ENVIRONMENTAL IMPACT ASSESSMENT

Direct, indirect and cumulative impacts of the issues identified through the basic assessment were assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5;
- The **magnitude**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- the **status**, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the *degree* to which the impact can be *mitigated.*

The **significance** is calculated by combining the criteria in the following formula:
S=(E+D+M)P

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

» < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
» 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
» > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

1. Impact Assessment

IMPACTS THAT MAY RESULT FROM THE PLANNING AND DESIGN PHASE
Alternative (preferred alternative)

No impacts are anticipated that may result from the planning and design phase of the proposed development.

IMPACTS THAT MAY RESULT FROM THE CONSTRUCTION AND OPERATIONAL PHASES

Only three major aquatic related impacts have been highlighted in this study. These impacts have been rated based on the direct versus indirect project actions / impacts, as well as any potential cumulative impacts during the construction and operational phases of the project. These were also assessed with and without mitigation. It should be noted that all of the impacts assessed would have a negative impact on the aquatic systems, being assessed with a high degree of confidence based on the understanding of aquatic systems in the region. Impacts would be similar for all of the roads and watercourse crossings, due to similarities in structure and function.

1.1. Impact 1: Diversion and increased velocity of surface water flows – Changes to the hydrological regime and increased potential for erosion

Nature of the impact

Due to the nature of the proposed project this would be an long term operational phase impact due to the installation of hard surfaces, limited to once the roads, stormwater management features, erosion protection structures and the culvert watercourse crossings have been constructed. These structures could interfere with natural run-off patterns, diverting flows and increasing the velocity of surface water flows. This then has the potential to increase the potential for erosion in the study area, while increasing sedimentation of downstream areas, once flows subside.

Significance of impacts without mitigation

The soils within the study area are susceptible to erosion when subjected to high flows (high volumes and velocities), with head-cuts readily forming within the streams and wetlands. This creates bed and bank instability in the aquatic ecosystems and consequent sedimentation of downstream areas. Should surface water flows be diverted, changes in local hydrological patterns could also occur, i.e. lead to the drying out of certain areas.

Due to the nature of the study area hydrology, its present state and the surrounding impacts (existing informal roads and alien plants), the negative impact, although permanent would be localised and probably result in a medium intensity impact. Thus the overall significance of the impact would be rated as **LOW** as downstream areas show a greater degree of degradation as compared to the site.

Proposed mitigation

The proposed stormwater management and erosion control plan, as well as a rehabilitation plan (As included within the Water Use License Application documentation approved by DWA) should be implemented. Stormwater and any runoff generated by the hard surfaces should be discharged into retention swales or areas with rock rip-rap. These energy dissipation structures should be placed in manner that flows are managed prior to being discharged back into the natural systems, thus not only preventing erosion, but would support the maintenance of natural base flows within these systems, i.e. hydrological regime (water quantity and quality) is maintained. The culvert crossings should also not trap any run-off, thereby creating inundated areas, but allow for free flowing systems. The degree of this mitigation would be rated as **LOW** (Table 1).

Significance of impact with mitigation

Although permanent changes to the local hydrological regime are probable, the intensity of the negative impact during the operational phase would be low, and thus the overall significance of this impact would be **LOW** (Table 3). This impact is also partially reversible should the roads and related infrastructure be decommissioned, i.e. changes to local soil structure and surrounding vegetation would still be apparent in the long term.

Table 1: Impact as a result of flow diversion and increased surface flow velocities

Potential impact on aquatic systems	**Proposed road and bridge crossings**
Nature of impact	Changes to localised hydrological regimes
Extent and duration of impact	Localised and permanent
Intensity of impact	Medium
Probability of occurrence	Probable
Degree to which impact can be reversed	Partially
Irreplaceability of resource	Low
Cumulative impact prior to mitigation	Low
Significance of impact pre-mitigation	Low
Degree of mitigation	High
Proposed mitigation	• Culvert structures within the watercourse should be kept to a minimum and not retain any middle channel flows • Include stormwater management systems along the roads that would reduce flow velocities. • Minimise the diversion of flows into different catchments.
Cumulative impact post mitigation	Low
Significance after mitigation	Low

1.2. Impact 2: Diversion and increased velocity of surface water flows – reduction in permeable surfaces

Nature of the impact

Road and culvert construction involves the creation of hard surfaces, which usually includes the provision of stormwater drainage. This will divert flow away from one water body, while increasing flow velocities of run-off into another, during the operational phase. This impact is closely linked to the previous impact, but the lack of permeable surfaces does require a separate assessment. This is due to the need for surface water to permeate into shallow, as well as deeper groundwater systems. This is important in both the maintenance of local aquifers, as well riparian associated vegetation dependent on subsurface flows. The action of percolating water through permeable surfaces also aids in the

reduction and / or removal of organic and inorganic pollutants contained in the surface waters.

Significance of impacts without mitigation

The soils within the study area are susceptible to erosion when subjected to high flows (high volumes and velocities), with head-cuts readily forming within the streams and wetlands. This creates bed and bank instability of the aquatic ecosystems and consequent sedimentation of downstream areas. Should surface water flows be diverted, changes in regional hydrological patterns could also occur, i.e. lead to the drying out of certain areas.

Due to the nature of the study area hydrology and its present state and the surrounding impacts (existing informal roads and alien plants), the negative impact, although permanent would be localised and probably result in a medium intensity impact. Thus the overall significance of the impact would be rated as **LOW** as downstream areas show a greater degree of degradation as compared to the site (Table 2).

Proposed mitigation

A stormwater and erosion control plan, as well as a rehabilitation plan should be implemented. Stormwater and any runoff generated by the hard surfaces should be discharged into retention swales or areas with rock rip-rap. These could be used to enhance the sense of place, if they are grassed with indigenous vegetation. These energy dissipation structures should be placed in manner that flows are managed prior to being discharged back into the natural systems, thus not only preventing erosion, but would support the maintenance of natural base flows within these systems, while the use of grassed swales would allow for localised groundwater recharge, i.e. hydrological regime (water quantity and quality) is maintained. The degree of this mitigation would be rated as low (Table 2).

Significance of impact with mitigation

Although permanent changes to the local hydrological regime are probable, the intensity of negative impact in the operational phase would be low, thus the overall significance of this impact would be **LOW**. This impact is also partially reversible should the roads and related infrastructure be decommissioned, i.e. changes to local soil structure and surrounding vegetation would still be apparent in the long term (Table 2).

Table 2: Potential impacts due to reduction in permeable surfaces

Potential impact on aquatic systems	Proposed road and bridge crossings
Nature of impact	Reduction in permeable surfaces
Extent and duration of impact	Localised and permanent
Intensity of impact	Medium
Probability of occurrence	Probable
Degree to which impact can be reversed	Partially
Irreplaceability of resource	Low
Cumulative impact prior to mitigation	Low
Significance of impact pre-mitigation	Low
Degree of mitigation	High
Proposed mitigation	All stormwater control features should have soft engineered areas that attenuate flows allowing for water to percolate in the local aquifers
Cumulative impact post mitigation	Low
Significance after mitigation	Low

1.3. Impact 3: Impact of changes to water quality

Nature of the impact

Presently little is known about the water quality of the region, but it is assumed due to the agricultural activities in the study area (cultivated lands and livestock grazing) the aquatic systems already contain high levels of nitrates, phosphates and organic matter.

During construction various materials, such as sediments, diesel, oils and cement, will pose a threat to the continued functioning of the wetland and instream areas, if by chance it is dispersed via surface run-off, or are allowed to permeate into the groundwater. The potential changes to water quality during the operational phase would be limited to sedimentation and erosion related issues assessed in Impact 1. These negative impacts would persist into the medium term

Significance of impacts without mitigation

Changes to water quality (surface and groundwater) impact on the functioning of plants and other wetland and instream biota. This impact without mitigation would have a **LOW** significance, as excessive pollution will also impact on wetland and instream conditions due the introduction of toxins (Table 3).

Proposed mitigation

- A stormwater management and erosion control plan, as well as a rehabilitation plan should be implemented.
- An environmental monitoring programme should be implemented.

- Chemicals used for road surfacing and culverts must be stored safely on site and surrounded by bunds. Chemical storage containers must be regularly inspected so as to prevent leaks into aquatic systems.
- Littering and contamination of water sources during construction must be mitigated by effective construction camp management.
- Emergency plans must be in place in case of spillages onto road surfaces and watercourses.
- No stockpiling should take place within a watercourse.
- All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds.
- Stockpiles must be located away from the wetland and watercourse areas if at all possible and for as short a time as possible.
- Erosion control of all banks must take place so as to reduce erosion and sedimentation into watercourses.
- The construction camp and necessary ablution facilities meant for construction workers must be well removed from the wetland and watercourse areas, preferably at a distance greater than 100m.

Significance of impact with mitigation

Should the construction site and the works be managed properly, the negative impacts would remain localised and in the short-term. This would result in an overall significance of **LOW** (Table 3).

Table 3: Impact on water quality

Potential impact on aquatic systems	**Proposed road and bridge crossings**
Nature of impact	Impacts water quality
Extent and duration of impact	Localised and short term
Intensity of impact	Medium
Probability of occurrence	Improbable
Degree to which impact can be reversed	Partially reversible
Irreplaceability of resource	Low
Cumulative impact prior to mitigation	Low
Significance of impact pre-mitigation	Low
Degree of mitigation	Low
Proposed mitigation	See list above
Cumulative impact post mitigation	Low
Significance after mitigation	Low