GA Environment

REHABILITATION PLAN

FOR THE PROPOSED SLURRY AND RETURN WATER PIPELINE FROM TGT 2 TAILINGS STORAGE FACILITY (TSF) TO FREDDIE'S 9 TSF, ALLANRIDGE (WELKOM) IN THE FREE STATE PROVINCE

DMRE REF: FS30/5/1/2/226MR

NOVEMBER 2022

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PROJECT INFORMATION

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Environmental Assessment Practitioner:	GA Environment (Pty) Ltd.
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SIGNING OF THE ORIGINAL DOCUMENT

Original	Prepared by	Reviewed by	Approved by
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Version 0	Signature:	Signature:	Signature:

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1 INTRODUCTION

GA Environment (Pty) Ltd, has been appointed by Harmony Gold Mining Company (Harmony) to undertake a Basic Assessment and a Water Use Licence Applications process for the proposed construction a new slurry and return water pipelines from Target Tailings Storage Facility (TSF) to Freddie's 9 Tailings Storage Facility (TSF). The Free State Operations have been mining the Vaal Reefs since approximately 1950. The Target Operations consist of Target Plant and the three shafts (Target 1, 2 and 3 Shafts). The associated supporting infrastructure includes the metallurgical plant which processes gold, the tailings storage facilities (TSF), waste rock dumps and the sewage treatment plant. Target 1 Shaft operations are at the depths of the underground workings of approximately 2500m below ground level. Operations at Target 2 Shaft ceased during 2009 and the underground workings have been flooded.

Infrastructure at this shaft has not been demolished as the old hostels are currently used to store core samples. Operations at Target 3 Shaft ceased in September 2014 and the shaft is currently under care and maintenance. This shaft continues to pump water from the underground workings to maintain safe operations at Target 1 Shaft, as these two shafts are connected via their underground workings. The Target Metallurgical Plant is situated south of Target 1 Shaft, where reef material from Target 1 Shaft and waste rock from the waste rock dumps at the shafts is processed. Harmony is proposing to construct a new slurry and return water pipelines from Target TSF to Freddie's 9 TSF to deposit tailings at the Freddie's 9 TSF as Target 1 and 2 TSF is reaching their final design height and are unserviceable.

The National Environmental Management Act 107 of 1998, as amended (NEMA) and the Environmental Impact Assessment Regulations 2014 (as amended) requires that listed activities follow an Environmental Authorisation (EA) process from the competent authority prior to commencing with the activity. Since the proposed pipelines will be transporting mining slurry and return water and deposit tailing and directly relate to the extraction and the primary processing of a mineral, the Department of Mineral Resources & Energy will be the competent authority for the environmental authorisation as stipulated in the Mineral and Petroleum Resources Development Act, Act 28 of 2000. Based on the triggered listed activities as indicated in the basic assessment report, a basic assessment process has been undertaken to determine any potential environmental impact that will emanate during the construction of the pipeline.

It must be noted that the Basic Assessment (BA) process was also triggered due to four listed activities that were applicable as the proposed construction of the pipeline will result in the clearance of indigenous vegetation and development of infrastructure within 32m and 100 metres of wetlands or watercourses. All construction activities associated with the development of the pipeline has a potential to cause erosion problems. This document will provide the Contractor, the Developer, and the ECO with guidelines on how to plan revegetation and rehabilitation work and assists in understanding the concepts behind successful rehabilitation. This plan must be implemented in conjunction with the approved EMPr as well as other management plans prepared for this proposed development. The exact details of the rehabilitation plan will depend on the extent of rehabilitation that will have to be undertaken, available funding, and the desired end state of the vegetation after rehabilitation.

1.1 Site location

The existing slurry and return water pipelines are located in the Free State Province within the Lejweleputswa District Municipality (LDM), approximately 7 km north of Odendaalsrus, 3 km south of Allanridge and 26 km east of Wesselsbron. The proposed development site is located in Allanridge west of the Nyakallong Township. The proposed return water pipeline will be 8.3km long and the proposed slurry pipeline will be about 5.6km in length.

The proposed new pipeline starts from Freddie's 9 Dam at coordinates 27°50'31.66"S and 26°40'32.30" and heads northwest and to the immediate northeast of TGT 2 TSF. The end coordinates where the TGT 2 TSF ends are 27°47'32.23"S and 26°38'20.25"E (Figure 1 and 2). From this point, the proposed pipeline will be connected to the existing pipelines towards the Target Plant. The two pipelines will run parallel to each other along the proposed route. One of the pipelines will transport tailings from the Target Gold Plant to the existing Freddie's 9 TSF and the other will transport return water from Freddie's return water dam (RWD).

The proposed slurry pipeline of 5.6km will have a diameter of 300mm and an average flow rate of 93 ℓ/s and starts from TGT 2 TSF to the Freddie's 9 TSF. The proposed return water pipeline (8.3km) starts from Freddie's 9 Return Water Dam (RWD) and heads northwest to immediately northeast of TGT 2 TSF where it is connected to the existing pipelines towards the Target Plant. The return water pipe will have a diameter of 200mm and an average flow rate of 40 litres per second (ℓ/s). The two pipelines run parallel to each other along the proposed route as illustrated in Figure 1. One pipeline will transport return water from Freddie's return water dam (RWD) and the other pipeline tailings from Target Plant to Freddies TSF. The site locality is indicated in **Figure 1**.

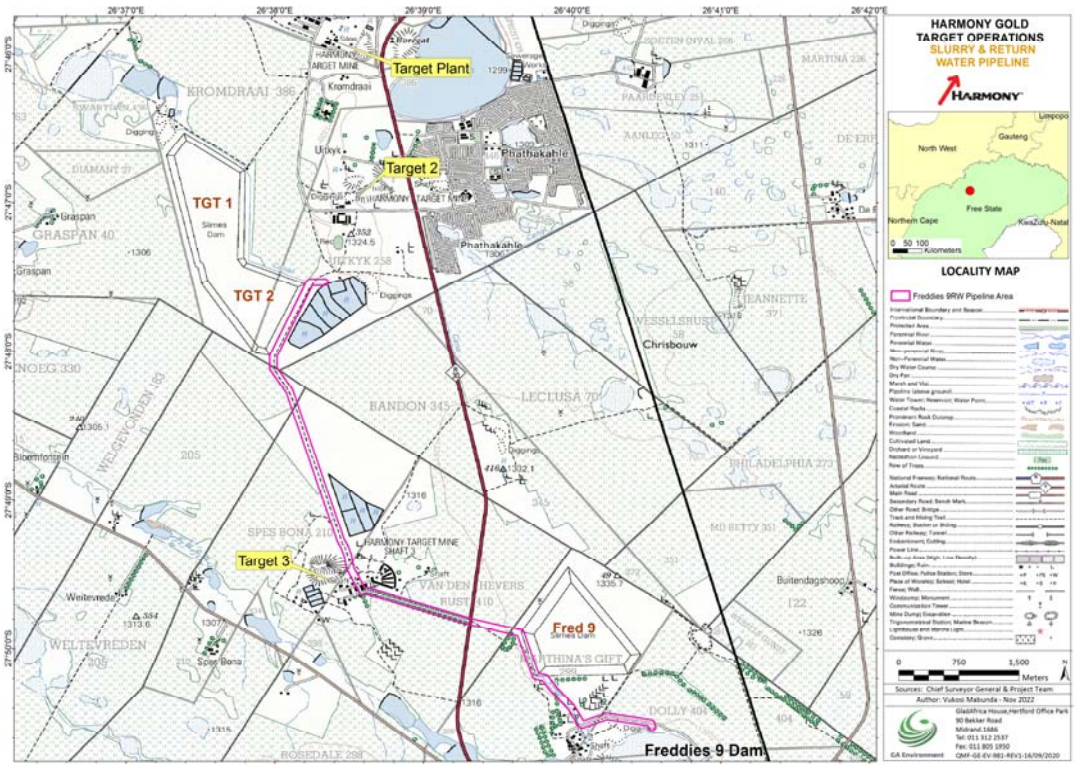

Figure 1: Locality Map of the proposed pipelines

1.2 Definition of Environmental rehabilitation

Rehabilitation does not necessarily refer to the restoration of vegetation to its natural state but to a specific predetermined status that is as close as possible to the original state or suitable for the area to mainly ensure the restoration of ecosystem functions as far as possible and reduce the likelihood of erosion and provide necessary (Hoare, 2014). Information on the biophysical environment and the ecological species that are likely to be impacted in the project site is detailed in the Terrestrial Biodiversity Report attached to the Basic Assessment report**.**

As indicated in the Terrestrial Biodiversity Assessment Report undertaken by the Biodiversity Company (2022), the project area is situated within the Grassland Biome. In terms of vegetation structural composition, grasslands are characteristically dominated by grasses of the *Poaceae* Family (Mucina & Rutherford, 2006). The Grassland Biome in South Africa occurs mainly on the Highveld, the inland areas of the eastern seaboard, the mountainous areas of KwaZulu-Natal and the central parts of the Eastern Cape. The topography is mainly flat to rolling, but also includes mountainous regions and the Escarpment (Mucina & Rutherford, 2006). Major macroclimatic traits that characterize the Grassland Biome include:

- Summer to strong summer rainfall and winter drought; and
- Frost is common, and fog is found on the upper slopes of the Great Escarpment and seaward scarps (Mucina & Rutherford, 2006).

On a fine-scale vegetation type, the project area is located within the Vaal-Vet Sandy Grassland. The Vaal-Vet Sandy Grassland vegetation type is restricted to the North-West and Free State Provinces, where it extends south of Lichtenburg and Ventersdorp, stretching southwards to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort area north of Bloemfontein. The ecosystem is characterised by a plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands are present with an abundant karroid element, where the dominance of *Themeda triandra* is an important feature. (Mucina & Rutherford, 2006). According to Mucina and Rutherford (2006) this vegetation type is classified as 'Endangered', with the national target for conservation protection being 24%, only very small parts are statutorily conserved in the Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. More than 63% has been transformed for cultivation (ploughed for commercial crops) and the rest is under strong grazing pressure from cattle and sheep.

Three habitat units are delineated for the project area: Transformed, Modified Sandy Grassland, and Seep Wetland. The Transformed habitat unit includes all areas that maintain very little to no functional vegetation, such as portions of cultivated land and areas utilised for roads and mining activity. Modified Sandy Grassland was found to occur in largely separated sections along the pipeline routes and is characterised by overgrazed and disturbed fields dominated by pioneer species. These portions do however maintain a level of ecosystem functionality, particularly towards the south of the pipeline routes around Freddies Dam, and they will be supportive of regular fauna activity. The seep wetland unit includes the three artificial wetland systems which intercept with the specified pipeline routes, as delineated and defined by the project freshwater assessment report (TBC, 2022). Although these systems were listed as 'Seriously Modified' by the wetland report, they maintain an important level of functionality which supports the local fauna species and encourages regular foraging in the area.

The terrestrial biodiversity theme sensitivity as indicated in the screening report (compiled by the National Web based Environmental Screening Tool) was derived to be 'Very High'. The completion of the terrestrial biodiversity desktop and field studies disputes the 'Very High' sensitivity presented by the screening tool report, as relevant to the proposed footprint areas. As discussed above, the proposed footprint area is largely degraded and as such it is assigned an overall sensitivity rating of 'Very Low' to 'Low'. The screening report classified the animal species theme sensitivity as being of a 'High' sensitivity, and the plant species theme as 'Low'. Following the field survey findings, both the animal and plant species themes should be classified as 'Low' sensitivity. This is due to the fact that the frequent occurrence of sensitive SCC is considered unlikely within the local habitats as they maintain only a low level of functionality.

It must be noted that no portion of the pipeline routes represents intact Vaal-Vet Sandy Grassland vegetation, and the areas listed as Irreplaceable CBAs by the provincial conservation plan exist in a modified state due to the heavy grazing of the areas, the invasion of alien species, and the additional related effects of nearby agricultural and mining activity. No SCC flora or fauna were recorded during the field survey; however, it is noted that certain SCC fauna may move through the area infrequently due to the abundance of wetland systems in the region. Summary of habitat types delineated within field assessment area of the project area is provided in **Table 1**.

Table 1: Summary of habitat types delineated within field assessment area (TBC, 2022)

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
Transformed	Medium	Low	Low	High	Very Low
Modified Sandy Grassland	Medium	Medium	Medium	High	Low
Seep Wetland (Artificial)	Medium	Medium	Medium	Medium	Medium

Important plant taxa are those species that have a high abundance, a frequent occurrence, or are prominent in the landscape within a particular vegetation type (Mucina & Rutherford, 2006). The following species are considered important in the Vaal-Vet Sandy Grassland vegetation type (d = dominant):

Graminoids: *Anthephora pubescens (d), Aristida congesta (d), Chloris virgata (d), Cymbopogon caesius (d), Cynodon dactylon (d), Digitaria argyrograpta (d), Elionurus muticus (d), Eragrostis chloromelas (d), E. lehmanniana (d), E. plana (d), E. trichophora (d), Heteropogon contortus (d), Panicum gilvum (d), Setaria sphacelata (d), Themeda triandra (d), Tragus berteronianus (d), Brachiaria serrata, Cymbopogon pospischilii, Digitaria eriantha, Eragrostis curvula, E. obtusa, E. superba, Panicum coloratum, Pogonarthria squarrosa, Trichoneura grandiglumis, Triraphis andropogonoides.*

Herbs: *Stachys spathulata (d), Barleria macrostegia, Berkheya onopordifolia var. onopordifolia, Chamaesyce inaequilatera, Geigeria aspera var. aspera, Helichrysum caespititium, Hermannia depressa, Hibiscus pusillus, Monsonia burkeana, Rhynchosia adenodes, Selago densiflora, Vernonia oligocephala.*

Geophytic Herbs: *Bulbine narcissifolia, Ledebouria marginata.*

Succulent Herb: *Tripteris aghillana var. integrifolia.*

Low Shrubs: *Felicia muricata (d), Pentzia globosa (d), Anthospermum rigidum subsp. pumilum, Helichrysum dregeanum, H. paronychioides, Ziziphus zeyheriana.*

Endemic Taxon: Herb: *Lessertia phillipsiana.*

Based on the Plants of Southern Africa (BODATSA-POSA, 2019) database, over 620 plant species have the potential to occur within the pipeline routes and its surroundings. Of these species, none are listed as being SCC.

1.3 Scope and Objectives of the Rehabilitation Plan

Since the proposed development will require the removal of indigenous vegetation, it is critical that rehabilitation plan be developed, and restoration must be undertaken as soon as possible after completion of construction activities. It is anticipated that this plan will assist in mitigating the impacts caused by the construction activities and will attempt to restore the disturbed site back to a satisfactory standard. This report is intended to serve the following purposes:

- Maintain and minimise impacts to the ecosystem within the study area;
- Addresses the need to mitigate all impacts leading to disturbed fauna and flora, loss of species potential, disturbed soil surfaces, and generally bare soils prone to erosion;
- Provide a detailed roles and responsibilities involved in ensuring effective implementation of the rehabilitation programme;
- Re-establish vegetation cover with suitable indigenous plant species;
- Prevent adverse environmental impacts that may arise from areas that are not rehabilitated;
- Present a rehabilitation implementation strategy;
- Describe proposed rehabilitation methods;
- Present a rehabilitation and monitoring programme;
- Support the Environmental Management Programme for the project; and
- Guide Harmony to make Financial Provisions for the rehabilitation for the site, this document must be included in the Contractor ‘s tender document.

1.4 Details of Environmental Assessment Practitioner

This rehabilitation plan was compiled by:

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This Rehabilitation Plan was prepared by **Mr. Vukosi Mabunda** a Registered Environmental Assessment Practitioner (EAP) employed by GA Environment. Mr. Vukosi Mabunda is a current Geographic Information Systems (GIS) Specialist and Environmental Assessment Practitioner with 4 years’ working experience. Vukosi is a Registered Environmental Assessment Practitioner with the Environmental Assessment Practitioners Association of South Africa (EAPASA). He is one of the few dual registered professionals with SACNASP as a Professional Geospatial Scientist and Professional Environmental Scientist. Vukosi has dual professional background in Geographic and Environmental Sciences with a Master of Science Degree in Geography.

1.5 Key role players and responsibility matrix

In order for the rehabilitation plan to be successfully implemented, all the role players involved in the project need to co-operate. As a result, each role player must clearly understand the roles and responsibility in execution of the rehabilitation plan.

Key role players for the rehabilitation phase and the post rehabilitation monitoring phases are as follows:

- Developer/Project Manager;
- Engineer;
- Contractor;
- Environmental Control Officer; and
- Environmental Assessment Practitioner.

The functions and responsibilities of each of these role players are outlined in **Table 2**.

Table 2: Functions and responsibilities of the project team for the implementation of the Rehabilitation Plan

ROLE	PHASE OF INVOLVEMENT	RESPONSIBILITIES
Developer and Project Manager ***Harmony***	Rehabilitation and post rehabilitation Monitoring	• Appointing project team; and • Ensuring that the Rehabilitation Plan, is circulated to the project team. • Ensuring overall compliance with the rehabilitation plan • Ensure that environmental control activities are undertaken to restore environmental conditions as outlined in the rehabilitation plan *The Project manager has overall responsibility for managing the project, Contractors, and Consultants and for ensuring that the environmental management requirements are met. All decisions regarding environmental procedures must be approved by the PM. The PM has the authority to stop any construction activity in contravention of the Rehabilitation Plan in accordance with an agreed* warning procedure.
Contractor *To be appointed*	Rehabilitation	• Undertakes Rehabilitation Plan; and • Addresses all non-compliances raised by the Consulting Engineer or Environmental Control Officer
Environmental Control Officer *To be appointed*	Rehabilitation	• Ensuring that the Contractor undertakes all rehabilitation activities in line with the Rehabilitation Plan • Assess environmental performance of the rehabilitation plan i.e. auditing as required by Competent Authority
ENGINEER *To be appointed*		• The Engineer is contracted by the developer to design and specify the project engineering aspects. Generally, the engineer runs the works contract and oversee the overall implementation of the project as well as the compliance of the EMPr and incorporate any environmental consideration recommended in the EMPr and this rehabilitation plan into the design.

ROLE	PHASE OF INVOLVEMENT	RESPONSIBILITIES
ENVIRONMENTAL ASSESSMENT PRACTITIONER *GA Environment (Appointed by Harmony Gold Mining Company Limited)*		• The definition of an Environmental Assessment Practitioner (EAP) in Section 1 of NEMA is "the individual responsible for the planning, management and coordination of environmental impact assessments, strategic environmental assessments, environmental management plans or any other appropriate environmental instruments introduced through regulations". • The Environmental Assessment Practitioner is generally responsible for undertaking environmental processes necessary to authorise the project activities proposed. The Developer can also appoint the Environmental Assessment Practitioner to act an Environmental Control Officer during the post-construction or rehabilitation phase of the project to ensure the environment is remediated as far as possible.

2 REHABILITATION IMPLEMENTATION STRATEGY

For effective rehabilitation purposes, it is crucial that a strategy must be implemented by the Contractor in consultation with the ECO. *It must be highlighted that rehabilitation on site must as far as possible be progressive and not wait until the end of the overall construction activities.*

2.1 Principles to be ensure successful rehabilitation with the use of vegetation

The overall objectives for the re-vegetation of disturbed areas include the prevent erosion on areas exposed during construction, restoration of all disturbed areas in order to allow for the reestablishment of the ecosystem processes and restoration of biodiversity of the as far as possible. In order to ensure successful rehabilitation of vegetation, the following must be adhered to:

- It will also be important to review the recommendation regarding the management of vegetation on site highlighted in the BAR, Terrestrial Biodiversity Assessment report and the EMPr compiled during the Basic Assessment process;
- Where necessary, a Horticulturist must compile a landscape design plan for areas that have been affected by removal vegetation or change of landscape and as a result require restoration;
- The ECO may also undertake this task should they have a background in Landscape Architecture, Horticulture or Botany;
- Only indigenous plant species must be used for rehabilitation. Under no circumstances should alien species may be used;
- Ensure that all site personnel are educated about the importance of rehabilitation and maintenance of rehabilitated areas.

The steps below must guide the rehabilitation. Each of these will be discussed further below:

1. Site Preplanning and Preparation
2. Design of the Rehabilitation Plan and required interventions
3. Design an Implementable Rehabilitation action plan
4. Implementation of the Rehabilitation Plan
5. Rehabilitate all affected areas with suitable plant species
6. Demarcate rehabilitated areas that must be rehabilitated and ensure maintenance of the fence throughout the rehabilitation phase
7. Ensure that photographic records of all sites intended for rehabilitation are kept during rehabilitation and post rehabilitation phases. (i.e.; monitoring).
8. Ensure ongoing monitoring of rehabilitated areas

2.1.1 Site Preplanning and Preparation

It is of critical importance that the Contractor understand the site in order to implement successful rehabilitation. The first step in compiling and implementing a successful rehabilitation and re-vegetation plan is to understand the site in question and be aware of the interactions between the biophysical environment and infrastructure on site. It will also be important to review the Terrestrial Biodiversity report and the EMPr compiled during the Basic Assessment process. In order to achieve this, a map should be created of the development area clearly showing the following.

- Areas of natural and indigenous vegetation.

- Areas that will be cleared for construction purposes and may be invaded by invasives.
- Infrastructure within the development area.
- Roads within the development area.
- Indigenous vegetation transformed through land use activities.

2.1.2 Design of the Rehabilitation Plan and required interventions

The Contractor in consultation with Harmony will have to decide what intervention will be necessary, desirable, and feasible to enable the development to occur as well as the long-term maintenance of infrastructure. For each area, an operational guideline must be compiled and may cover the following:

- What will happen in each area (no-go, some rehabilitation or extensive rehabilitation)?
- What needs to be mitigated (this includes stormwater and erosion management)?
- Which areas need priority intervention/mitigation?
- How will this mitigation/intervention be undertaken (method statements)?
- What is the realistic and desirable end state for each area following rehabilitation?

2.1.3 Design an Implementable Rehabilitation action plan

Rehabilitation efforts typically aim at improving ecosystem function that consists of a series of processes, which can be evaluated against a desired outcome or referenced state of the environment. Attainable goals of rehabilitation should be possible and viable to cover at least the following:

- Stabilisation of soils on site.
- Stabilisation of previously disturbed sensitive area on site.
- Storm water reduction from constructed infrastructure.
- Clearing of invasive plants.

The degree of rehabilitation, which takes place on site, should be determined according to available project funding, personnel and project requirements. It is important to note that the rehabilitation measures should at least result in an improvement to the current conditions on site and the condition of the environment should never be worse than prior to project implementation.

2.1.4 Implementation of the Rehabilitation Plan

The plan must include the specific management actions required to ensure successful rehabilitation of the site. The Plan must also make provision for the rehabilitation of all areas of the site and the short- and long-term maintenance thereof. This plan must include the following actions, which should be updated based on site conditions and construction progress at the time:

- Bare soil should be kept to a minimum.
- Exposed areas on the site are particularly prone to wind erosion and, thus, precautions should be taken to avoid excessive disturbance. Any cleared areas within the development footprint that are no longer or not required for construction or operational activities should be re-seeded with locally-sourced seed of suitable species (e.g.; refer to revegetation options below). Brush-packing with locally cleared indigenous vegetation will allow local plant seed to enter the topsoil and allow the re-establishment/re-generation of vegetation on these bare areas, as well as limit erosion.

- The edges of hardened surfaces must be re-seeded with locally-sourced seed of suitable species to encourage vegetation re-generation and to limit erosion.
- Storage of materials should not be within the 1:100 floodline, watercourses or associated buffer areas.
- In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water and Sanitation (DWS) must be informed immediately.
- Regular monitoring for erosion must be conducted across the site (particularly near hardened surfaces and infrastructure) to ensure that no erosion problems are occurring. Rectification of erosion problems should include brush-packing and re-vegetation as far as possible.
- Regular monitoring must be undertaken to ensure that alien plants do not establish or increase in numbers on site as a result of construction and operational disturbances.
- Final levels of all disturbed areas are, where feasible, to be consistent with the natural topography of the area.
- The area from which this material is taken must be approved by the ECO and must not result in environmental degradation.
- Only in exceptional circumstances will sourcing of plant material from further afield or grass seed mixes be considered and approved by the ECO.
- Reinstatement and rehabilitation are required for all areas disturbed by the project. This includes the entire development site, access roads (temporary and permanent), servitudes for any services that may have been established.
- The Contractor shall reinstate and rehabilitate all disturbed areas outside the demarcated working area at his own cost and to the satisfaction of the ECO. The cost of rehabilitation must be included in the Contractor tender document.
- All areas disturbed by contract activities are to be revegetated to the satisfaction of the ECO.
- Methods of vegetation removal and re-establishment, where required, shall be specified by the ECO and Method Statements be provided in terms of:
    - Removal and storage of vegetation.
    - Source of vegetative material.
    - Ground preparation.
    - Weed removal.
    - Irrigation.
    - Planting times.
- Fertilisers and compost may not be used unless agreed to by the ECO.
- All sites disturbed by construction activities shall be monitored for colonisation by invasive alien plant species as per the EMPr.
- The ECO shall identify those plants that require removal during both the construction and maintenance period, for the contractor's action.
- The ECO shall provide advice as to effective methods of removal and control of alien plant species. Existing alien plants are to be removed and their spread prevented.

2.1.5 Rehabilitation with suitable plant species

The main aim of re-vegetation of the disturbed area is to restore the area to the indigenous Vaal-Vet Sandy Grassland vegetation status. It is advised to restore the study area as far as possible to a stable and sustainable ecosystem. Vegetation is useful in rehabilitation as it binds and stabilises soil and slows the

velocity of stormwater water. This reduces soil erosion and in turn prevents the deposition of sediment in the nearby watercourse (wetlands). Despite this however, measures such as Erosion Control Blankets must be used to provide immediate protection to soil after the soil has been left bare. It is crucial that all areas from which plants have been removed must be revegetated with indigenous plant species endemic to the area. Alien plant species must not be utilised. Once the final topsoil layer has been placed on site, suitable vegetation must be replanted. Each of these are further discussed below.

a) Grasses

The rehabilitated areas need to be stabilised with vegetation, mainly grasses at first. It is crucial that all grassing be undertaken by a suitably qualified Contractor, making use of the appropriate equipment. Where seed is used in grassing, all seed supplied should be labelled in accordance with the Government Seed Act (Act No. 20 of 1961). One of the ways in which grassing can be undertaken is through hydroseeding or sodding. Each of these will be discussed in the next sections. It is expected that the Contractor on behalf of Harmony will use the most cost and time effective method for the revegetation of areas cleared of vegetation. A minimum grass cover of 80% is required. Grassing can be undertaken by either **hydroseeding** or **sodding.** Seed mixes must be undertaken in consultation with a botanist or rehabilitation specialist qualified in the fields discussed below.

b) Hydroseeding

Hydroseeding entails adding a specified seed mix to a slurry containing water, seed, fertilizer and other approved materials to enhance plant growth potential. This mixture is applied by means of a spraying device onto the prepared ground areas to be seeded. Hydroseeding is a quick and cost-effective method of seeding and is especially suited to slopes. It provides homogenous cover which is key in rehabilitation efforts and also prevents possible erosion. The following must however be borne in mind for hydroseeding:

- The soil should be loose and uniformly wet to a specified depth before any seeding commences.
- Add the specified seed mix and necessary fertiliser to the required amount of water and apply using an approved hydro-seeding machine.
- Unless otherwise specified, the rate of application of the slurry will not be less than 30 cubic metres per hectare and will be applied in such a manner as to ensure even distribution of seed and fertiliser throughout.
- Additional ingredients to be added to the slurry may be specified.
- In certain cases, the specification may require that mulch be applied by hand to the area to be hydro-seeded, prior to hydro-seeding.
- If possible, keep the seedbed moist after hydro-seeding, to ensure good germination.
- Irrigate as required until the grass is able to survive independently (i.e. depending on the rainfall).

c) Sodding

Sodding is defined as the laying of grass sods. Sodding may be done at any time of the year but seeding must be done during the summer when the germination rate is better. The following is key for sodding:

- The soil should be uniformly wet to a depth of at least 150 mm before planting of grass sods;
- Protect sods against drying out: keep these moist from the time of harvesting until final placement;
- Rake or spike the area to give a loose surface to a depth of 100 mm;
- Lay the first row of sods in a straight line, starting at the bottom of a slope, where possible;
- Place the next row of sods in the same way, tightly against the bottom row with the joints staggered, until the full area is covered with sods;

- Tightly butt sods together, taking care not to stretch or overlap sods;
- Where a good fit cannot be obtained, the intervening spaces may be filled with parts of sods or topsoil;
- On steep slopes the sods must be secured using timber stakes of at least 300 mm in length;
- After planting, water sods to prevent drying out; and
- Irrigate as required until the grass is able to survive independently (i.e. depending on the rainfall).
- Ensure 100% cover for sodding.

2.1.6 Grassing mix and Herbs/Forbs for vegetative cover

The vegetative cover must comprise grasses that are indigenous to the site. According to the Terrestrial Biodiversity Compliance Statement (Biodiversity Company, 2022), the vegetation that occurs within the study area is indicated in **Table3**. The Graminoids that naturally grow in this area as per Mucina and Rutherford (2006) which can form part of the grassing mix include the following:

Table 3: Natural growing Graminoids in the area

Vaal-Vet Sandy Grassland (d = dominant)		
Anthephora pubescens (d)	*Heteropogon contortus (d)*	*Panicum coloratum*
Aristida congesta (d),	*Panicum gilvum (d)*	*Pogonarthria squarrosa*
Chloris virgata (d),	*Setaria sphacelata (d)*	*Trichoneura grandiglumis*
Cymbopogon caesius (d)	*Themeda triandra (d)*	*Triraphis andropogonoides*
Cynodon dactylon (d)	*Tragus berteronianus (d)*	*E. obtusa*
Digitaria argyrograpta (d),	*Brachiaria serrata*	*E. superba*
Elionurus muticus (d),	*Cymbopogon pospischilii*	*E. plana (d)*
Eragrostis chloromelas (d)	*Digitaria eriantha*	*E. trichophora (d)*
E. lehmanniana (d)	*Eragrostis curvula*	

Local nurseries must be consulted to check the availability of seeds, sods or cuttings for any of the above. Where these are not available, equivalent and suitable indigenous species can be used subject to the approval of a reputable nursery and/or Contractor or Hydroseeding Company. Instructions for application must also be checked with these persons prior to the commencement of grassing.

2.2 Maintenance of rehabilitation

The general conditions for the maintenance of rehabilitation are as follows.

- Control access to rehabilitated areas;
- Allow for a maintenance period of at least one year following completion of rehabilitation;
- Re-vegetation must match the vegetation type which previously existed;
- In the case of sodding, acceptable cover entails that 100% cover is attained by the specified vegetation;
- Bare areas that show no specified vegetation growth after three months of the Rehabilitation Work are to be spread with additional topsoil, ripped to a depth of 100 mm and re-planted, re-sodded, re-hand sown or re-hydroseeded; and
- The mitigation measures put in place to limit or negate the construction related impacts on the watercourse must be monitored. Where these mitigation measures are not sufficient or breached, immediate corrective action should be taken.

2.2.1 Access Control

Areas under rehabilitation must be cordoned off as no-go areas to prevent vehicular, pedestrian and animal access. Danger tape, steel droppers, fences or other or suitable measures must be used as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access. All site employees must be notified of the importance of rehabilitation and the need to avoid unauthorised entry into rehabilitated areas.

2.2.2 Maintain photographic records

This is important to indicate the progress of rehabilitation. Photographs must be taken immediately prior to the undertaking of rehabilitation as well as weekly until vegetation has become fully established.

2.2.3 Erosion control

Erosion is one of the major sources of damage to rehabilitated areas. Erosion on can be caused by detachment and movement of soil particles due to water, wind as well as other factors such as uncontrolled movement in rehabilitated areas. Specification for protection of the site from erosion may include but not limited to the following:

- Complete vegetative cover; and
- Selection of non-erodible and non-dispersive topsoil to avoid erosion.

2.2.4 Post Rehabilitation Monitoring

A post rehabilitation monitoring plan is used to ensure that critical aspects of rehabilitation are monitored. These aspects may include but are not limited to those listed in **Table 4.**

Table 4: Specifications for monitoring

Environmental Aspect	Description	Frequency and record keeping method
Re-establishment of plants /Biodiversity of Monitoring	Biodiversity assessments should be undertaken by a qualified ecologist / botanist to monitor the rehabilitation progress with regards to flora. This must be undertaken where plants were not successfully established	• Annually
Soil erosion	Monitoring of the site to ensure that topsoil is not eroded especially on the slopes of the capped cells and in other vulnerable areas. Identification of possible areas of poor vegetation cover which might lead to erosion. Any evidence of erosion should be addressed.	• Weekly inspection for the first 2-3 months after establishment of vegetation • Photographic record
Alien vegetation	Alien vegetation must be eradicated from the site	• Monthly inspection • Photographic record
Access control	Cordoned off areas should remain intact and the site must not be accessed by unauthorized persons.	• Monthly inspection • Photographic record

2.3 Monitoring and Auditing

Throughout the lifecycle of the development, regular monitoring and adaptive management must be in place to detect any impacts to the environment caused by the proposed development and to remedy these as soon as detected. During the construction phase, the ECO and contractor will be responsible for initiating and maintaining a suitable monitoring system. Once the development is operational, the project

proponent will have to identify a suitable entity that will be able to take over and maintain the monitoring cycle and initiate adaptive management as soon as it is required. Monitoring personnel must be adequately trained in identifying both the impacts and causes of the impacts observed on site.

In order to monitor the rehabilitation of the affected areas, Harmony must ensure that adequate auditing is undertaken to sure that the rehabilitation objectives are met. A checklist relevant to the aspects that will be monitored must be created and used during the audit. Furthermore, photographs must be taken to indicate site conditions. In order to record the findings of the audits, monthly reports with photographic records must be compiled. The reports must indicate the following minimum information:

- Date/s of audit;
- Name of auditor;
- Areas audited;
- Areas of concern and suggested corrective measures accompanied by timeframes;
- Feedback on previous requests for the implementation of corrective measures;

3 CONCLUSIONS AND RECOMMENDATIONS

Rehabilitation of disturbed areas is crucial for environmental protection and to address or prevent erosion. The revegetation for all affected areas from which vegetation will be cleared to allow for the proposed development of the pipelines must be guided by the following key requirements:

- The Rehabilitation Plan must be adhered to and must be read along with all conditions of the Environmental Authorisation as well as the Environmental Management Programme;
- The rehabilitated areas site must be demarcated to prevent disturbances to the rehabilitation as this can compromise the rehabilitation process;
- Ongoing monitoring and maintenance of rehabilitated areas must be undertaken as per the timeframes specified in this report;
- If the plants have not established and the 80% is not achieved within the specified maintenance period, maintenance of these areas shall continue until at least 80% cover is achieved (excluding alien plant species);
- Additional seeding or planting may be necessary to achieve 80% cover;
- Any plants that die, during the maintenance period, shall be replaced by the contractor (at the contractor's cost);
- Succession of natural plant species should be encouraged on site;
- The pipeline should be regularly inspected (quarterly) for any signs of failure, damage or leaks. Adequate maintenance measures need to be implemented upon finding pipeline issues and failures;
- Monitoring of rehabilitation success and follow-up adaptive management, together with clearing of emerging invasives shall be carried out during the operational phase of the proposed development; and
- A detailed cost breakdown for the proposed activities must be undertaken prior to the commencement of the activities.

4 REFERENCES

1) Hoare, D. (2014). *Vegetation Rehabilitation Plan Longyuan Mulilo Maanhaarberg* Wind Energy Facility, De Aar, Northern Cape.

2) Mucina, L., and Rutherford, M. C. 2006. *The vegetation of South Africa, Lesotho and Swaziland. South Johannesburg.* South African National Biodiversity Institute, Pretoria.

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APPENDIX 1: VEGETATION TYPES

a) Vaal-Vet Sandy Grassland (Gh10)

VT 50 Dry *Cymbopogon–Themeda* Veld (47%), VT 48 *Cymbopogon–Themeda* Veld (sandy) (24%) (Acocks 1953). LR 37 Dry Sandy Highveld Grassland (74%) (Low & Rebelo 1996).

Distribution North-West and Free State Provinces: South of Lichtenburg and Ventersdorp, stretching southwards to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort area north of Bloemfontein. Altitude 1 220–1 560 m, generally 1 260–1 360 m.

Vegetation & Landscape Features Plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element. Dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally low cover of *T. triandra* and the associated increase in *Elionurus muticus*, *Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall.

Geology & Soils Aeolian and colluvial sand overlying sandstone, mudstone and shale of the Karoo Supergroup (mostly the Ecca Group) as well as older Ventersdorp Supergroup andesite and basement gneiss in the north. Soil forms are mostly Avalon, Westleigh and Clovelly. Dominant land type Bd, closely followed by Bc, Ae and Ba.

Climate Warm-temperate, summer-rainfall climate, with overall MAP of 530 mm. High summer temperatures. Severe frost (37 days per year on average) occurs in winter. See also climate diagram for Gh 12 Vaal-Vet Sandy Grassland (Figure 8.23).

Important Taxa Graminoids: *Anthephora pubescens* (d), *Aristida congesta* (d), *Chloris virgata* (d), *Cymbopogon caesius* (d), *Cynodon dactylon* (d), *Digitaria argyrograpta* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. plana* (d), *E. trichophora* (d), *Heteropogon contortus* (d), *Panicum gilvum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus berteronianus* (d), *Brachiaria serrata*, *Cymbopogon pospischilii*, *Digitaria eriantha*, *Eragrostis curvula*, *E. obtusa*, *E. superba*, *Panicum coloratum*, *Pogonarthria squarrosa*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*. Herbs: *Stachys spathulata* (d), *Barleria macrostegia*, *Berkheya onopordifolia* var. *onopordifolia*, *Chamaesyce inaequilatera*, *Geigeria aspera* var. *aspera*, *Helichrysum caespititium*, *Hermannia depressa*, *Hibiscus pusillus*, *Monsonia burkeana*, *Rhynchosia adenodes*, *Selago densiflora*, *Vernonia oligocephala*. Geophytic Herbs: *Bulbine narcissifolia*, *Ledebouria marginata*. Succulent Herb: *Tripteris aghillana* var. *integrifolia*. Low Shrubs: *Felicia muricata* (d), *Pentzia globosa* (d), *Anthospermum rigidum* subsp. *pumilum*, *Helichrysum dregeanum*, *H. paronychioides*, *Ziziphus zeyheriana*.

Endemic Taxon Herb: *Lessertia phillipsiana*.

Conservation Endangered. Target 24%. Only 0.3% statutorily conserved in the Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. More than 63% transformed for cultivation (ploughed for commercial crops) and the rest under strong grazing pressure from cattle and sheep. Erosion very low (85.3%) and low (11%).

References Louw (1951), Morris (1973, 1976), Bredenkamp & Bezuidenhout (1990), Kooij et al. (1990b, 1992), Bezuidenhout et al. (1994a).