Royal HaskoningDHV
Enhancing Society Together

D1841 Ndumo Road Upgrade, Kwa-Zulu Natal

Watercourse Crossings

Construction Work Method Statement

April 2016

Document Description

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D1841 Ndumo Road Upgrade, Kwa-Zulu Natal – Watercourse Crossings Construction Work Method Statement - April 2016

QUALITY VERIFICATION

This Report has been prepared under the controls established by a Quality Management System that meets the requirements of ISO9001: 2008:

VERIFICATION	CAPACITY	NAME	SIGNATURE	DATE
Checked by	Project Manager	Leandre Reitz		25/05/2016
Authorised by	Principal In Charge	Peter Forrest		25/5/2016

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1 DESCRIPTION OF ACTIVITY

Royal HaskoningDHV has been appointed by the KwaZulu-Natal Department of Transport (hereafter referred to as KZN DOT) to upgrade the D1841 Ndumo road, between Nduom and eKuhlehleni, Jozini Local Municipality, uMkhanyakude District Municipality, KwaZulu-Natal. The project proposes the upgrade and realignment of the road from Ndumo to eKuhlehleni (D1841, D1842 and D1884). This road provides a link between the eKuhlehleni Pass and Ndumo via eManyiseni. The total length of the road is 32.1 kilometres. In terms of the TRH 26 Road Classification and Access Management Manual, the D1841 has been classified as a Class 3 Rural Minor Arterial.

The proposed D1841 upgrade comprises the relocation of services, the provision of surface and road prism drainage structures, the construction of bulk earthworks required for alignments of the existing road formation and the construction of road layerworks and surfacing, including the associated ancillary works for the construction of the access roads of these district roads to neighbouring communities.

The required road works starts in Ndumo Town at the intersection of Main Road 435 and continues through the towns of Mbadleni, Khume, Magwandu and terminates at eKuhlehleni. The existing road will be upgraded to a Class 3 single carriageway 6.5 m wide surfaced road with 1 m wide surface shoulders in both directions including adequate stormwater drainage facilities provide. To achieve an improved, more direct route between eManyiseni and Ndumo a re-alignment is proposed which is 6 km in length.

The proposed D1841 road upgrade has potential impacts on six (6) watercourse crossings as per the *Biodiversity Assessment for the Ndumo Road (Project 3) Upgrade in Northern Kwazulu-Natal*, (Terratest, July 2014), with localities indicated in Figure 1. Start and end co-ordinates are summarised in Table 1.

Watercourse crossings are typically categorised as follows:

- **Type 1:** Applicable where the road founding layers do not intercept saturated soils, and culverts and or pipes are used to convey surface runoff from the upslope to downslope of the road. Sediment movement along the road verges will be minimised by constructing berms that distribute water frequently into the adjacent grasslands so as to avoid discharging water onto already saturated wetland soils.
- **Type 2:** Standard culvert designs in channelled valley bottom systems, where if the stream is permanent and contains stretches of open water, the culvert slab will be placed under water.
- **Type 3:** These crossings are those where surface water is managed in the normal way, but the soils are saturated on the surface and the use of subsurface drains is required to collect water on the upslope and then transfer across the road to discharge on the downslope. Trench breakers will be installed to prevent water in the cut off drains from simply flowing down the drains. Storm-water pipes are installed across the road to ensure the flow of water is uninterrupted. A minimum of 1m clean dump rock, or greater depending on the ground conditions, is constructed to ensure fill stability and safe infiltration of water from one side to the other.
- **Type 4**: Where a road crosses wider or larger watercourses, bridge crossings will be constructed to mitigate the effect on the natural drainage system.

This Construction Work Method Statement pertains to the **Type 2** crossings. See Table 1 for schedule of crossings.

Only four (4) of the six (6) watercourse crossings identified in the specialist study are to be directly impacted upon by construction activities. These crossings are identified as WC1 (Figure 2), WC2 (Figure 3), WC5 (Figure 4) and WC6 (Figure 5) in Table 1. The crossings identified as WC3 and WC4 will remain as per their existing condition (i.e. left unaltered as Type 2 crossings).

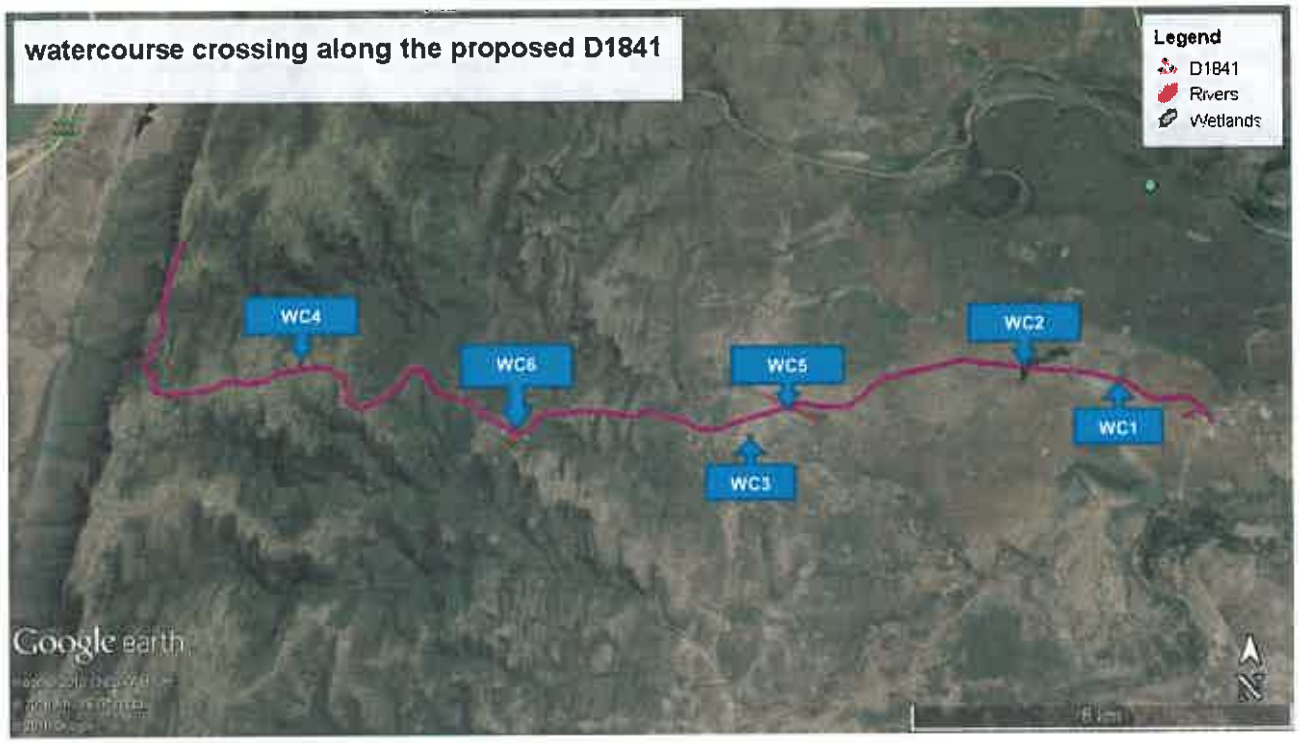


Figure 1: Localities of the watercourse crossing sites within the proposed upgrade of Section Km0.0 to Km32.01 of the D1841

Figure 2: Water Crossing 1

Figure 3: Water Crossing 2

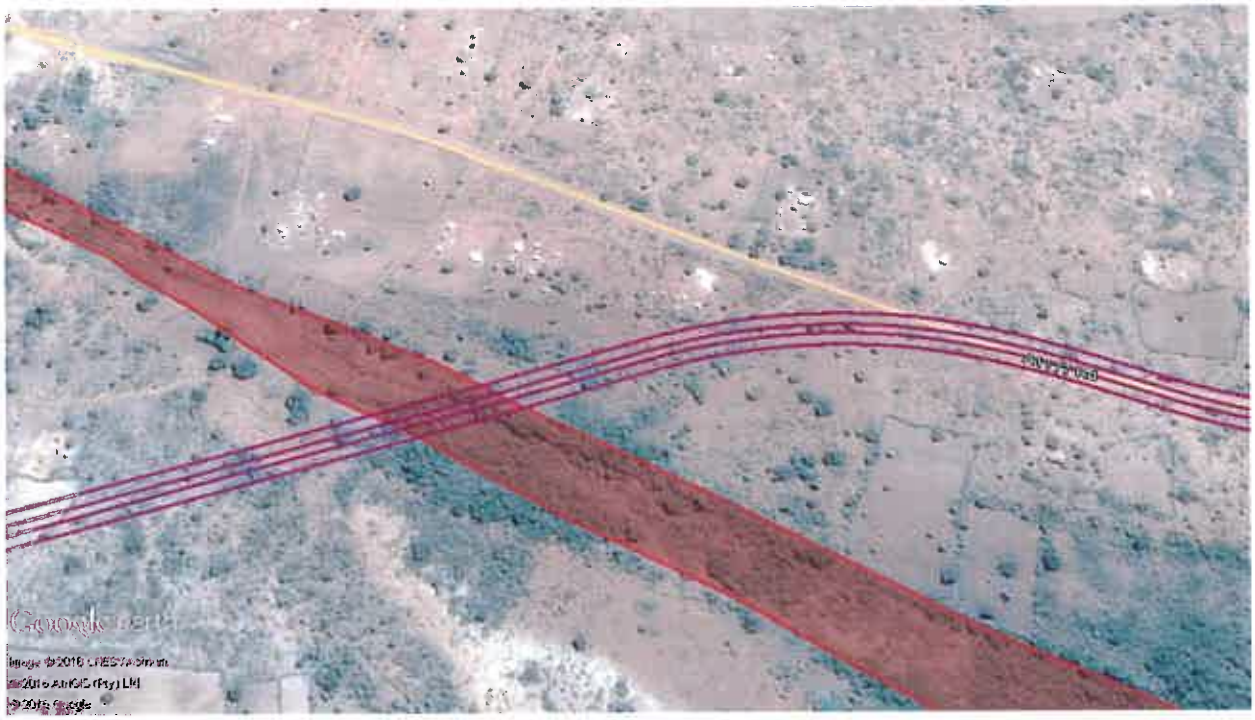


Figure 4: Water Crossing 5

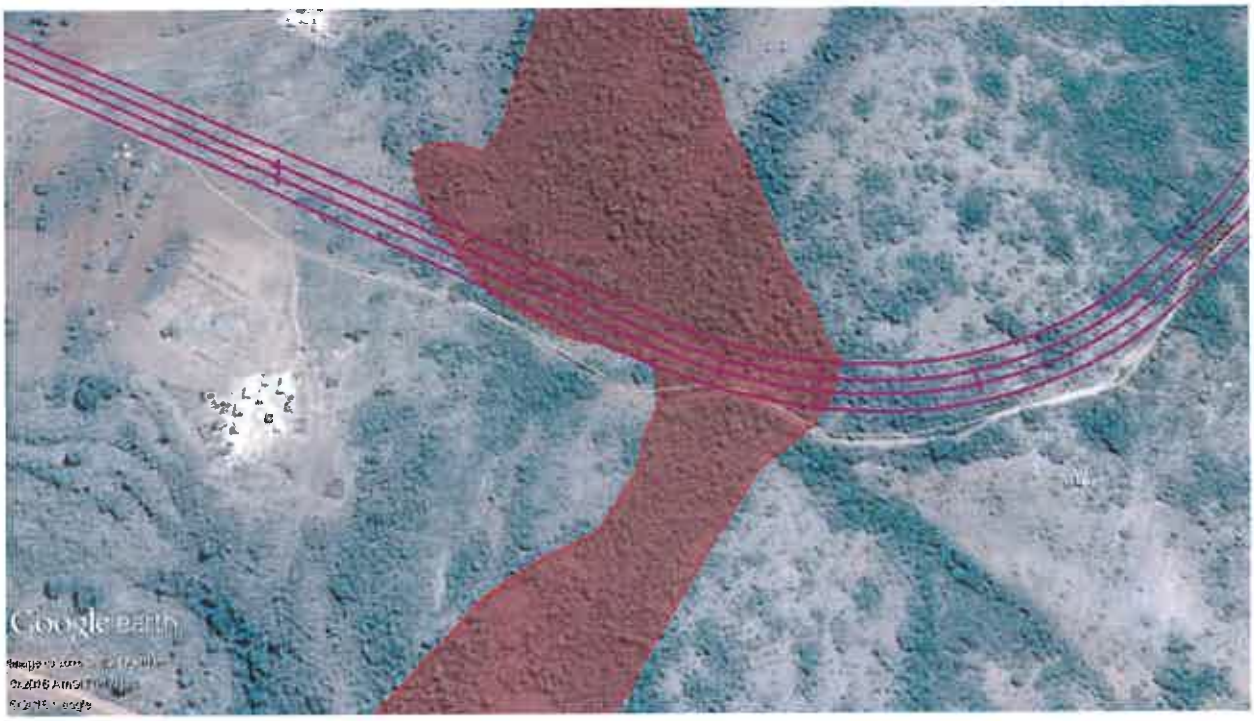


Figure 5: Water Crossing 6

Table 1: Schedule of Crossings[1]

No.	Coordinates	Wetland Type	River Name	Crossing Type
WC1	**26°54'51.18"S 32°14'00.87"E**	Depression / Pan		Type 2
WC2	26°54'40.11"S 32°12'40.44"E	Depression / Pan		Type 2
WC3	26°55'34.09"S 32°08'42.17"E	Depression / Pan		Type 2
WC4	26°54'34.09"S 32°02'25.28"E	Depression / Pan		Type 2
WC5	**26°55'10.41"S 32°09'17.40"E**	River	**Msunduze River**	Type 2
WC6	26°55'32.53"S 32°05'26.55"E	Perennial Tributary	Unnamed	Type 2

[1] The watercourse crossings highlighted in bold text are those that are going to be impacted upon directly by construction activities.

2 CONSTRUCTION PROGRAMME

The construction programme is estimated at this stage, depending on the receipt of Environmental Authorisation (EA), a Water Use Licence as well as procurement of a Contractor.

Table 2: Estimated Construction Programme

No.	Coordinates	Wetland Type	Estimated Start Date	Estimated End Date
WC1	**26°54'51.18"S 32°14'00.87"E**	**Depression / Pan**	01/08/2016	31/07/2018
WC2	**26°54'40.11"S 32°12'40.44"E**	**Depression / Pan**	01/08/2016	31/07/2018
WC3	26°55'34.09"S 32°08'42.17"E	Depression / Pan	n/a	n/a
WC4	26°54'34.09"S 32°02'25.28"E	Depression / Pan	n/a	n/a
WC5	**26°55'10.41"S 32°09'17.40"E**	**River**	01/08/2016	31/07/2018
WC6	**26°55'32.53"S 32°05'26.55"E**	**Perennial Tributary**	01/08/2016	31/07/2018

3 METHODOLOGY

The construction methodology adopted for each individual watercourse will be dependent on:

- the season within which construction arrives; and
- the permanent/ semi-permanent saturation status of the wetland.

At this stage, the Engineer (Royal HaskoningDHV) proposes that the construction methodologies applied to watercourses will depend on the above factors, and the approaching construction stage. Ultimately, the method to be adopted by the approaching construction stage will be dictated by the saturation status of the wetland (wet or dry), in order to protect and preserve existing hydrological functionality. Some stages of construction e.g. works within the stream/river bed for the purposes of constructing box culverts, will be undertaken according to the season within which construction arrives. At all times, the Contractor will take cognisance of the measures detailed within the *Biodiversity Assessment for the Ndumo Road (Project 3) Upgrade in Northern Kwazulu-Natal*, (Terratest, July 2014), as well as the Environmental Management Programme (EMPr), Wetland Rehabilitation Plan, Stormwater Management Plan and all other relevant documentation.

It has been noted by the Engineer that some mitigation measures are commonly applied to every wetland, as detailed in the biodiversity assessment study, and as such, becomes standard to all wetlands regardless of its saturation status. Only general mitigation measures for construction shall be discussed in this Construction Work Method Statement. For site specific mitigation measures consult the above-mentioned biodiversity assessment study, stormwater management plan, and EMPr as submitted as part of the Basic Assessment Study undertaken by the Environmental Assessment Practitioner (EAP), namely Terratest, on behalf of the developer.

General guidelines for construction of the wetland crossings are provided below, following which the sequence to be followed by the Contractor shall be elaborated upon.

3.1 General Guidelines

The Contractor shall, where applicable, flume ditches, canals, small streams and drains so as not to interfere with or cause pollution of the water flow and to avoid damage to stream banks.

No ditches, canals, streams or drains shall be filled, bridged or otherwise obstructed without written approval of the Project Manager, Environmental Control Officer (ECO) and the relevant Competent Authorities having effective control over such watercourses.

The following principles will be observed:

- The Contractor shall ensure that the construction footprint is kept to a minimum in these areas;
- Should water be pumped from the dry working space within any watercourses, this water must be pumped into a retention dam/silt lagoon (or similar structure) to ensure sediment settles and clean water is released back into the watercourse;
- All necessary material for silt and pollution control will be installed at the watercourse crossing, including, but not limited to, silt fences, filtering material;
- Should there be any watercourse crossings within the wetland then soil/ topsoil stockpiles shall be kept away from the banks to avoid silt run off. Soil/ topsoil stockpiles shall be appropriately protected using silt fences, sand bag barriers and other methods as required;
- No refuelling or fuel storage will be allowed within 40 m of water bodies or wetland areas;
- Specific oil spill response equipment will be kept on site for intervention. Where required, bunds, grips and other measures will be implemented adjacent to watercourses to prevent silt/ pollutants ingress from the construction spread;
- Wherever possible, and in case work during the dry season cannot be achieved, work in stream channels will be carried out without the use of 'in-river' techniques, instead using techniques that divert the flow around the works through flumes or by damming and pumping. This will minimise sediment release;

- If wet cement and/or concrete works are necessary, ready-mix is to be preferred and care should be taken not to spill any product. All priming of hoses for concrete pours must be done away from sensitive areas in a manner that reduces environmental impacts to the bare minimum and can be cleared from site easily, for safe disposal to a licensed waste landfill site;
- Full reinstatement of the beds shall be undertaken upon completion of the necessary works within any watercourses;
- The pre-construction profile must be restored, and the banks must not be steeper than at pre-construction;
- The pre-construction gradient of the drainage line must be reinstated as exactly as possible, without humping or hollowing over the Construction Right of Way (ROW) so as to limit erosion of replaced material and possible creation of knick-points;
- All surplus, and especially loose, materials must be removed from the watercourse to preserve water quality and avoid sedimentation of downstream riverine habitat;
- Banks must be re-vegetated as soon as construction works are completed. Standard grassing procedures should be used, except in wetland and except if there is significant risk of fertilizer entering the channel when transplanting local plants, as for wetlands, must be undertaken. Again, the sourcing of transplants must be careful and scattered so as not to create new problems.
- During site establishment, where watercourses will cross the construction site it may be necessary to minimise pollution by:
  - Temporarily diverting watercourses around the working area (i.e. over-pump);
  - Temporarily culvert the watercourse through the working area (i.e. flume through).
  - Where site traffic has to cross watercourses, temporary bridges or culverts/ flumes with retaining boards will be installed.
- Non-project related vehicles or persons will be prohibited from using the Construction Right of Way (ROW).
- Construction personnel shall be made aware (through training) and reminded of all project-related environment requirements.

3.2 Preparation Activities

The method adopted during the preparation activities, specifically the Right of Way (ROW) phase of construction, will depend on the saturation status of the wetland and watercourse.

Prior to any construction activity, the boundary of each wetland / river crossed by the proposed works shall be demarcated in the field.

A 32 m buffer area shall be maintained around each watercourse that will not be directly impacted on by the development and for which a Water Use Licence (WUL) has not been granted, and will be dependent on site specific conditions, topography and construction requirements.

Within this 32 m buffer zone a setback buffer area shall be preserved where vegetation and root systems will remain undisturbed. Topsoil will only be removed from any temporary accesses (where applicable) and on the construction footprint.

The footprint of the construction area as it traverses wetlands / rivers will be kept as narrow as possible.

Demarcation of wetlands within the ROW will be undertaken by trained environmental personnel as per the approved EMPr.

The ROW working width will be reduced where possible to minimise effects of the works on the wetlands / rivers which it passes through. During this phase protected species will be identified and relocated / removed if present under the appropriate governmental permits as obtained by the Employer, or through a subcontracted ecological specialist.

Where the wetland is deemed to be permanent (written decision undertaken in agreement with the Wetland Specialist and/ or ECO present), or is encountered in a saturated state during the demarcation, topsoil stripping width will be minimised. The stripping operation will subsequently allow the installation of a

temporary load spreading access, and allow construction operations to proceed with limited damage to the topsoil or underlying soils.

However, if in the opinion of the site supervisor responsible for ROW preparation, stripping the topsoil would be detrimental to the wetland and hamper construction progress, the topsoil may remain in place. Only the ROW preparation crew would pass through the wetland, until a temporary access can be laid. Topsoil and vegetation left *in situ* would add structural integrity within the wetland, and support the temporary access. It is widely regarded that this aids reinstatement and avoids heavy disturbance to the wetland.

Topsoil stripped from the ROW will be windrowed on the opposite side of the ROW to the storage of subsoil arising from stripping operations (if applicable), and suitably protected from washout and compaction through soil retention curtains and sandbags where necessary; to retain the functionality of the wetland uppermost stratum.

Planning of crossings will incorporate the location of all environment and pollution prevention devices and equipment. This includes: location of parking and refuelling areas (if any), location of environment equipment storage where appropriate, of spill response equipment, silt control measures, retention dams (silt lagoons), etc.

It is envisaged that the working width with regards to topsoil, sub-soil, temporary access (running track) and general construction can be maintained within a 30 m corridor or less.

3.3 Construction Activities

One major structure required for the proposed D1841 road upgrade, is the culvert structure located at km 10.4 along the new alignment of the D1841. 4 box cells with a width and depth of 4.8 m has been designed. This structure has a total length of 21.2 m and a total depth of 5.6 m.

The design criterion for this structure is as follows:

- Catchment Area: 60.64 km^2
- Longest Collector: 25.38 km^2
- 1085 Height Difference: 320
- Drainage Basin Number: 27
- Basin Mean Annual Precipitation: 890 mm
- 1085 Catchment Slope: 0.0168 m/m
- Regional Maximum Flood RMF: 1634 m^3/s
- Design Return Period QT: 20 years
- Design P:eak Flow Rate: 293.06 m^3/s

Design drawings are included as Annexure A, indicating the box culvert design.

3.3.1.1 Site Establishment

This will include the establishment of the Contractor's site camp, including site offices, services and amenities. The project team will ensure that work is competently supervised with respect to managing environmental impacts, as well as health, safety and quality aspects. A detailed environmental risk assessment will be produced and construction monitored accordingly.

The site camp will be securely fenced to prevent unauthorised access and will have:

- Approval from the ECO for the location and layout of the site camp;
- A designated, bunded plant refuelling area situated a minimum of 40 m away from any watercourse; and
- Emergency spill kits will be available and maintained at all times.

In addition to this all plant will be inspected on a daily basis for fluid leaks and will not be allowed to be used if a leak is identified until it is repaired.

All other requirements contained in the Environmental Authorisation (EA), EMPr, and all other relevant permits and licenses (where required), related to site establishment, shall be adhered to at all times for the duration of the project.

3.3.1.2 Access

Access to the works areas are required for the transport of plant, machinery and materials during construction and will be via a temporary load spreading access.

Where machinery is to be used, the necessary precautionary mitigation measures need to be implemented to minimise their environmental impact, especially when this involves entering a watercourse. Vehicles with tracks (as opposed to tyres) are preferable – the wider the track the more load spreading and therefore less compaction there is.

Clearing and grubbing works will be undertaken over the full extent of the works area, including access roads. This will require the removal of vegetation, topsoil and sods, all of which must be used for the sole purpose of rehabilitation.

The method adopted during this phase of construction will depend on the saturation status of the wetland.

The temporary access in a saturated wetland will comprise a geotextile, which will underlie an amount of locally sourced stone-material appropriately wide to allow subsequent construction operations to proceed in a safe manner, providing a safe stable working platform to support plant during construction. Alternatively the Contractor may consider gaining access to saturated wetland areas *via* suitable bog-mats.

Where a dry wetland is encountered, topsoil stripping will also be minimised and stored in a similar manner to protect it from vehicular compaction and washout. In this situation, no locally sourced stone-material will be laid to complement the temporary access, as a safe working platform can be provided on the dry stable underlying strata.

If precipitation is encountered, access through such areas may be restricted, to prevent compaction of soils. Access will be restored once the soil conditions permit. Furthermore, if access is urgently required, or rainfall is encountered during a vital phase of construction, the method employed for a saturated wetland will be implemented to protect the underlying geology and permit construction to proceed in a safe manner.

3.3.1.3 Road Construction

Road construction would require a layer of medium, even grade gravel that will be layered on the surface of a suitable hard-core foundation and compacted to make a hard and even surface.

Unlined meadow drains and concrete lined v-drains will be provided along the edge of the road as required. These drainage facilities will serve to channel the stormwater to the predetermined discharge positions. Stormwater will either be discharged directly onto the grassland or onto the gabion mattress structure stone pitching, depending on the discharge velocities.

Concrete kerbing and channelling will be provided along the edge of the road as and where required. These drainage facilities will serve to channel the stormwater to the predetermined discharge positions.

Side drains will be provided to collect and convey water from the cut slopes, road surface and general up-sloping terrain. Catchwater banks will be constructed where necessary to reduce the flows towards these side drains.

All the grid inlets will lead to cross-road drainage pipes. Other stormwater drainage pipes will be installed at high fills to prevent the ponding of water.

Subsoil pipe systems will be installed in cut situations to collect any groundwater from the cut banks. The subsoil system will either discharge water onto the fill banks, stormwater manholes, outlet and inlet field structures and road site inlets.

Pipes ranging in diameter from 600 mm to 1200 mm will be strategically placed to regularly disperse overland and road surface run-off collected in side drains.

Formalised accesses along the proposed upgrade as well as accesses to adjacent properties will be underlain by 600 mm x 450 mm box culverts to allow the continuous conveyance of stormwater runoff flowing in the adjacent side drains.

Outlet structures at a culvert will be equipped with either stone pitching, gabion mattresses or boxes to reduce velocities to natural flow in order to mitigate the impacts of erosion in addition also protecting the unlined downstream channels against soil erosion.

4 box cells, with a width and depth of 4.8 m x 4.8 m and a total length and depth of 21.2 m and 5.6 m respectively, will be installed at the UMsunduze River located at km 10.4 along the new alignment of the D1841.

The contractor shall prepare a Stormwater Control Plan that will ensure that all construction methods adopted on site do no cause, or precipitate, soil erosion. The contractor will take adequate steps to ensure that the requirements of the Stormwater Management Plan are met before, during and after construction. The contractor will ensure that no construction activity commences before the Stormwater Control measures are in place and approved by the engineer on site.

3.3.1.4 Excavations

Where material is excavated from the works area at a saturated wetland, the excavations will be side dug from the temporary access, with careful separation of soil types/ strata as identified. Where a previously dry wetland is saturated, a temporary access will be installed to prevent rutting and degradation of the exposed subsoil, to permit construction to proceed.

Where excavating operations arrive at a dry seasonal wetland, the excavation will be dug on-line, creating a much narrower excavation, with less subsoil removed as a result, and at a greater speed. The soils will be removed in such a way that they can be easily reinstated (if required) in the reverse order as detailed below.

A common approach is to be applied to all wetlands, with regard to removal of excavated material, whether side dug or on-line. The soil that is removed from the excavation at its deepest point will be laid closest to the excavation. The first layer of topsoil will be laid furthest away from the excavation. This will ensure that soil layers (strata) are well separated and can be more successfully re-used for rehabilitation elsewhere.

Subsoil will not be stored on geotextile, but instead will be laid directly on the un-stripped topsoil.

As a result of the standard approach to excavations, whereby separate strata as identified are removed and stored to one side in the order in which they were removed, rehabilitation operations elsewhere are somewhat simplified.

Where special conditions occur, such as the presence of an impermeable clay layer, the foreman will be advised accordingly on site by an Environmental Representative (ER) of the Contractor, and may be instructed via signage at the entrance to the wetland area to ensure it is clearly returned to the same depth and compaction as the surrounding layer (if the intention is to return the soil to the area excavated).

Where trench breakers are required, these will be imported appropriately and installed by a suitably qualified and experienced crew, as instructed by the Engineer, using information provided in the relevant specialist reports.

However, if a saturated wetland is encountered, it will be important to ensure that any backfill (where required) to excavations is not overly compacted, such that it creates a subsurface dam. In these areas, the Engineer proposes that mechanical compaction should be minimised as far as possible. The principal aim will be to restore the backfilled material to a compaction resembling that of the trench walls and existing strata.

Where a dry wetland is encountered, backfill (where required) will be done to the standard specification using mechanical aids, if and when practicable.

Depending on the type of material removed from the excavated area, it will be necessary to import amounts of layering material. This is typically defined by the Engineer according to the Clients specifications.

Any large boulders encountered during excavations will not be returned to the excavation, but removed off site and disposed of according to the requirements outlined in the EA and EMPr.

Excess soil material will be temporarily windrowed and used within the rehabilitation phase elsewhere on site.

During excavation, or any other relevant works, the watercourse and its banks will be continually monitored.

3.3.1.5 Stream/River Crossings

It is envisaged that temporary restriction of watercourses will be required during the construction of the culvert sub-structures. This portion of the works must take place in the dry season (if possible) which would result in reduced risk and associated impacts on the watercourse because of the substantially lower flow. In the event of a storm during the dry season, overtopping of the working platform will permit the storm flow to be contained within the normal stream profile. River / stream flow will be maintained at all times through fluming or damming by constructing a cofferdam and over-pumping, with sufficient pump capacity available in case of flooding.

The construction servitude (footprint) within the watercourse crossings must be kept to 30 m in width.

Only non-erodible material may be used to create any cofferdams (if required) to divert waters away from the works area.

River/ stream flow will be maintained at all times through fluming or damming/ over-pumping, with sufficient pump capacity available in case of flooding.

Wherever possible, and in case work during the dry season cannot be achieved, work in stream channels will be carried out without the use of 'in-river' techniques, instead using techniques that divert the flow around the works through flumes or by damming and pumping. This will minimise sediment release;

Should water be pumped from the dry working space within the watercourse, this water must be pumped into a retention dam/silt lagoon (or similar structure) to ensure sediment settles and clean water is released back into the watercourse.

No fuel may be stored within the (dry) bund area inside the stream/river, or anywhere else within 40 m of a watercourse.

The onus is on the Contractor to routinely check weather forecasts (on a daily basis) to prepare for inclement weather conditions, including possible flood events. All tools, equipment and machinery that could potentially have an adverse effect of the environment must be removed from the floodlines before the arrival of inclement weather with the potential for flooding. Appropriate spill response material must be available on site.

All petrochemical, cement and/or concrete and other hazardous spillages must be reported to the ECO, the Project Manager and any of the relevant authorities. Incidents are to be captured on the environmental incidents register when they occur and must be closed-out by the ECO following corrective action, where applicable, by the Contractor.

Prefabricated elements will be used where practicable in order to minimise construction duration and potentially environmental impacts associated to fabricating elements on site.

If wet cement and/or concrete works are necessary, ready-mix is to be preferred and care should be taken not to spill any product. All priming of hoses for concrete pours must be done away from sensitive areas in a manner that reduces environmental impacts to the bare minimum and can be cleared from site easily, for safe disposal to a licensed waste landfill site.

Waste management and house-keeping must be maintained at all times during construction. Sufficient waste receptacles must be available in the laydown area/s for containment of all waste produced on site. As a minimum requirement, general and hazardous waste must be separated and kept within sealed receptacles which do not allow for the ingress of water.

No material may be stored for longer than 24-hours within the working area within streams/rivers. Material sufficient for the day's work may only be allowed within the working area within the stream/river.

Where the Contractor wishes to deviate from this prescribed construction method statement, they must draft a site specific method statement for the approval of the Project Manager and ECO, and must ensure the method statement complies in its entirety with the EA, EMPr and all applicable licenses and permits for the project.

Monitoring will be undertaken as per the requirements stipulated in the EA, EMPr and all applicable license and permits, including the Water Use Licence.

3.4 Rehabilitation Activities

As soon as backfilling is complete, and the crew has vacated the watercourse, reinstatement of the construction footprint including dewatering areas (if required), can commence subject to appropriate site conditions.

Where a saturated wetland is encountered, all machines will work on the temporary access. The access will be removed in the reverse order in which it was laid.

Machines will remove the stone material which may be transported to another location and re-used if it is required (dependent upon the progress of construction), removed correctly to a licensed facility, or offered to the landowner. The geotextile base material is also removed during this operation, which ensures that no foreign material is left behind in the watercourse. Following the removal of these materials, the area below can be ripped to an appropriate depth to remove any minor compaction suffered by the preceding construction operations, and topsoil replaced. The pre-construction landscape profile will be restored, matching as closely as possible to the original land form prior to the distribution of the topsoil. This includes the re-distribution of any remaining windrowed material.

Where a dry wetland is encountered, there is no temporary access material to remove. The process of reinstatement will be similar to that described above. Machines will enter the area, and rip the subsoil area to a greater depth to fully reverse compaction from the preceding construction operations. All foreign materials, including boulders which may have arisen from the excavations, will be removed completely. Working out of the watercourse, the topsoil will be replaced in the same position as it was originally sited, and de-compacted where necessary in preparation for seeding.

For all watercourses, reinstatement will be implemented through continued liaison with a Wetland Specialist and/or the ECO, and both the Employer and Contractor environmental teams. Local wetland plants may be transplanted into the reinstatement area. Where possible, plants will be relocated during ROW preparation. However, the Contractor considers that rates of survival following transplantation of plants out of a watercourse and into a nursery-type area are often poor and involve increasing the footprint of the construction in the watercourse, and as such this is not the preferred method.

Transplantation of plants from one part of the undisturbed portion of the watercourse into the reinstated area can often prove far more successful in terms of survival rates, and this will be the preferred method for reinstatement, bolstered with the original seedbank within the replaced topsoil. Sourcing of wetland plants for transplanting will be scattered so as to limit impact on the source areas.

Mineral fertilizers and organic material (manure, compost, chicken litter etc.) will not be used in re-vegetation of wetland areas, and reliance will be chiefly on transplanting (as above).

All efforts will be taken to reverse compaction wherever it has occurred by loosening the soil to its original texture and restoring the natural soil profile of the affected area.

Special mitigating measures such as drainage, riprap, sediment and silt traps, diversion berms and gabions will be used throughout where required to mitigate soil erosion as per design by the Employer. Information in the wetland database, experience and judgment of the terrain will be used to inform the location of such measures.

Regular inspections of the reinstatement efforts are to be carried out by the Contractor's Environmental Representative/s and ECO/s to monitor the progress of the reinstatement and to determine when such efforts are deemed to be successful. Such inspections will be undertaken throughout the duration of the contract

period. Should additional measures be required within this period, the Contractor will implement these on instruction. Rehabilitation of disturbed watercourses will be completed to the satisfaction of the ECO.

The content of this Construction Work Method Statement will be brought to the attention of all persons associated with the undertaking of these activities and such measures as necessary will be taken to bind such persons to the requirements herein.

A copy of the Construction Work Method Statement and all applicable documents as set out in the EMPr will be on site at all times.

4 ENVIRONMENTAL MANAGEMENT STRATEGY

4.1 Environmental Impact Management

This Section must be read in conjunction with the EMPr prepared by Terratest. The EMPr sets out the specific actions and protocols for environmental management on site.

Changes and impacts to hydrology at landscape level; alteration of stream flow; increased erosion and deterioration of water quality (turbidity) are addressed in the design of the road and associated culverts, and watercourse crossings and the incorporation of sound environmental design principles as set out in the design drawings, and within the the *Biodiversity Assessment for the Ndumo Road (Project 3) Upgrade in Northern Kwazulu-Natal*, (Terratest, July 2014) and all other referenced documentation.

Nevertheless, certain activities and aspects associated with the actual construction, according to these designs, may still cause impacts as a result of how these activities are undertaken, where, when and the duration thereof. These include:

- Clearing of the road footprint (including extending activities beyond the maximum impact foot print)
- Establishment and management of the construction camp/s
- Management of construction materials (movement, storage, preparation/handling)
- Management of machinery (movement, storage, maintenance)
- Management of sanitation and waste (movement, storage)
- Management of stormwater
- Management of sediment (structures and containment)
- Rehabilitation

Possible impacts associated with these activities have been assessed in the Basic Assessment Study along with environmental significance ratings pre- and post-mitigation (i.e. indicating effectiveness of the mitigation measures set out). Mitigation measures are therefore provided according to activities and aspects described in the Environmental Aspects Register contained within the EMPr.

4.2 Monitoring and Review Strategy

Monitoring and reporting will be undertaken as set out in the EA, EMPr and WUL.

Steps for non-compliance are set out in the EMPr.

5 RESPONSIBILITIES

Various stakeholders responsibilities are as follows:

- The Employer, as the holder of the EA, shall be responsible for compliance to the requirements contained within the Final BAR, EA, EMPr, WULA and all relevant legislative requirements.
- The Design Engineer (Royal HaskoningDHV), as the Employer's Representative, manages the project on behalf of the Employer. The Design Engineer shall thus employ one (or more) Project Managers.
- The Contractor is responsible for overseeing and ensuring all prescribed activities as detailed by applicable project plans, method statements and statutory documents are executed accordingly on site; and reports to the Design Engineer.
- The Contractor's Safety Manager is responsible for advising on all safety aspects of construction activities. He reports to the relevant Project Manager.
- The Contractor's Designated Environmental Manager is responsible for advising on all environmental aspects of construction, and reports to the relevant Project Manager.
- The Environmental Representative/s of the Contractor, are responsible for ensuring all construction teams adhere to the appropriate environmental project plans, method statements and statutory documents. They report to the Contractor's Environmental Manager.
- The Environmental Control Officer/s (ECO/s) are an independent appointment. ECO/s is responsible for identifying and demarcating wetlands on the ground, following training from an appropriate Specialist, and auditing Contractor construction team performance against stipulations as outlined in the EA and EMPr. They report to the Employer and/or Design Engineer and the relevant Competent Authority according to the conditions of the EA, EMPr and WUL.

6 DECLARATIONS

6.1 Declaration of Understanding of EMPr

A Declaration of Understanding of the EMPr as presented below must be signed by a representative of each Developer, Engineer, Contractor and ECO and kept within the Site Environmental File on site.

DECLARATION OF UNDERSTANDING OF THE ENVIRONMENTAL MANAGEMENT PROGRAMME

I, _____

Representing _____

declare that I have read and understood the contents of the Environmental Specifications (which include the Environmental Management Programme, the Record of Decision and the Amended Environmental Authorisation, the Project Specifications and this guideline document) for Contract _____

I also declare that I understand my responsibilities in terms of enforcing and implementing the Environmental Specifications for the aforementioned Contract.

Signed: _____

Place: _____

Date: _____

Witness 1: _____

Witness 2: _____

6.2 Declaration of Understanding of Construction Work Method Statement

6.2.1 *Design Engineer*

The work described in this Work Method Statement, if carried out according to the methodology described, is satisfactorily mitigated to prevent avoidable environmental harm.

_____

Signed

_____

Print Name

_____

Date

6.2.2 *Site Manager*

I understand the contents of the Work Method Statement and the scope of works required from me.

_____

Signed

_____

Print Name

_____

Date

6.2.3 *Environmental Control Officer*

The works described in this Work Method Statement are approved.

_____

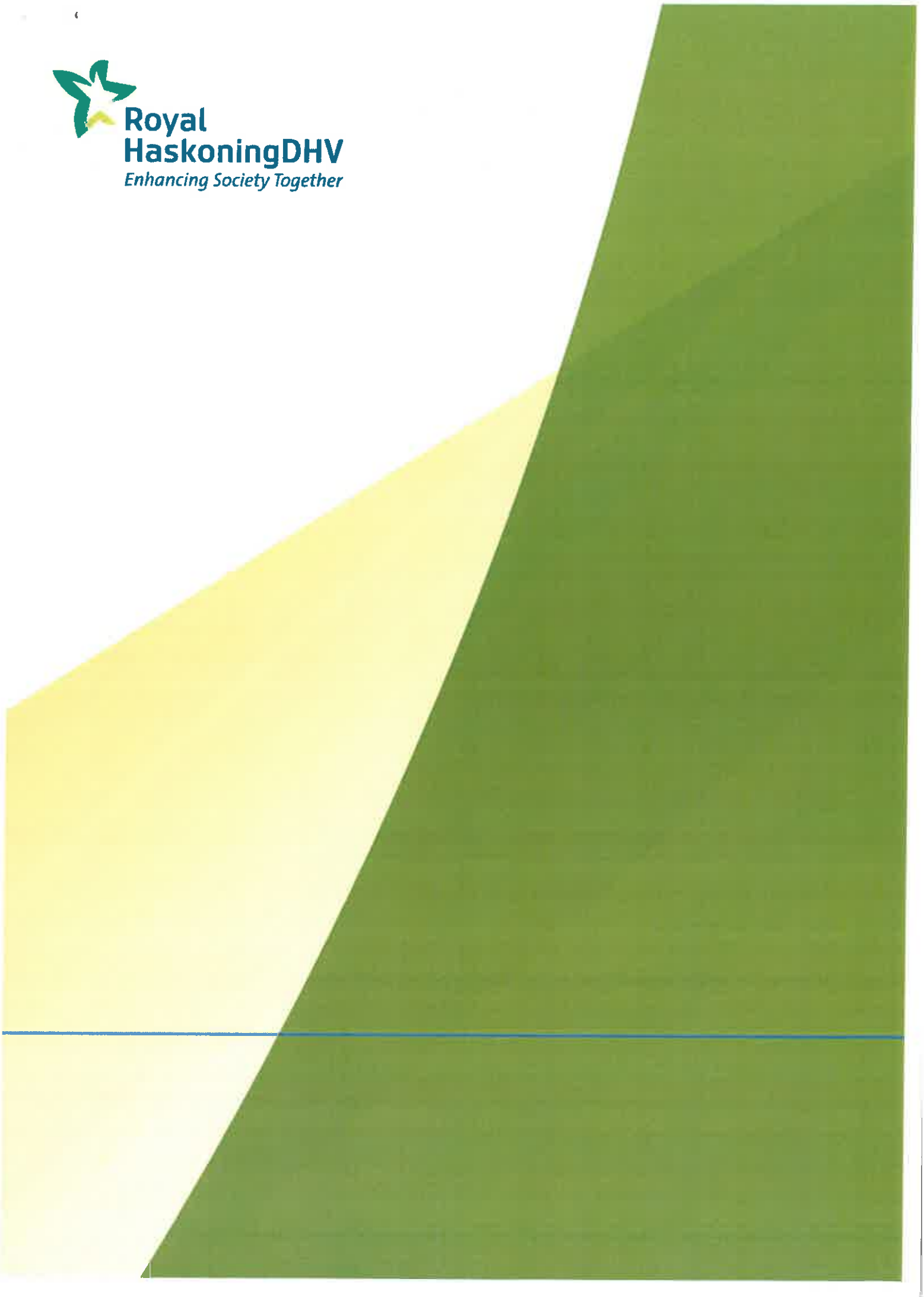
Signed

_____

Print Name

_____

Date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