Management Plan

Surface Water

Risk Statement: High

This document will be reviewed on a one yearly basis, unless a process change occurs earlier than this period. The information in this document relates to management, monitoring and associated reporting required by Development Consent 11_0600 and Mining Leases 1247, 1367, 1641 and 1743.

Doc No.	Version No.	Next Review Date	Owner
PLN-0090	7.01	28/06/2023	Environment & Farms Superintendent

Revision Summary

First Issue	Issue Date	Implementation Requirements	Approved By
1	1 Aug 14	Sent for approval to DPE	MP

Version No.	Revision Date	Summary of Revision Details	Approved By
2	30 Sep 16	Updated to new format and included SRK information. Reformatted document to follow order of requirements from PA 11_0060 Schedule 6, Condition 3.	MP
3	May 17	Update to include EPA comments and update for water infrastructure changes around TSF1 & TSF2 infill.	MP
4	May 18	Minor updates	
5	21 Feb 20	Updated to new DCS	M Row
6	June 20	Annual Review	C Higgins
7	June 21	Annual Review	C Higgins
7.01	Oct 22	Annual Review – no change – D Shaw	C Higgins

Consultation Required	Hard Copy Locations
Environment REG Champion	Northparkes Website

Associated Documents to be Reviewed
Not Applicable

Table of Contents

1. OVERVIEW

1.1 Background

CMOC Mining Services Pty Limited (CMOC) is the manager of the Northparkes Joint Venture, an unincorporated joint venture between CMOC Mining Limited (80%); Sumitomo Metal Mining Oceania Pty Ltd (13.3%) and SC Mineral Resources (6.7%). Northparkes is a copper-gold operation in Goonumbla, situated 27 kilometres north-west of the town of Parkes.

Construction of the ore processing plant and associated facilities began in 1993. Open cut mining commenced on the E22 and E27 ore bodies in late 1993. Development of the E26 lift 1 block cave underground mine began in 1994, with full scale production commencing in 1997.

1.2 Mining Context

Operations at Northparkes primarily comprises underground mining from multiple ore sources that feed a processing plant with a capacity of 6½ million tonnes per annum (Mtpa). The underground mine is accessed via a decline ramp from the surface for people and materials with ore transported to the surface via inclined conveyors and a hoisting shaft, with a nominal capacity of 7.2 Mtpa. Northparkes utilises low cost block and sub-level cave mining and exploits industry leading technology, such as semi-autonomous loaders and various cave monitoring systems.

The ore processing operation consists of four stages: crushing, grinding, flotation and thickening / filtering. In addition to producing concentrate, the ore processing team also manages tailings disposal. The concentrator was constructed in two modules. Each module consists of its own grinding circuit with a single flotation circuit, concentrate thickener and filter. After extracting the copper and gold bearing minerals, the tailings are combined in a single tailings thickener before being deposited in the active tailings storage facility.

Northparkes' copper concentrate is transported to a rail siding where it is then transported by rail to Port Kembla, for shipping to overseas customers.

1.3 Surface Water Management

The Surface Water Management Plan (SWMP) forms an Appendix of the Northparkes Mines (Northparkes) Water Management Plan (WMP).

The SWMP has been developed to comply with Development Consent 11_0060 (DC 11_0060) as per Schedule 3, condition 23 Water management Plan.

2. SCOPE

This document applies to all activities undertaken by Northparkes including mining and exploration activities, processing of copper / gold ore resources, project development, maintenance activities, mine closure, logistics, associated service and support functions, bore fields, farming operations and products.

3. PURPOSE / OBJECTIVES

The primary objectives of water management at Northparkes are to manage dirty and contaminated catchment runoff, divert clean water around operational areas of the mine and to collect and store water to minimise the need for external water supplies. A critical component of the Northparkes water management system is to maintain zero discharge of contaminated water into the surrounding environment and as such there are no off-site water transfers of contaminated water.

The water management strategy at Northparkes includes the separation of clean, dirty and contaminated water, categorised as follows:

- Clean water includes surface runoff from areas not affected by mining operations and includes runoff from undisturbed areas and rehabilitated areas and water supplied by external sources. The clean water system includes diversion drains and farm dams (FD) surrounding active mining areas in order to capture and divert clean water away from areas disturbed by mining operations.
- Dirty water includes sediment-laden runoff from disturbed areas, including waste rock stockpile areas, TSF walls and surface infrastructure areas that do not handle any ore. Runoff from these areas is collected in settlement ponds (SP) to allow sediment to fall out of suspension.
- Contaminated water includes water associated with mining, ore processing and tailings storage. Any potentially contaminated water is managed within retention ponds (RP), stilling ponds (STP), the Caloola Dams, the Process Water Dam and the Return Water Dam to avoid uncontrolled discharge into surrounding watercourses and to maximise water reuse.

This document has been reviewed as a result of the development of proposed new trigger levels for Surface Water Quality. This has been conducted as per Section 9.3 Surface Water Monitoring Performance Criteria below.

4. RESPONSIBILITIES

General role responsibilities are outlined in the Health, Safety and Environment Responsibilities and Accountabilities Procedure (PRO-0080). Personnel carrying out work under this document must be familiar with and comply with it in full. The following persons have specific responsibility:

Table 1: Responsibilities

Role	Responsibility
all workers	– undertake activities in accordance with relevant Northparkes policies, procedures and management plans and statutory and contract requirements. – implement appropriate environmental management measures in accordance with the SWMP. – report all environmental incidents to the Water Champion.
water team	– review or arrange a review of activities associated with the SWMP on a regular basis. – maintain a record of water monitoring results. – investigate SWMP non-conformances in accordance with relevant TARPs. – determine appropriate management strategies and implement contingency measures in consultation with relevant departments. – complete all internal and external reports required by the SWMP. – investigate and report on all incidents and complaints relevant to the SWMP. – maintain a record of all incidents and complaints relevant to the SWMP.
operations and engineering manager	– Installation, maintenance and operation of water management infrastructure – consult with the Water Team to determine appropriate environmental management strategies and contingency measures required by the SWMP. – consult with the Water Team with respect to the management of any contractor activities that may affect the effectiveness of the SWMP.
reg champion	– the principal point of contact in relation to the SWMP. – coordinate the Water Team and delegate tasks and water enquiries at Northparkes.

5. SURFACE WATER MANAGEMENT REQUIREMENTS

DC11_0060, Schedule 3, Condition 23(c)(ii) provides minimum requirements for this plan. These include:

- Baseline data on water flows and quality of water bodies that may be impacted by the Project;
- Description of water management systems;
- Surface water monitoring programs;

- Performance criteria for assessing potential impacts on identified water resources;
- Reporting procedures for monitoring programs; and
- Management of exceedance of performance criteria.

These requirements will be addressed in Sections 6-12 of this document.

6. BASELINE DATA

6.1 Clean Water System

The Clean Water System includes monitoring points from the farm dams and watercourses. This baseline information has been adapted from the Northparkes Step Change Project (Umwelt, 2013), Appendix 11, Surface Water Assessment. The data that was assessed for this baseline information was from 2005 – 2012).

6.1.1 pH

The water quality in the water courses is variable. This is consistent with the variable nature of precipitation and runoff of the various water courses that are included in the monitoring program. The Surface Water Quality Assessment from the Step Change EA indicated that an assessment of data from 2005 – 2012 indicated a mean pH value of 6.9 across all watercourses. Data analysis also found that pH values of above 8 and below 6.5 were also recorded for all watercourses except one. The maximum recorded pH level was 8.75 at WC7.

The mean pH for farm dams was higher than watercourses being 8.0. The maximum recorded pH for farm dams was 9.06 at FD21 which is located within the eastern section of the Project Area. The higher pH recorded for samples at the farm dam may be attributed to the capture and concentration (by evaporation) of alkaline materials within the farm dams.

6.1.2 Electrical conductivity

The mean EC values for all watercourses was 142 uS/cm. The maximum recorded EC was 515 uS/cm at WC7 (upstream of Northparkes on Tenandra Creek).

The mean EC values for farm dams was 469 uS/cm. The maximum recorded EC was at FD8 at 4010 uS/cm.

The data analysis indicated that the EC in the farm dams is higher than the watercourses. This may be attributed to the capture and concentration (by evaporation) of alkaline materials within the farm dams.

6.1.3 Total suspended solids

Mean TSS of watercourses were found to be 119 mg/L for all watercourses. The maximum recorded TSS was 740 mg/L at WC1 (downstream of Northparkes on Cookopie Creek).

Data analysis indicated that the TSS within the watercourses exceeds the maximum ANZECC default trigger value of 40 mg/L at all monitoring locations.

Analysis of farm dam TSS indicated a mean TSS of 48 mg/L across all farm dam monitoring data. The maximum recorded TSS value was 356 mg/L at FD21 (located to the east of Northparkes).

The ANZECC default trigger value for TSS is 350 uS/cm.

6.1.4 Copper

Mean copper concentrations of watercourses samples was 0.04 mg/L. When compared to the ANZECC default trigger 1.4 ug/L) the copper concentrations within the watercourse monitoring locations were consistently above this guideline. Only WC12 recorded copper concentrations below the ANZECC default trigger value.

Mean copper concentrations in the farm dam water data were 0.03 mg/L which is above the ANZECC default trigger value. None of the farm dams monitoring data included copper concentrations below the ANZECC default trigger value.

The justification for reviews of trigger levels to determine appropriate and relevant trigger values for the various monitoring locations, is due to the fact that the monitoring data indicating elevated natural levels of various parameters for numerous locations.

6.2 Dirty Water Systems (Sediment Ponds (SP's))

6.2.1 pH

Mean pH values across all years was 8.0. The pH of the dirty water system was found to be similar to that of the clean water system.

6.2.2 Electrical conductivity

Data analysis indicated the EC levels are consistently high across all sediment ponds which is higher than the clean water system. EC values exceed 20,000 uS/cm. This exceeds the ANZECC default trigger value of 40 mg/L.

6.2.3 Total Suspended Solids

Analysis indicated that Total Suspended Solids (TSS) was typically above ANZECC default trigger values. In particular SP2, SP3 and SP10.

6.2.4 Copper

The mean concentration for copper across all monitoring data for the dirty water system was 0.07 mg/L. This is consistently above the ANZECC default trigger value of 1.4 ug/L. The analysis conducted indicated that the copper concentrations in the dirty water system were typically comparable to the recorded levels for the clean water system.

6.3 Contaminated Water System (Retention Ponds (RP's))

6.3.1 pH

Mean pH values for the dirty water system were 7.9. They are typically high and often exceeding the ANZECC default trigger value of 8.0. Water within the Retention Ponds (RP) tend to be higher in pH, however this was variable. Water within the pit areas also had higher pH levels.

6.3.2 Electrical conductivity

EC levels were consistently high in the contaminated water system. EC values in the RP's reached 7500 uS/cm and over 12000 uS/cm in Surge Dam 1 and 2.

6.3.3 Copper

The mean concentration of copper in dirty water system monitoring locations was 0.122 mg/L. This is consistently above the ANZECC default trigger value of 1.4 ug/L. No recorded copper concentrations were below the ANZECC default trigger value.

6.4 Summary

The analysis of the background data conducted in the Step Change Environmental assessment has shown;

- The Clean Water System data indicates EC, TSS, and copper levels that exceed the ANZECC default trigger levels;
- The Dirty Water System data indicates EC, TSS and copper levels consistently above the ANZECC default trigger levels; and
- The Contaminated Water System data exceed pH and consistently exceed EC and copper levels which are above the ANZECC default trigger levels.

Northparkes commissioned SRK to conduct a review of all data available for surface water monitoring locations to determine appropriate and relevant trigger levels for all parameters monitored. These trigger levels are detailed in the Water Management Plan.

7. WATER MANAGEMENT SYSTEMS

7.1 Clean Water Management

Clean water management at Northparkes involves:

- The diversion of clean catchments away from areas of disturbance.
- Maintaining the integrity of existing farm dams within the Project Area.
- Maintaining disturbance outside of riparian corridors of watercourses within the Project Area and surrounding areas.
- The monitoring of surface water quality within watercourses and existing farm dams within the Project Area and surrounding areas.

7.1.1 Farm dams

A number of farm dam storages are located within and outside the Project Area. These storages have existed historically as part of previous agricultural land uses. The farm dams are not utilised as part of the water management system at Northparkes as a source of water, however the storages are monitored for water quality.

When required the operations utilise existing farm dams that are appropriately located as settlement ponds, where disturbance activities have been required. With the rehabilitation of the areas of disturbance, these settlement ponds are reverted back to farm dams.

7.1.2 Raw water tank

The Raw Water Tank receives water from the Parkes Shire Council (PSC) supply pipeline under a supply agreement with the PSC, which is sourced from the Lachlan Valley borefield and the Lachlan River. This tank supplies water to the Water Treatment Plant with excess water transferred to the Process Water Dam.

7.1.3 Water treatment plant

The Water Treatment Plant treats raw water supplied by PSC. Treated water for dust suppression in the rill towers, the concrete batching plant and the processing plant is supplied directly from the Water Treatment Plant, with the remaining water stored in the Potable Water Tank. When flows from the Water Treatment Plant exceed requirements and the storage capacity of the Potable Water Tank, excess water is transferred to the Process Water Dam.

7.1.4 Potable water tank

Treated water from the Water Treatment Plant is stored in the Potable Water Tank for supply to the administration and office buildings, contractor's yard, dust suppression (truck fill point), truck washdown and the underground mining operations. Excess water is transferred from the Potable Water Tank to the Process Water Dam.

7.1.5 Watercourses

The Project Area is located within the Macquarie-Bogan catchment and is part of the Murray Darling Basin in the central-west of NSW. The Bogan River rises near Goonumbla approximately 11 km south of the mine and flows in a north-west direction for approximately 620 km before joining the Darling River near Bourke.

The Project Area is located within the catchments for the Bogan River, Tenandra Creek, Goonumbla Creek and Cookopie Creek. The Bogan River flows in a northerly direction immediately west of Northparkes. The three other creek systems all drain directly to the Bogan River.

All the watercourses within and surrounding the Project Area are ephemeral with poorly defined channels. Flow rates in these watercourses typically fluctuate in response to rainfall patterns and generally flow for relatively brief periods following significant rainfall events. Flow within the Bogan River becomes perennial downstream of the Project Area. In 2017, there was only one rainfall event that produced flow in watercourses within and surrounding the Project Area (Northparkes, 2017).

7.2 Dirty and Contaminated Water Management

Storages associated with the dirty and contaminated water management systems have been summarised in Table 2.

To reduce the risk of contamination from the use and storage of chemicals and hydrocarbons, these products will be stored in bunded areas in accordance with the relevant Australian Standards. These areas will be inspected as part of the site Auditing and Reporting Program.

Table 2: Dirty and Contaminated Water Storages

Storage Name	Cumulative Volume (ML)	Licensing
Settlement ponds SP3, SP10, SP15, SP16	49.6	Not required
Retention ponds RP1-10, RP12, RP13, RP15, RP16, RP19, RP20-30, RP32	170.3	Not required
Process Water Dam	200	Not required
Surge Dams 1 and 2	7.1	Not required
Caloola Dams	1088.5	Not required
E22 open cut void	27,000 (estimated to top of bank)	Not required

A detailed breakdown of each settlement and retention pond storage and their respective catchments has been provided in Appendix A – Surface Water Storage Assessment.

7.2.1 Retention ponds

There are currently 26 retention ponds present at Northparkes which collect and store surface water runoff from areas associated with mining and ore processing. Also, RP9 has now replaced the Return Water Dam and is receiving the decant water from Estcourt and E27 TSF's along with process water pumped back from Caloola ponds and it receives water recovered from the contractor's yard and the catchment to the west of the Rosedale TSF. The water level in the retention ponds are maintained low by pumping water to the Process Water Dam.

7.2.2 Process water dam

The Process Water Dam receives water from the Raw Water Tank and excess water from the Water Treatment Plant and Potable Water Tank, in addition to water pumped from the retention ponds, RP9, underground workings and water recovered from the administration and office buildings.

7.2.3 Tailings storage facilities

The TSFs receive tailings from the processing plant generated by ore processing. The tailings settle out and supernatant water and runoff is contained and decanted to the Process Water Dam for reuse in the water management system. The proportion of water recovered from the TSFs is dependent on evaporation and the entrainment of water in the tailings. Annually, approximately 30% of the total water is recovered from the Tailings Facilities.

7.2.4 Settlement ponds

A total of four settlement ponds are operated by Northparkes to collect and store sediment laden runoff from disturbed areas. The water level in the settlement ponds are maintained low by pumping water to the Return Water Dam.

7.2.5 Return water dam-decommissioned 2017

As part of the TSF1 infill project the Return Water Dam has been decommissioned and this area will be filled with tailings.

The decant pipes from both TSF1 and TSF2 have been decommissioned and any rainfall stormwater caught on these TSF's is currently pumped now to RP9 or Caloola. As part of the TSF1 rehabilitation works TSF1 decant water during the central deposition will be drained into the Estcourt TSF system.

The Caloola North Dam and Caloola South Dam allow for the temporary storage of water recovered from the TSFs during periods of excess water via pumped transfers to and from the RP9.

7.2.6 Existing watercourse crossing structures

A total of six crossing structures exist along Goonumbla Creek that allow vehicles and conveyors to pass over the watercourse corridor. The use of multiple-unit, wide spanning structures with a shallow structure height allows for flooding to pass through the underground facilities area in a safe and controlled manner.

8. SURFACE WATER MANAGEMENT

Surface Water Management includes the following programs;

- Surface Water Monitoring Programs;
- Flood mitigation Works;
- Sediment and Erosion Control; and
- Management and transfer for dirty and contaminated water.

Sections 9 – 12 provide information on the management programs.

9. SURFACE WATER MONITORING PROGRAMS

9.1 Water Quality Monitoring

9.1.1 Monitoring locations for water sample analysis

Water quality monitoring is undertaken at Northparkes specifically within the three defined water management systems of;

- Clean water management system, which includes farm dams and watercourses;
- Dirty water management system, which includes settlement ponds; and
- Contaminated water management system, which includes all aspects of ore processing, and retention ponds.

The monitoring locations of watercourses and surface water storages are provided in Figure 1: Surface Water Monitoring Locations. Table 3 identifies surface water monitoring locations assessed for each of the above listed water management systems. There were some dams within the water management system that are typically dry or have only recently been constructed. These monitoring locations were identified to have insufficient or no water quality data available for assessment.

Due to the location of the Caloola dams being in the Cookapie Creek catchment, two additional monitoring locations will be added to the surface water monitoring program. These will be named WC15 and WC16.

Table 3: Surface Water Quality Monitoring Locations

Clean water management system	Dirty water management system	Contaminated water management system
Upstream WC4. WC6, WC 7, WC13, W14 **Downstream** WC1, WC2, WC3, WC5, WC11 WC12,WC15, WC16 **Farm Dams** FD04, FD05, FD06, FD07, FD11, FD12, FD16, FD18, FD21, FD25, FD26, FD27	SP03, SP10, SP15, SP16	RP01, RP02, RP03, RP04, RP05, RP06, RP07, RP08, RP09, RP10, RP12 RP13, RP15, RP16, RP19, RP20, RP21, RP22, RP23, RP24, RP25, RP26, RP27, RP29, RP32, RP33 Grease Trap 1, Grease Trap 2, Process Water Dam, Sediment Dam 1 and 2, Caloola Dams.

The locations of Grease Trap 1 and 2 are within the underground operations area and are capture points for industrial runoff as a result of maintenance areas typically capturing oils, greases and other hydrocarbons. While the water quality from these areas is important to manage, the assessment of the monitoring against criteria is not expected to be of benefit for the purposes of surface water management as these areas are managed through extraction. These locations have not been further assessed.

Surge Dams 1 and 2 service the dewatering activities from the underground mining area. The surface water quality monitoring of these locations provides a representation of water typically dewatered from the underground. The assessment of this water quality against groundwater bore information can provide an indication as to whether activities in the underground workings are potentially having an impact on water quality within the groundwater environment. These sediment dams are assessed as part of the contaminated water management system.

Figure 1: Surface Water Monitoring Locations

9.1.2 Monitoring frequency and parameters analysed

Water quality sampling frequency and monitored parameters are summarised in Table 4: Monitoring Locations, Frequencies and Parameters.

In addition to this scheduled inspections of the underground facilities area and the ore processing plant area are undertaken. As part of this monitoring, water levels within settlement ponds, retention ponds and other surface water storages are monitored and recorded. Monitored data from these inspections is recorded into the capacity tracking spreadsheet. During these inspections, erosion and sediment control monitoring and maintenance will also be undertaken.

Table 4: Monitoring Locations, Frequencies and Parameters

Water management system	Monitoring Frequency	Monitoring Parameters
Clean water system – farm dams	Quarterly	pH, EC, TSS, TDS, Cu, Na, K, Ca, Mg, Cl, SO4, HCO3, CO3
Clean water system – watercourses	Quarterly	pH, EC, TSS, TDS, Cu, Na, K, Ca, Mg, Cl, SO4, HCO3, CO3
Dirty water management system	Quarterly	pH, EC, TSS, TDS, Cu, Na, K, Ca, Mg, Cl, SO4, HCO3, CO3
Contaminated water management system	Quarterly	pH, EC, Cu
	Annually	TSS, TDS, Na, K, Ca, Mg, Cl, SO4, HCO3, CO3, Al, As, Ba, Be, Cd, Co, Cu, Cr, Mo, Ni, Pb, Se, Th, U, Zn

9.1.3 Quality assurance

Northparkes will utilise laboratories with NATA accreditation for the analysis of samples.

9.2 Watercourse Stability

The monitoring of watercourse stability is required to manage the potential impact on the watercourse from instabilities formed as a result to changes in the watercourses hydraulic operation. As part of the water quality monitoring in the watercourse locations, visual assessments are conducted to determine any visible instabilities. Records will be made including comments regarding bed and bank condition as well as presence of riparian vegetation. Photographs may also be taken to provide further information on the status of the watercourse. Table 5 provides information on the watercourse stability monitoring program.

Table 5: Watercourse Stability Monitoring Program

Location	Frequency	Assessment Requirements
WC13, WC14, WC3, WC5	Quarterly, additional sampling following heavy rainfall events.	Visual assessment of channel form, presence of instabilities in watercourse banks or in crossing structure (bridge/culvert). Photographs to be taken to provide visual evidence of the condition of the watercourse.
Crossing structures – Goonumbla Creek	Quarterly, additional sampling following heavy rainfall events.	Photographs to be taken to provide visual evidence of the condition of the watercourse.

9.3 Surface Water Monitoring Performance Criteria

Northparkes commissioned an independent consultant to review existing surface water monitoring data to determine appropriate and relevant two stage trigger levels. These trigger levels are presented in an Appendix of the Water Management Plan (WMP).

A copy of the full report completed by SRK is provided in an Appendix of the WMP.

9.4 Reporting Procedures for Surface Water Monitoring Programs

Reporting at Northparkes involves a number of internal and external reporting procedures that comply with statutory and operational requirements. Reporting requirements related to water management are detailed in the following sections and summarised in Table 6.

Table 6: Summary of Water Management Reporting

Report	Frequency	Information Required	Responsibility	Recipient
Internal monthly report	Monthly	Water management performance and targets	Environment and Farms Team	Northparkes Leadership Team
Environmental Monitoring Summary	Quarterly	Monitoring results for surface water quality, groundwater quality and groundwater levels as required by the EPL	Environment and Farms Team	Public via the Northparkes website
Community Consultative Committee	Biannual	Discussion of water management performance	Strategic Adviser Community and External Relations	Representatives from a crosssection of the community
Neighbours meeting	Biannual	Discussion of water management performance	Strategic Adviser Community and External Relations	Neighbours of Northparkes lease boundary
Annual Review	Annual	Monitoring results for surface water quality, groundwater quality and groundwater levels; assessment of water management system performance	Environment and Farms Team	Government agencies; public via the Northparkes website
National Pollution Inventory	Annual	Monitoring results for surface water quality and groundwater quality	Environment and Farms Team	Shareholders; public via the Northparkes website

9.4.1 Incident reporting

Any incident which occurs within the Project Area or is associated with operations at Northparkes must be reported by the employee or contractor who has been associated with or witnessed the incident. The method for reporting the incident is outlined in the Northparkes Incident Reporting Procedure.

9.4.2 Environment protection licence

In accordance with the requirements of EPL 4784, Northparkes, its employees or contractors must notify the EPA of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident. Notifications must be made by telephoning the Environment Line service on 131 555. Northparkes must also provide written details about the notification to the EPA within seven days of the incident.

9.4.3 Water access licences

Northparkes must notify DPI Water in writing immediately upon becoming aware of a breach of any conditions set out in WALs held by Northparkes.

9.4.4 Annual review

Northparkes will prepare and Annual Review (AR) that reviews the performance of operations at Northparkes against the requirements of the Water Management Plan, provides an overview of environmental management actions taken and summarises the monitoring results over the 12 month reporting period. The AR typically includes the following elements specific to water management;

- A summary of any complaints or incidents relating to the performance of the water management system;
- A summary of the monitoring results collected over the reporting period and assessment against any relevant criteria;
- An evaluation of any trends in the monitoring results occurring across the site;
- Any non-compliance recorded during the reporting period;
- An evaluation of the site water balance;
- Any recommendations for management action;
- Any amendments to licensing or statutory approvals;
- Management actions identified in the AR relating to the water management system may include:
- Refinements to water quality criteria and objectives;
- Changes to monitoring frequency, parameters or locations; and
- The initiation of any remedial actions.

9.4.5 Surface water quality monitoring data

In accordance with Section 66(6) of the Protection of the Environment Operations Act 1997 and requirements issued by the EPA, Northparkes must publish water quality monitoring data that has been collected as a result of EPL 4784 requirements. A summary of all monitoring results is made publicly available at the mine and on the Northparkes website and is updated on a quarterly basis.

9.5 Management of Exceedance of Trigger Levels or Potential Impacts on Neighbouring Stakeholders Water Use

Five monitoring bores are located on privately owned land surrounding the mine lease. In the event that a complaint is received regarding potential impact on groundwater levels or quality, Northparkes would implement the same procedure as outlined in the Water management Plan. In addition to this the Northparkes Complaints Management process would be implemented. Compensation would be developed if required in consultation with the private landowner where an investigated has indicated that Northparkes related activities have adversely affected the groundwater level or quality. To date, no complaints have been received in relation to the groundwater or surface water supply of private landowners.

10. FLOOD MITIGATION WORKS

As part of the Step Change Project (Umwelt, 2013a), it was determined that all existing and proposed mining activities, water management and associated infrastructure is located outside of the 100 year ARI flood extent. As part of the Step Change Project it was proposed that a 1 m high berm be constructed at the toe of proposed waste rock stockpiles. This berm structure will be constructed from earth sourced locally from existing pits and will consider geotechnical advice such that the berm will be stable in the long-term and under flooding conditions.

Currently, there is a limited amount of flood mitigation and protection works along Goonumbla Creek. Generally flooding events through the Project Area consist of wide and slow moving bodies of water, typically not resulting in significant watercourse erosion. Flooding however does promote the transport and deposition of sediment from the catchment area to watercourses and within crossing structures.

11. SEDIMENT AND EROSION CONTROL

As part of surface water management, erosion and sediment control is critical to the mitigation of excessive soil loss from activities that require disturbance of existing groundcover.

11.1 Disturbance Activities

The following activities have been identified to have the potential to create sediment loads within the operations of Northparkes:

- Vegetation clearing
- Topsoil stripping, construction of embankments and the stockpiling of ore and other materials
- Construction of new plant and the development of roads and access tracks
- Open cut mining operations
- Runoff from hardstand areas which include processing areas, site facilities and tailings storage areas.

Without mitigation these activities have the potential to have a loss of topsoil from the Project Area, sedimentation of downstream watercourses and a degradation of water quality.

11.2 Implementation of Erosion and Sediment Controls

All erosion and sediment controls measures implemented at Northparkes follow the requirements and guidelines provided in Managing Urban Stormwater: Soils and Construction, Volume 1 and Volume 2E (Landcom, 2004; DECC, 2008).

- Existing management plans should be referenced in with respect to mitigating potential impacts of erosion and sediment control which include:
    - Topsoil Management Plan.
- The Step Change Project (Umwelt, 2013a) outlined a series of procedural controls to be implemented as part of existing and future operations. These proposed changes along with existing control strategies include:
    - Implementation of Northparkes site disturbance permits which assess each clearing or disturbance activity individually, assessing potential impact and what specific erosion and sediment controls are necessary.
    - Use of open channels, diversion bunds and surface storages to manage sediment runoff. A minimum sediment storage volume of a 20 year ARI, 1 hour storm event, will allowed for.
    - Progressive rehabilitation with minimal areas of disturbance.
    - Controlled access to areas of disturbance or rehabilitation.
    - Minimising slope lengths of rehabilitated areas.
    - Ground ripping along the contour of slopes to allow for maximum infiltration.

All erosion and sediment controls are to remain in place until the area of disturbance can be satisfactorily rehabilitated and stabilised.

11.3 Commissioning and Decommissioning Farm Dams as Settlement Ponds

As part of erosion and sediment control on areas of new disturbance, existing farm dams have been converted to settlement ponds to manage sediment laden runoff (Umwelt, 2013a). As areas of disturbance become rehabilitated and stabilised, settlement ponds will remain as surface water storages, where practicable, and be converted back to farm dams for future agricultural applications.

The process of commissioning and decommissioning of farm dams as settlement ponds be supported by capacity calculations and a storage form that is consistent with Managing Urban Stormwater: Soils and Construction, Volume 1 and Volume 2E (Landcom, 2004; DECC, 2008). When decommissioning settlement ponds, accumulated sediment will be excavated and appropriately stockpiled or used as topsoil in the rehabilitation process.

As part of the development of TSF 3, a number of surface water storages have been decommissioned. This includes FD13 and FD14.

11.4 Stabilisation Works

In the event that monitoring programs identify instability from stockpiles or disturbance areas an assessment will be conducted to determine appropriate corrective action. This may include;

- Review of sediment and erosion control structures in place to ensure they are well maintained or adequate for the structure or area disturbed;
- Conduct maintenance activities on sediment and erosion control structures as required;
- Implement additional sediment and erosion controls if required (contouring of stockpiles, installation of diversion drains, additional ground cover establishment);
- Conduct additional monitoring to ensure new controls are effective.

12. MANAGEMENT AND TRANSFER OF DIRTY AND CONTAMINATED WATER

12.1 Surface Water Management Design Criteria

The design criteria for water management structures was developed as part of the Step Change Project (DC11_0060). This is summarised in Table 7. An assessment of the surface water storages at Northparkes is provided in Appendix A.

Table 7: Extract from DC 11_0060 – Water Management Performance Measures

Table 6: Water Management Performance Measures

Feature	Performance Measure
Water Management - General	• Minimise the use of clean water on site
Construction and operation of linear infrastructure (including Goonumbla Creek road crossing)	• Design, install and maintain erosion and sediment controls generally in accordance with the series *Managing Urban Stormwater: Soils and Construction* including *Volume 1, Volume 2A – Installation of Services* and *Volume 2C – Unsealed Roads* • Design, install and maintain the infrastructure within 40 m of watercourses generally in accordance with the *Guidelines for Controlled Activities on Waterfront Land (DPI 2007)*, or its latest version • Design, installation and maintenance of creek crossings generally in accordance with the *Policy and Guidelines for Fish Friendly Waterway Crossings* (NSW Fisheries, 2003) and *Why Do Fish Need To Cross The Road? Fish Passage Requirements for Waterway Crossings* (NSW Fisheries 2003), or their latest versions
Clean water management system	• Design, install and maintain the clean water system to capture and convey the 100 year ARI flood • Maximise as far as reasonable and feasible the diversion of clean water around disturbed areas on site
Dirty water management system	• Design, install and maintain the dams generally in accordance with the series *Managing Urban Stormwater: Soils and Construction – Volume 1 and Volume 2E Mines and Quarries* • Designed to capture the 90th percentile 5-day duration rainfall event
Contaminated water management system	• Nil discharge from site • On-site storages (including tailings dams, mine infrastructure dams, groundwater storage and treatment dams) are suitably lined to comply with a permeability standard of < 1 x 10^{-9} m/s in line with the *NSW Environmental Guidelines for Solid Waste Landfills* (EPA, 1996) • Design, construct and maintain other aspects of the tailings dams in accordance with the standards set out in the *Environmental Guidelines – Management of Tailings Storage Facilities* (VIC DPI, 2006), including a requirement to maintain a minimum freeboard of 600 mm or a sufficient freeboard to accommodate a 1 in 100-year ARI, 72 hour rainfall event without overtopping at all times, whichever is greater • Design and construct the tailings storage facilities in accordance with the requirement of the Dam Safety Committee
Chemical and hydrocarbon storage	• Chemical and hydrocarbon products to be stored in bunded areas in accordance with the relevant Australian Standards

As part of any new surface water management structure to be designed and constructed at Northparkes, compliance with the criteria provided in Table 7 should be followed.

12.2 Capcity Assessment

A capacity assessment was undertaken on all settlement and retention ponds within the Northparkes site. As the settlement and retention ponds are all dewatered back to a central point for either reuse or retention, the consideration of each storage can be relatively independent to the other. This can apply for a majority of storages with the exception of:

- Process Water Dam.
- Surge Dams 1 and 2.
- RP9 Retention Pond 9.
- Caloola Dams.

The surface water storages listed have a combination of pumped inflows and catchment runoff that can only be appropriately assessed through the use of the site water balance model. The capacity and operation of these listed storages has been further discussed as part of the site water balance assessment (GHD, 2014b).

As part of the SWMP, the capacity of settlement ponds and retention ponds were assessed for their adequacy to capture and contain dirty water in the event of a rainfall event in accordance with Managing Urban Stormwater: Soils and Construction, Volume 1 and Volume 2E (Landcom, 2004; DECC, 2008) guidelines. Table 8: Assessment Criteria provides the assessment criteria that were used in the evaluation of the capacity of the surface water management system.

Table 8: Assessment Criteria

Criteria	Input
Rainfall event (settling volume estimation)	Five day management period – 90th percentile rainfall depth.
Settlement pond type	Type F
Volumetric runoff coefficient	0.9
Sediment loss calculation (sediment volume estimation)	Revised Universal Soil Loss Equation (RUSLE). Estimating a two month sediment load for required storage estimation. Where appropriate, 50% of settling volume sediment load volume was assumed for some storages.
Soil erodibility factor – K	0.05

12.3 Water Management Feature Modifications

Northparkes have a continual upgrade process for the water management system. The upgrades are documented below in Table 9. During 2014 upgrades were conducted of some of the components of the Northparkes Water Management System. Details and images of these upgrades are provided in Table 9 and Table 10. During 2017 changes have been made to the water catchment system mostly in relation to the infill and closure projects on TSF1 and TSF2 - refer to Figure 2: Water Management Features.

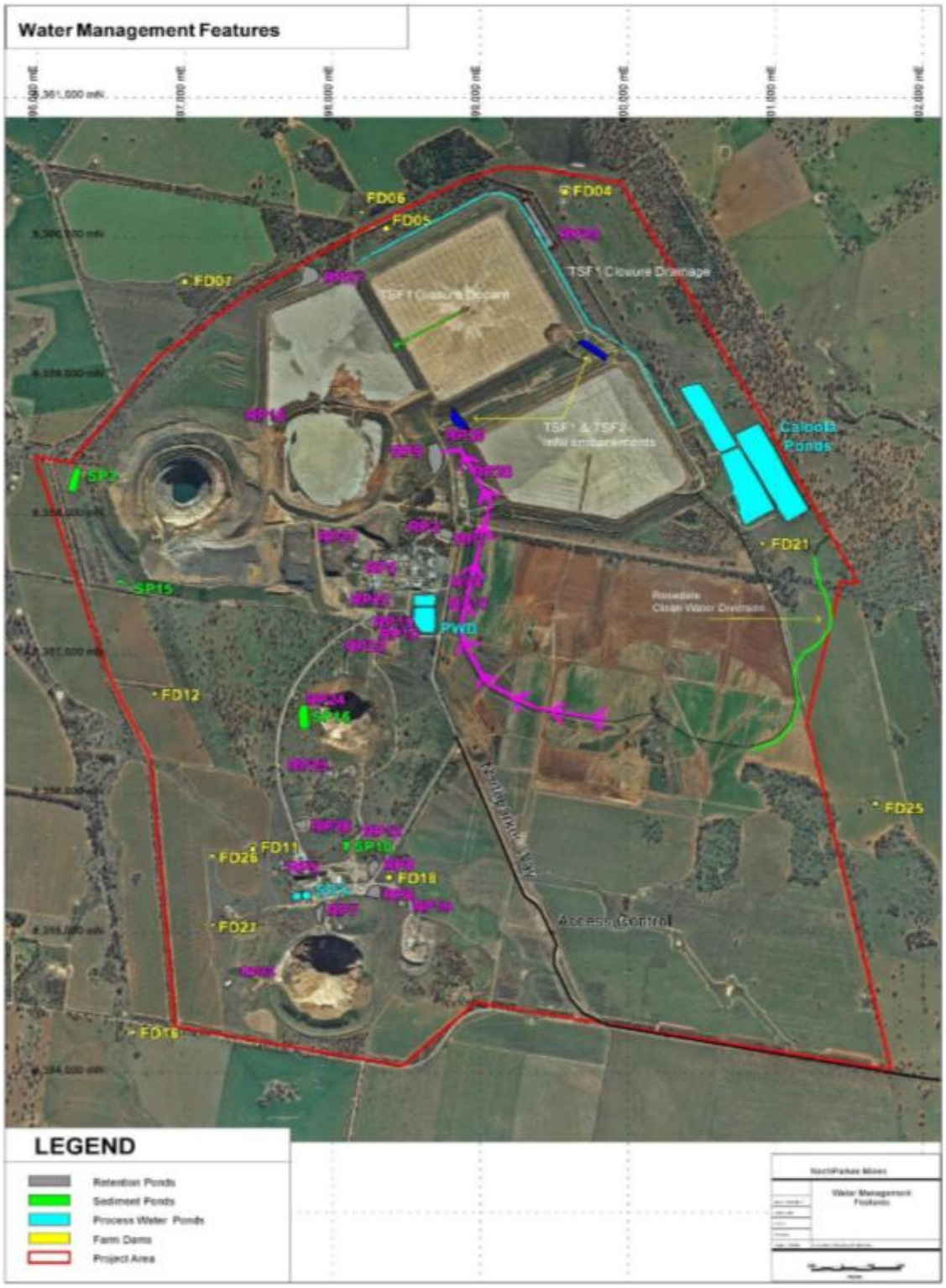

Figure 2: Water Management Features

Table 9: Northparkes Water Management System Upgrades

Water Infrastructure Name	Changes Made	Date Completed
SP1	combined with RP20 renamed RP20	2014
SPSP53	Increased capacity to 28800	2014
RP1	Converted to RP9	2014
RP15	Increased capacity 3400m^3 to 13250m^3	2014
RP26	Increased capacity 600m^3 to 2915m^3	2014
RP8	Increase Bund height	2014
RP12-RP8	Installation of permanent pipework	2014
RP20 – Process Water Dam	Installation of permanent pipework	2014
UG Access Rd.	Clean out of culverts	2014
Pumps	2 x Truflow 70/50 Vac Pump (70L/sec)	2014
WC15 and WC16	Added to the water course monitoring requirements-Cookopie Creek	2017
TSF1 TSF2 Infill	The void between TSF1 and TSF2 has been closed with TSF embankments on the East and West to allow tailings emplacement into the Infill.	2017
Rosedale Clean Water Diversion	Commissioned 2017 to divert clean water from Eastern side Rosedale	2017
SP04	Decommissioned by TSF1 infill project	2017
Return Water Dam	Decommissioned by TSF1 infill project	2017
RP9	Now catching runoff West of Rosedale which reported to SP4 and decant water from TSF and Caloola Overflow capacity to E22	2017
New RP (RP32)	Bunding installed around the oxide saprolite stockpile E26	2017
RP20	Extended in size as part of TSF 1 Closure	2017
RP31	Decommissioned as part of Rosedale	2017

Table 10: Photos of Northparkes Water Management System Upgrades

Before Upgrade	After Upgrade
 RP1 capacty 3,400m^3	 RP1 capacty 13,250m^3
 RP15 capacity 600m^3	 RP15 capacity 2,915m^3

Before Upgrade	After Upgrade
 RP26 capacty 1,650m³	 RP26 capacty 10,000m³
 SP3 capacity 6,100m³	 SP1 capacity 28,280m³
 Oxide stockpile new RP32 capacity 2,880m³	

12.4 Settlement and Retention Pond Operation

The operation of settlement and retention ponds around the Northparkes operations is managed as part of two procedural documents which are;

- Water Infrastructure Procedure

As part of these procedures a number of areas and storages have been highlighted for pumping priority in the event of rainfall. The areas have been identified as; Underground facilities area;

- Ore processing plant; and
- TSFs.

For each of these areas, priorities are in place for pumping and dewatering water storages down to management levels (typically less than 30% of capacity) on a weekly basis. Dewatering of water storages occur at a controlled rate using mobile pumping infrastructure to specific locations which include;

- Caloola Dams;
- E22 Void; and
- Process Water Dam.

In emergencies, pumping to either of the TSF's is also an option however this is to be only undertaken if all other storages are at capacity.

As Northparkes are a 'zero discharge' operation, controlled discharges to the receiving environment are not to occur as a result of management of water levels within existing retention pond operations.

12.5 Emergency Discharges to the Receiving Environment

Due to the topography of the site, there is no single watershed that the site will naturally drain to in the event of a controlled discharge or emergency overflow event. The Project Area can be separated into three distinct areas where discharges to downstream watercourses could occur in the event of an emergency or extreme event. These areas are to the north (Cookapie Creek), south (Goonumbla Creek) and west (Bogan River) of the site. Potential emergency discharge locations are identified in Figure 3: Potential Emergency Discharge Locations. In the event of a discharge from these areas, the discharge would most likely be as a result of a settlement pond or retention pond overflowing.

In the case of potential discharges to the north, this could be as a result of the following storages exceeding their capacity;

- Caloola Dams;

Potential discharges to the west of the Project Area could occur as a result of the following storages exceeding their capacity;

- SP03; and
- SP15.

Within the southern areas of the Project Area, Goonumbla Creek will receive water from any settlement or retention ponds that may potentially discharge in the event that capacity of the system is exceeded. These storages include;

- SP10;
- RP05;
- RP08;
- RP12;
- RP19; and
- RP26.

The results of the site water balance (GHD, 2014b) indicated that the likelihood of emergency discharges was less than 5% in any given year, based on the historic rainfall record of 114 years. This is further supported by the TARP for the emergency management of TSFs and operational water features.

Figure 3: Potential Emergency Discharge Locations

13. REQUIREMENTS UNDER LEGISLATION

Table 11 provides a summary of the DC 11_0060 requirements regarding surface water management and the corresponding section which fulfils each requirements within this plan. Relevant legislation for this management plan is detailed in the Water Management Plan (WMP). A list of current Licences held by Northparkes are detailed in Table 12: Northparkes Water Act 1912 Licences and Table 13: Northparkes Water Access Licences.

Table 11: Development Consent 11_0060 Requirements Regarding Surface Water Management

Condition	Requirement	Section
DC 11_0060 Schedule 3 Condition 19	The Proponent shall ensure that is has sufficient water for all stages of the project, and if necessary, adjust the scale of operations on site to match its available water supply.	8.0
DC 11_0060 Schedule 3 Condition 20	The proponent shall provide a compensatory water supply to any landowner of privately owned land whose water supply is adversely and directly impacted (other than an impact that is negligible) as a result of the project, in consultation with NOW, and to the satisfaction of the Secretary. The extent of adverse impact on water quality must be investigated in accordance with the procedures outlined in Condition 4, of Schedule 5. The compensatory water supply measures must provide an alternative long term supply of water that is equivalent to the lost attributable to the project. Equivalent water supply should be provided (at least on an interim basis) within 24 hours of the loss being identified, unless otherwise agreed with the landowner. If the proponent and the landowner cannot agree on measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Secretary for resolution. If the Proponent is unable to provide an alternative long-term supply of water, then the Proponent shall provide alternatively compensation to the satisfaction of the Secretary.	10.5
DC 11_0060 Schedule 3 Condition 21	Unless an EPL authorises otherwise, the Proponent shall comply with Section 120 of the POEO Act	8.0
DC 11_0060 Schedule 3 Condition 22	The Proponent shall comply with the performance measures in Table 6 to the satisfaction of the Secretary.	8.0, 8.2, 12.0, 12.1.2, 13.1.1
DC 11_0060 Schedule 3 Condition 23	The Proponent shall prepare and implement a Water Management Plan for the Project to the satisfaction of the Secretary. This plan must: a) be prepared in consultation with DPI (Department of Primary Industries) Water and the EPA, by suitably qualified and experienced persons. b) be submitted to the Secretary for approval. c) in addition to the standard requirements for management plans (condition 3 of Schedule 6), this plan must also include a: (i) Site Water Balance (ii) Surface Water Management Plan (iii) Groundwater Management Plan	Water Management Plan
DC 11_0060 Schedule 3 Condition 23	(ii) The Surface Water Management Plan must include: – Detailed baseline data on water flows and quality in the waterbodies that could be affected by the Project – A detailed description of the water management system on site – Detailed plans, including design objectives and performance criteria, for the o Tailings storage facilities o Final voids – Detailed performance criteria for the following, including trigger levels for investigating any potentially adverse impacts associated with the Project. o the water management system (clean, dirty and contaminated) o downstream surface water quality o downstream flooding impacts; and o stream and riparian vegetation health for surrounding creeks; – A program to monitor and report on: o The effectiveness of the water management systems (clean, dirty and contaminated); o Surface water flows and quality, stream and riparian vegetation health in the downstream flooding impacts; – Reporting procedures for the results of monitoring program; and – A plan to respond to any exceedances of the performance criteria, and mitigate any adverse surface water impacts of the project.	7.0, 8.0, 8.2.3, 10.3, 10.4, 10.5

Condition	Requirement	Section
DC 11_0060 Schedule 6 Condition 3	The proponent shall ensure that the management plans required under this approval are prepared in accordance with the relevant guidelines, and include: a) detailed baseline data b) a description of the relevant statutory requirements (include any relevant approval, licence or lease conditions); any relevant limits or performance measures/criteria the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria d) a program to monitor and report on the: Impacts and environmental performance of the project; Effectiveness of any management measures (see c above) e) a contingency plan to manage any unprecedented impacts and their consequences; f) a program to investigate and implement ways to improve environmental performance of the project overtime; g) a protocol for managing and reporting any; incidents; complaints; non compliances with statutory requirements; and exceedances of the impact assessment criteria and/or performance criteria; and h) A protocol for periodic review of the plan	7.0, 5.0, 10.0, 10.3, 10.4, 10.5, 13.2
SOC 6.10.1	Northparkes will continue to manage its operations in accordance with its existing Water Management Plan, which will be updated to reflect the proposed amendments to the surface water catchments and additional monitoring and management measures. This will involve updates to the existing Northparkes Water Management Plan and environmental monitoring program.	2.0
SOC 6.10.2	Additional catch drains will be developed around operational mining areas to intercept sediment-laden runoff and direct this material to new sediment dams. Consistent with the existing water management system, these works will seek to maintain separation between the three classifications of water on site (clean, dirty and contaminated water). To manage potential flood risk, Northparkes proposes to include a 1 m high bank at the toe of the proposed waste rock stockpiles which will incorporate the proposed catch drain.	11.0
SOC 6.10.3	Northparkes will continue to manage contaminated water on site as a closed circuit process designed to manage runoff up to and including a 1 in 100 year average recurrence interval, 72 hour design storm event.	13.0
SOC 6.10.4	All erosion and sediment control measures will continue to be carried out in accordance with the relevant guidelines for erosion and sediment control, including Managing Urban Stormwater: Soils and Construction (the Blue Book) Volume 1 and Volume 2E Mines and Quarries (DECC, 2008).	12.0

*SOC – Statement of Commitments Northparkes Mines Step Change Project

The SWMP has been prepared in consultation with the NOW and EPA, as required by conditions required by the DC 11_0060.

Table 12: Northparkes Water Act 1912 Licences

Licence Number	Issue Date	Expiry Date
80BL244990	16 July 2008	Perpetuity
80BL244991	16 July 2008	Perpetuity
80BL244992	17 July 2008	Perpetuity
80BL620200	7 September 2011	Perpetuity
80BL620201	9 September 2011	Perpetuity
80BL620202	9 September 2011	Perpetuity
80BL620405	22 May 2014	Perpetuity
80BL620406	22 May 2014	Perpetuity
80BL620407	22 May 2014	Perpetuity
80BL620408	22 May 2014	Perpetuity
80BL620203	9 September 2011	Perpetuity
80BL155192	09 August 1994	Perpetuity
80BL236021	17 April 1997	Perpetuity
80BL236023	17 April 1997	Perpetuity
80BL237290	15 April 1997	Perpetuity
80BL241019	MBPWD1, MBPWD2, MBPWD3, W6, W11, W13, E22, MBOPP1, MBOPP2, MBOPP3, MBOPP4, MBOPP5 are capped due to Estcourt tailings dam. MB13 bore is still in operation.	
80BL241020	E48 bore is capped.	Bore licence surrendered in 2016.
80BL241021	E26-P89, E268-P71AS	Bore licence surrendered in 2016.
80BL241023	MB08, E27, W7, W5, W1 bored are no longer in existence. These bores are capped. MB10 and W14 are operational.	
80BL241039	W15 is capped and no longer exists. MB11 and MB12 are in operation.	
80BL241042	E26-P147, E26-OPEN CUT MINE, E26-D129W1 are capped. E26-P149 and E26-P139 are in operation.	
80BL241045	E31R-P123 and W12 are capped and no longer exists.	

Table 13: Northparkes Water Access Licences

Water access licence number	Extraction limit (ML/year)	Waer sharing plan	Description
Surface Water			
1698	486	Lachlan River Regulated River Water Source	General security licence.
7866	495	Lachlan River Regulated River Water Source	General security licence.
8241	2976	Lachlan River Regulated River Water Source	General security licence.
9995	260	Lachlan River Regulated River Water Source	High security licence.
13108	300	Lachlan River Regulated River Water Source	General security licence.
Groundwater			
31850	500	Lachlan Unregulated and Alluvial Water Sources	Aquifer.
31863	634	Lachlan Unregulated and Alluvial Water Sources	Aquifer.
31930	600	Lachlan Unregulated and Alluvial Water Sources	Aquifer.
31963	700	Lachlan Unregulated and Alluvial Water Sources	Aquifer.
31969	1728	Lachlan Unregulated and Alluvial Water Sources	Aquifer.
32004	1600	Lachlan Unregulated and Alluvial Water Sources	High security licence (Avondale Bores 6 and 7).
32120	1050	Lachlan Unregulated and Alluvial Water Sources	High security licence (Dawes Bore 8).
32138	1110	Lachlan Unregulated and Alluvial Water Sources	Aquifer.
34955	232	NSW Murray Darling Basin Fractured Rock Groundwater Sources	Dewatering of E22, E26, E27 and E48 underground and open cut mining areas.

14. REFERENCE MATERIALS

Table 14: Reference Materials

Document Title	ID No. | Year
Northparkes Incident Reporting Procedure	
Environment Monitoring and Measuring Procedure	PRO-0150
Environment Monitoring and Measuring Schedule	3-3877
Northparkes Water Management Plan	PRO-0056
ANZECC and ARMCANZ (2000), Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australia and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra.	2000
DECC (2008), Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and quarries, NSW Department of Environment and Climate Change, June 2008.	2008
GHD (2014a), Northparkes Mines: Water Management Plan, prepared for North Mining Limited, GHD Pty Ltd.	2014
GHD (2014b), Northparkes Mines: Site Water Balance, prepared for North Mining Limited, GHD Pty Ltd.	2014
GHD (2014c), Northparkes Mines: Groundwater Management Plan, prepared for North Mining Limited, GHD Pty Ltd.	2014

Document Title	ID No. | Year
GoldSim Technology Group (2011), GoldSim Version 10.5, (SP2).	2011
Groundwater Resource Management (2004), Northparkes Mine GoldSim Water Balance, prepared for North Mining Limited.	2004
Landcom (2004), Managing Urban Stormwater: Soils and Construction – Volume 1, 4th Edition, Landcom NSW.	2004
Natural Resource Consultants (2006), Soils Survey and Land Capability Assessment of the Northparkes Mines – E48 Project, Geoff Cunningham Natural Resource Consultants Pty Ltd.	2006
Natural Resource Management Ministerial Council, the Environment Protection and Heritage Council, and the National Health and Medical Research Council (2009), Australian Guidelines for Water Recycling, Stormwater Harvesting and Reuse, National Water Quality Management Strategy, Document No 23, Biotext, Canberra.	2009
NOW (2012a), Guidelines for Instream Works on Waterfront Land, NSW Department of Primary Industries, Office of Water.	2012
NOW (2012b), Controlled Activities on Waterfront Land, Guidelines for riparian corridors on waterfront land, NSW Department of Primary Industries, Office of Water.	2012
Northparkes (2008), Management Plan Sitewide: Topsoil, Northparkes Mines.	2008
Northparkes, (2009), Water Quality Guidelines for Northparkes Mines Water Monitoring Locations, Northparkes Mines.	2009
Northparkes (2012), Procedure: Water Infrastructure, Northparkes Mines.	2012
Northparkes (2013), Annual Environmental Management Plan (AEMR), January 2013 – December 2013, Northparkes Mines.	2013
Northparkes (2014), Tailings Storage Facility and Operational Water Emergency Management (Flood & Drought) TARP, (TRIGGER ACTION RESPONSE PLAN), Northparkes Mines.	2014
Rio Tinto (2011), ARD (Acid Rock Drainage) Risk Review – Northparkes, Rio Tinto Technology and Innovation.	2011
Strahler, AN (1952), Hypsometric (Area Altitude) Analysis of Erosional Topology, Geological Society of America Bulletin 63 (11) 1117-1142.	1952
Umwelt (2013a) Northparkes Mines Step Change Project, Surface Water Impact Assessment, Appendix 11, Environmental Impact Assessment, Umwelt (Australia) Pty Limited, July 2013.	2013
Umwelt (2013b) Northparkes Mines Step Change Project, Response to Submissions, Part 3A Environmental Assessment, Umwelt (Australia) Pty Limited, September 2013.	2013
SRK (2016) Water Quality Trigger Levels for Surface and Groundwater – Northparkes Mine	2016

15. ATTACHMENTS

15.1 Appendix A – Surface Water Storage Assessmet

Storage	Calculated Volume (ML) (GHD 2013)	Upgraded Volume	Catchment Size (ha)	Catchment Type
Sediment Ponds				
SP3	8.5	28.8	26.4	Dirty water management system
SP10	1.8		5.7	Dirty water management system
SP15	12.8		40.0	Dirty water management system
SP16	3.1	6.3	9.8	Dirty water management system
Retention Ponds				
RP1	2.8	13.2	8.7	Contaminated water management system
RP2	1.5		4.8	Contaminated water management system
RP3	4.6		14.3	Contaminated water management system
RP4	1.2		3.7	Contaminated water management system
RP5	1.9		5.9	Contaminated water management system
RP6	2.3		7.1	Contaminated water management system
RP7	9.5		29.7	Contaminated water management system
RP8	2.9	14.4	9.0	Contaminated water management system
RP9	9.6	7.6	30.0	Contaminated water management system
RP10	0.9		2.8	Contaminated water management system
RP12	0.8		2.6	Contaminated water management system
RP13	2.1		6.5	Contaminated water management system
RP15	0.2	2.9	0.5	Contaminated water management system
RP16	5.2		16.2	Contaminated water management system
RP19	3.7		11.6	Contaminated water management system
RP20	5.2		16.2	Contaminated water management system
RP21	0.8		2.6	Contaminated water management system

Storage	Calculated Volume (ML) (GHD 2013)	Upgraded Volume	Catchment Size (ha)	Catchment Type
RP22	1.4		4.3	Contaminated water management system
RP23	0.1		0.3	Contaminated water management system
RP24	0.2		0.8	Contaminated water management system
RP25	0.1		0.4	Contaminated water management system
RP26	0.1	10	0.2	Contaminated water management system
RP27	3.5		10.9	Contaminated water management system
RP29	1.9		6.0	Contaminated water management system
RP32	6.8		11.4	Contaminated water management system
Process Water Management System				
Process Water Dam	200		N/A	Contaminated water management system
E22 Void	27000		98.4	Contaminated water management system
Caloola Dams	670		N/A	Contaminated water management system
SD1 and SD2	7.1		N/A	Contaminated water management system