This chapter identifies and assesses the potential impacts the proposed Drennan PV power facility may have on soils, and surface- and groundwater. Listed activities specifically linked to this impact include:

- GN R 544 11 (xi), 22(ii)
- GN R 545 1, 8, 15
- GN R 546 14

These potential impacts are summarised in Table 7.1. There are six small dams that are located at points along the drainage lines within the Site, the nearest of which is located 35m to the south of the PV footprint (see Chapter 4).

The major ecological feature at the Site is a large drainage system which traverses the area and is considered ecologically sensitive and unsuitable for development. The proposed development, although located outside of the drainage system, presents a risk to sensitive receptors, specifically with regards to the potential for the run-off of soil debris or waste into the catchment areas surrounding drainage lines.

The specialist reports highlight that the entire Site is underlain by strongly structured duplex type soils (see Chapter 5). The defining characteristic of duplex soils is the enrichment of clay within the soil profile. This strong structure can be considered an impediment to root growth and water movement. Duplex soils present a variety of management challenges to farmers and engineers alike. The major concern relates to high erosion hazards that these soils exhibit. The main cause of erosion is clay dispersion, which gives rise to surface sealing and intensifies surface runoff.

**Table 7.1** Impact characteristics: Impacts on soils, surface water and groundwater

<table>
<thead>
<tr>
<th>Project Aspect/activity</th>
<th>Construction</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Soil compaction, removal of topsoil and erosion associated with clearance and preparation in the PV footprint, construction of compacted gravel tracks, laydown area etc.</td>
<td>(i) Soil erosion around cleared areas, roads and at the foot of PV panels.</td>
</tr>
<tr>
<td>(ii)</td>
<td>Impact on surface water and groundwater resulting from fuel, oils or cement spills.</td>
<td>(ii) Impact on surface water and groundwater resulting from fuel and oil spills.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(iii) Reduction of groundwater recharge due to sealed surfaces and PV panels.</td>
</tr>
</tbody>
</table>

Impact Type: Direct
### 7.1 LOSS OF TOPSOIL, SOIL COMPACTION AND EROSION

#### 7.1.1 Construction Phase Impacts

Preparation of the site for the establishment of PV arrays, underground cables, access road(s), temporary laydown area and buildings (control and accommodation) during the construction phase will require vegetation clearance, some site levelling and grading and soil compaction.

The area required for the PV array locations, buildings and access tracks linking infrastructure (PV Footprint) will be considerable. The total PV Footprint of the Drennan facility will be approximately 110 ha.

Construction at the Site could lead to increased erosion by concentrating water flows and removing the natural erosion protection (vegetation cover), as well as increasing run-off from the Site, thus reducing infiltration and groundwater recharge. This risk is compounded by the duplex soil type present at the site. The vegetation, surficial gravel layer and soil duricrust that is present on the Site all act as protection against erosion by water and wind. Removal of these by excavation, grading or clearing will encourage erosion. The vegetation cover is the most important physical factor influencing soil erosion. An intact cover reduces physical impact from rain-drops on the soil, slows down surface run-off, filters sediment and binds the soil together for more stability. The intensity of potential erosion is also influenced by precipitation which is generally low in this semi-arid region. The Mean Annual Precipitation (MAP) for the Study Area is 379 mm.

Run-off within the Site occurs over the entire area in the form of sheetwash\(^1\). Compaction of soils from increased levelling and grading of areas of the Site will result in lower permeability and therefore decrease infiltration and increased runoff. Without appropriate measures, runoff from PV panels, compacted areas and hardstanding areas in addition to erosion by wind may increase erosion and increase the sediment load in run-off. Potential impacts to surface water are assessed further in Section 7.2.

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\(^1\) Sheetwash refers to gradual erosion whereby a thin film of water transports soil particles over the land surface, without resulting in the formation of gullies or channels (definition adapted from the Oxford Dictionary of Geography).
In addition, the permanent removal of the topsoil horizon changes the soil profile which may inhibit rehabilitation which may, in turn, increase the erosion potential of the soil.

Furthermore, soil may undergo chemical degradation as a result of spills or leaks of fuels, oils and lubricants from construction vehicles. These impacts are dependent on the size of the spill and the speed with which it is remediated. The likelihood of a spill is also associated with the volume of product that may be stored onsite. Typically for a development of this nature, above ground storage tanks for diesel and varying amounts of hydraulic oils, transformer oil and used oils will be required onsite during the construction phase.

Box 7.1  
**Construction Impact: Loss of Topsoil, Soil Compaction and Soil Erosion**

<table>
<thead>
<tr>
<th>Nature:</th>
<th>The loss of topsoil, changes in the soil profile through compaction, potential soil erosion and contamination will have a <strong>negative direct</strong> impact on the soils of the Site.</th>
</tr>
</thead>
</table>

**Impact Magnitude – Medium**

- **Extent:** The extent of the impact is **local**. Although the impacts are predominantly limited to the boundaries of the Site, there is a chance they may extend beyond the Site.
- **Duration:** The duration would be **long-term** since although removal of topsoil and compaction in areas of the Site will occur largely during the construction phase, the effect may continue through the Project lifecycle.
- **Intensity:** The intensity is **medium** since although topsoil removal and soil compaction may be limited to specific areas of the Site, potential erosion may affect a larger area.

**Likelihood** – It is **likely** that this impact will occur.

**IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-VE)**

**Degree of Confidence:** The degree of confidence is **medium**.

### 7.1.2 Operational Phase Impacts

Soil erosion caused by stormwater or surface water runoff may occur during the operational phase as a result of additional impervious surfaces onsite, such as the gravel compacted roads, and the laydown and storage areas used for the construction phase, resulting in increased runoff. In addition, although the disturbance associated with the construction phase will have ended, unless mitigation measures are undertaken, loss of topsoil may continue during the operational phase of the Project. No topsoil clearing is anticipated during routine operation and maintenance of the facility, although effects of wind could exacerbate erosion where vegetation cover has been removed.

Obstructions such as poles supporting the PV structures, building foundations and compacted gravel tracks on the Site may concentrate water flows into catchment areas feeding surrounding drainage lines. Surface water flows diverted along tracks and infilled trenches could also result in in the formation of eroded gullies or dongas.
Box 7.2 Operational Impact: Loss of Topsoil, Soil Compaction and Soil Erosion

Nature: Routine operational and maintenance activities may result in a negative direct impact on the soils at the Site, whereas PV panels acting as wind breaks result in a positive direct impact on soils located in the vicinity of the PV Footprint.

Impact Magnitude – Medium
- **Extent:** The extent of the impact is local; the impacts are predominantly limited to the Site boundaries but may extend to the immediate surrounds of the Site.
- **Duration:** The duration would be long-term as the soils may be affected at least throughout the operational phase of the Project.
- **Intensity:** The intensity is medium since the source of the impact will be limited to areas inside the infrastructure footprint, however, significant loss of soil can result from erosion caused by excessive runoff if not mitigated adequately.

Likelihood - It is likely that these impacts will occur.

IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE (-VE)

Degree of Confidence: The degree of confidence is medium.

7.1.3 Mitigation

**Design Phase**

- Clearing activities will be kept to a minimum and will only be undertaken during agreed working times as permitted by suitable weather conditions. If heavy rains or severe winds are expected, clearing activities will be put on hold. In this regard, the developer and contractor will be cognisant of regional weather forecasts and the seasonal climate characteristics of the Study Area.

**Construction Phase**

- Drainage lines or hydraulic corridors identified traversing the Site, especially immediately below the culvert outlets (at the railway), will be kept open. Should the drainage lines not be avoided, adequate breadth and width below panels and supports will be maintained so as not to trap debris.

Following the clearing of an area, the surfaces of all exposed slopes will be roughened to retain water and increase infiltration (especially important during the wet season). Any steep or large embankments that are expected to be exposed during the rainy months will either be armoured with fascine like structures or vegetated\(^1\).

- Regular diversion berms will be built on gravel compacted roads.

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\(^1\) A fascine structure usually consists of a natural wood material and is used for the strengthening of earthen structures or embankments.
- The removal of vegetation and soil cover will be restricted to only those areas necessary for the development. In particular, the unnecessary removal of groundcover vegetation from slopes will be prevented, especially on steep slopes.

- Soil conservation measures will be implemented such as stockpiling topsoil or gravel for the remediation of disturbed areas.

- Stockpiles will be vegetated or appropriately covered to reduce soil loss as a result of wind or water erosion.

- Disturbed areas will be rehabilitated as soon as possible to prevent erosion.

- Work areas will be clearly defined and where necessary demarcated to avoid unnecessary disturbance of areas outside the development footprint.

- Fuel, oil and used oil storage areas will be contained in bunds of 110 percent capacity of the stored material.

- Spill containment and clean up kits will be available onsite and clean-up from any spill will be appropriately contained and disposed of.

- Construction vehicles and equipment will be serviced regularly and off site.

- Construction vehicles will remain on designated and prepared compacted gravel roads. The additional creation of access roads will be kept to a minimum. Where roads need to be created, a dual tyre track road will be used rather than clearing the entire road width.

**Operational Phase**

- Laydown or infrastructure assembly areas not required during the operational phase of the PV power facility will be re-vegetated with indigenous vegetation to prevent erosion immediately after these areas are no longer required for construction.

- Bi-annual monitoring of erosion in the vicinity of roads, PV arrays and other hard-standing surfaces will be conducted before and after the rainy season to ensure erosion sites can be identified early and remedied.

**7.1.4 Residual Impacts**

Assuming the above stipulated mitigation measures are implemented, the residual impact significances for the construction and operational phases are reduced to *Minor* negative.
Table 7.2  Pre- and Post-Mitigation Significance: Loss of Topsoil, Soil Compaction and Erosion

<table>
<thead>
<tr>
<th>Phase</th>
<th>Significance (Pre-mitigation)</th>
<th>Residual Significance (Post-mitigation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>MODERATE(-VE)</td>
<td>MINOR(-VE)</td>
</tr>
<tr>
<td>Operation</td>
<td>MODERATE(-VE)</td>
<td>MINOR(-VE)</td>
</tr>
</tbody>
</table>

7.2 IMPACT ON SURFACE AND GROUNDWATER

7.2.1 Construction Phase Impacts

As mentioned in Section 7.1, soil compaction and vegetation clearance may increase the intensity and volume of surface water runoff as a result of a decrease in water infiltration recharging the groundwater. This may impact drainage lines within the Site by exacerbating erosion features, and increasing the sediment load of the water entering these channels when they are flowing. Increased run off from hard standing areas could result in the creation of drainage lines and damage to solar infrastructure and installation equipment by debris, and the deepening and lateral erosion of channels and loss of infiltration.

The major surface water feature is the drainage system present on the Site. The PV Footprint avoids the drainage lines, and therefore has no direct impact on them.

The storage of petroleum products on site (diesel, petrol (ULP) and oil) in ASTs poses a potential risk of soil contamination. Hydrocarbons are toxic to the ecosystem. Unintended leaks or spills of petroleum products would have a negative impact on the soil ecosystem. The extent and impact of potential groundwater or surface water contamination is largely dependent on the nature of the subsurface soil conditions. The risk of petroleum products in the ecosystem is judged using a source-receptor model. The presence of a receptor in the area such as an aquifer, increases the risk of the potential impact, as the aquifer acts as a receptor and further disperses the hydrocarbons. As mentioned above petroleum products are also a potential human health and safety problem.

Groundwater may be impacted as a result of infiltration of contaminants associated with spills or leaks of fuels, oils and lubricants from construction vehicles or storage tanks. Petroleum product storage on site is described in Chapter 4. Hydrocarbons are toxic to the ecosystem, with spills and leaks of hydrocarbon product having potential negative impacts on the surface and groundwater ecosystems. Hydrocarbons are also a health and safety risk to humans. Hydrocarbons such as diesel and petrol may cause respiratory tract irritation, headaches, dizziness, drowsiness, nausea and may lead to unconsciousness. Additionally, the Benzene contained in these petroleum products is carcinogenic (cancer causing). The likelihood of a spill is
associated with the volume of product that may be stored onsite. These impacts are dependent on the size of the spill and the speed with which it is remediated, as well as the vulnerability and susceptibility of the aquifer\(^{(1)}\). Given the low level of vulnerability and susceptibility of the aquifer, the potential impacts due to spills are likely to be of a lower significance.

**Box 7.3 Construction Impact: Impact on Surface and Groundwater**

**Nature:** Surface and groundwater impacts resulting from soil compaction, increased sediment load or through leaks or spills would result in a **negative direct** impact.

**Impact Magnitude – Low**
- **Extent:** The extent of the impact is **local** since the impacts are limited predominantly to the boundaries of the Site or in the vicinity of the Site.
- **Duration:** The duration for impacts to the creation of new drainage channels would be **permanent** since the Site’s natural pattern of runoff would be permanently altered. Impacts to water quality from spills would be **short-term** depending on the size or nature of the spill.
- **Intensity:** The intensity is **medium** since runoff is expected to be of a low to medium level of intensity, in addition to the fact that the quantity of dangerous goods stored onsite will be relatively small.

**Likelihood** – It is **likely** that this impact will occur.

**IMPACT SIGNIFICANCE (PRE-MITIGATION) – MINOR (-VE)**

**Degree of Confidence:** The degree of confidence is **medium**.

### 7.2.2 Operational Phase Impacts

Soil erosion caused by storm water or surface water runoff may occur during the operational phase and result in an increase in the sediment load of onsite runoff. Obstructions such as foundations and roadways may concentrate water flows into catchment areas feeding surrounding drainage lines. Similarly, flows diverted along tracks and infilled trenches may also result in soil erosion, creating new gullies or dongas. These impacts will last the duration of the operational phase.

Surface water and groundwater impacts associated with leaks and spills are reduced during the operation phase since on-site storage of hydrocarbons and site activities will be considerably reduced.

Due to proposed hard standing areas (lay down areas, building foundations, compacted gravels roads), compacted soil (rows between arrays) and PV panels covering large parts of the Site (covering approximately 110 ha), recharge to groundwater from rainfall is expected to be reduced on the Site.

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\(^{(1)}\)Vulnerability in this instance refers to the tendency or likelihood for contaminants to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer. Susceptibility refers to a qualitative measure of the relative ease with which a groundwater body can be potentially contaminated by anthropogenic activities and includes both aquifer vulnerability and the relative importance of the aquifer in terms of its classification.
Box 7.4  

**Operational Impact: Impact on Surface- and Groundwater**

**Nature:** Increased sediment loads in runoff, spills and leaks during routine operational and maintenance activities and reduced groundwater recharge may result in a **negative direct** impact on surface- and groundwater.

**Impact Magnitude – Medium-Low**

- **Extent:** The extent of the impact is **local** since the impacts are limited predominantly to the boundaries of the Site or in the vicinity of the Site.
- **Duration:** The duration for contamination would be **short to long-term** depending on the size of the spill. The duration for increased sediment loads and reduced groundwater recharge would be **long-term**.
- **Intensity:** The intensity is **low** since the size of a spill is likely to be small given the limited volume of product to be stored onsite. Intensity for change in flow during the operation phase and increased sediment load will be **medium** and for reduced groundwater recharge **low** since the natural groundwater recharge from rainfall in the area is low.

**Likelihood** – It is **likely** that this impact will occur.

**IMPACT SIGNIFICANCE (PRE-MITIGATION) – MODERATE-MINOR (-VE)**

**Degree of Confidence:** The degree of confidence is **medium**.

### 7.2.3 Mitigation

**Design Phase**

- Appropriate contractors who will be responsible for removing spillage residue from the Site will be appointed. Handling, storage and disposal of excess or containers of potentially hazardous materials will be in accordance with the requirements of the relevant legislation (see **Chapter 2**).

**Construction Phase**

- Drainage lines or hydraulic corridors identified traversing the Site will be kept open, especially immediately below the culvert outlets (at the railway on the eastern boundary of the Site).

- Fuel, oil and used oil storage areas will be contained in bunds of 110 percent capacity of the stored material.

- Spill containment and clean up kits will be available onsite and clean-up from any spill will be appropriately contained and disposed of at a registered landfill site.

- Project staff will not be permitted to utilise any water sources (stream, river, or other water bodies) for the purposes of bathing, washing of clothing or for any other construction or related activities.
- Construction vehicles and equipment will be serviced regularly.

- Construction vehicles and equipment will be serviced off site.

*Operational Phase*

- Fuel, oil and used oil storage areas will be contained in bunds of 110 capacity of the stored material.

### 7.2.4 Residual

The PV Footprint avoids the drainage lines which occur at the Project Site. Assuming the above stipulated mitigation is implemented, the residual impact significances on surface and groundwater is reduced to *Minor* negative in the construction and operational phases (*Table 7.3*).

**Table 7.3 Pre- and Post-Mitigation Significance: Impacts on Surface and Groundwater**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Significance (Pre-mitigation)</th>
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