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Mulilo De Aar 2 South Wind Energy Facility: Erosion Management Plan

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1. BACKGROUND

Mulilo De Aar 2 South (Pty) Ltd Wind Energy Facility (WEF) has identified a site ideal for the development of a Wind Energy Facilities, located south of the Regional Route 48 (R48) between De Aar and Philipstown, northeast of De Aar in the Northern Cape, South Africa, as indicated in Figure 1. The site extends across 9 farm portions located on a plateau.

Activities associated with the development of a Wind Energy Facility can impact negatively on existing drainage systems. By recognizing natural hydrological patterns, it is possible to develop an erosion management system in a manner that reduces any negative impacts. The greatest risks associated with inappropriate erosion management are increased erosion and potential flooding.

Because of the above risk, this Erosion Management Plan as well as the Stormwater Management Plan should be read and managed together.

Figure 1. Mulilo De Aar 2 South Wind Energy Facility locality map

2. PURPOSE AND SCOPE

An Erosion Management Plan provides early information on how the contractor will address the management and mitigation of significant impacts relating to soil erosion. The erosion management plan should be read in conjunction with, and complement the stormwater management plan. The objective of the plan is to provide:

- An outline of methods to monitor, manage and rehabilitate erosion in ensuring that all erosion caused by this development will get addressed and,
- A framework for erosion management, enabling the contractor to better identify areas where erosion can be accelerated from their action.

The geographical scope of this management plan is:

- The entire De Aar 2 South Wind Farm site as set out in the Environmental Impact Assessment.

3. LEGISLATION

This document will ensure that the developer meets the South African legislative requirements and the IFC standards with regards to monitoring, managing and rehabilitating soil erosion on the wind energy facility site. Reference the following documents:

- National Environmental Management Act No 107 of 1998; and
- Environmental Conservation Act No 73 of 1989;
- Conservation of Agricultural Resources Act No 43 of 1983;
- National Forestry Act No 84 of 1998;
- The Department of Water Affairs and Forestry (DWAF), February 2005. Environmental Best Practice Specifications: Construction Integrated Environmental Management Sub-Series No. IEMS 1.6. Third Edition. Pretoria.

4. AREAS WITH A HIGH SOIL ERODIBILITY POTENTIAL

The following areas are generally associated with high soil erodibility potential:

- All areas without vegetation cover;
- Excavated areas;
- Any areas where developments cause water flow to accelerate on a soil surface; and
- Steep areas;
- Areas where the soil has already been degraded;
- Areas with material of a low porosity;
- Areas which undergo overland flow of water;
- Areas close to water;
- Irrigated areas;
- Compacted areas;
- Rivers where construction activities influence water flow in any way;
- Drainage lines and;
- Coarsely gravelly covered surfaces.

5. MANAGEMENT ACTIVITIES TO AVOID EROSION

The ECO and the contractor must assess all:

5.1. Infrastructure and equipment placements and function to ensure that the infrastructure or equipment is not causing accelerating soil erosion on the site.

5.2. Construction activities to ensure that no erosion indicators are forming as a result of the construction activities.

5.1. MONITORING

5.1.1. GENERAL EROSION

The ECO must assess the site for erosion indicators in the monitoring process, which include:

- Bare soil;
- Desiccation cracks;
- Terracettes;
- Sheet erosion;
- Rill erosion (small erosion features with the same properties and characteristics as gullies);
- Hammocking (Soil build-up);
- Pedestalling (Exposing plant roots);
- Erosion pavements;
- Gullies; and
- Evidence of Dispersive soils.

The frequency at which these erosion indicators should be assessed should be:

- During Construction – monthly and/or after heavy rainfall events
- During Operation – once every 6 months, which can be downgraded to an annual check if no issues are identified during the first year of operation.

If any activities or placement of equipment cause pooling on the site, degrade the vegetation, result in removal of the surface or subsurface soil horizons, create compacted surfaces with steep gradients, or minimize runoff areas, the erosion potential on the site will increase.

If any erosion features start forming or are present as a result of the activities mentioned above theECO must:

- Assess the situation;
- Take photographs of the soil degradation;
- Determine the cause of the soil erosion;
- Inform and show the relevant contractors the soil degradation;
- Inform the contractor that rehabilitation must take place and that the contractor is to implement a rehabilitation method statement and management plan;
- Monitor that the contractor is taking action to stop the erosion and assist them where needed;
- Report and monitor the progress of the rehabilitation weekly and recorded all the findings in a site diary; and
- All actions with regards to the incidents must be recorded in a monthly compliance report which will be submitted to the Department of Forestry, Fisheries and the Environment.

The contractor/ developer (with the ECO's consultation) must:

- Select a system to treat the erosion;
- Design the treatment system;
- Implement the system;
- Monitor the area to see if the system functions like it should, if the system fails, the method mustbe adapted or adjusted to ensure the accelerated erosion is controlled; and
- Monitoring must continue until the area has been stabilized and rehabilitated.

5.1.2. STORMWATER MANAGEMENT

The ECO is responsible for monitoring the site and the activities to ensure that the natural flow ofwater is not blocked by:

- Excavated material stockpiles
- Import material stockpiles
- Roads, temporary or permanent;
- Material or equipment in laydown areas or anywhere else on site
- Cable trenches or any other excavations
- Substation platforms
- Turbine foundations and hardstands

If any erosion features are present as a result of the activities the ECO must:

- Assess the situation;
- Take photographs of the soil degradation;
- Determine the cause of the erosion;
- Inform the contractor that rehabilitation must take place and that the contractor is to implement a rehabilitation method statement and management plan;
- Monitor that the contractor is taking action to stop the erosion and assist them where needed;
- Monitor and document the rehabilitation process weekly; and
- All actions with regards to the incidents must be reported in the monthly compliance monitoringreport.

The contractor/ developer must (with the ECO's consultation):

- Select a system to treat the erosion;
- Design the treatment system;
- Implement the system;
- Monitor the area to ensure that the erosion has been addressed adequately; and
- Monitor the soil rehabilitation process until the area has been stabilized.

5.2. GENERAL EROSION MANAGEMENT

This section's discussion addresses the equipment required to remediate erosion, the precautionary measures which must be taken to avoid erosion and mitigation requirements for already degraded areas.

5.2.1. EQUIPMENT

The contractors may use the following (but not limited to) instruments to combat erosion when andwhere necessary:

- Reno mattresses;
- Slope attenuation;
- Hessian material;
- Shade catch nets;
- Gabion baskets;
- Mulching Run-off control (increase the amounts of runoff areas to disperse the water);
- Silt fences;
- Storm water channels and catch pits;
- Soil bindings;
- Geofabrics;
- Hydroseeding and/or re-vegetating;
- Mulching over cleared areas;
- Stone packing; and
- Tilling (roughing the surface).

5.2.2. METHODS TO PREVENT ACCELERATED EROSION

The following practices must be considered and adhered to:

- Ensure steep slopes are stabilized.
- Ensure that steep slopes are not stripped of vegetation and left to dry out and become water repellent (which will cause increased runoff and a decreased infiltration rate) increasing the erosion potential.
- Ensure that all water on site (rain water or water wastage from the construction process) does not result in any surface flow (increase velocity and capacity of water) as a result of poor drainage systems.

- Ensure that pooling of water on site is avoided, as the site and the general area consists of dispersive soils, pooling will cause an increase of infiltration on one area, causing the subsurface to begin eroding.
- Ensure that heavy machinery does not compact those areas which are not intended to be compacted (i.e. areas intended to be managed), as this will result in compacted hydrophobic, water repellent soils which increase the erosion potential of the area. Where compaction does occur, the areas should be ripped.
- Ensure that compacted areas have adequate drainage systems to avoid pooling and surface flow.
- Prevent the concentration or flow of surface water or stormwater down cut or fill slopes, or along pipeline routes or roads, and ensure measures to prevent erosion are in place prior to construction.
- Ensure that stormwater and any runoff generated by hard surfaces should be discharged into retention swales or areas with rock rip-rap. These areas should be grassed with indigenous vegetation. These energy dissipation structures should be placed in a manner that surface flows are managed prior to being discharged back into a natural watercourse to support the maintenance of natural base flows within the ecological systems and prevent erosion, i.e. hydrological regime (water quantity and quality) is maintained.
- Prevent siltation and sedimentation through the use of the erosion equipment mentioned.
- Ensure that all stormwater control features have soft engineered areas that attenuate flows, allowing for water to percolate into the local ground water table in low quantities (to reduce runoff but prevent subsurface erosion).
- Minimize and restrict site clearing to areas required for construction purposes only and restrict disturbance to adjacent undisturbed natural vegetation.
- Ensure that vegetation clearing is conducted in parallel with the construction progress across the site to minimize erosion and/or run-off.
- Ensure that large tracts of bare soil which would cause dust pollution in high winds, or have high erosion susceptibility and increase sedimentation in the lower portions of the catchment are controlled through temporary surface covering.
- Ensure no diversion of water flows in catchment occurs.
- Ensure that dust control measures are implemented, but prevent over-wetting/ saturating the area (to cause pooling) and run-off (that may cause erosion and sedimentation).
- Watercourse (stream) crossings should not trap any run-off, thereby creating inundated areas, but allow for free-flowing watercourses.

5.2.3. MITIGATION FOR PREVIOUSLY DEGRADED AREAS

Previously degraded areas could pose a threat to construction activities in the area and musttherefore be stabilized then remediated and rehabilitated through:

- Protecting, stabilize and isolate the degraded areas to ensure no further damage is caused byerosion due to construction activities.
- Increase the drainage in the area but avoid pooling.
- Prevent increasing sedimentation in areas that have been choked by soils from degradedareas.

- Once construction has been completed, a method statement must be drafted for the rehabilitation of the previously degraded areas, using equipment mentioned above.
- Stabilization of steep slopes must be undertaken.
- Ensure that bare soil is covered and hydro seeded to reduce topsoil loss.

5.3. METHODOLOGIES

The following erosion control measures and rehabilitation specifications may be required to be implemented to ensure that good environmental practice is conducted and environmental complianceis achieved.

- Topsoil covered with a geotextile or hessian material and a grass seed mixture (see Rehabilitation Specifications).
- Logging or stepping following the contours of the slope, to reduce surface runoff.
- Earth or rock-pack cut-off berms.
- Packed branches to roughen the surface and promote infiltration.
- Benches (sand bags).
- Stabilization of near vertical slopes (1:1 – 1:2), if created during construction, will be required to utilize hard structures that have a natural look. The following methods may be considered:
    - Gabions (preferred method with geotextile material);
    - Retaining walls; and
    - Stone pitching.
- The slopes of all stream diversions must be protected. The following methods may be considered:
    - Reno mattresses (preferred method), ensure that the reno mattresses are buried deep into the subsurface, to avoid undercutting from the water;
    - Coarse rock (undersize rip-rap);
    - Sandbags; and
    - Stone packing with geotextile.
- Where feasible use rubber dams as stream diversions when establishing water course crossings. Although (and considering that these are non-perennial watercourses) the recommendation is to construct watercourse crossings during dry periods (or no flow periods), where possible.
- Any concentration of natural water flow caused by road works or hardstands areas will be treated as follows:
    - If water flow is sub-critical, nothing is required; and
    - If water flow is supercritical, the outlets will be provided with protection (either gabions or stone pitching – depending on the flows) to release water subcritical back into the watercourse at a low velocity.

5.4. ENGINEERING SPECIFICATIONS

A detailed Stormwater Management Plan describing and illustrating the proposed stormwater control measures must be prepared by the Civil Engineers during the detailed design stage, and this includes erosion control.

Requirements for project design:

- Erosion control measures to be implemented before and during the construction period, including the final stormwater control measures (post construction).
- The location, area/extent (m²/ha) and specifications of all temporary and permanent water management structures or stabilization methods.
- A resident Engineer to be responsible for ensuring implementation of the erosion control measures on site during the construction period.
- The Developer holds ultimate responsibility for remedial action in the event that the approved stormwater plan is not correctly or appropriately implemented and damage to the environment is caused.
- Concrete lined drains placed adjacent to roads to transfer the water to the existing water courses.
- Frequent gravel drains hydroseeded placed on permanent roadway edges.
- At the point where stormwater is discharged, energy dissipaters to be constructed to reduce the flow rate of run-off.
- All cut and fill banks will be seeded with an approved seed mix (as per the rehabilitation specifications) to ensure bank stabilization and the elimination of potential erosion. Reno mattresses may be used to ensure that the area remains stable.

5.5. REHABILITATION SPECIFICATIONS

- If suitable resources don't already exist on site, the EPC contractor should consider employing a Horticultural Landscape Contractor to fulfil the rehabilitation of disturbed areas post- construction.
- A detailed Rehabilitation Plan describing and illustrating the proposed rehabilitation activities onsite must be prepared i.e. areas of top soiling, seeding and replanting of vegetation; species mix; requirements for fertilization; seed sowing rates; watering etc. (i.e. bill of quantities).
- The following document should be consulted for further support with respect to information regarding rehabilitation, namely: The Department of Water Affairs and Forestry, February 2005.Environmental Best Practice Specifications: Construction Integrated Environmental Management Sub-Series No. IEMS 1.6. Third Edition. Pretoria.
- These specifications may be modified by the consideration of on-site conditions

5.6. POST- AND DURING CONSTRUCTION REHABILITATION ACTIVITIES

- Correct and appropriate stockpile management of topsoil will be required during the constructionphase.
- Rehabilitation of disturbed areas will be implemented as these areas become available for rehabilitation.
- Disturbed areas will include, for example: construction camp site, areas where undergroundcabling has been layer/buried, roadsides of new access roads.

5.7. REHABILITATION STEPS TO MITIGATE THE ERODED AREAS

- Stockpiled topsoil must be spread over disturbed areas (100 – 150 mm thick) just prior to planting/seeding.
- Rip and scarify along the contours of the newly spread topsoil prior to watering and seeding.
- Organic fertilizers or compost shall be used if site conditions require it and can be applied as part of hydro-seeding applications.
- Seed should be sown into weed-free topsoil that has been stockpiled (i.e. original topsoil from the site).
- Indigenous plants shall be used to rehabilitate disturbed areas.
- Applying the seed through hydro mulching (hydro-seeding) is advantageous (or organic mulching after seeding).
- Watering is essential and rehabilitation should ideally occur during the wet season.
- The topsoil in the area is vulnerable to erosion therefore the hydro-seeded surfaces could be covered with a shade cloth material or natural fiber (hessian material) to reduce the loss of soil while the plants establish.

5.8. 'WATERING' TO AVOID EROSION

- Movement of livestock in newly rehabilitated areas must be restricted, where possible, while taking into consideration drinking areas/paths.
- Watering the rehabilitated areas should be undertaken in the wet/rainy season but if this is not possible, an initial watering period (supplemental irrigation) will be required to ensure plant establishment (germination and established growth). However, this may need to be extended into the dry season until rehabilitation of disturbed area is complete.
- Generous watering during the first two weeks, or until the seeds have germinated, is required (unless adequate rainfall occurs) i.e. seed beds will need to be kept moist for germination to occur.
- For grass to establish (once germination has occurred), rainfall or irrigation is needed at regular intervals, ideally every few days and possibly every day if weather conditions require it.
- During dry periods, with no rainfall, or where there is less than 100mm of rain over a month, it may be necessary to establish plants capable of surviving dry weather (or otherwise specified by the Horticultural Landscape Contractor).

5.8.1. SEEDING

The developer should make use of an appropriate mix of grass species for rehabilitation (to be determined in consultation with a suitably qualified ecologist) and they must be mixed for sowing either in summer or in winter. Grass species application (Rutherford, 2006) is at the rate specified as kg/ha.

5.8.2. STEEP SLOPES

- Areas that have a steep gradient and require seeding for rehabilitation purposes should be adequately protected against potential run-off erosion e.g. with coir geotextile netting or other

appropriate methodology.

- Provision for wind should also be made on these slopes to ensure the fine-grained soil is not removed. This can be done by the following:
    - Using a tarp to cover exposed services
    - Mixing less fine-grained material into the sand
    - Vegetation of the slopes
    - Saturate the soil as often as needed

5.9. MAINTENANCE AND DURATION

- Rehabilitation will occur during construction, as areas for plant rehabilitation become available.
- The rehabilitation period post construction is estimated to be over a period of 6 (minimum) to 12 months (maximum), or a time period specified by the Horticultural Landscape Contractor or a Rehabilitation Specialist, particularly if planting of trees and shrubs occurs.
- The rehabilitation phase (including post seeding maintenance) should be at least six months (depending on time of seeding and rainfall) to ensure establishment of plants with a minimum 80% cover achieved (excluding alien plant species).
- If the plants have not established and the 80% is not achieved within the specified maintenanceperiod, maintenance of these areas shall continue until at least 80% cover is achieved (excluding alien plant species).
- Additional seeding may be necessary to achieve 80% cover.
- Any plants that die during the maintenance period must be replaced.
- Succession of natural plant species should be encouraged.

5.10. CONCLUSION

The Erosion Management Plan is a document to assist the contractor, the Developer and the ECO with guidelines on how to manage erosion. The implementation of management measures is not only good practice to ensure minimization of degradation, but also necessary to ensure compliance with legislative requirements. This document forms part of the EMP, and is required to be considered and adhered to during the design, construction, operation and decommissioning phases of the project.

5.11. REFERENCES

Department of Environmental Affairs. (1983). Conservation of Agricultural Resources Act 43 of 1983. Pretoria: Department of Environmental Affairs.

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