

**METHOD STATEMENT**  
**FOR**  
**KANGRA COAL (PTY) LTD**  
**BALLENGEICH COLLIERY**



**M<sup>2</sup>ENCO**

## **EXECUTIVE SUMMARY**

This Method Statement has been compiled in response to the Department of Water and Sanitation (DWS) requirements contained in the Water Use Licence Application (WULA) Acknowledgement Letter (Ref: WU33839, dated 17 December 2024) for Kangra Coal (Pty) Ltd's Ballengeich Colliery. The report has furthermore been prepared in accordance with Section 7.1 of the prescribed WULA template for Section 21(c) and (i) water uses in terms of the National Water Act, 1998 (Act 36 of 1998). The purpose of this Method Statement is to describe the proposed construction, rehabilitation, operational and closure activities associated with the project, as well as the measures that will be implemented to avoid, minimise and manage potential impacts on watercourses, wetlands and associated aquatic environments. The document should be read in conjunction with the Section 19 Directive (Ref: 16/2/7/V301/A/1, August 2013), the Water Use Licence Application Report (WULAR), and associated specialist and engineering studies prepared in support of the application.

The Ballengeich Colliery is a defunct coal mine situated at the confluence of the Horn River (V31F; NFEPA) and the Ngagane River (V31K; FEPA), approximately 15 km south of Newcastle, KwaZulu-Natal, within the Pongola-Mtamvuna Water Management Area. The proposed rehabilitation and water management infrastructure is located within and adjacent to the Horn River and Ngagane River systems, as well as within delineated wetland buffer areas and associated floodplain environments. The site falls within the 1:100-year floodline and contains a Floodplain Wetland (PES Class C; EIS High) and a Channelled Valley Bottom Wetland (CVB-01; PES Class C; EIS Moderate), both of which were confirmed to be artificial in origin during the wetland delineation assessment undertaken by MENCO (March 2025).

This Method Statement addresses all six lifecycle phases of the project, from pre-construction preparation through to post-closure monitoring:

- Phase 1: Pre-construction preparation, site establishment, and infra-red drone survey of the discard dump
- Phase 2: Construction of passive AMD treatment infrastructure (primary Section 21(c) and (i) activities including ALD 1, ALD 2, SAPS, Oxidation Pond, Aerobic Wetlands 1 and 2)
- Phase 3: Stormwater management, PCD lining programme (PCDs 3, 4, 7, 8 and the proposed Quantum PCD), and flood protection berm construction
- Phase 4: Discard dump rehabilitation (Scenario 1: in situ reshaping, capping and revegetation) and riparian restoration along approximately 740 m of the Horn River
- Phase 5: Operational phase – passive AMD treatment system operation, monitoring and maintenance
- Phase 6: Decommissioning, closure and post-closure monitoring

For each project phase, the Method Statement outlines the proposed activities, construction methodology, equipment requirements, sequence of implementation, environmental

management measures, erosion and sediment control measures, waste management requirements, quality assurance procedures and responsible personnel. The document should be read together with the WULAR, Integrated Water and Waste Management Plan (IWWMP), Stormwater Management Plan (SWMP), Wetland Delineation Report, Rehabilitation Plan, Environmental Management Programme (EMPr), Contingency Plans and associated engineering designs.

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## 1. INTRODUCTION

### 1.1 Purpose and Legislative Basis

A Method Statement is required in terms of Section 7.1 of the prescribed DWS WULA template for all Section 21(c) and (i) water uses under the National Water Act, 1998 (Act 36 of 1998) (NWA). Section 21(c) of the NWA covers the impeding or diverting of the flow in a watercourse; Section 21(i) covers altering the bed, banks, course, or characteristics of a watercourse. Both are extensively triggered by the proposed activities at Ballengeich due to the site's location at the confluence of the Horn and Ngagane Rivers and the proximity of all activities to delineated wetlands and NFEPA rivers.

This Method Statement is compiled in accordance with the following legislation and regulatory instruments:

- Section 21(c) and (i) of the National Water Act, 1998 (Act 36 of 1998);
- GN 267 of 24 March 2017 (Regulations for Water Use Licence Applications);
- GN 4167 of 8 December 2023 (National Water Act: Licensing Regulations);
- Government Notice 704 (GN 704, June 1999) — Regulations relating to the safety of dams, residue deposits, and PCDs in terms of the NWA;
- Best Practice Guidelines H4 (Water Treatment) and G1 (Stormwater Management);
- National Environmental Management Act, 1998 (Act 107 of 1998) — EMP conditions (EMP/2024/086, November 2024); and
- Mine Health and Safety Act, 1996 (Act 29 of 1996) — for all activities on the discard dump

### 1.2 Summary of Section 21(c) and (i) Activities

The proposed project entails the following main construction activities, all of which occur within or adjacent to the Horn River and/or the Ngagane River, and within delineated wetland buffer zones. All activities are cross-referenced to the Water Uses Register (Rev 5, June 2026; 60 individual water use entries) and Master Layout Plan G2025/06/338-100 Rev 2 (GFK, 9 April 2026).

**Table 1: Summary of Section 21(c) and (i) Activities and Water Resource Interactions**

| No. | Activity                                               | S21 Use     | Water Resource Interaction                                                              | Property |
|-----|--------------------------------------------------------|-------------|-----------------------------------------------------------------------------------------|----------|
| 2   | Anoxic Limestone Drain 1 (ALD 1) — 420 m buried trench | 21(c) & (i) | Within 100 m NFEPA river buffer; within 500 m wetland buffer; within 1:100-yr floodline | Ptn 25   |
| 3   | Anoxic Limestone Drain 2 (ALD 2) — 230 m buried trench | 21(c) & (i) | Within 100 m NFEPA river buffer; within 500 m wetland buffer                            | Ptn 19   |

| No. | Activity                                                                                      | S21 Use          | Water Resource Interaction                                                                  | Property    |
|-----|-----------------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------------------|-------------|
| 4   | Successive Alkaline Producing System (SAPS) — minimum 18,900 m <sup>2</sup>                   | 21(c) & (i)      | Within floodplain wetland area; 100 m NFEPA river buffer; 500 m wetland buffer              | Ptn 25      |
| 5   | Sedimentation / Oxidation Pond — 670 m <sup>2</sup> minimum; minimum 2 cells                  | 21(c) & (i)      | Within floodplain wetland (PES Class C; EIS High); 100 m NFEPA river buffer                 | Ptn 25      |
| 6   | Aerobic Wetland Unit 1 — 1.3 ha; discharge to Horn River                                      | 21(c), (i) & (f) | Within floodplain wetland; 100 m NFEPA river buffer; treated AMD discharge to Horn River    | Ptn 25      |
| 7   | Aerobic Wetland Unit 2 — 4.4 ha; cut-off system                                               | 21(c) & (i)      | Within 100 m NFEPA river buffer; 500 m wetland buffer; 1:100-yr floodline                   | Ptn 19      |
| 8   | Flood Protection Berm — ~20,400 m <sup>3</sup> fill; crest 1,183.1 m amsl                     | 21(c) & (i)      | Parallel to Ngagane River; within 1:100-yr floodline; within 100 m NFEPA buffer in sections | Ptn 19      |
| 9   | PCD lining — PCDs 3, 4, 7, 8 (Class C HDPE, GNR 636); new Quantum PCD (8,600 m <sup>3</sup> ) | 21(c) & (i)      | All within 500 m wetland buffer; within 1:100-yr floodline                                  | Ptns 19, 25 |
| 10  | Discard dump rehabilitation — reshape; 600 mm cover; grass (164,120 m <sup>2</sup> total)     | 21(c) & (i)      | Within 500 m wetland buffer; toe drainage adjacent to Dam 6 (old Horn River section)        | Ptn 19      |
| 11  | Riparian and riverbank rehabilitation — Horn River (approximately 740 m)                      | 21(c) & (i)      | Directly within the Horn River watercourse and riparian zone (NFEPA)                        | Ptn 19      |
| 12  | Stormwater channels and culverts (concrete-lined dirty; grass-lined clean)                    | 21(c) & (i)      | Traverse and adjoin drainage lines; culvert D4 under railway (Transnet approval required)   | Ptns 19, 25 |
| 13  | V-notch weir rehabilitation —                                                                 | 21(c) & (i)      | Directly within the Horn River watercourse at the Ngagane River                             | Ptn 19      |

| No. | Activity                | S21 Use | Water Resource Interaction | Property |
|-----|-------------------------|---------|----------------------------|----------|
|     | Horn/Ngagane confluence |         | confluence (NFEPA)         |          |

## 2. GENERAL CONDITIONS AND CONSTRAINTS FOR ALL CONSTRUCTION ACTIVITIES

### 2.1 Overarching Construction Constraints

The following constraints apply to ALL construction activities at the Ballengeich Colliery without exception. These constraints are non-negotiable and take precedence over any schedule, cost, or convenience consideration.

**Table 2: General Construction Constraints Applicable to All Phases**

| Constraint                                   | Detail and Method of Compliance                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Seasonal construction restriction</b>     | Construction within sensitive aquatic environments should, where reasonably practicable, be undertaken during the dry season to minimise erosion, sedimentation and flood-related risks.                                                                                                                                                                                                                     |
| <b>Infra-red drone survey — discard dump</b> | A specialist thermal infra-red drone survey must be completed over the full discard dump surface before any earthworks commence on the dump. No persons, vehicles, or plant may access the dump surface until the drone survey confirms no active combustion zones, and a qualified geotechnical engineer provides written clearance.                                                                        |
| <b>Environmental Control Officer (ECO)</b>   | An ECO must be appointed for the full duration of construction. The ECO must do regular inspections and attendance during sensitive activities. The ECO has full authority to immediately stop any work that violates the EMPr or this Method Statement.                                                                                                                                                     |
| <b>No-go zones</b>                           | The following areas are strict no-go zones where no construction activity, vehicle access, or disturbance of any kind is permitted: (1) CVB-01 Channelled Valley Bottom Wetland and its 100 m buffer; (2) Ngagane River and its 100 m NFEPA buffer (except flood berm and culvert D4 works as specifically authorised by DWS); (3) active groundwater monitoring boreholes (GW series) and their 5 m radius. |
| <b>Pollution prevention — hydrocarbons</b>   | All vehicles and plant must be refuelled and serviced at least 100 m from any watercourse or PCD. Drip trays under all stationary plant. No fuel storage within 100 m of a watercourse. Spill                                                                                                                                                                                                                |

| Constraint                                    | Detail and Method of Compliance                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                               | containment kits on site at all times. Any hydrocarbon spill >5 L to be reported to the ECO within 1 hour.                                                                                                                                                                                                                                                                                  |
| <b>Concrete works</b>                         | No concrete mixing, truck washout, or concrete placement within 50 m of any watercourse. Concrete washout sump: lined pit (minimum 5 m <sup>3</sup> ); minimum 100 m from Horn River; minimum 500 m from Ngagane River. Lime-contaminated concrete washout water must be contained and neutralised to pH <9 before disposal. Not dischargeable to the river system under any circumstances. |
| <b>Temporary erosion and sediment control</b> | All disturbed areas not yet revegetated must be protected within 48 hours of earthworks completion: hessian sandbag silt fences on downslope edges; temporary annual grass seeding on all stripped areas >0.5 ha. Silt fences must be inspected weekly and repaired within 48 hours of any failure.                                                                                         |
| <b>Vegetation clearance</b>                   | Indigenous vegetation clearance to be minimised and limited to the approved construction footprint. No burning of cleared vegetation within 200 m of any watercourse. All cleared material from within the wetland and riparian zone must be inventoried and photographed. Suitable organic material (Eucalyptus timber, composted) is retained for the SAPS organic carbon layer.          |
| <b>Construction waste management</b>          | No waste may be disposed of within 200 m of any watercourse. All construction waste must be sorted (recyclable; hazardous; general) and removed from site by a licensed contractor at intervals not exceeding 14 days. Hazardous waste (AMD-contaminated soil; HDPE liner offcuts; sludge from PCD dewatering) requires a waste manifest and disposal at an approved Class C facility.      |
| <b>Surface monitoring during construction</b> | Monthly water quality sampling at all monitoring points (SW3(1), SW4, SW5, SW6, SW7) must continue throughout the construction phase. Any anomalous reading (pH decrease >0.5 units from baseline; EC increase >50 mS/m) must be reported to the ECO and DWS within 24 hours per the Contingency Plans (MENCO, June 2026).                                                                  |

## 2.2 Responsible Persons

**Table 3: Responsible Persons**

| Role                                                | Responsibilities                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Project Manager — Kangra Coal (Pty) Ltd             | Overall responsibility for project delivery and regulatory compliance. Appointed in terms of the Mining Right. Reports to General Manager, Kangra Coal. Conducts weekly compliance reviews. Authorises emergency expenditure without delay when required.                               |
| Environmental Control Officer (ECO)                 | On-site monitoring of full EMPr and Method Statement compliance during construction. Full authority to stop any work at any time. Maintains daily site diary. Submits monthly reports to DWS KZN (Mrs B. Dukhea).                                                                       |
| Principal Civil Engineer — GFK Consulting Engineers | B.D. Muhl, Pr.Eng. Civil (ECSA 202604247). Responsible for civil design compliance; as-built certification (ECSA stamp); GN 704 compliance sign-off on all PCDs and stormwater structures; Engineer's Certificate of Compliance (GN 704 Regulation 12) within 60 days of commissioning. |
| Contractor Site Agent                               | Responsible for day-to-day construction management; induction of all workers and subcontractors into the Environmental Induction Register; implementation of this Method Statement; and CIDB grading appropriate for the scope of works.                                                |
| Wetland Specialist — Menco                          | Required to undertake specialist inspections during key construction milestones and provide specialist oversight where required.                                                                                                                                                        |
| Geotechnical Engineer — to be appointed             | Required before discard dump surface access; for dump slope stability assessment; for CQA of HDPE liner subgrade; and for flood berm foundation preparation sign-off.                                                                                                                   |

### **3. PHASE 1: PRE-CONSTRUCTION PREPARATION AND SITE ESTABLISHMENT**

#### **3.1 Objectives and Sign-Off Requirements**

Phase 1 covers all activities required to prepare the Ballengeich Colliery for active construction without yet disturbing watercourse or wetland environments. Phase 1 activities should be completed prior to the commencement of Section 21(c) and (i) water use activities to ensure that all environmental controls and pre-construction requirements have been appropriately implemented and documented.

#### **3.2 Pre-Construction Activities**

##### **3.2.1 Infra-Red Thermal Drone Survey of the Discard Dump**

No person, vehicle, or plant may access the discard dump surface for any purpose until this drone survey is complete and ALL identified hot spots have been extinguished and confirmed cold by a qualified geotechnical engineer.

A specialist thermal infra-red drone survey must be conducted over the FULL discard dump surface to identify hot spots and areas of active spontaneous combustion before any earthworks commence. Survey specifications:

- Specialist drone operator with confirmed experience in mine waste thermal surveys (proof of three comparable surveys required).
- 100% coverage of the dump surface at a resolution capable of identifying temperature anomalies  $\geq 3^{\circ}\text{C}$  above ambient.
- Survey to be conducted within 7 days of site mobilisation.
- Results reviewed by Kangra's project team AND an independent registered geotechnical engineer.
- All hot spots must be: mapped and tagged with GPS coordinates; physically marked with exclusion zone flagging on the dump surface; and treated by controlled water injection before earthworks commence in those areas.

##### **3.2.2 Site Establishment**

Prior to any earthworks, the following site establishment activities must be completed and verified by the ECO:

- Contractor camp and laydown area established: minimum 200 m from the Horn River; minimum 100 m from any PCD. Area to be fenced and demarcated.
- Construction zone perimeter fencing erected: clearly distinct from the operational site security fence; signs in English and isiZulu.
- No-go zone markers and fencing installed around: CVB-01 wetland and its 100 m buffer; both Horn River bank sections; Ngagane River and 100 m buffer; all groundwater monitoring boreholes (GW series) with 5 m buffer.

- Ablution facilities (chemical toilets: minimum 1 per 15 workers) established minimum 100 m from any watercourse.
- Concrete washout sump (HDPE-lined; minimum 5 m<sup>3</sup>; minimum 100 m from Horn River) established.
- Plant refuelling area established on an impervious surface with bunded drip tray: minimum 100 m from any watercourse.
- Temporary silt fences installed along the downslope perimeter of all areas to be disturbed.
- Site signage erected in English and isiZulu: site name; authorised entry only; emergency contacts; ECO contact; no-go zone markers.

### **3.2.3 Environmental Induction**

ALL persons on site — contractor employees, subcontractors, Kangra personnel, and visitors must complete a formal environmental induction and sign the induction register before accessing the construction area. The induction must cover:

- Site layout and no-go zones (with reference to Master Layout Plan G2025/06/338-100 Rev 2).
- Sensitive areas: location, extent, and ecological significance of the floodplain wetland, CVB-01, NFEPA river buffers, and 1:100-year floodline.
- AMD hazards: pH, Fe, Al, Mn toxicity; PPE requirements when handling or working near AMD (gloves; safety glasses; chemical-resistant boots).
- Pollution prevention procedures: hydrocarbon spill response; AMD spill response (lime dosing); reporting requirements.
- Waste management: sorting (recyclable, general, hazardous); storage; removal schedules; waste manifest requirements.
- Emergency procedures: dump hot spot discovery; AMD spill; flood event; worker injury; fire.
- ECO authority and unqualified right to stop work.

### **3.2.4 Baseline Surveys Before Earthworks**

- Photographic record (geo-tagged; time-stamped) of all watercourses, wetland units, and the construction footprint in pre-construction condition.
- Surface water quality sampling at all monitoring points (SW3(1), SW4, SW5, SW6, SW7) on the same day as or the day before earthworks commence.
- Groundwater levels in all accessible monitoring boreholes (GW series): record water levels during earthworks has commence.
- Vegetation survey of the construction footprint: confirm no Red Data Book or nationally protected species present. Document all species to be cleared.

### **3.2.5 Topsoil Stripping and Storage**

- Strip topsoil (100–200 mm depth) from all areas within the approved construction footprint before bulk earthworks commence.

- Stockpile topsoil in clearly demarcated, fenced areas: minimum 50 m from the construction footprint; minimum 100 m from any watercourse. Maximum stockpile height: 2.0 m.
- Topsoil stockpiles must be seeded with a temporary annual cover crop (*Eragrostis curvula* at 10 kg/ha) within 14 days if construction is delayed beyond 30 days.
- Topsoil from AMD-impacted areas (pH <6.5 or EC >200 mS/m when tested) must be stockpiled separately, lime-treated, and re-tested before use as cover material on rehabilitation areas.

## 4. PHASE 2: CONSTRUCTION OF PASSIVE AMD TREATMENT INFRASTRUCTURE

This phase covers the construction of all passive treatment components: ALD 1 and ALD 2; the Successive Alkaline Producing System (SAPS); the Sedimentation/Oxidation Pond; and the two Aerobic Wetland units. These activities constitute the primary Section 21(c) and (i) water uses and involve direct work within the Floodplain Wetland (PES Class C; EIS High) and the 100 m NFEPA river buffer of the Horn River. All Phase 2 works must be conducted during the DRY SEASON ONLY (May to September). The Wetland Specialist must be physically present during all Phase 2 activities in the wetland and NFEPA buffer.

### 4.1 Proposed Construction Sequence

**Table 4: Construction Sequence for Section 21(c) and (i) Activities**

| Step | Activity                                                                        | Critical Constraints and Method Notes                                                                                                                                                                                                                                                                                                                                       |
|------|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | Site clearing — ALD 1 and SAPS footprint                                        | Strip vegetation and topsoil (stored separately from non-AMD areas). Eucalyptus trees to be felled progressively by a qualified arborist (not clear-felled simultaneously). Trees within 50 m of the Horn River: directionally felled AWAY from the river. All felled Eucalyptus organic material retained for SAPS compost (composted minimum 90 days on site before use). |
| 3    | ALD 1 excavation and construction (Ptn 25; 420 m; 27°53'33.43"S; 29°57'41.38"E) | See Section 4.2 for full ALD construction method. This is the first CONSTRUCTED treatment element. During excavation: AMD decant directed to West Decant PCD via the installed pipeline. Any groundwater encountered: test pH; if <6.5 treat with lime before pumping to unlicensed PCDs; if ≥6.5 may be pumped to the Horn River.                                          |
| 4    | SAPS construction                                                               | See Section 4.3. HDPE liner installation and CQA required. Compost layer: use on-site Eucalyptus material (composted ≥90 days). Compost                                                                                                                                                                                                                                     |

| Step | Activity                                                                                   | Critical Constraints and Method Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | (Ptn 25; min. 18,900 m <sup>2</sup> ; 27°53'27.58"S; 29°57'45.68"E)                        | test before placement: pH 5.5–7.0; C:N ratio ≥30:1; EC <2 mS/cm; no AMD contamination.                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 5    | Oxidation / Sedimentation Pond (Ptn 25; 670 m <sup>2</sup> ; 27°53'27.86"S; 29°58'30.75"E) | See Section 4.4. Minimum 2 cells; max L:B 3:1; side slopes 1:2. HDPE-lined; scour valves; flow distribution inlet. Sludge dewatering beds minimum 50 m from any watercourse.                                                                                                                                                                                                                                                                                                                                      |
| 6    | Aerobic Wetland Unit 1 (Ptn 25; 1.3 ha; 27°53'22.97"S; 29°57'47.24"E)                      | See Section 4.5. HDPE-lined. Soil substrate tested before placement. Discharge outfall: riprap scour apron at Horn River bank (D50 = 150 mm; 2 m wide; 1 m upstream and 2 m downstream of outfall). Reed planting: final step after hydraulic testing confirms system integrity. DISCHARGE ONLY AFTER pH >5.5 AND Fe <10 mg/L CONFIRMED.                                                                                                                                                                          |
| 7    | Aerobic Wetland Unit 2 (Ptn 19; 4.4 ha; 27°53'16.84"S; 29°57'58.77"E)                      | Same specification as Unit 1. Installed as a cut-off system along the eastern Horn River boundary. Lower embankment crest elevation to align with the 1:100-yr floodline at 1,183.1 m amsl. The Unit 2 design must account for the flood protection berm location to the south.                                                                                                                                                                                                                                   |
| 8    | Reed planting (both aerobic wetland units)                                                 | FINAL STEP in Phase 2. Must not commence until: (a) all HDPE liner integrity confirmed by spark test; (b) hydraulic test of the full treatment train completed; (c) cells flooded with pre-treated water (NOT raw AMD). Species: Typha capensis (bulrush) and Phragmites australis (common reed) at 3–4 plants/m <sup>2</sup> as primary species; Scirpus spp. and Juncus spp. as secondary. Source: registered nursery or harvested from the uncontaminated Horn River (minimum 500 m upstream of decant point). |

## 4.2 Anoxic Limestone Drains (ALD 1 and ALD 2) — Detailed Construction Method

### 4.2.1 How ALDs Function

Anoxic Limestone Drains are buried trenches filled with crushed limestone. AMD is gravity-fed through the drain in anoxic (oxygen-free) conditions. The absence of oxygen prevents metal oxidation and armouring of the limestone by iron and aluminium precipitates, ensuring

sustained alkalinity production through limestone dissolution over 10+ years. ALDs are specifically appropriate at Ballengeich because the AMD has DO >5 mg/L and Al <25 mg/L — both confirmed by the EWS Hydrogeology Assessment (April 2025) and the Bhekani Civil Design (February 2023).

#### **4.2.2 Step-by-Step Construction Method — ALD 1 and ALD 2**

1. Survey and peg the ALD alignment at 10 m intervals. Confirm the as-designed alignment does not intersect groundwater monitoring boreholes (minimum 5 m clearance required).
2. Excavate ALD trench: width 2–3 m; depth 1.5–2.0 m. Maintain stable side slopes (1:0.5 minimum in clay; steel sheet pile support if required in saturated or weak ground). All excavated material tested for pH; lime-treat (50 kg agricultural lime per 10 m<sup>3</sup> of material) if pH <5.0 before use as fill elsewhere.
3. Prepare trench base: compact to 95% Modified AASHTO; lay 150 mm G7 sand bedding layer (maximum particle size 3 mm; no sharp objects).
4. Install HDPE geomembrane 'burrito wrap': single piece of 1.5 mm smooth HDPE geomembrane lining the trench bottom and both sides, with sufficient excess to fold over and seal the top of the limestone layer after fill. All seams fusion-welded (minimum 25 mm overlap; dual-track weld). Integrity test of all seams by vacuum box (minimum 35 kPa) or spark test (10 kV per mm liner thickness) before limestone placement.
5. Install 110 mm HDPE perforated influent pipe at the upstream end: perforated (4 mm holes at 200 mm spacing on lower half only) along the full ALD length to distribute AMD evenly across the limestone layer. Connect to the AMD collection point or West Decant PCD outlet valve.
6. Backfill with crushed limestone aggregate: 8–25 mm nominal size; minimum CaCO<sub>3</sub> content 90%; maximum fines passing the 4.75 mm sieve: 5%. Minimum fill depth: 1,000 mm. Compact lightly in 300 mm layers using plate compactor (not heavy roller which would fracture limestone).
7. Install 110 mm HDPE non-perforated effluent pipe at the downstream end: inlet elevation set at the TOP of the limestone layer (not at the base) to ensure full submergence of limestone and anoxic conditions at all times. Outlet directs treated water to the SAPS inlet.
8. Fold HDPE geomembrane over the top of the limestone layer and fusion-weld the folded edge to form a sealed 'burrito'. Install 0.6 m compacted clay cover (minimum 95% Modified AASHTO) over the entire ALD length. Seed clay cover with indigenous grass (*Eragrostis curvula* at 10 kg/ha) immediately after placement.
9. Install inspection ports (100 mm HDPE standpipes with screw caps) at 50 m intervals and at both ends to allow monitoring of pH, alkalinity, and flow rate without disturbing the cover.

10. Mark ALD alignment on the surface with permanent concrete marker posts at 25 m intervals to prevent inadvertent damage during future excavation works on site.

#### 4.2.3 Watercourse Interaction and Mitigation

- ALD 1 and ALD 2 are both fully subsurface (buried) structures. No above-ground flow diversion is required.
- During ALD excavation: AMD is continuously directed to the West Decant PCD via existing surface drainage. No AMD may reach the Horn River during construction.
- Trench dewatering: groundwater encountered during excavation must be pumped to a dewatering sump (minimum 2 x 3 m<sup>3</sup> sumps). Test pH before disposal: if pH <6.5 treat with lime before pumping to unlicensed PCDs; if pH ≥6.5 may be discharged to the Horn River at a rate not exceeding 2 L/s.
- ALD alignments do not cross any active watercourse. Influent and effluent pipes route to above-ground structures only.

### 4.3 Successive Alkaline Producing System (SAPS) — Detailed Construction Method

#### 4.3.1 How SAPS Functions

A SAPS is a compost-over-limestone passive treatment cell. Acidic water flows vertically downward through an organic compost layer where dissolved oxygen is consumed and ferric iron (Fe<sup>3+</sup>) is reduced to ferrous iron (Fe<sup>2+</sup>). The deoxygenated, reduced water then flows through a limestone layer beneath the compost, where alkalinity is generated. The SAPS specifically addresses the Ballengeich AMD condition of DO >5 mg/L and Fe<sup>3+</sup>/Fe<sup>2+</sup> ratio >25% (approximately 35%), which would cause armoring of a standalone ALD without SAPS pre-treatment.

#### 4.3.2 Step-by-Step Construction Method

1. Prepare the SAPS footprint: strip topsoil and vegetation from the approved footprint. Compact subgrade to 93% Modified AASHTO. Remove all soft spots, organic material, and AMD-contaminated soil from the subgrade.
2. Lay 150 mm G7 sand bedding layer (maximum particle size 3 mm; no sharp objects) over the entire SAPS base.
3. Install HDPE liner (2 mm thick; smooth; SANS 10409) over A4 non-woven geotextile (270 g/m<sup>2</sup>). Liner to extend minimum 500 mm beyond the berm toe at all edges. Anchor in trench (minimum 400 mm deep). All seams fusion-welded; tested by spark test and vacuum box. Protect liner from UV by immediate placement of overlying layers (do not leave HDPE exposed to sunlight overnight).
4. Install ALD limestone gravel layer (200–300 mm depth; 8–25 mm CaCO<sub>3</sub> aggregate) above the liner occupying the lower portion of the SAPS cross-section.

5. Install HDPE perforated distribution manifold within the limestone layer to distribute AMD uniformly across the full SAPS cell footprint. Connect manifold inlet to the ALD effluent pipe.
6. Install organic compost layer (800–1,000 mm depth) above the limestone. Compost specification: minimum C:N ratio 30:1; pH 5.5–7.0; decomposed Eucalyptus material (from site decommissioning, composted on site for minimum 90 days in a designated compost area). Test compost before use: pH, EC, C:N ratio, and heavy metals (Cu, Pb, Zn). Reject any material with EC > 2.0 mS/cm (AMD contamination).
7. Install inlet distribution manifold (perforated HDPE pipe) above the compost layer at the inlet end of the SAPS cell. Maximum surface loading: 1,000 m<sup>3</sup>/day over minimum 18,900 m<sup>2</sup> (53 L/m<sup>2</sup>/day).
8. Install overflow weir at the outlet end at the design water level elevation (top of compost layer). Connect weir overflow to the Oxidation Pond inlet.
9. Construct earthen embankments around the SAPS perimeter: minimum 500 mm freeboard above the design water level; side slopes 1:1.5 (compacted earth); topsoil and indigenous grass on outer slopes.
10. Install standpipes at four corners and the centre for water level and pH monitoring (minimum monthly, recorded in ECO site diary).

#### **4.4 Sedimentation / Oxidation Pond — Detailed Construction Method**

##### **4.4.1 Function and Design Basis**

The Oxidation Pond provides a 24-hour retention time for oxidation of residual Fe<sup>2+</sup> to Fe<sup>3+</sup> and precipitation of iron hydroxide floc (Fe(OH)<sub>3</sub>). Metal precipitates settle to the pond floor. The pond requires periodic desludging every 5–7 years via the installed scour valve. Minimum design specification: total surface area 670 m<sup>2</sup>; minimum 2 cells in series; maximum L:B ratio 3:1; water depth 1,500 mm; minimum 600 mm freeboard; side slopes 1:2 (1V:2H); HDPE-lined (2 mm; SANS 10409).

##### **4.4.2 Step-by-Step Construction Method**

1. Excavate pond cells to design depth (minimum 2,100 mm below natural ground level = 1,500 mm water depth + 600 mm freeboard). Confirm pond dimensions achieve maximum L:B ratio of 3:1. Side slopes 1:2 (1V:2H).
2. Compact subgrade to 93% Modified AASHTO. Lay 150 mm G7 sand bedding layer.
3. Install HDPE liner (2 mm; smooth; SANS 10409) over A4 non-woven geotextile. All seams fusion-welded and tested. Anchor trenches at all edges (minimum 400 mm deep; backfilled and compacted).
4. Install 100 mm diameter HDPE ball valve scour valve at the lowest point of each cell floor. Connect to desludge pipeline leading to sludge dewatering beds (minimum 50 m from any watercourse; on impervious surface).

5. Install flow distribution inlet (perforated manifold, not a single inlet point) at the inlet end; V-notch overflow weir at the outlet end set at the design water level elevation. Connect weir overflow to Aerobic Wetland Unit 1 inlet.
6. Construct embankments around the pond perimeter: minimum 600 mm freeboard; side slopes 1:1.5; topsoil and indigenous grass on outer slopes.

Pond sludge accumulates at approximately 50–100 mm per year. Sludge composition (iron hydroxide floc; gypsum) must be characterised annually per GNR 635. If classified as hazardous waste (Type 3), removal must be by a licensed hazardous waste contractor to an approved Class C facility with a waste manifest. Sludge may not be spread on open ground.

#### **4.5 Aerobic Wetlands (Units 1 and 2) — Detailed Construction Method**

##### **4.5.1 Function and Design Basis**

Aerobic wetlands are shallow planted ponds that oxidise residual  $\text{Fe}^{2+}$  and precipitate  $\text{Fe}(\text{OH})_3$ . They provide final polishing of aluminium, manganese (at circum-neutral pH), and suspended solids. Reed vegetation supports bacterial oxidation, sediment trapping, and provides long-term ecological value to the floodplain riparian environment. Aerobic Wetland Unit 1 is the final treatment step before discharge to the Horn River; Unit 2 intercepts eastern seepage before it reaches the Horn River from the opencast side.

##### **4.5.2 Step-by-Step Construction Method**

1. Clear and strip the wetland cell footprint. Remove and stockpile topsoil (tested; separate stockpile from AMD areas). Any felled Eucalyptus material not used in SAPS compost to be chipped for potential wetland substrate enhancement.
2. Excavate to design depth (minimum 1,600 mm below natural ground level = 1,000 mm water depth + 400 mm soil + 200 mm bedding). Side slopes 1:2 (1V:2H).
3. Compact subgrade to 93% Modified AASHTO. Remove ALL sharp objects from subgrade that could puncture the liner.
4. Lay 150 mm G7 sand bedding layer (maximum particle size 3 mm; no sharp objects; no AMD-contaminated material).
5. Install HDPE liner (2 mm thick; smooth; SANS 10409) over A4 non-woven geotextile. All seams fusion-welded. Anchor trenches at all edges (minimum 400 mm deep). Protect liner from UV exposure immediately.
6. Place 400 mm soil fill above the liner. Soil specification: pH 5.5–7.5; no sharp objects; adequate plant nutrients (N, P, K tested); not AMD-contaminated. On-site topsoil stockpile (tested and approved by ECO) preferred.
7. Install perforated HDPE flow distribution manifold along the inlet end; V-notch outlet weir at the outlet end at the design water level elevation. Maximum L:B ratio 3:1.
8. Plant with indigenous aquatic reeds at 3–4 plants/m<sup>2</sup>: primary species *Typha capensis* and *Phragmites australis*; secondary species *Scirpus* spp. and *Juncus* spp. Source from a

registered nursery or harvest from the uncontaminated section of the Horn River riparian zone (minimum 500 m upstream of the AMD decant point).

9. Flood cells to the design water level (1,000 mm above soil surface) with PRE-TREATED WATER from the Oxidation Pond outflow. Under no circumstances flood cells with raw AMD during establishment — reed establishment requires circum-neutral pH water (pH 6.0 minimum).
10. Monitor and maintain reed planting for a minimum of 90 days until minimum 80% establishment is confirmed in writing by the Wetland Specialist (MENCO). Record establishment progress in ECO site diary with weekly photographs.
11. Aerobic Wetland Unit 1 only: connect V-notch outlet weir to the Horn River discharge point via a riprap-lined scour protection apron (D50 = 150 mm; minimum 2 m wide; 1 m upstream and 2 m downstream of outfall). Install automated data logger (pH; EC; DO; temperature) at the outfall. Discharge to the Horn River ONLY after a minimum of three consecutive weekly samples confirm pH  $\geq 5.5$  AND Fe total  $\leq 10$  mg/L.

## **5. PHASE 3: STORMWATER MANAGEMENT, PCD LINING, AND FLOOD BERM**

This phase covers the GN 704-compliant stormwater management infrastructure, HDPE lining of existing PCDs 3, 4, 7, and 8, construction of the new Quantum PCD (8,600 m<sup>3</sup>), and construction of the flood protection berm. All civil works are designed and signed by GFK (Drawing G2025/06/338-100 Rev 2 (April 2026)).

### **5.1 Stormwater Management Infrastructure**

#### **5.1.1 Dirty Water Channels — Concrete-Lined Trapezoidal**

Concrete-lined trapezoidal dirty water channels route contaminated runoff from the Quantum site, stockpile area, and railway catchment to the lined PCDs via concrete silt traps. Manning's  $n = 0.017$  (concrete); velocities: 0.6 m/s minimum (self-cleansing) to 4.4 m/s maximum; 1:50-year SCS design flows. The following construction method applies:

- Set out channel alignment per GFK Drawing G2025/06/338-100. Confirm gradients by on-site survey to ensure self-cleansing velocity is achieved at low flow.
- Excavate channel to the trapezoidal profile per GFK Table 7 sizing. Compact trench walls and floor to 95% Modified AASHTO. No organic material or soft spots in channel foundation.
- Install formwork; pour unreinforced concrete (minimum 25 MPa; 75 mm cover to any steel). Minimum wall thickness: 100 mm. Expansion joints at 5 m intervals (10 mm width; filled with approved polyurethane sealant).
- Install rounded corners (minimum radius 3 x channel width) at all 90° bends or energy dissipation structures to prevent spilling. Specific attention required at channel junction D3.1 where critical flow conditions exist per the GFK hydraulic model.

- Install concrete silt traps at each lined PCD inlet per GFK Table 10 specifications. Ramp access at 1:6 slope for TLB cleaning. Clean at 28-day intervals during October–April; 14-day intervals for PCDs 3 and 7 where single silt trap is provided (space constraint).

#### 5.1.2 Clean Water Channels — Grass-Lined V-Drains

Grass-lined V-drains intercept and direct clean stormwater runoff from the rehabilitated discard dump toe platform. Design: 1:50-year flow; velocity 1.0–1.5 m/s (Manning's  $n = 0.035$  for established indigenous grass). Method:

- Excavate V-drain (V-profile; dimensions per GFK Table 8) at the confirmed gradient. Compact V-drain soil to 90% Modified AASHTO.
- Place 100 mm topsoil over compacted channel. Seed immediately with *Eragrostis curvula* (20 kg/ha primary) and *Cynodon dactylon* (5 kg/ha secondary).
- Install temporary hessian sandbag erosion control at 3 m spacing along the channel bottom until grass achieves minimum 70% cover. Do not remove sandbags until ECO confirms establishment.
- Where V-drains converge to Culvert V1: concrete-line inlet for minimum 2 m upstream to prevent erosion at the transition.

#### 5.1.3 Culvert Installation

- Culvert D4 (under railway line): Only SATS SAR-type portal culverts permitted (pipe culverts prohibited under railway due to flat slopes, high live loads, and minimal cover). Obtain Transnet written approval before commencement of any railway infrastructure works.
- All new culvert installations: brick headwalls with concrete base and concrete cut-off keys at both inlet and outlet to prevent scour.
- Minimum culvert capacity per GFK Table 9. Mine access roads: designed to 1:5-year return flow (Class 6 road). Watercourse crossings: 1:50-year return flow.
- All existing culverts (D9, D3, D4) to be physically inspected, cleared of siltation, and surveyed before assuming existing capacity is adequate.

#### 5.2 PCD Lining Programme — PCDs 3, 4, 7, and 8

Four existing earthen PCDs are to be lined with Class C HDPE geomembrane in accordance with GNR 636. This work requires dewatering and temporary storage of the existing AMD-contaminated dam water, which has pH as low as 2.5 and  $\text{SO}_4$  up to 8,000 mg/L. A Construction Quality Assurance (CQA) Plan is required for each liner installation, to be signed off by GFK.

**Table 5: PCD Dewatering and Lining Method Summary**

| PCD                    | Capacity (m <sup>3</sup> ) | Dewatering Source and Lining Method                                                                                                                                                                                                                                                                                                                 |
|------------------------|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PCD 7</b>           | 5,600                      | FIRST PCD to be lined (priority: smallest volume; serves Quantum). Pump contents to Quantum PCD (if constructed) or to temporary bladder dam. Once dry: remove and characterise accumulated sediment (GNR 635). Lime-treat any soft spots (pH <6.5 subgrade). Install Class C HDPE liner per GNR 636. Install leakage detection pipe at liner base. |
| <b>PCD 8</b>           | 5,600                      | After PCD 7 is lined: pump PCD 8 contents to PCD 7 (now lined; confirmed capacity available). Dewater; desludge; inspect and treat subgrade; compact; install Class C HDPE liner. Install linking spillway to PCD 7 per GFK design.                                                                                                                 |
| <b>PCD 3</b>           | 15,500                     | Pump PCD 3 contents to unlicensed PCDs 1, 2, 5, or 6 (same water quality; no cross-contamination). Dewater; desludge; subgrade treatment; compact; install Class C HDPE liner. Install 110 mm perforated leakage detection pipe at liner base. Install spillway connection to PCD 4.                                                                |
| <b>PCD 4</b>           | 6,800                      | Pump PCD 4 contents to same destination as PCD 3. Dewater; desludge; compact; install Class C HDPE liner. Install linking spillway to PCD 3.                                                                                                                                                                                                        |
| <b>New Quantum PCD</b> | 8,600 (new)                | New construction. Excavate to design depth; compact subgrade to 95% Modified AASHTO; 150 mm G7 sand bedding; Class C HDPE liner (GNR 636); anchor trench; concrete silt trap at inlet.                                                                                                                                                              |

All sludge removed from PCDs during dewatering must be sampled and characterised per GNR 635. If classified as Type 3 or higher hazardous waste: dispose at an approved Class C lined facility with a waste manifest. Sludge may NOT be disposed of on the discard dump or spread on open ground under any circumstances.

### 5.3 Flood Protection Berm — Detailed Construction Method

The flood protection berm is a compacted earth embankment with a total fill volume of approximately 20,400 m<sup>3</sup>, designed to contain the 1:100-year flood event (HEC-RAS 2D model; SDF method; GFK, February 2026). Crest elevation: 1,183.1 m amsl (minimum 0.8 m freeboard above the 1:100-year flood level). The berm protects all lined PCDs and treatment infrastructure from flood inundation and cross-contamination with clean floodwater from the Ngagane River.

The flood protection berm **MUST** be fully constructed and signed off by the Principal Civil Engineer before the start of the first wet season (October) following commencement of

construction. If berm construction cannot be completed by October in Year 1, berm construction must be the highest-priority activity in the Year 1 dry season (May–September).

1. Set out berm alignment per GFK Layout Plan G2025/06/338-100 Rev 2. Confirm the HEC-RAS flood levels on the ground by survey before setting out the crest elevation.
2. Strip topsoil from the full berm footprint (stored in dedicated topsoil stockpile for later use as crest cover). Compact subgrade. Remove all organic material, soft spots, and AMD-contaminated soil from the berm foundation footprint.
3. Foundation preparation: lime-treat any foundation soils with pH <5.5. Excavate cut-off keys along the berm centreline (minimum 500 mm deep; 500 mm wide) and backfill with compacted clay to prevent seepage under the berm.
4. Source fill material: approximately 70,000 m<sup>3</sup> available on site from cutting and reshaping of overburden area identified on Layout Plan G2025/06/338-100 Rev 2. Balance (approximately 30,000 m<sup>3</sup>) to be imported: approved selected fill (G7 or better; Plasticity Index <10; gravel content 40–60%). All fill material must be tested for pH, Atterberg limits, and compaction characteristics before use.
5. Compact fill in maximum 150 mm loose layers to minimum 95% Modified AASHTO. Moisture content within  $\pm 2\%$  of Optimum Moisture Content (OMC). Compaction testing at minimum 1 test per 500 m<sup>3</sup> fill placed, with results recorded in the CQA register.
6. River-facing slope protection: geocell panels (200 mm depth; HDPE; 200 mm x 200 mm grid) filled with minimum 250 mm 5 MPa soilcrete. Backing: 4.4 mm knitted geotextile. Foundation: 300 mm ballast layer and silt sand base per GFK Drawing G2025/06/338-100/09.
7. Berm crest: 600 mm topsoil over compacted fill; seed with indigenous grass mix (*Eragrostis curvula* at 10 kg/ha; *Themeda triandra* at 8 kg/ha). Minimum crest width: 3.0 m to allow vehicle access for annual inspection.
8. As-built survey to confirm crest levels match design elevations before the first wet season. Engineer's sign-off required on the as-built levels before October commissioning.

## **6. PHASE 4: DISCARD DUMP REHABILITATION AND RIPARIAN RESTORATION**

### **6.1 Discard Dump Rehabilitation — Scenario 1 (In-Situ Reshaping)**

The method below applies to Scenario 1 (dump retained on site, reshaped, capped, and revegetated). If Kangra elects Scenario 2 (reprocessing and removal via ProSizer crusher/screener to Karbochem, Newcastle), the reprocessing contractor's method statement must be submitted separately to DWS for approval before commencement. The full rehabilitated dump surface area under Scenario 1 is 164,120 m<sup>2</sup> (GFK SWMP).

#### **6.1.1 Sequence of Operations**

1. Infra-red drone survey and clearance: conduct repeat drone survey and confirm all hot spots are extinguished and certified cold by a qualified geotechnical engineer before any earthworks or vehicle access to the dump.
2. Geotechnical slope stability assessment by a registered geotechnical engineer before any heavy plant accesses the dump surface. Written clearance required.
3. Establish safe access ramp: maximum gradient 1:10; minimum width 4 m; compacted crusher run surface; demarcated with safety barriers. Ramp to remain in place throughout rehabilitation for ongoing maintenance access.
4. Reshape existing discard material to designed profiles: maximum 1:2.5 side slopes with benched terraces at 5 m height intervals (minimum 3 m wide flat bench; cross-fall to terrace drain). Use dozer and TLB. Design profiles per GFK SWMP Precon dump design (Section 12 reference).
5. Construct seepage collection toe drain: excavate and install 110 mm perforated HDPE drain pipe at the dump toe platform perimeter (northern and eastern sides adjacent to water bodies). Drain pipe bedded in permeable gravel; back-filled with permeable material. Discharge to inspection manholes at 50 m intervals. Solar-powered submersible pumps (minimum 0.5 L/s) at each manhole to pump intercepted seepage to lined PCDs 3 and 4.
6. Construct toe platform: approximately 103,000 m<sup>3</sup> fill (70,000 m<sup>3</sup> on-site cut; balance imported if required). Compact to 90% Modified AASHTO. Platform minimum width 5 m. Install grass-lined V-drain along inner platform edge.
7. Apply minimum 600 mm softs cover uniformly over all reshaped dump slopes and plateau. Material must be geotechnically tested: clay content <40%; no carbonaceous material; no ASS potential. Place in 300 mm layers; compact to minimum 85% Modified AASHTO.
8. Apply 150 mm topsoil layer (from Phase 1 stockpiles, tested and approved) over the softs cover on all slopes and plateau. Rip topsoil surface with agricultural ripper before seeding.

9. Seed immediately after topsoil placement: *Eragrostis curvula* (10 kg/ha), *Themeda triandra* (8 kg/ha), and *Cynodon dactylon* (5 kg/ha). Apply temporary biodegradable hessian erosion control blanket on all slopes steeper than 1:4.
10. Establish terrace drains (grass-lined or rock-lined) at each bench level; connect to toe V-drain system via riprap scour apron to the toe platform.

The full rehabilitated dump surface area of 164,120 m<sup>2</sup> requires minimum 98,500 m<sup>3</sup> of compacted cover material. These volumes must be confirmed by as-built survey before DWS can accept dump rehabilitation as complete under the WULAR conditions.

## **6.2 Riparian and Riverbank Rehabilitation — Horn River (Approximately 740 m)**

The Horn River has been severely degraded by the historical river diversion (late 1980s), uncontrolled AMD impacts over three decades, and physical bank erosion. Riverbank rehabilitation is required along the northern bank of the Horn River at the eastern opencast spoil zone; the southern bank adjacent to the discard dump toe; the Horn River at its junction with the old diversion channel; and the V-notch weir at the Horn/Ngagane confluence. All riparian rehabilitation work must be conducted during the dry season only (May to September) with the Wetland Specialist physically on site.

1. Pre-rehabilitation survey: photograph and measure all affected bank sections (bank height; angle; undercutting; active erosion; AMD seepage). Install erosion pins at 25 m intervals (20 mm diameter steel; 600 mm long; GPS-tagged) for ongoing displacement monitoring.
2. Clear invasive alien vegetation from all affected bank sections: *Arundo donax* (giant reed) if present; *Eucalyptus* spp. within 10 m of the bank edge. Stack cleared material away from the river edge; do not burn within 50 m of any watercourse.
3. Construct gabion aprons at severely undercut bank sections: double-twist hexagonal wire mesh gabion baskets (PVC-coated; 2.0 m x 1.0 m x 0.5 m; fill D<sub>50</sub> ≥ 150 mm; hard, durable, non-calcareous stone). Install at the bank toe. Use rock from on-site opencast material (test for pH neutrality before use as gabion fill; pH must be > 6.5).
4. Shape eroded bank profiles to maximum 1:2 slope. Compact shaped slopes to 90% Modified AASHTO.
5. Apply 200 mm topsoil layer to all reshaped bank sections. Revegetate immediately with coir fibre brush mattresses (pegged at 500 mm centres) as primary erosion control; seed with indigenous riparian grass mix (*Phragmites australis*; *Typha capensis*; *Juncus effusus*) behind the brush mattresses.
6. Install living fascines (bundles of indigenous riparian shrubs: *Salix mucronata*, *Acacia karroo*, *Ficus* species; minimum 1 m long bundles) at 1 m horizontal intervals along the bank face at the low water level to consolidate the bank toe and provide long-term root reinforcement.

7. V-notch weir rehabilitation at Horn/Ngagane confluence: install or repair the sharp-crested V-notch weir with concrete apron and reinforced concrete sill. Install downstream riprap scour protection ( $D_{50} = 200$  mm; 2 m wide; 3 m long). Weir flow measurements to be used as part of the monitoring programme (flow gauging data for the IWWMP annual update).
8. Post-rehabilitation monitoring: measure erosion pin displacements at 3-month intervals for the first 2 years post-rehabilitation. Any bank sections showing displacement >20 mm per year to be repaired within 30 days of identification. Report results in the annual IWWMP update.

## 7. PHASE 5: OPERATIONAL PHASE — PASSIVE TREATMENT SYSTEM OPERATION

### 7.1 System Start-Up and Commissioning

Prior to commissioning of the passive treatment system and commencement of any authorised discharge to the Horn River, the constructed infrastructure should be inspected and verified to ensure that it has been completed in accordance with the approved engineering designs, environmental management requirements and applicable regulatory obligations. The commissioning process should include the following:

- Verification by the Principal Civil Engineer that the constructed infrastructure substantially conforms to the approved engineering designs, supported by the relevant as-built drawings and construction quality assurance records.
- Confirmation by the ECO that the treatment system, stormwater management infrastructure, erosion control measures and associated environmental management measures have been implemented and are functioning as intended.
- Notification to the Department of Water and Sanitation (DWS) regarding the proposed commissioning of the treatment system, including relevant monitoring information where required.
- Verification through baseline commissioning monitoring that the passive treatment system is operating as intended and that the quality of treated water is consistent with the applicable water quality objectives, licence conditions and operational performance criteria.

### 7.2 Routine Operational Maintenance Schedule

**Table 6: Routine Operational Maintenance Schedule**

| Frequency | Activity             | Method and Responsibility                                                                                                                                 |
|-----------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Weekly    | Full site inspection | Inspect all treatment cells, channels, PCDs, flood berm, and monitoring boreholes. Check reed health; check for AMD seepage outside the treatment system; |

| Frequency        | Activity                                 | Method and Responsibility                                                                                                                                                                                                                                                                                                                                |
|------------------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  |                                          | check for vandalism or physical damage to HDPE liners and pipes. Complete site diary. Report anomalies to ECO within 24 hours. Responsibility: Site Supervisor.                                                                                                                                                                                          |
| <b>Monthly</b>   | Surface water quality monitoring         | Collect water samples at all monitoring points (SW3(1), SW4, SW5, SW6, SW7; Aerobic Wetland 1 outfall; Aerobic Wetland 2 outfall; Horn River upstream control). Analyse for: pH, EC, TDS, SO <sub>4</sub> , Fe, Al, Mn, Ca, Mg, Na. Compare to GN 1873 RQOs. Report to ECO; include in IWWMP annual update. Responsibility: ECO or delegated specialist. |
| <b>Monthly</b>   | Treatment train component sampling       | Sample sequentially: ALD 1 outflow; SAPS outflow; Oxidation Pond outlet; Aerobic Wetland 1 outfall. Analyse pH, EC, Fe at minimum. Compare to expected performance at each stage. Identify any underperforming component early. Responsibility: ECO.                                                                                                     |
| <b>Monthly</b>   | Mechanical evaporator check (Scenario 1) | Inspect 22 kW mechanical evaporator: pump function; evaporator nozzles; float switch calibration. Confirm evaporator is positioned over a lined PCD at all times during operation. Evaporate minimum 614 m <sup>3</sup> /month during December–March peak rainfall under Scenario 1. Responsibility: Site Supervisor.                                    |
| <b>Monthly</b>   | Silt trap cleaning                       | Clean all concrete silt traps at each lined PCD using TLB. Remove accumulated sediment via ramp access (1:6 slope). Characterise silt per GNR 635; dispose as appropriate. Increase to 14-day intervals during October–April. Record volumes removed. Responsibility: Site Supervisor / Contractor.                                                      |
| <b>Quarterly</b> | Groundwater monitoring                   | Sample all accessible groundwater monitoring boreholes (UGBH1–GW23; plus EWS BH1 and EWS BH2 once drilled) per IWWMP Table 7-10. Analyse for pH, EC, TDS, SO <sub>4</sub> , Fe, Al, Mn, Na, Cl, NO <sub>3</sub> . Compare to V31K RWQO (GN 1873, March 2022). Responsibility: EWS or ECO with specialist oversight.                                      |

| Frequency                   | Activity                        | Method and Responsibility                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Bi-annual</b>            | Aquatic biomonitoring (SASS5)   | SASS5 survey at five monitoring sites (Horn US, Horn DS1, Horn DS2, Ngagane US, Ngagane DS) during wet season (November) and dry season (May). Compare to baseline (June 2022 and November 2023). Bi-annual WetHealth Level 2 assessment at floodplain wetland (treatment area) and CVB-01 (reference). Responsibility: MENCO Aquatic Ecologist.                                               |
| <b>5–7 years</b>            | Oxidation desludging Pond       | Open scour valve; dewater; remove iron hydroxide sludge via TLB and pump. Characterise sludge per GNR 635. If Type 3 hazardous: licensed contractor; approved Class C facility; waste manifest. If non-hazardous: spread as thin layer ( $\leq 10$ mm) on rehabilitated dump surface for pH amendment benefit. Responsibility: Kangra Coal; licensed contractor as required.                   |
| <b>10 years</b>             | ALD limestone replacement (50%) | Excavate 50% of limestone from each ALD; replace with fresh limestone (8–25 mm; $\text{CaCO}_3 > 90\%$ ). Inspect and replace 50% of HDPE liner concurrent with limestone replacement. Inspect and replace 50% of piping. Retain the other 50% of original limestone to maintain alkalinity production continuity during replacement. Responsibility: specialist passive treatment contractor. |
| <b>Annual</b>               | Reed harvesting                 | Harvest mature reed biomass from aerobic wetland cells (above-water-level cutting). Remove harvested reed biomass from the cells; do not allow it to decay in the cell (contributes unwanted organic load). Dispose of as compost or biomass fuel. Responsibility: Kangra Coal / Site Supervisor.                                                                                              |
| <b>Annual (by 30 April)</b> | IWWMP update                    | Update the IWWMP with: annual monitoring results; any incidents or spills; changes to project scope; assessment of progress toward GN 1873 RQOs. Submit to DWS KZN. Responsibility: MENCO.                                                                                                                                                                                                     |

### 7.3 Operational Emergency Procedures

The following immediate actions apply during operational incidents. Detailed procedures are contained in the Contingency Plans (MENCO, June 2026):

### **7.3.1 AMD Spill or Overflow from a Lined PCD**

1. Immediately close all downstream dirty water channel gates or install a temporary sandbag berm to contain the spill within the dirty area footprint.
2. Notify ECO within 1 hour. ECO notifies DWS within 24 hours (Section 19 NWA obligation).
3. Deploy quicklime bags to any AMD reaching open ground (approximately 0.5 kg/m<sup>3</sup> to raise pH above 6.0).
4. Pump the spilled volume back to the PCD once contained. Confirm no AMD has reached the Horn River.
5. Inspect HDPE liner of the affected PCD; repair any puncture or seam failure within 48 hours.

### **7.3.2 Passive Treatment System Performance Failure**

1. If aerobic wetland outfall pH falls below 5.5 or Fe exceeds 10 mg/L: immediately close the outfall valve or install a sandbag berm at the Horn River outfall.
2. Continue diverting untreated AMD to the West Decant PCD via existing surface drainage.
3. Assess root cause at each treatment stage (see Contingency Plan CP-04, Section 5).
4. Notify ECO and DWS within 24 hours. Remediate and recommission as per CP-04 protocol.

### **7.3.3 Flood Event Overtopping the Flood Protection Berm**

1. Evacuate all personnel from the treatment area immediately. No re-entry until ECO confirms safe.
2. Monitor berm stability remotely. Do not access the berm during active flooding.
3. After flood recession: inspect all lined PCDs and treatment cells for siltation, liner damage, or structural disturbance. Collect post-flood water quality samples at all monitoring points within 24 hours.
4. Notify ECO and DWS within 72 hours of the event. Confirm integrity of all treatment infrastructure before recommencing operation.

## **8. PHASE 6: DECOMMISSIONING, CLOSURE, AND POST-CLOSURE MANAGEMENT**

### **8.1 Trigger Conditions for Decommissioning**

The passive AMD treatment system is designed to operate indefinitely (design life >30 years for aerobic wetland components). Decommissioning will only be considered when all of the following conditions have been met and confirmed by a minimum of 3 consecutive years of monitoring data:

- AMD decant from the underground workings has ceased: artesian head has dissipated and the underground mine water level has stabilised below the decant point elevation (confirmed by EWS groundwater monitoring).
- Surface water quality at Horn DS1 and Horn DS2 has consistently met GN 1873 RQOs for 3 consecutive years without any contribution from the passive treatment system.
- Groundwater SO<sub>4</sub> concentrations in all monitoring boreholes have reduced to below 500 mg/L.
- Wetland PES at the treatment area has improved to Class C or better and is demonstrably self-sustaining without the treatment system.

Decommissioning of the passive AMD treatment system requires WRITTEN APPROVAL from DWS before commencement. Kangra Coal must submit a Decommissioning Motivation Report supported by the monitoring data above and receive written DWS approval before any infrastructure is removed or modified.

## **8.2 Decommissioning Method**

1. Disconnect AMD inflow to the treatment system. Allow all treatment cells to drain naturally over a minimum 90-day period while monitoring water quality at all downstream monitoring points (SW01–SW10). If water quality deteriorates after 90 days of no treatment: reconnect system and reassess trigger conditions.
2. If water quality at Horn River monitoring points remains within GN 1873 RQOs after 90 days: proceed to decommissioning.
3. Remove all HDPE liner material from treatment cells. HDPE liner at end of useful life is classified as general waste and may be recycled at an approved facility or disposed of at a licensed general waste facility. Waste manifest required.
4. Remove ALD piping and limestone. Spent, pH-neutral limestone may be used as general fill or agricultural lime supplement on site (test for neutrality before use). No hazardous waste classification expected.
5. Excavate and remove SAPS compost layer. At decommissioning stage, the compost will be highly decomposed and potentially metal-contaminated. Sample and characterise per GNR 635 before disposal. If hazardous: licensed contractor; approved facility; waste manifest.
6. Reshape all excavated areas to stable gradients (maximum 1:4). Cover with minimum 400 mm topsoil and seed with indigenous grass mix.
7. Flood protection berm: assess whether retention is required as permanent flood management infrastructure. If retained: maintain as permanent earth berm with annual inspection. If removed: rehabilitate to original ground profile with topsoil and indigenous grass.

8. Retain lined PCDs (3, 4, 7, 8, and Quantum PCD) as permanent stormwater containment infrastructure until the DMRE issues a Mine Closure Certificate confirming all residual contamination is resolved.

### 8.3 Post-Closure Monitoring

Post-closure monitoring must continue for a minimum of 5 years after decommissioning of the passive treatment system, or until DWS issues formal confirmation that the Section 19 Directive (Ref: 16/2/7/V301/A/1) has been fully complied with. The minimum post-closure monitoring programme comprises:

- Surface water quality at all monitoring points (SW01–SW10): quarterly for 5 years, then annually subject to DWS approval.
- Groundwater quality at all accessible monitoring boreholes (UGBH1–GW23 plus EWS BH1 and EWS BH2): bi-annual for 5 years.
- Aquatic biomonitoring (SASS5) at five monitoring sites: annually for 5 years.
- Annual IWWMP update submitted to DWS until the Mine Closure Certificate is issued.

## 9. QUALITY ASSURANCE AND QUALITY CONTROL

### 9.1 Construction Quality Assurance Plan (CQA)

A Construction Quality Assurance Plan (CQA) must be developed and implemented for the HDPE liner installation in all treatment cells and PCDs. The CQA must meet the requirements of GNR 636 and is referenced on GFK Construction Drawing G2025/06/338-100/03-1 (signed 24 March 2026). The CQA must include:

**Table 7: Construction Quality Assurance (CQA) Requirements**

| CQA Requirement                                | Standard, Method, and Minimum Frequency                                                                                                                                                                                                                                                                                                                            |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Liner qualification (incoming material)</b> | Melt Flow Index (MFI) per ASTM D1238; tensile yield and break strength per ASTM D6693; puncture resistance per ASTM D4833; tear resistance per ASTM D5884; oxidative induction time (OIT) per ASTM D5885; thickness per ASTM D5199. Frequency: one sample per roll of HDPE liner delivered. Materials with non-conforming results: rejected and removed from site. |
| <b>Field seam testing</b>                      | Spark test (10 kV per mm liner thickness) for 100% of all field seams before backfill. Destructive tensile shear and peel test per GRI-GM19 at minimum 1 per 150 m of seam. Both tests required — spark test only is not sufficient.                                                                                                                               |
| <b>Vacuum box test (patches and repairs)</b>   | All repaired seams and patches: vacuum box test at 35 kPa minimum. Confirm bubble-free for minimum 30 seconds.                                                                                                                                                                                                                                                     |

| CQA Requirement                      | Standard, Method, and Minimum Frequency                                                                                                                                                                                                           |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Subgrade acceptance</b>           | Geotechnical engineer sign-off before HDPE liner placement: confirm subgrade compaction (95% Modified AASHTO for PCDs; 93% for treatment cells); confirm no sharp objects; confirm G7 sand bedding is properly placed. Written sign-off required. |
| <b>Anchor trench compaction</b>      | Compaction testing at minimum 1 test per 10 m of anchor trench length. Minimum 95% Modified AASHTO. Results in CQA register.                                                                                                                      |
| <b>As-built liner layout drawing</b> | As-built drawing showing panel layout, seam locations, anchor trench positions, and all patch repairs. Signed by Principal Civil Engineer.                                                                                                        |
| <b>CQA Final Report</b>              | All testing results compiled in the CQA register. Non-compliant areas repaired and re-tested. Final CQA report signed by engineer and submitted with as-built drawings to DWS.                                                                    |

## 9.2 As-Built Drawings and Engineer's Certificate

Upon completion of all construction activities, the following documentation must be submitted to DWS as confirmation of construction compliance:

- As-built drawings for all constructed works: signed by GFK (Pr.Eng. Civil; ECSA 202604247) with ECSA stamp. As-built drawings must reflect actual constructed dimensions, elevations, and GPS coordinates of all treatment cells, PCDs, channels, culverts, and the flood berm. Must be in A1 format, scale 1:2500, datum WGS84/LO29.
- Engineer's Certificate of Compliance (GN 704 Regulation 12): confirming all dams, PCDs, and residue deposits comply with GN 704. Must be submitted within 60 days of commissioning. Signed by Principal Civil Engineer.
- CQA Final Report: signed by Principal Civil Engineer. Filed with DWS as a project record.
- ECO Completion Certificate: confirming all EMPr and Method Statement conditions have been complied with during the construction phase. Signed by registered ECO.

## 10. REFERENCES AND SOURCE DOCUMENTS

- Bhekhani (Pty) Ltd (2023) *Ballengeich Colliery Preliminary Civil Design Report for AMD Passive Treatment Design*. Revision 00. February 2023.
- DWS (1999) *Department of Water and Sanitation (previously DWAF). Government Notice 704 (GN 704): Regulations on the Use of Water for Mining and Related Activities*. Government Gazette 20118. June 1999.
- DWS (2017) *Government Notice 267 (GN 267): Regulations for Water Use Licence Applications*. Government Gazette 40712. March 2017.
- DWS (2022) *Schedule: Proposed Water Resource Classes and Resource Quality Objectives for Thukela Catchments in the Pongola-Mtamvuna Water Management Area*. Government Notice 1873. 11 March 2022.
- DWS (2023) *Government Notice 4167 (GN 4167): National Water Act Licensing Regulations*. 8 December 2023.
- DWS (2024) *Water Use Licence Application Acknowledgement Letter*. Ref: WU33839. 17 December 2024. DWS KZN Regional Office.
- EWS (2025a) *Elemental Water Services (Pty) Ltd. Hydrogeology Assessment for the Proposed AMD Treatment at the Ballengeich Colliery*. Report No. EWS24-12\_GW. 22 April 2025.
- EWS (2025b) *Elemental Water Services (Pty) Ltd. Desktop Hydrogeology Assessment for the Proposed AMD Treatment at the Ballengeich Colliery*. 23 April 2025.
- EWS (2025c) *Elemental Water Services (Pty) Ltd. Hydrology Assessment for the Proposed AMD Treatment at the Ballengeich Colliery*. Report No. EWS24-12\_SW. April 2025.
- GFK (2026a) *GFK Consulting Engineers CC. Water and Stormwater Management Report for WULA Purposes — Ballengeich Mine*. Report No. G2025/06/338(1). Signed B.D. Muhl Pr.Eng. Civil (ECSA 202604247). 24 March 2026.
- GFK (2026b) *GFK Consulting Engineers CC. Master Layout Plan Rev 2 — Drawing G2025/06/338-100*. Signed B.D. Muhl Pr.Eng. Civil (ECSA 202604247). April 2026.
- MENCO (2024a) *M2 Environmental Connections (Pty) Ltd. GN 704 Audit and Application for Exemption from Regulations 4 and 5*. December 2024.
- MENCO (2024b) *M2 Environmental Connections (Pty) Ltd. Rehabilitation Plan and Environmental Management Programme (EMPr) for Ballengeich Colliery*. Report No. EMP/2024/086. November 2024.
- MENCO (2025a) *M2 Environmental Connections (Pty) Ltd. Integrated Water and Waste Management Plan (IWWMP) for Kangra Coal (Pty) Ltd: Ballengeich Colliery*. Report No. 2025/IWWMP/KANGRA\_BALLEN. January 2025 (updated March 2026).
- MENCO (2025b) *M2 Environmental Connections (Pty) Ltd. Wetland Delineation and Assessment for Kangra Coal: Ballengeich Colliery*. Report No. WET/KANGRA/03/25. March 2025.
- MENCO (2026a) *M2 Environmental Connections (Pty) Ltd. Water Use Licence Application Summary Report (WULAR) for Kangra Coal (Pty) Ltd: Ballengeich Colliery*. Ref: WU33839. June 2026.
- MENCO (2026b) *M2 Environmental Connections (Pty) Ltd. Contingency Plans for the Proposed Passive AMD Treatment System and Site Rehabilitation — Ballengeich Colliery*. June 2026.
- SANS 10409 *South African National Standard 10409: Geomembranes for Use in Landfills*. South African Bureau of Standards.
- ASTM D6693 *Standard Test Method for Determining Tensile Properties of Non-Reinforced Polyethylene and Non-Reinforced Flexible Polypropylene Geomembranes*. ASTM International.
- GRI-GM19 *Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes*. Geosynthetic Research Institute.
- NWA *National Water Act, 1998 (Act No. 36 of 1998). Sections 19, 20, 21(c), 21(i), 21(f), 40, and 151*. Republic of South Africa.

*NEMA (EMPr) National Environmental Management Act, 1998 (Act No. 107 of 1998). Environmental Management Programme (EMPr): EMP/2024/086. November 2024.*

*Mine Health and Safety Act Mine Health and Safety Act, 1996 (Act No. 29 of 1996). Republic of South Africa.*