (or similar) 300 slotted drain pipes with geotextile wrap to be placed on top of compacted clay base across both TSF2 Cells 1 and Cell 2. • Underdrainage pipes that drain to the outfall pipe trench and return water pond <u>Tailings deposition</u> • Embankment perimeter wall fitted with a tailings deposition pipeline that contains multiple discharge spigot attachment valves located at nominal 20m intervals; • Multiple spigots used to discharge tailings sub-aerially on the upstream edge of the perimeter embankment; • Tailings discharge at low velocity and spigot locations changed periodically to maximise tailings beach consolidation around the edge of the TSF and minimise the size and location of the decant pond towards the centre of each cell; • Tailings deposition will be managed to contain rainfall associated with a 1 in 100 year, 72- hour duration Average Recurrence Interval rainfall event. <u>TSF decant tower</u> • Each TSF cell will have a centrally located decant tower and access causeway; • Recovered decant water will be recycled back into processing plant via a return water pond and cyanide destruction plant. <u>TSF pipelines</u> • Will be contained within bunded open trenches to contain leaks and spillages from pipe burst events; • Will be fitted with automatic leak detection and shut off systems to minimise discharge and allow for

	Infrastructure
	maintenance and recovery of materials. Return water pond and cyanide destruction plant • Area of not less than 2500m^2 (50m x 50m) and a depth of not less than 2.8m. • Lined with HDPE • Fenced compound • Pumping station • Hydrogen peroxide dosing unit
2	Decommissioning of exploration, monitoring and seepage management bores within TSF2 footprint area Includes: • 10 monitoring bores; • 7 seepage management bores; • more than 100 exploration bores where possible Resealed: Decommissioning of bores according ASTM D5299/D5299-17to prevent water moving vertically in the bore as follows: • including the annular space surrounding the casing; • using grout, bentonite or concrete at concentrations adequate to seal the bore above and below each aquifer that is intersected; • to prevent flow of groundwater flow to the surface; and • to a minimum depth of 5m below the surface
3	Construction of new monitoring bores* Groundwater monitoring bores • 15 groundwater monitoring bores constructed and sampled in accordance with the application at the following locations prior to deposition: GWMB12: 362054E 6615268N GWMB13: 362054E 6615505N GWMB14: 362303E 6615787N GWMB15: 362513E 6615787N GWMB16: 362932E 6615787N GWMB17: 363141E 6615787N GWMB18: 363391E 6615504N GWMB19: 363391E 6615268N GWMB20: 363537E 6614670N GWMB21: 361900E 6614704N GWMB22: 362390E 6613915N GWMB23: 363119E 6616005N GWMB24: 362366E 6616740N GWMB25: 362366E 6616101N GWMB26: 361928E 6615350N • Constructed according to: ASTM D5092/D5092M-16; • Well construction details shall be documented to demonstrate compliance with ASTM D5092/D5092M16; and • Logged as per AS1726 for the unified classification system for soils • Top of casing elevations surveyed to millimeter accuracy • The results from the construction activity shall be reported in accordance with the requirements of ASTM D5092/D5092M-16

*Bore location to be confirmed post commissioning

4.3 Exclusions to the Premises

The engineering and geotechnical stability characteristics of TSF2 are assessed by the Department of Mining, Industry Regulation and Safety and are not included in this assessment. These aspects of the premises are covered by Mining Proposal Registration ID 71009.

5. Legislative context

Table 4 summarises approvals relevant to the assessment.

Table 4: Relevant approvals and tenure

Legislation	Number	Subsidiary	Approval
Mining Act (WA) 1978	Reg ID 71009, 20 March 2018	Northern Star (Kanowna) Pty Limited	Approval for the construction and operation of TSF2
Dangerous Goods Safety Act 2004	Dangerous Goods Licence DGS012576	Northern Star (Kanowna) Pty Limited	Dangerous goods storage and handling
Part IV of the EP Act (WA)	Statement Number 331	Peko Gold Ltd	Operation of the Gold Roaster to treat refractory ore at the Kanowna Belle Gold Mine
Part V of the EP Act (WA)	L5029/1992/11	Northern Star (Kanowna) Pty Limited	Licence of emissions and discharges from the prescribed activities at the Kanowna Belle Gold Mine
Granted under section 51E of the EP Act	Clearing Permit CPS 7808/1	Northern Star Resources Ltd	Allows for clearing of up to 300Ha for the purpose of mining and related activities
Rights in Water and Irrigation Act 1914	GWL 62498(6)	Northern Star (Kanowna) Limited	Allows for dewatering of up to 3,030,000kL from the Paleaochannel- fractured rock aquifer.

5.1 Part IV of the EP Act

5.1.1 Background

The Applicant has stated construction of TSF2 has not been referred under part IV of the EP Act for assessment under s38 of the EP Act as the assessment was not considered to be a significant change to the existing operations.

5.1.2 Ministerial Statement

Ministerial Statement (MS) 331 published on 7 December 1993 relates to aspects of the operation which are outside the scope of this decision report with the exception of Condition 4. Condition 4 provides a statement requiring the monitoring of groundwater to be undertaken.

The Delegated Officer has determined the requirements of MS331 are not specifically associated with the risks associated with the current works approval. The current works are suitable for the application of controls under this works approval.

5.2 Contaminated sites

TSF2 will be constructed on Mining Lease 27/92 in an area that was classified as *Possibly contaminated –investigation required* under the *Contaminated Sites Act 2003* on 16 June 2010. The existing TSF1, the Kanowna belle Mine pit, and part of the general processing plant are also located within this classification area.

5.2.1 Department of Lands

The land upon which TSF2 will be constructed is partially covered by the Mt Vetter's pastoral Lease. An access agreement exists between the lease holders: J &A Stevens and the Applicant.

5.3 Part V of the EP Act

5.3.1 Applicable regulations, standards and guidelines

The overarching legislative framework of this assessment is the EP Act and EP Regulations.

The guidance statements which inform this assessment are*Guidance Statement: Regulatory Principles (July 2015)*

- *Guidance Statement: Setting Conditions (October 2015)*
- *Guidance Statement: Decision Making (February 2017)*
- *Guidance Statement: Risk Assessments (February 2017)*
- *Guidance Statement: Environmental Siting (November 2016)*

6. Consultation

The Licence Holder was provided with the draft Works Approval on 28 March 2018. Comments were received from the Works Approval Holder on 9 April 2018 and a summary of these is included in Appendix 2.

7. Location and siting

7.1 Siting context

The Kanowna Belle Gold Mine is suitable approximately 18km north east of Kalgoorlie within the Goldfields region. Situated on the Yilgarn Craton, the area is mineral rich and has some of the largest known gold deposits found anywhere in the world. The region is arid, and although freshwater is scarce, the area has a rich biodiversity containing many endemic fauna and flora species (Botanica, 2017).

7.2 Residential and sensitive Premises

The distances to residential and sensitive receptors are detailed in Table 5.

Table 5: Receptors and distance from activity boundary

Sensitive Land Uses	Distance from Prescribed Activity
Residential Premises-	The Ninga Mia Aboriginal Community is located approximately 15km east of TSF2 The city of Kalgoorlie is approximately 18.5km south west of TSF2

7.3 Specified ecosystems

Specified ecosystems are areas of high conservation value and special significance that may be impacted as a result of activities at or Emissions and Discharges from the Premises. The distances to specified ecosystems are shown in Table 6.

Table 6: Environmental values

Specified ecosystems	Distance from the Premises
Threatened Ecological Communities and Priority Flora	Priority 1 Flora 3.8km north of TSF2

7.4 Groundwater and water sources

Groundwater at the premises is hypersaline and the nearest wetlands are a salt lake system some 5.5km to the north as indicated in Table 7.

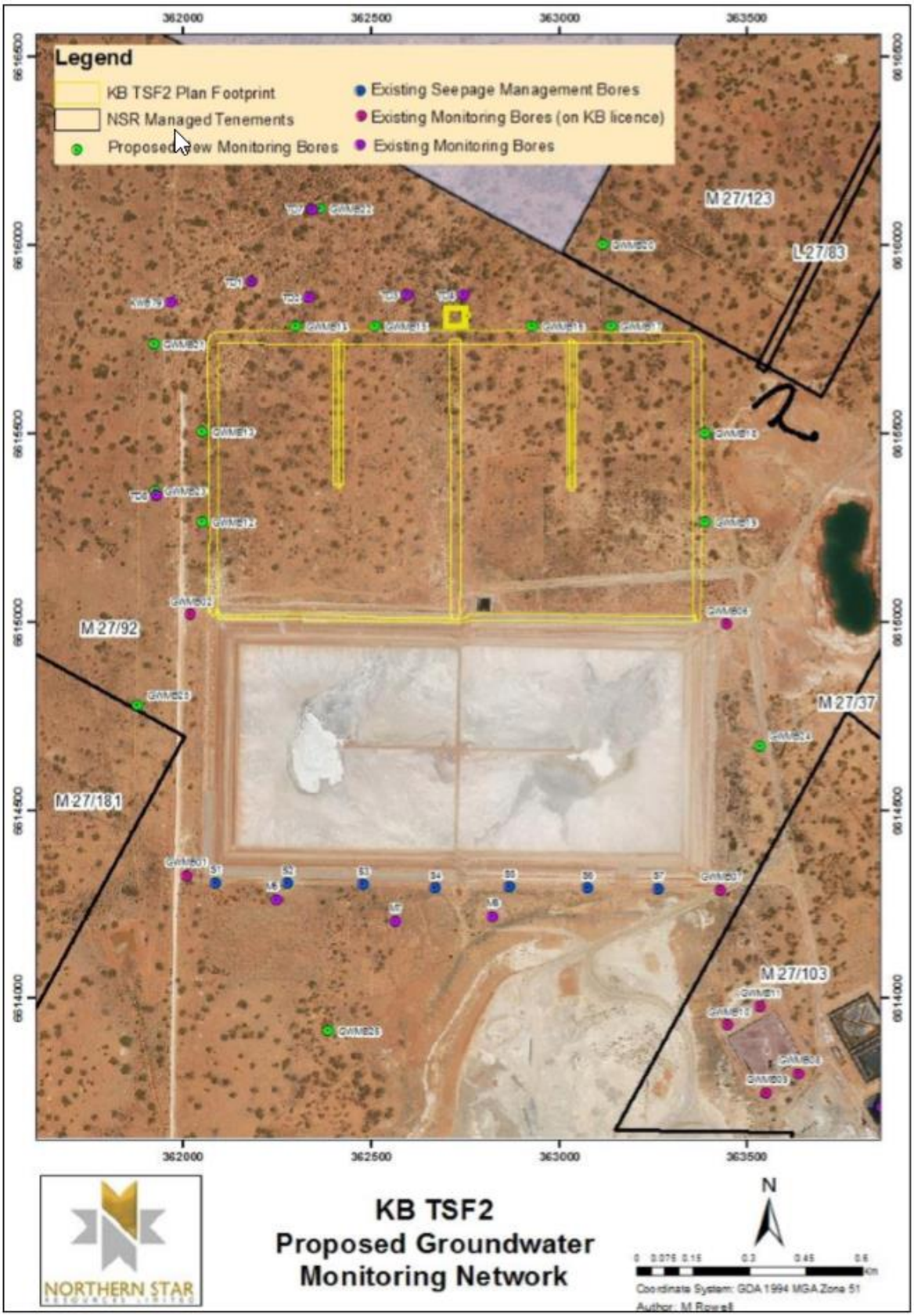
Table 7: Groundwater and water sources

Groundwater and water sources	Distance from Premises	Environmental value
Major waterbodies	Salt lakes system 5.5km north	Likely ecological value will include localised bacteria, insects, birds and fringing vegetation.
Groundwater	The premises lies within the Goldfields Groundwater Area Proclaimed under the *Rights in Water and irrigation Act 1914* Historical baseline monitoring in the vicinity of TSF2 at the time TSF1 was constructed of TSF1 indicated a depth to the shallow aquifer of approximately 12mbgl. Due to seepage from TSF1 shallow groundwater mounding occurred and levels are currently between 3.5mbgl and 8.5mbgl within or near the TSF2 footprint area.	Groundwater in the area is naturally hypersaline and is not suitable for supporting flora or fauna. It has a naturally low pH, high TDS. Elevation or mounding due to seepage has the ability to affect localised vegetation growth where the groundwater reaches the root zone of plant species which in the Eastern Goldfields Region generally extend up to 6m below the surface.

Although the beneficial use of the groundwater beneath TSF2 is limited, there is mounding beneath TSF1 which has the potential to adversely impact on deep rooted vegetation species within the area. Ground water mounding is managed at the premises through a network or monitoring bores, seepage recovery bores and vegetation monitoring, and these practices are reflected in the operating Licence for the premises. The existing and proposed groundwater

monitoring network surrounding TSF1 and TSF2 is shown in Figure 1 below.

Figure 1: Existing and proposed groundwater monitoring bore network surround TSF1 and TSF2

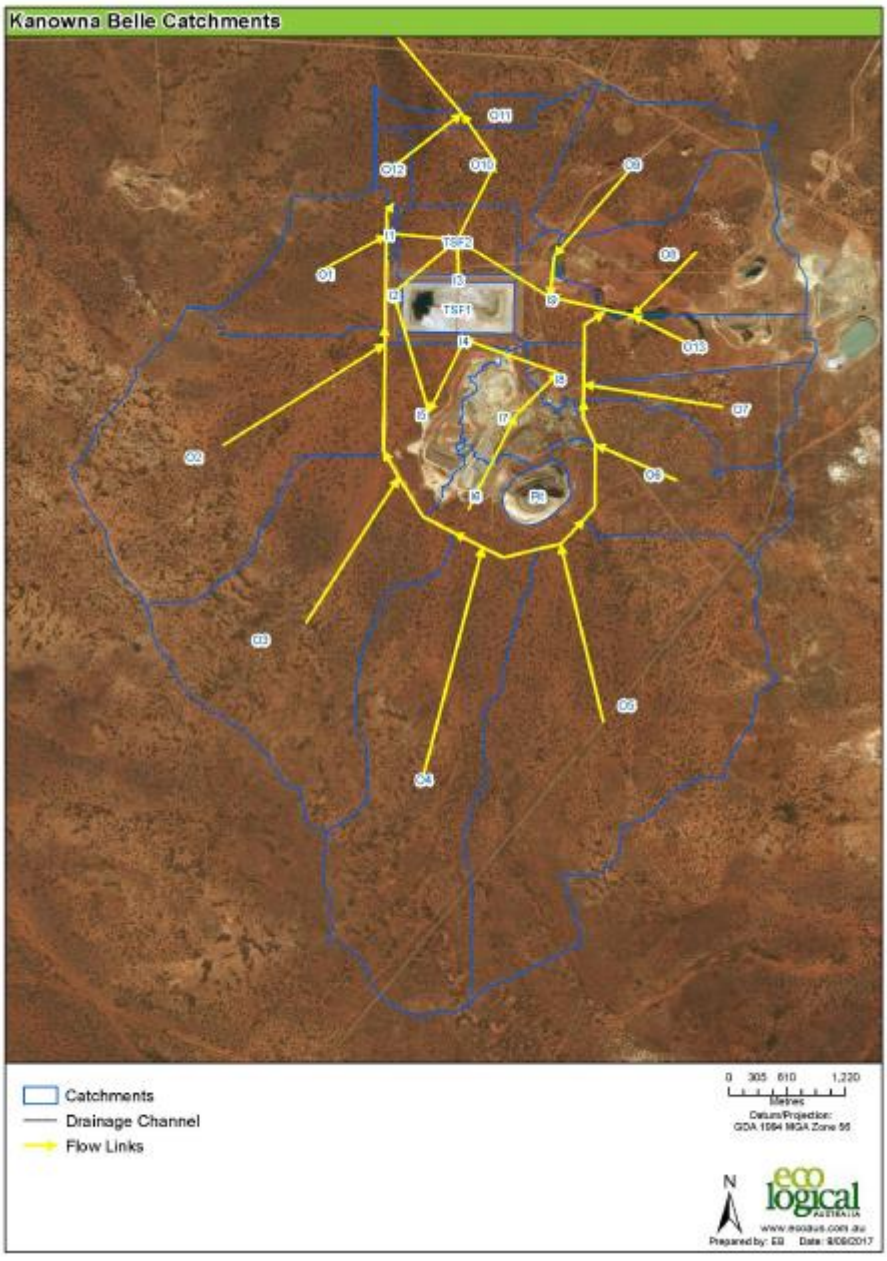


Source: Figure 9: Licence Amendment Supporting Document – Kanowna Belle Tailings Storage facility 2 (TSF2) (Northern Star (Kanowna) Pty Ltd, 2017)

Although there are no natural surface water resources with the premises boundary, there are a number of historical mining voids which have a lake like appearance from aerial imagery due to infiltration of hypersaline groundwater.

There are 13 surface water catchment areas that drain towards the TSF as shown by the blue outline in Figure 2 below. The yellow lines indicate the flow of surface runoff as a result of natural surface inclination and constructed levees, culverts and drainage trenches (existing and proposed). During high rainfall storm events there is a risk that flooding flood waters could inundate the TSF1 and TSF2 area without these water diversion structures (see in Section 8.7 of this report for further detail on this aspect of the proposal).

Figure 2: Surface water catchments and water drainage lines

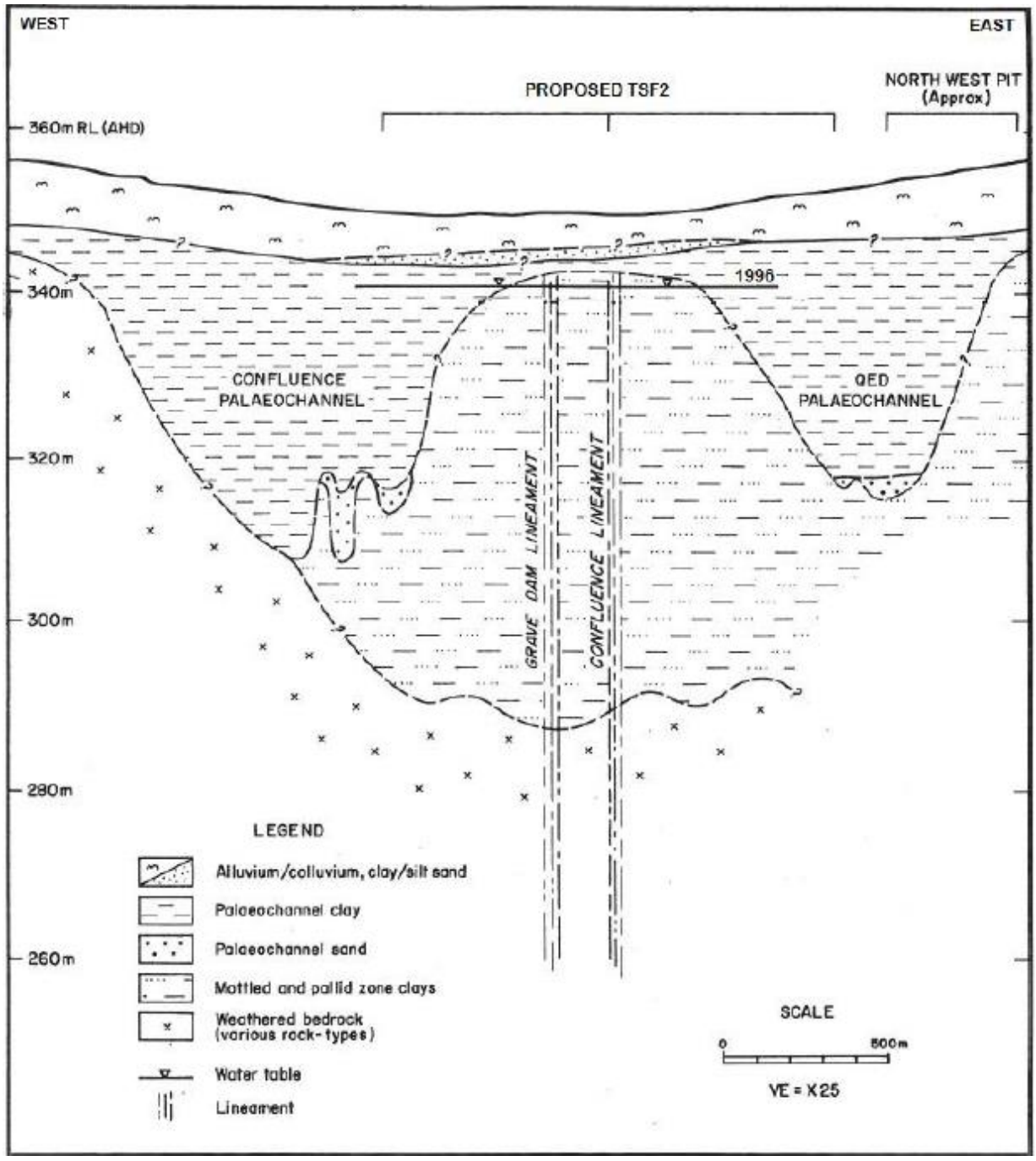


Source: Figure 1 from Flood modelling for Kanowna Belle Mine: Preliminary high level assessment (Ecological, 2017)

7.5 Soil type

The geology beneath TSF2 is complex due to the deep bedrock overlain by paleo channel clays and a mottled pallid zone which may extend up to 70m deep before reaching the bedrock. Typically, the soil profile contains a top soil coverage of between 10cm and 40cm which overlies a colluvial low permeability clay layer which is interspersed with some sand and gravel lenses up to a depth of 6mbgl. These predominantly clay deposits form a base for the shallow aquifer as shown in Figure 3.

Figure 3: Cross section of site geology beneath TSF2



Source: Figure 4.2 Report of Kanowna Belle TSF Expansion Groundwater review (AGE, September 2017). The Schematic diagram was adapted from (Rockwater, 1996)

The works approval application includes a geotechnical investigation which involved the construction of 15 bore test pits within the TSF2 footprint area to 2.5mbgl or refusal. Five falling head permeability tests were able to be conducted on soil collected at a depth of 15mbgl and test results showed the average permeability is very low (between 3.9 x10^{-8}m/s and 7.9 x 10-^{7}m/s) indicating that contaminants are not able to move significantly within the soil profile at depth (Coffey, 2017). The permeability of soil closer to the surface is 1 x 10^{-6}m/s or less. Table 8 details soil types and characteristics relevant to this assessment.

Table 8: Soil and sub-soil characteristics

Distance from Premises (approximate depth below ground)	Soil type	Groundwater and water sources
0-2m	Light red-brown clayey silt or sand	Dry- but expected to hold water following heavy rainfall
2-7m	Clay, dark red-brown, with blue-grey mottling at depth	Dry- plant roots observed to depths of 5m. Potential to behave as a confining aquitard layer
7-11m	Sandy clay, clayey sand and gravels	Wet- with significant groundwater yields
11-16m	Clay, sandy clay, occasionally gravelly	Wet- with significant groundwater yields
16m+	Clay	Variable- no significant yields (if water encountered it is from the confined aquifer)

Source: Figure 4.2 Report of Kanowna Belle TSF Expansion Groundwater review (AGE, September 2017).

7.6 Other site characteristics

The locations of other receptors are shown in Table 9.

Table 9: Other landscape features, relevant factors or receptors

Other receptors or areas of concern	Location
Aboriginal site of significance	Burial site within Lease M27/92 approximately 1.1km from TSF2

7.7 Meteorology

7.7.1 Rainfall and temperature

The Kanowna Belle Gold Mine is located in a semi-arid part of Western Australia which is characterised by very hot summers and cool winters. Rainfall on average is low (average of 266mm) however it is not uncommon for annual rainfall to vary between 110mL and 530mL (Weatherzone, 2018). Rainfall is evenly distributed throughout the year (3-4 days per month) and spring tends to tends to be the driest part of the year with the highest rainfall occurring during summer, driven by cyclonic weather patterns in the north of the state. Rainfall generated by the cyclonic systems tends to occur in short sharp bursts where large volumes are experienced over short timeframes which can lead to flood events.

The Premises receives most of its rainfall during the summer months and has its own weather monitoring station. The average rainfall recorded is 274mm per annum averaged over the

period from 2006 to 2017 (NSR, 2018a). According to the Bureau of Meteorology the closest active weather station to Kanowna is one located at the Kalgoorlie-Boulder Airport. The average annual rainfall is 266.9mm and the mean evaporation is approximately 2,628mm per annum at this location (BOM, 2017).

8. Risk assessment

8.1 Determination of emission, pathway and receptor

In undertaking its risk assessment, DWER will identify all potential emissions pathways and potential receptors to establish whether there is a Risk Event which requires detailed risk assessment.

To establish a Risk Event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission. Where there is no actual or likely pathway and/or no receptor, the emission will be screened out and will not be considered as a Risk Event. In addition, where an emission has an actual or likely pathway and a receptor which may be adversely impacted, but that emission is regulated through other mechanisms such as Part IV of the EP Act, that emission will not be risk assessed further and will be screened out through Table 13.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Tables 10 and 11 below.

Table 10. Identification of emissions, pathway and receptors during construction

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Construction, mobilisation and positioning of infrastructure associated with TSF2	Vehicle movements on unsealed access roads	Noise	No residences or other sensitive receptors within 15km of TSF2	Air / wind dispersion	Amenity impacts	No	No residences or sensitive land uses within 15km of the premises so minimal to impacts are expected
		Dust	No residences or other sensitive receptors within 15km of TSF2 Nearby native vegetation		Amenity impacts Deposition which may harm plants by reducing photosynthesis and plant respiration	No	No residences or sensitive land uses within 15km of the premises so minimal to impacts are expected No impacts evident on native vegetation from existing activities
	Earthworks for construction of new TSF and associated infrastructure	Noise	No residences or other sensitive receptors in proximity	Air / wind dispersion	Amenity impacts	No	No residences or sensitive land uses within 15km of the premises so minimal to impacts are expected
		Dust	No residences or other sensitive receptors within 15km of TSF2 Nearby native vegetation		Amenity impacts Deposition which may harm plants by reducing photosynthesis and plat respiration	No	No residences or sensitive land uses within 15km of the premises so minimal to impacts are expected Delegated Officer considers impacts on vegetation to be insignificant and unlikely to occur. There is no record of Declared Rare Flora within 3.5km of TSF2.
		Sediment/soil	Vegetation	Stormwater runoff	Partial burial of vegetation	No	Delegated Officer considers impacts on vegetation to be insignificant and unlikely to occur. There is no record of Declared Rare Flora within 3.5km of TSF2.
		Hydrocarbons	Soil vegetation	Direct discharge/ stormwater	Soil contamination inhibiting vegetation growth and survival	No	Spills resulting from earthworks are unlikely to occur and impacts will be insignificant due to small volumes and spill response procedure.

Table 11: Identification of emissions, pathway and receptors during operation

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Tailings Deposition into TSF2	Tailings surface	Dust	No residences or other sensitive receptors within 15km of TSF2 Nearby native vegetation	Air / wind dispersion	Human health and amenity. Potential suppression of photosynthetic and respiratory functions	No	No residences or sensitive land uses within 15km of the premises so minimal to impacts are expected No impacts evident on native vegetation from existing activities. There is no record of Declared Rare Flora within 3.5km of TSF2.
	Tailings delivery and return water pipelines	Rupture of pipeline causing tailings discharge to land	Native vegetation and soil adjacent to tailings pipeline alignment	Direct discharge	Soil contamination inhibiting vegetation growth and survival	Yes	See Section 8.4
	Seepage	Leachate	Soil and groundwater	Direct discharge	Groundwater mounding Groundwater contamination	Yes	See Section 8.6
	Overtopping of TSF2	Tailings release	Native vegetation and soils	Overtopping of supernatant pond or tailings release during extreme rainfall event	Soil contamination. Impacts to terrestrial vegetation and ecosystems. Seepage leading groundwater contamination	Yes	See Section 8.5
	Stormwater runoff	Stormwater contaminated with tailings and tailing liquor	Soils and vegetation within the stormwater catchment area	Sheet runoff and infiltration	Soil contamination inhibiting vegetation growth and survival	Yes	See Section 8.7
Return water pond compound	Cyanide destruction plant	Hydrogen peroxide spills and breach of containment	Soil and vegetation adjacent to storage and pumping areas	Direct discharge, stormwater runoff	Soil contamination inhibiting vegetation growth and survival	No	The cyanide destruction plant and infrastructure existed previously and will be relocated. If build to the design specifications as outlined in the application represents no

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
	Seepage	Leachate	Native vegetation and soil adjacent to return water pond	Direct discharge	Groundwater contamination	No	change to the overall risk profile of the premises

8.2 Consequence and likelihood of risk events

A risk rating will be determined for risk events in accordance with the risk rating matrix set out in Table 12 below.

Table 12: Risk rating matrix

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	Low	Low	Medium	Medium	High

DWER will undertake an assessment of the consequence and likelihood of the Risk Event in accordance with Table 13 below.

Table 13: Risk criteria table

Likelihood		**Consequence**		
The following criteria has been used to determine the likelihood of the Risk Event occurring.		**The following criteria has been used to determine the consequences of a Risk Event occurring:**		
			Environment	**Public health* and amenity (such as air and water quality, noise, and odour)**
Almost Certain	The risk event is expected to occur in most circumstances	Severe	• **onsite impacts**: catastrophic • **offsite impacts local scale**: high level or above • **offsite impacts wider scale:** mid-level or above • Mid to long-term or permanent impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are significantly exceeded	• Loss of life • **Adverse health effects:** high level or ongoing medical treatment • Specific Consequence Criteria (for public health) are significantly exceeded • **Local scale impacts:** permanent loss of amenity
Likely	The risk event will probably occur in most circumstances	Major	• **onsite impacts**: high level • **offsite impacts local scale**: mid-level • **offsite impacts wider scale**: low level • Short-term impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are exceeded	• **Adverse health effects:** mid-level or frequent medical treatment • Specific Consequence Criteria (for public health) are exceeded • **Local scale impacts**: high level impact to amenity
Possible	The risk event could occur at some time	Moderate	• **onsite impacts**: mid-level • **offsite impacts local scale**: low level • **offsite impacts wider scale**: minimal • Specific Consequence Criteria (for environment) are at risk of not being met	• **Adverse health effects:** low level or occasional medical treatment • Specific Consequence Criteria (for public health) are at risk of not being met • **Local scale impacts:** mid-level impact to amenity
Unlikely	The risk event will probably not occur in most circumstances	Minor	• **onsite impacts**: low level • **offsite impacts local scale**: minimal • **offsite impacts wider scale**: not detectable • Specific Consequence Criteria (for environment) likely to be met	• Specific Consequence Criteria (for public health) are likely to be met • **Local scale impacts:** low level impact to amenity
Rare	The risk event may only occur in exceptional circumstances	Slight	• **onsite impact**: minimal • Specific Consequence Criteria (for environment) met	• **Local scale**: minimal to amenity • Specific Consequence Criteria (for public health) met

^ Determination of areas of high conservation value or special significance should be informed by the *Guidance Statement: Environmental Siting.*

* In applying public health criteria, DWER may have regard to the Department of Health's *Health Risk Assessment (Scoping) Guidelines.*

"onsite**"** means within the Prescribed Premises boundary.

8.3 Acceptability and treatment of Risk Event

DWER will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment Table 14 below:

Table 14: Risk treatment table

Rating of Risk Event	Acceptability	Treatment
Extreme	Unacceptable.	Risk Event will not be tolerated. DWER may refuse application.
High	May be acceptable. Subject to multiple regulatory controls.	Risk Event may be tolerated and may be subject to multiple regulatory controls. This may include both outcome-based and management conditions.
Medium	Acceptable, generally subject to regulatory controls.	Risk Event is tolerable and is likely to be subject to some regulatory controls. A preference for outcome-based conditions where practical and appropriate will be applied.
Low	Acceptable, generally not controlled.	Risk Event is acceptable and will generally not be subject to regulatory controls.

8.4 TSF2 pipeline failure

8.4.1 Risk assessment

There is potential for the discharge of tailings or return water to the environment through pipelines failing, bursting or leaking.

Tailings slurry and decant water contain soluble metals and metalloids (other chemicals) which are toxic to vegetation and fauna.

Overflow of tailings and decant water may cause vegetation and faunal death through contact with soft tissues such as through absorption or ingestion. Discharges of significant quantities tailings and return water may cause contaminants to seep into the soil profile and in significant quantities impact on the roots of deep rooted vegetation such as tree species and diminish ambient groundwater quality.

The relevant land and groundwater criteria include for discharges is the Guidelines for fresh and marine waters (ANZECC and ARMCANZ, 2000), and the National Environmental Protection (Assessment of Site Contamination) Measure (NEPC, 2013) for soil and groundwater.

The application states that the TSF has been designed in accordance with the *Code of practice: tailings storage facilities in Western Australia* (DMP, 2013) and the *Guidelines on Tailings Dams Planning, Design, Construction, Operation and Closure* (ANCOLD, 2012)

Leakage and failure of tailings and decant water pipelines will be managed through the use of an automatic leak and flow rate detection system, shut off valves, a standby pump, regular inspections, regular maintenance and the bunding of pipelines in open trenches. An operating manual has been provided for TSF2 and includes inspection of tailings and decant lines during each shift, twice daily (Coffey, 2017).

The Delegated Officer has considered the location of TSF2, the composition of tailings and decant water and that there are no declared rare flora or priority communities with 3.8km of

TSF2 and determined that a tailings spillage would result in low level on site impacts. Therefore, the Delegated Officer considers the consequence to be **minor**.

The Delegated Officer has considered the infrastructure requirements for the TSF2 pipelines (tailings and return water) on the Existing Licence, distance to specified ecosystems; the impermeable nature of the insitu soils and determined that the environmental impact from a tailings/decant liquor spill to the environment will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood of the consequence occurring to be **unlikely**.

The overall rating for the risk of tailing and decant water spill through leaks, pipeline failure or rupture events during operation is **medium** and acceptable subject to regulatory controls.

8.4.2 Regulatory Controls

The Delegated Officer considers the following conditions are sufficient for managing the risks associated with TSF2 pipeline failure:

- Existing Licence Condition 1.3.1 requires all tailings delivery and return water lines to and from the TSF2 to be placed within secondary containment vessels to contain any spills. The pipelines are required to be fitted with a leak detection and automatic shut off system in the case of burst events.
- Existing Licence Condition 1.3.3 will be amended following completion of works to include TSF2 as tailings containment infrastructure
- Existing Licence Condition 1.3.4 will be updated following completion of works to ensure a 300mm operational freeboard is maintained on TSF2 as well as other containment infrastructure.
- Existing Licence Condition 1.3.10 will be amended following satisfactory completion of works to require routine visual inspection of TSF2 infrastructure.

8.5 TSF2 overtopping during operation

8.5.1 Risk assessment

Overtopping of TSF2 occur if deposition into Cell 1 and Cell 2 exceeds the holding capacities of each cell, or as a result of a significant rainfall event, or a combination of both of these events. In the instance of an overtopping event, tailings slurry and decant water contain soluble metals and metalloids (other chemicals such as cyanide) which are toxic vegetation and fauna would be discharged to the environment leading to soil contamination and possibly impacts to terrestrial ecosystems, such as plant and animal deaths. Large discharge volumes or discharge over sustained periods could result in eventual groundwater contamination.

The risks of an overtopping event would be assessed against relevant land and groundwater criteria include the Guidelines for fresh and marine waters (ANZECC and ARMCANZ, 2000), and the National Environmental Protection (Assessment of Site Contamination) Measure (NEPC, 2013) for soil and groundwater.

The design and operation standard for TSF's is the *Guidelines on Tailings Dams Planning, Design, Construction, Operation and Closure* (ANCOLD, 2012) and the *Code of practice: tailings storage facilities in Western Australia* (DMP, 2013). The Code requires a minimum operational freeboard of 300mm to be maintained as well as a 200mm tailings beach freeboard (a total of 500mm). A combined freeboard of 500mm will be maintained at all times during normal operations which is easily able to accommodate rainfall from a 1 in 72 hour ARI event which is predicted to result in a 178mm raise within the TSF.

The application specifies the method of tailings storage will create a depressed truncated prism over the area of TSF2 to ensure drying of the tailings and to facilitate removal of decant

water. The depressed area will also allow for the temporary storage of volumes of storm water away from the perimeter embankments where it can impact on embankment stability (which is managed under the *Mining Act 1978*). The Operating Manual proposes a 30 days upper timeframe for removing excess storm water from a TSF following an extreme rainfall event.

The primary control methods used to prevent overtopping are the design specifications; the Operating Manual which includes freeboard markers, routine inspections (twice daily); regular maintenance; and minimizing the size and extend of a centrally located decant pond and to ensure maximum water is returned to the plant. The design features include the construction of cut off trenches adjacent to the upstream edges of the perimeter starter embankment, a sloped embankment crest, placement of rocks on the outer embankment for erosion control and operation of central decant tower.

If an overtopping event occurs, the Delegated Officer has determined that the impact of tailings and decant water discharge will have will have mid-level onsite impacts. Therefore, the Delegated Officer considers the consequence of an overtopping event to be **moderate.**

The Delegated Officer has considered the controls in place for TSF2 including embankment freeboard, capacity to accommodate a 1 in 100 years 72 hour rainfall event, design and infrastructure requirements as well as operational procedures as specified in the operations manual and determined that while overtopping of TSF2 will only occur in exceptional circumstances, impacts could occur if overtopping occurs. Therefore, the Delegated Officer considers the likelihood of the consequence occurring to be **possible**.

The overall rating for the risk of overtopping of TSF2 on environmental receptors during operation is **medium** and acceptable subject to regulatory controls.

8.5.2 Regulatory Controls

The Delegated Officer considers the following conditions are suitable for managing the risks associated with overtopping of TSF2 and the return water pond:

- Existing Licence Conditions1.3.3 will be amended following satisfactory completion of works to include reference to TSF2 in the *Operating Manual- KB TSF1 at Kanowna Belle Gold Mine*.
- Existing Licence Conditions1.3.4 will be amended following satisfactory completion of works to include reference to TSF2. It requires maintenance of a 300mm minimum operational freeboard at all times.
- Existing Licence Condition 1.3.10 will be amended following satisfactory completion of works to include reference to TSF2. The condition requires 12 hourly visual inspection of ponding and freeboard capacity.

8.6 TSF2 seepage during operation

8.6.1 Risk assessment

Seepage from the base of the TSF2 liner could occur and has the potential to cause groundwater contamination and mounding beneath TSF2. Groundwater beneath the TSF2 footprint area is hypersaline and the only beneficial use for the water in the area is as a process water supply for the processing of ore in mining operations. The depth to groundwater varies from 3.5-8mbgl which is higher than baseline data (~12mbgl) collected at the time the adjacent TSF1 was constructed. Seepage from TSF2 has the potential to further elevate groundwater levels and impact of the growth of vegetation. The root zone of plant species typical of the Eastern Goldfields Region generally extend to 6m below the surface and as the seepage is toxic to vegetation.

A geotechnical investigation was conducted by Coffey (2017) and found that the natural soil

permeability at the site is low (at least 7.9 x 10^{-7}m/s at 15mbgl) and HDPE lining of the facility was not considered necessary as the clay soils will act as an aquitard. TSF 2 will have a clay liner comprised of in-situ soils and with a permeability of 1 x 10^{-6}m/s. The tests undertaken by Coffey (2017) also revealed that some sand (up to 33%) and gravel lenses (up to 10%) occur within the upper soil profile (from 2-15mbgl) meaning that any seepage through the base of the liner would impact on the shallow aquifer vegetation within proximity to TSF2.

Seepage modelling undertaken by Coffey (2017) suggests that the seepage flux through the base of TSF2 will be in the order of 120m^3/day (starter embankment) and 405m^3/day (final embankment) during the design life of this facility. This rate of seepage has the potential to adversely affect groundwater quality and cause mounding if the base of the TSF is not engineered to have a low hydraulic conductivity. Mounding is likely to be further exacerbated if any of the 100+ historical exploration bores constructed within the TSF2 footprint area are not adequately sealed prior to construction of TSF2, as they may form a direct conduit between seepage and groundwater. The Licence Holder has confirmed via email that 71 of the historical bores have been located to date and attempt to locate the remaining 29 historical exploration bores will be made during the TSF bore hole decommissioning/grouting program (NSR, 2018b).

TSF 1 will continue to operate after TSF 2 is constructed and this facility currently causes localised mounding, including within the TSF 2 footprint area. A seepage recovery network exists in the vicinity of TSF1 to manage this mounding and some of these bores will be decommissioned as part of the construction works for TSF2. Groundwater levels along the northern boundary of TSF1 and within the TSF 2 footprint area were recorded as between 3.45mbgl (GWMB04) and 5.07mgbl (GWMB07) in January 2018. The addition of seepage from TSF2 to that already present is likely to further increase mounding. The Application contains a number of recommended locations for placement of seepage recovery bores (AGE, 2017). These will not be included within the works approval to allow the construction of new monitoring bores first. The data obtained from the new monitoring bore construction and monitoring will then be used to inform optimal of placement of seepage recovery bores.

The relevant land and groundwater criteria include for discharges within the 6m root zone of vegetation is the Guidelines for fresh and marine waters (ANZECC and ARMCANZ, 2000), and the National Environmental Protection (Assessment of Site Contamination) Measure (NEPC, 2013) for soil and groundwater.

To reduce the risk of seepage the following considerations have been incorporated into the TSF2 design:

- Decommissioning of bores within the TSF2 footprint area to prevent and block potential seepage pathways to groundwater;
- Construction of a cut off trench beneath and in the centerline of the external perimeter embankment to a depth where low permeability materials are encountered. This will act as a hydraulic barrier and prevent horizontal flow of seepage from within the TSF to the external environment. This will be particularly effective where sandy or gravelly soils are present;
- *Insitu* clay will be compacted for the base of TSF2;
- An underdrainage system comprised of approximately 6.3km of network of finger drains will be constructed along the clay base of the 100Ha TSF base and to collect seepage;
- A toe drain will be constructed along the external perimeter to capture seepage from the underdrainage system and near ground surface seepage. Collected seepage will drain to a toe drain sump and be pumped to the return water pond;
- Eight piezometer arrays will be constructed along the perimeter embankments to allow for early detection of seepage within the embankments. Each array will include three piezometers: one within the center of the embankment, and two either side of the

embankment upstream and downstream of the tailings deposition;

- Decant structures to maximize the recovery of process water in each cell.
- Tailings discharge conducted in a manner that ensures process water is constantly positioned around the central decant structure ensuring ponding is kept away from the perimeter embankments.
- Groundwater regularly monitored
- The 50m x 50m return water pond will be HDPE lined
- Regular inspection and maintenance as proposed in the TSF Operating Manual (Coffey, 2017)

The Delegated Officer has considered the sitting of TSF2 and the low permeability soils within that location, the poor groundwater quality and relatively short distance to groundwater and determined that mid-level on site impacts will result from basal discharge from the TSF liner. Therefore, the Delegated Officer considers the consequence to be **moderate**.

The Delegated Officer has considered the works that will be undertaken to locate and decommission bores within the TSF2 footprint area, the design and construction standards of TSF2 including an underdrainage system, the operational procedures for management of TSF2, and the natural low permeability of the *insitu* soils and determined that the impact of seepage will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood of the consequence occurring is **unlikely**.

The Delegated Officer considers the overall rating for the risk of seepage from TSF2 during operation is **moderate**, and acceptable subject to regulatory controls.

8.6.2 Regulatory Controls

The Delegated Officer considers the following conditions are suitable for managing the risks associated with seepage through the TSF2 liner:

Works Approval Condition 1 requires a number of existing monitoring, seepage recovery and other historical bores within the TSF2 footprint area will be decommissioned under this works approval.

Works Approval Condition 1 also requires that new bores are constructed to replace those in the TSF2 footprint are. Established bore construction methodologies, quality assurance and reporting practices are required to be undertaken to ensure the data obtained from the monitoring program is scientifically defensible.

Works Approval Conditions 9 and 10 have been included requiring the Works Approval Holder to submit a seepage recovery management plan that includes the location and construction timeframe for replacement seepage recovery bores.

8.7 Contaminated Stormwater Runoff TSF2 during operation

8.7.1 Risk assessment

Stormwater runoff from TSF2 has the potential to become contaminated with sediments from tailings slurry, decant liquor, hydrocarbons, heavy metals, metalloids and hazardous chemicals and wastes during operation. Sodium cyanide forms metal complexes which are toxic and highly soluble in water. This can lead to contamination of land through direct contact and infiltration into soils. Soil contamination may inhibit vegetation growth and cause health impacts to fauna and through bioaccumulation in the food chain. Groundwater may also be contaminated because groundwater in the vicinity of TSF2 is relatively shallow (3.5mbgl-8.5mbgl).

The premises is located in a semi-arid region and rainfall at the premises characterised by short duration high intensity rainfall which has the potential to be contaminated by any spillage that has not been cleaned up, mobilising the contaminants within the premises leading to the spread of localised contamination. Thirteen catchment areas and subareas drain towards the TSF. There is the potential for cyclonic rainfall to release 186mm of rain in a 1 in 100 ARI over a 72 hour period over a catchment area of approximately 100km^2 causing flooding around the base of the TSF and associated infrastructure including toe drains, culverts and the return water pond. There is currently a series of stormwater diversion drains constructed around TSF1 which deflects surface runoff around and away from the TSF and associated infrastructure.

Flood modelling was undertaken by Ecological (2017) and peak flows of sheet-wash following an annual exceedance probability for worst case scenarios of a 0.1% rainfall event over a 7 day period. The study assumed the existing infrastructure and a *closed drain system* and indicated that overtopping of the existing diversion drains could occur, which could potentially mobilise materials into the environment.

The primary control mechanism for managing contaminated stormwater runoff is to limit contact of surface runoff with the TSF and associated infrastructure following extreme rainfall events. The flood modelling study indicates that incorporation of the following considerations into the design and operation of TSF2 will have the effect of isolating the TSF from flood conditions:

- Construction of seepage trenches and toe drains around the external embankment perimeter of the new TSF;
- an extension to the existing western diversion drain and levee which will divert storm water around the TSF2 as well as TSF1 to divert surface runoff from high intensity cyclonic rainfall events;
- repair of existing levee and diversion drain, maintenance and cleaning debris out of drains and culvert where required to allow clear passage of storm water.

The Delegated Officer has considered the location of TSF2 within the catchment drainage areas, the possibility of severe weather events, the solubility and toxicity of potential contaminants and the existing drainage systems and levees around the TSF1 (which it is noted require maintenance) and determined that storm water runoff from an extreme weather event could result in mid-level on-site impacts. Therefore, the Delegated Officer the consequence to be **moderate.**

The Delegated Officer has considered the infrastructure requirements for TSF2 including the requirement to extend the existing western drain, the construction of toe drains and seepage trenches around the TSF2 embankment, maintenance works to existing drains and culverts (in addition to those spill management measures specified in the Operating Manual) and considers impacts from high intensity storm water runoff events will only occur in rare instances. Therefore, the Delegated Officer considers the likelihood of the consequence occurring to be **rare**.

The overall rating of the risk of seepage from the TSF (1 & 2) impacting on vegetation and contaminating soil to be **medium**, and acceptable subject to regulatory controls.

8.7.2 Regulatory Controls

The Delegated Officer considers the following conditions are suitable for managing the risks associated with overtopping of TSF2 and the return water pond:

- Existing Licence Conditions1.3.10 will be amended following satisfactory completion of works to include reference to the stormwater diversion culverts, drains and levee around the TSF1 and TSF2 to require regular inspection and maintenance of this infrastructure.

9. Determination of Works Approval and Licence Conditions

9.1.1 Works Approval controls

The conditions in the issued Works Approval can be found in Attachment 1 These have been determined in accordance with the *Guidance Statement: Setting Conditions*.

The Guidance Statement *Licence Duration* has been applied and the issued works approval expires in three years from date of issue. This duration the Works Approvals Holders to meet anticipated timeframes for decommissioning works (June 2018), construction works (September 2018) and proposed commencement date for deposition of tailings (April 2019). The duration allows the Works Approval to remain valid for an additional two years period to accommodate unexpected delays.

The Works Approval Holder should lodge of an application to amend the Existing Licence at the earliest convenient time following submission of the Works Approval documentation, allowing for timely processing of the amendment application.

9.1.2 Licence controls

Conditions and controls relating specifically to the operation of TSF are likely to be included in the Existing Licence. It should be noted that the proposed Licence conditions, as stated in Sections 8.4.2, 8.5.2, 8.6.2 and 8.7.2 of this report are not final. When an application to amend the Existing Licence is received, DWER will assess the application subject to compliance with conditions of the issued Works Approval. The proposed Licence conditions may change subject to this assessment and if additional information becomes available to further inform the risk assessment (as per the Guidance Statement: Risk Assessments).

9.1.3 Review of regulatory controls

Please note the Delegated Officer may reconsider the appropriateness and accuracy of controls at any time and following a review, DWER may initiate an amendment to the Works Approval or Licence under the EP Act.

10. Applicant Comments

The Applicant was provided with the Draft Decision Report and draft Works Approval on 28 March 2018. The Applicant provided comments on 9 April 2018. A summary of these is provided in Appendix 2. On 30th April 2018 a second draft version was submitted to the applicant. On the 11 May 2018 two new comments were received back relating to typographical errors.

11. Conclusion

This assessment of the risks and activities on the Premises has been undertaken with due consideration of a number of factors, including the documents and policies specified in this Decision Report (Summarised in Appendix 1). Based on this assessment it has been determined that the issued Works Approval will be granted subject to conditions commensurate with the determined controls, administration and reporting requirements.

Appendix 1: Key documents

	Document title	In text ref	Availability
1.	Licence L5029/1992/11 – Kanowna Belle Gold Mine	L5029/1992/11	accessed at www.der.wa.gov.au
2.	Weatherzone	Weatherzone, 2018	http://www.weatherzone.com.au/climate/station.jsp?lt=site&lc=12038
3.	Bureau of Meteorology climate data for Kalgoorlie – Boulder Airport Weather Station	BOM, 2017	http://www.bom.gov.au/climate/averages/tables/cw_012038.shtml
4.	Licence Amendment Supporting Document - Kanowna Belle Tailings Storage Facility 2 (TSF2): Kanowna Belle Gold Mine L5029/1992/11 (Norther Star Resources Limited, November 2017.	*"the application"*	DWER records A1583519
5.	Licence Amendment Supporting Document - Appendix A: Kanowna Belle Gold Mine: Tailing Storage Facility 2 – Design Report, Coffey Mining Pty Ltd, September 2017	Coffey, 2017	DWER records A1581950
6.	Licence Amendment Supporting Document - Appendix B: Kanowna Belle TSF Expansion – Groundwater Review, Australasian Groundwater and Environmental Consultants Pty Ltd, September 2017;	AGE, 2017	DWER records A1581954
7.	Licence Amendment Supporting Document - Appendix C: Flood Modelling for Kanowna Belle Mine: Preliminary High-Level Assessment, Eco Logical Australia, September 2017;	Ecological, 2017	DWER recordsA1581957
8.	Licence Amendment Supporting Document Appendix D: Kanowna Belle Tailings Storage Facility Expansion – Flora and Fauna Reconnaissance Survey, Botanica Consulting, October 2017	Botanica, 2017	DWER records A1581950
9.	Email correspondence on average rainfall as recorded at the Kanowna Belle Gold Mine	NSR, 2018a	DWER record A1639642
10.	Email correspondence on decommissioning of exploration bores within TSF2	NSR, 2018b	DWER record A1639635

Appendix 2: Summary of applicant's comments on risk assessment and draft condition

Condition	Summary of Licence Holder comment	DWER response
1	Editorial comments were made to Table 2 including to: • TSF embankment height, • minimum operational freeboard, • embankment construction standard, • megaflop pipe, • spacing of spigots, • detail for the return water pond and cyanide plant was missing, • changes to reference of historical bores being decommissioned and described instead as historical exploration bores • Site map plans in Schedule 2 • Renaming of groundwater monitoring bores required to be constructed • Removal of Table 3 (duplication from condition 5)	Changes accepted with the exception of reference to Cell 2 stage 1 for the TSF embankment height to 357.5m AHD as this is not approved under this works approval. The text was deleted.
1	The Applicant also requested the removal of the requirement to construct seepage management bores under this instrument on the basis that replacement seepage recovery bore locations would need to be finalised following the construction of the new monitoring bores which will enable shallow geology and localised groundwater levels to inform the best location for these.	The requirement to construct seepage recovery bores is considered important for the protection of deep rooted vegetation species where groundwater mounding occurs within 6m of the natural ground surface. Conditions 9 and 10 have been included requiring a seepage management plan to be submitted as part of this Works Approval.
Schedule 1 & 2	Request to use most current version of Premises map. Request to change the Site Plan 2 and 3 used from those provided in the Kanowna Belle TSF Expansion Groundwater Review (AGE, 2017) to those provided by Licence Holder's own supporting documentation as the bore names have been updated. Typographical errors identified	All changes made.

Attachment 1: Issued Works Approval W6125/2018/1