Appendix I

Stormwater Management Plan

STORMWATER MANAGEMENT PLAN

THE PROPOSED CONSTRUCTION OF A SECTION OF A WATER PIPELINE TO CONNECT THE BLOEMSPRUIT WWTW TO MOCKES DAM, BLOEMFONTEIN

Applicant: Mangaung Metropolitan Municipality
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1. Project description

The proposed project entails the proposed construction of a pipeline.

Please refer to the map in Appendix A of the Basic Assessment Report for an indication on the locality of the proposed activities.

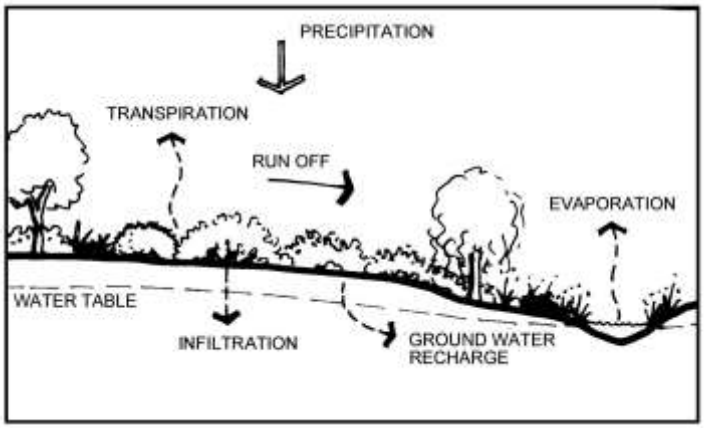
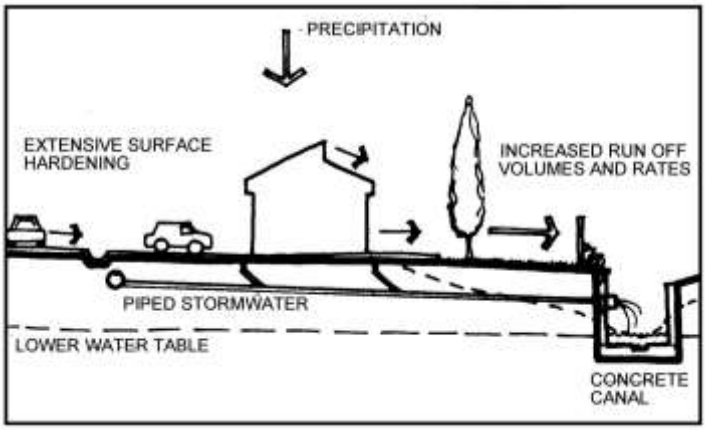
2. Stormwater Management Objectives

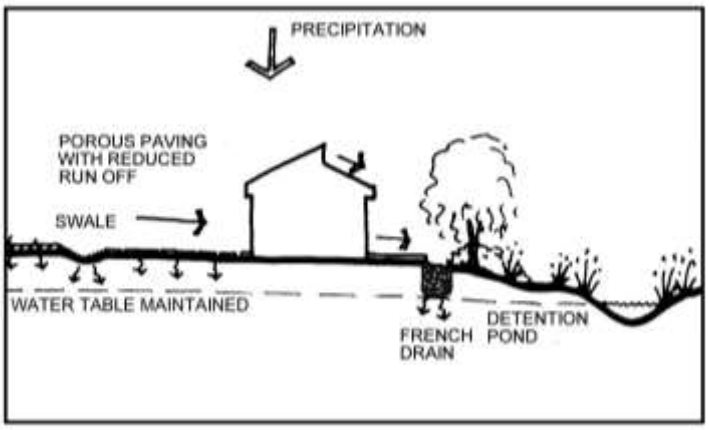
The main objective of the stormwater management plan is to minimise the effect of the proposed project on the environment. This objective can be divided into the following sections:

2.1 Minimising effect of proposed project on environment

The aim of the stormwater management plan is to minimise the effect of the proposed project on the environment (Figure 1).

Figure 1: Indication of effect of stormwater management in a developed area

Nr	Description	Drawing
1	Natural Environment	
2	Developed Area, without sufficient stormwater mitigation measures being implemented	

3	Developed Area, with sufficient stormwater mitigation measures being implemented	

2.2 Minimalize the possibility of flooding

The minimisation of the possibility of flooding remains a key objective of any stormwater management system. However the challenge when contemplating design of stormwater management systems is to consider the following:

- To mimic pre-development responses to storms.
- To reduce the volume of runoff by promoting infiltration.
- To reduce the peak flows and increase the time-to-peak through detaining the runoff and releasing it at a gradual rate.
- Where necessary, to construct means to contain flood waters and safely convey them out of the urban area.

2.3 Protection of Receiving Water Bodies

The receiving water body is not necessarily the system into which stormwater is discharged directly, but can also be a natural system located further downstream in the catchment. Every endeavour should be made to achieve the following as far as possible:

- Maintain natural flow regimes and seasonality
- Prevent deterioration in water quality
- Prevent erosion or sedimentation of natural wetlands or rivers.
- Preserve natural river channels, wetlands and vegetation, and preclude engineering interventions that may alter their physical and ecological characteristics.

The need to design appropriate stormwater management systems for new developments should be seen as an opportunity to preserve or, if possible,

improve natural freshwater ecosystems that have suffered degradation as a result of past activities, and in some cases to create additional freshwater habitats that will contribute to the availability of appropriate, high quality river and wetland habitat that mimics the natural condition.

2.4 Promote Multi-Functional Use of Stormwater Management Systems

Resources such as land and water are becoming increasingly scarce and multiple uses of these must be strived for. Stormwater systems provide a wide range of opportunities for multi-functionality. These can have significant implications on:

- The initial and long term costs of development (e.g. Instead of constructing a detention pond and a sports field, these uses could be combined)
- The quality of the natural and urban environment [e.g. the pressure of private development requirements on land for public land use, conservation, etc. can be alleviated by combining compatible land uses such as conservation, recreation and stormwater systems (including wetlands, marshes, dams and rivers) enabling an improved natural and urban environment]
- Maintenance efficiency (e.g. instead of meeting the maintenance requirements of stormwater systems and public open space separately, they could be combined and could include walking/bicycle trails and parks).

2.5 Development of Sustainable Environments

The long-term involvement with the project and consideration of the sustainability of the stormwater management system that is to be implemented should be kept in mind. All relevant factors that will impact on future operation and maintenance should be taken into account. Environmental policies such as promoting the use of locally indigenous vegetation in planting programmes will also reduce the long-term maintenance requirements of the development.

3. Stormwater Planning Regarding the Proposed Project

Adequate planning is crucial to the success of the project as a whole.

3.1. Need for Multi-disciplinary Expertise

To maximise opportunities to manage stormwater, the input from various design teams are necessary (Table 1).

Table 1. Indication of the role that various team members play

No	Team member		Role
1	Civil Engineer		An engineer skilled in the design of stormwater systems should determine runoff flows for the required recurrence intervals and proposed land uses and design appropriate measures to attenuate peak flows and safely convey the runoff.
2	Environmental Consultant		Alert the engineer at the conceptual stage of the development to crucial aspects of the environment, which are fulfilling an important role with respect to stormwater and should be taken into consideration, as well as opportunities for enhancement or rehabilitation of existing natural features.
3	If required	Freshwater Ecologist	Provide insight regarding the functioning of natural rivers, streams and wetlands and advice regarding the ecological aspects of the design of the components of the system, including water quality enhancement and the land needed for the system to function.
		Landscape Architect	Provide a holistic site analysis of the existing natural and man-made landscape and advice on the opportunities, constraints and implications of the site on the development planning and design.

3.2. Incorporation of Existing Information into Planning Stage

The following information (where relevant) should be investigated, during the planning stage and used to feed into more detailed site assessment:

- Catchment area in which the site is located
- Catchment or river management plans (overall management objectives and recommended key management actions with respect to runoff quantity, quality and other associated environmental and social issues, where such plans exist for the catchment in question, must be met in the design stage)
- Stormwater management master plan (identifies bulk infrastructure, including stormwater flow routes, required within developing areas and may identify particular issues such as pollution which must be addressed

at a local level. The existence of a stormwater management master plan which covers the area to be developed should be established and its recommendations applied to the design.
- Existing reports relating to the sensitivity of known wetlands / rivers / other natural ecosystems on or associated with the study area.

Interdependencies exist between the various water related services such as water supply, sanitation and stormwater management. Thus, consideration of the impact of effluent discharges into or water abstraction from stormwater management systems should be taken into account.

3.3. Site Analysis

The physical characteristics of the site reflect the existing course of runoff and stormwater. Working with the natural environment and environmental processes has been found to be safer, more sustainable and easier to maintain in the long term, than more traditional engineering approaches aimed at controlling these processes.

On sites that have been substantially disturbed, consideration should be made of what the natural drainage and runoff conditions would have been, as well as the existing situation. This will enable potential problems, and opportunities, to be identified.

3.3.1. Topography

The consideration of various topographical factors is important for the compilation of a stormwater management plan, due to the following:

- Gradients dictate the direction of flow and runoff/drainage routes can be plotted over land, identifying areas of ponding and concentration of loads
- In some areas which are very flat, earthworks may be required to provide sufficient grade for drainage
- Topography influences the potential for erosion to occur
- Topography informs the feasibility of different locations for stormwater routes, outlets and treatment areas; the main stormwater routes should be located along natural drainage routes
- In ecological terms, different habitats, some of higher conservation value than others, are frequently associated with changes in topography

- From an environmental and stormwater management perspective, as the slope increases, erf sizes should also increase to prevent excessive run-off and potential erosion
- Road and planning layouts should also reflect the topography of an area, to enable integrated stormwater design and management
- The commercial (and aesthetic) value of different sections of a development area is also frequently derived from different topographical characteristics.

3.3.2. Geology, Soils and Groundwater

The infiltration potential of the site is mostly determined by the geology, soil and groundwater conditions of the area. The following factors should be considered, where possible:

- Soil types affect surface permeability and hence rate of runoff
- The mapping of geology and soils will indicate areas of potential groundwater recharge
- Geology and soils influence the potential for erosion to occur
- Soil types should be identified, along with the characteristics of the different soils, such as levels of infiltration, permeability and their water-bearing capacity
- The presence of contaminated soils, which may pose a threat to surface and groundwater quality should be identified and plotted
- Areas of high groundwater levels can limit the possibilities and/or desirability of groundwater recharge and filtration methods.
- It should be noted that large-scale removal of certain vegetation types, such as Port Jackson (Acacia saligna) and Bluegums (Eucalyptus sp.), that consume large volumes of water, might significantly raise groundwater levels
- Need to determine seasonal and longer term trends in groundwater level fluctuation
- Soil types indicate the likely occurrence of particular plant communities, some of which may play a role in the stormwater management plan
- Assessing soils can also indicate the presence of both existing and even historic wetlands
- Seasonal variation of groundwater levels should be taken into account
- The geology and soils of a site will inform the feasibility of different locations for stormwater treatment areas and the potential for groundwater recharge

- Different habitats (some with high conservation value) are associated with specific geological features and soils

3.3.3. Climate

The following climatic factors should be considered, where necessary:

- Storm rainfall parameters are major design factors and must be carefully determined
- The general climatic characteristics of an area will also impact on the site and stormwater systems implemented, i.e. whether the site is generally waterlogged or dry and if evaporation levels are high or low
- Microclimate conditions can inform the spatial layout of water treatment and attenuation, particularly those associated with specific planting and multifunctional uses

3.3.4. Hydrology

It is essential, for successful, sustainable and integrated stormwater management, that the existing and/or natural hydrological response and functions of the site are understood. The following factors should be considered:

- The natural drainage that was characteristic of the development area, to the extent that this is possible, should be determined and both the irreversible as well as less permanent changes that have taken place should be identified
- The hydrology of the development area is a function of much of the other data, which is described under the Site Analysis section.

3.3.5. Cultural and Historical Landscapes and Archaeological Sites

Areas, routes, vegetation and landmarks that have a cultural and/or historical use or significance should be identified. Development and stormwater planning should avoid disturbing these areas where possible. Where possible they should generally be incorporated within the public open space of a development. This contributes a further function to the public open space system, and should be integrated into a network of public open space.

3.4. Development Requirements

The public open space and pedestrian access requirements of a development should be incorporated into the stormwater management planning of the site. The integration of public open space and access requirements with the spatial requirements of stormwater management not only reduces the conflict of pressure on land, but also enables the amalgamation of maintenance requirements, and maximises the use of resources. The following factors should be considered (where necessary):

- Land use planning should be done in relation to the natural context and characteristics of the site. The appropriate placement of land uses will enhance the multi-functionality of the stormwater systems and their use as an amenity by residents in the area.
- Innovative opportunities exist for future stormwater management systems to link-up and add value to educational initiatives (outdoor classroom), ownership (friends groups adopting the system), and water saving (re-use of stormwater/treated effluent for irrigation).
- These opportunities are also area specific and need to be identified up front, rather than as a nice-to-have-after-thought
- The need for a safe environment must be taken into account (e.g. avoid of potential hiding places for criminal elements; do not create unnecessary hazards in the selection of stormwater management options).
- The cost of stormwater implementation, management and maintenance, as well as flood risk, can be greatly reduced by identifying, retaining and enhancing the natural areas along which runoff and natural habitat retain ecological integrity. The advantages of this approach are not limited to stormwater, but can increase the visual, amenity and ecological value of a development.

3.5. Site Planning

3.5.1. Analysis

The developer should take the information stipulated in Section 2.3 into consideration during the Site Analysis Process.

3.5.2. Conceptual Layout

A general concept plan for the site layout should be developed, taking into account the legal and physical aspects of the site as developed through the site analysis process.

3.6. Design Phase

3.6.1. Appropriate Stormwater Management Facilities and Techniques associated with the project

Various stormwater management facilities and techniques were evaluated in terms of engineering, ecological, health, safety, aesthetic, social, construction and maintenance design objectives.

Various facilities and techniques may be utilised to manage stormwater runoff from the development.

3.6.2. Conveyance

Conveyance can be summarised as the use of natural or artificial channels, natural or artificial wetlands or pipes and culverts for stormwater conveyance as well as the prevention of erosion.

In general terms, the developer should consider the following aspects when selecting designs for stormwater conveyance:

- The slopes of the development area – stormwater design on steep slopes will need to incorporate methods for reducing erosion.
- Soil type and stability in the development area – the former will affect infiltration rates, as well as the potential for establishment of different kinds of plant communities in unlined conveyance structures; the latter will affect the degree of stabilisation that may be necessary.
- Seasonal changes in water table height – groundwater should not be exposed by unlined conveyance structures during summer, as this will promote drainage of the groundwater resource; infiltration capacity will be reduced if the water table is above an unlined channel base during winter.
- The cost of land – where land is at a premium, use of large areas for stormwater conveyance may be prohibitively expensive. Nevertheless, the increase in aesthetic and other forms of amenity value that may be

gained from sensitive and imaginative stormwater designs may make the use of such space more economically feasible.

- The anticipated quality of stormwater runoff – severely polluted water may constitute a health hazard to downstream residents and an ecological hazard to downstream aquatic ecosystems. Consideration should be given to the conveyance of such water off-site, and directly to water purification works, at least during low-flow periods when water quality is likely to be most impacted.
- Presence of natural water bodies that would lend themselves to the conveyance of stormwater
  - Habitat integrity, priority ranking and/or ecological importance and sensitivity of the system should be considered
  - Sensitive systems should be protected from, rather than incorporated into stormwater conveyance design.
- The volume of expected stormwater runoff, during within-year flood events, and during larger storm events.
- The availability of open space for stormwater conveyance – large areas of open public or private space often lend themselves to the creation of wide, artificial waterways, which may also have ecological, recreational and aesthetic value in addition to providing a stormwater function.
- The presence of litter and sediment which would result in blockages.

Erosion is unfortunately often associated with development as areas become disturbed or as stormwater runoff is concentrated at outlets. In order avoid these problems, options such as stabilisation, energy dissipation and the design of stormwater management systems, which do not concentrate flows, are recommended. A number of structures incorporated into stormwater design play a role in the dissipation of energy required to prevent erosion at outlet and inlet points, and at various points in different conveyance structures. This section provides brief commentary on the ecological, engineering and aesthetic function of each of these.

Soil which has been disturbed or from which the vegetation has been removed, should be stabilised to prevent erosion due to wind or runoff. Such erosion could cause the stormwater system to block, thereby resulting in the flooding of properties. Stabilisation would be short term, for the duration of the construction phase, followed by long term on completion of construction. Particular care should be taken of areas where development will not take place immediately on completion of the construction phase, e.g. wide verges in the road reserve which have been acquired to accommodate future road widening, or erven reserved for unspecified local authority use.

3.7. Construction

3.7.1. Civil Engineering Specifications

All materials and workmanship should comply with the SABS Specifications.

3.7.2. Environmental Management Programme

Please refer to Appendix G of the Basic Assessment Report for a copy of the EMPr.

3.7.3. Protection of Stormwater Systems during the Construction Phase

The proposed construction activities will be undertaken in the dry season (winter months), where possible in order to limit impacts on the flow of stormwater. The above will also be included in the documentation to the contractor.

3.7.4. Vegetation and Stabilisation

Structures that rely on infiltration for their efficacy should not come into operation until their runoff areas have been stabilised, following construction. This will prevent the need for early and costly maintenance of structures.

If stabilisation by planting is envisaged, plants should be established before the onset of the winter rains. A phased approach to construction should be considered, where the extent of the water course is such that planting of the whole area will take too long for stabilisation to be effective, or where construction activities are likely to take longer than the period between the end of the wet season and the end of the dry season, when planting should take place.

In some cases, delays in the design or tender stages of a project result in delaying construction such that plants are unlikely to be established before the start of the rainy season. Planting during the rainy season is likely to result in the costly loss of plants, due to washout, as well as the erosion of banks, often resulting in the destruction of careful landscaping of bank slopes and profiles. In such cases, it is suggested that planting be delayed until after the end of the rainy season – either until spring, or until the following autumn. Planting in late spring would allow a longer period for the establishment of plants before the next rainy season. However, for all zones except for

permanently wetted zones, frequent irrigation would be necessary to ensure the survival of the plants over summer.

Delays in planting are likely to have cost implications for the project as a whole: survival of pre-ordered, potted plants is often not good over a whole year; in addition, regarding and shaping of eroded banks may be necessary. Nevertheless, it should also be noted that there are advantages to such delays in planting – for one thing, it allows water levels and rates of flow to be observed over one year, and these observations can be used to guide plant zonation.

It is strongly recommended that any planting programmes carried out in stormwater management systems make use of locally indigenous plant species. Indigenous species tend to require less costly nurturing than do exotics. Moreover, they are often less prone to disease and, from an ecological perspective, can also provide areas of indigenous habitat, potentially linking areas of natural indigenous habitat, across the development area.

4. Stormwater Management Plan (Construction phase)

Given the project and site information as listed in the sections above it is possible to compile a Storm Water Management Plan in order to manage and limit possible environmental, surface and groundwater impacts associated with stormwater runoff.

4.1. Potential Pollution sources

The areas and activities that require particular attention with regard to the potential negative impacts of uncontrolled stormwater runoff need to be identified. The potential pollution sources related to the proposed project can be listed as follows:

- Construction base camp
- Stockpile area
- Trench excavation
- Concrete mixing

4.2. Preventative measures and stormwater management tools

The following preventative measures and Management tools can be implemented in order to minimise and prevent the negative effects of storm water impacts for the identified pollution sources as well as other project related activities.

4.3. General preventative measures and stormwater management tools during the construction phase

- The applicant will ensure that the contractors adhere to the recommendations of the of the EMPr as well as conditions set out in the Environmental Authorisation during construction
- An Environmental Control Officer (ECO) will be appointed to monitor the entire construction phase. Note that the ECO can be appointed independently or as part of the contractor's team.
- Regular monitoring and / or spot inspections must be conducted. It is recommended that the above mentioned monitoring / spot inspections occur at least every fortnight during the construction phase.
- Inspections must be documented and any shortcomings must be addressed immediately.
- An independent ECO will be appointed to monitor the construction phase. A report will be provided to the contractor upon completion thereof. This report and its findings should be made available to the environmental department if requested.

4.4. Construction base camp

- Proper sanitation, portable water and waste facilities must be in place before construction activities commence.
- Care must be taken to prevent any unnecessary damage to vegetation near construction base camp and any other construction activities.
- Potable water must be made available to workers on a daily basis.
- Caution must be taken to ensure that no construction materials are stored or dumped within 32 meters of a watercourse or buffer zones.
- Emergency plans must be available in case of any spillages into or near water resources.
- All chemicals used during the development, including fuel for the construction vehicles, will be stored in a proper storeroom or protected area to prevent pollution.

- Vehicles will be serviced at designated areas. No oil, diesel or other chemicals may be spilled or discharged anywhere.
- Where applicable, the contractors will ensure that all relevant national, regional and local legislation regarding storage, transport, use and disposal of petroleum, chemical, harmful or hazardous substances and materials are adhered to, where necessary.
- Cement and concrete mixing, if applicable, will only take place within the construction site. No concrete will be mixed directly on the ground.
- All environmental problems occurring on the site such will be reported to the ECO. The ECO should implement best practices to rectify the impacts thereof on the environment.
- The contractor is responsible for the removal of construction waste.
- Construction activities will be limited to designated construction areas to prevent peripheral impacts on surrounding natural habitats. Construction vehicles will also keep to constructed roads where possible, so that natural vegetation is not destroyed unnecessarily.
- All human movement and activities will be contained within designated construction areas in order to prevent peripheral impacts on surrounding natural habitat.
- The area where the construction base camp will be set out should be flat in terms of surface and not situated within 32meters from existing water courses.
- A temporary impervious surface should be provided where equipment and/or any hazardous materials (cement, lime, oil and fuel) can be stored, handled and used.
- In the event of any spillage incident the spillage should be cleaned, removed and discarded at the nearest authorised disposal facility.
- Chemical toilets must be serviced and cleaned regularly by the contracted entity.
- All and any waste generated by the construction workers must be disposed of in bins provided, these bins should be emptied and taken to the nearest applicable disposal facility on a regular basis.

4.5. Stockpile area

- Removed topsoil will be stockpiled in an area where it will not be disturbed by vehicles.
- Stockpiled material will be protected from washing away during rainstorms. For example, one layer of bricks or stones can be placed around the stockpiled material.
- On-site contractors are responsible for maintaining stockpiles.

- Weather forecasts from the South African Weather Bureau of up to three days in advance must be monitored on a daily basis in order to avoid exposure of soil, construction works or other harmful materials during a possible storm event.
- Weather forecasts must also be used as a tool to ensure that appropriate actions are taken to avoid the runoff/ erosion of topsoil or other stockpiled materials.
- The temporary stockpiling of soils or any other material should preferably be stored on flat surfaces, in flat topped mounds with side slopes not exceeding a 1:2 slope.
- The stockpiling of soils or other materials should occur more than 32meters from a water course on a relative flat surface.
- In the event of a surplus material or material unsuitable for backfilling however designated to remain onsite for landscaping, shall as early as possible be placed in its permanent position, be covered with top soil and vegetated.
- Stockpiled material will be placed on the cleared areas once construction is completed. Re-spreading of topsoil is preferably to be done to a maximum of 10 cm, depending on the natural depth.
- An alien control and monitoring programme will be developed starting during the construction phase and will be carried over into the operational phase.
- Any proclaimed weed or alien species that germinates during the contract period will be cleared by hand / approved chemicals before flowering thereof.
- Imported fill material will be monitored during and after construction for the presence of any alien species. Any such species will be removed immediately.

4.6. Trench Excavation

- Infilling, excavation, drainage and hardening of surfaces will not occur unnecessarily in water ways (i.e. permanent, seasonal or temporary) water courses or within 32 meters of them. The 32 meter buffer zone should be extended in cases where slope in combination with rainfall can potentially provide conditions for the transportation and deposition of materials within the applicable water resource.
- The total depth of excavation will be kept to a minimum, where possible.
- All trenches should be backfilled as soon as possible.
- Trenching shall not proceed unreasonably far ahead of pipe laying (if any) - especially in cases where a steep gradient exists.

- The time period for the construction or associated activities within and close proximity of streams should be kept to a minimum.
- Temporary mounds or sandbags shall be placed along the route of all backfilled trenches in order to prevent washout.

4.7. Mixing of concrete

- Cement mixing should take place on impermeable liners.
- The cleaning of cement mixing and related equipment will be conducted using proper cleaning trays.

4.8. Other activities related to the project

- Site clearance:
  - Vegetation should not be stripped for the entire construction site at project commencement.
  - Phased vegetation clearance as the project continues is advised.

- Topsoil strip:
  - Should only commence on areas where immediate work will commence.
  - The extent of these areas should be limited to a minimum and only commence as work progresses to new areas.
  - The period of time between completion of topsoil removal and the commencement of earthworks should be kept at a minimum.
  - The topsoil and seedbank should be stripped, and stockpiled separately and protected against weed infestation and erosion
  - Topsoil should be replaced on top of the soil surface from which it was removed as soon as possible.

5. Stormwater Management Plan (Operational phase)

It is not anticipated that the project should pose further negative potential stormwater impacts after construction, however the following Preventative measures and stormwater management tools should be implemented after the construction phase:

- After the completion of the construction phase a water way monitoring programme will be initiated to ensure the entire area is adequately rehabilitated.

- Following the completion of construction of all infrastructures, the area might be susceptible to erosion due to certain disturbances, areas should be evaluated post construction and determined.
- The areas found to be susceptible to erosion should be equipped with gabions or other geotextiles in order to prevent extensive erosion.
- Following the cessation of construction activities that took place in streams, streams should be inspected regularly for erosion and the necessary mitigation should be applied in order to rectify the situation and prevent further erosion.
- Any and/ all areas that have been compacted due to construction activities must be ripped and rehabilitated to its original state.
- After the cessation of construction related activities the area must be rehabilitated and transformed to its original state.
- The re-establishment of natural occurring vegetation should be monitored. Hydro- seeding should be implemented if natural re-establishment methods fail.
- After construction has ceased all construction materials should be removed from site.
- Regular inspections of the site should be conducted to identify leakages, poor vegetation regrowth and or any erosion occurrences. Soil erosion occurrences will be attended to immediately.

6. Summary of stormwater mitigation measures to be implemented

6.1. Prevent concentration of stormwater flow at any point where the ground is susceptible to erosion.
6.2. Reduce stormwater flows as far as possible by the effective use of attenuating devices (such as swales, berms, silt fences). As construction progresses, the stormwater control measures are to be monitored and adjusted to ensure complete erosion and pollution control at all times.
6.3. Minimse the area of exposure of bare soils to minimse the erosive forces of wind, water and all forms of traffic.
6.4. Ensure that development does not increase the rate of stormwater flow above that which the natural ground can safely accommodate.
6.5. Ensure that all stormwater control works are constructed in a safe and aesthetic manner in keeping with the overall development.
6.6. Design culvert inlet structures to ensure that the capacity of the culvert does not exceed the pre-development stormwater flow at that point.
6.7. Design outlet culvert structures to dissipate flow energy. Any unlined downstream channel must be adequately protected against soil erosion.

6.8. Permits will be obtained for the removal / transplantation of protected species (if any) that are located within the proposed road route where no alternatives are possible. Care will be taken to prevent unnecessary damage to vegetation near to construction activities.
6.9. The necessary Environmental Authorisation will be obtained before any activities listed in the Regulations (Regulations 982, 983, 984 and / or 985 of 2014) are undertaken.
6.10. Proper sanitation, potable water and waste facilities will be in place before construction activities are undertaken.
6.11. Care will be taken to prevent unnecessary damage to vegetation near to construction activities.
6.12. Potable water will be made available daily to workers on site.
6.13. No activities will be undertaken within 32 m of a watercourse / within the 1:100 year floodline, without the necessary authorisations (for example from DESTEA and DWS).
6.14. Emergency plans will be in place in case of spillages into the water resource(s).
6.15. All no-go areas will be demarcated under guidance of the Environmental Control Officer (ECO).
6.16. All chemicals used during the development, including fuel for the construction vehicles, will be stored in a proper storeroom or protected area to prevent pollution.
6.17. Vehicles will be serviced at designated areas. No oil, diesel or other chemicals may be spilled or discharged anywhere.
6.18. Where applicable, the contractors will ensure that all relevant national, regional and local legislation regarding storage, transport, use and disposal of petroleum, chemical, harmful or hazardous substances and materials are adhered to, where necessary.
6.19. Cement and concrete mixing, if applicable, will only take place within the construction site. No concrete will be mixed directly on the ground.
6.20. All environmental problems occurring on the site such will be reported to the ECO. The ECO should implement best practices to rectify the impacts thereof on the environment.
6.21. The contractor is responsible for the removal of construction waste.
6.22. Construction activities will be limited to designated construction areas to prevent peripheral impacts on surrounding natural habitats. Construction vehicles will also keep to constructed roads where possible, so that natural vegetation is not destroyed unnecessarily.

6.23. All human movement and activities will be contained within designated construction areas in order to prevent peripheral impacts on surrounding natural habitat.
6.24. Erosion management is important. Rehabilitation of disturbed areas will be undertaken to help the recovery of the vegetation.
6.25. Removed topsoil will be stockpiled in an area where it will not be disturbed by vehicles.
6.26. Stockpiled material will be protected from washing away during rainstorms. For example, one layer of bricks or stones can be placed around the stockpiled material.
6.27. Stockpiled material will be placed on the cleared areas once construction is completed. Re-spreading of topsoil is preferably to be done to a maximum of 10 cm, depending on the natural depth.
6.28. An alien control and monitoring programme will be developed starting during the construction phase and will be carried over into the operational phase.
6.29. Any proclaimed weed or alien species that germinates during the contract period will be cleared by hand / approved chemicals before flowering thereof.
6.30. Imported fill material will be monitored during and after construction for the presence of any alien species. Any such species will be removed immediately.
6.31. The total depth of excavation will be kept to a minimum, where possible.
6.32. Species, especially grasses, trees and shrubs occurring in the region will be used to rehabilitate disturbed areas.
6.33. An alien plant control and monitoring programme will be implemented.
6.34. Re-vegetation of disturbed areas will be undertaken with site indigenous species.
6.35. Soil erosion occurrences will be attended to immediately.
6.36. The applicant will ensure that the contractors adhere to the recommendations of the EMPr and conditions of the Environmental Authorisation during construction.
6.37. An Environmental Control Officer (ECO) will be appointed to monitor the construction phase. Note that the ECO may be appointed separately or can be part of the contractor's team.
6.38. Regular monitoring and / or spot inspections at least every two weeks during the construction phase is recommended.
6.39. Inspections should be documented and any shortcomings addressed immediately.

6.40. An independent ECO will be appointed to monitor the construction phase. A report will be provided to the contractor upon completion thereof. The findings thereof should be made available to DESTEA, should it be requested.

6.41. The drainage system for the site should be designed to specifications that can adequately deal with a 1:50 year intensity rainfall event or more to ensure sufficient capacity for carrying storm waters around and away from infrastructure.

6.42. Procedures for storm water flow through a project site need to take into consideration both normal operating practice and special circumstances. Special circumstances in this case typically include severe rainfall events.