

ROUTE PLANNING AND TRANSPORT ASSESSMENT REPORT

Planets & BBR Energy Facility (PV and BESS Energy Facility) —

Implementation, Construction and Operational Phases

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Project Cluster:	Gillimberg Cluster (Planets Energy Facility & BBR Energy Facility — 2 × 200 MWac PV + BESS) **Implementation, Construction, and Operational Phases**
Location:	± 46 km west of Polokwane / ± 40 km north of Mokopane, Limpopo Province, South Africa
Municipalities:	Mogalakwena LM (Waterberg DM) & Polokwane LM (Capricorn DM)
Grid Interconnection:	Eskom Borutho Substation
Primary Route:	N11 (Mokopane–Groblersbrug) → Raowele Turn-off → Luxemburg / Ga-Mashashane → Borutho Substation
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TABLE OF CONTENTS

1. INTRODUCTION 3
    1.1 Assessment Overview and Parameters 3
2. SITE LOCATION AND REGIONAL CONTEXT 3
3. ROUTE DESCRIPTION, GEOMETRY, AND DISTANCE ASSESSMENT 3
    3.1 Route Breakdown by Segment 4
    3.2 Total External Route Summary 4
4. EXTERNAL ROAD NETWORK AND ROUTE PLANNING ASSESSMENT 5
    4.1 N11 National Route and Raowele Intersection 5
    4.2 Existing Gravel Access Road (Raowele – Luxemburg / Ga-Mashashane – Borutho Substation) 5
    4.3 Proposed New Access Road (Eskom Borutho Substation to Project Site) 5
5. EXTERNAL TRANSPORT ASSESSMENT BY PROJECT PHASE 5
    5.1 Implementation (Pre-Construction / Mobilisation) Phase 5
    5.2 Construction Phase 6
    5.3 Operational Phase 6
6. PRELIMINARY INTERNAL TRAFFIC ASSESSMENT AND RISK EVALUATION 7
    6.1 Internal Road Hierarchy and Geometric Design Criteria 7
    6.2 Internal Traffic Generation and Circulation Zones 7
    6.3 Internal Traffic Flow and Conflict Interface Analysis 7
    6.4 Preliminary Internal Traffic Risk Evaluation Matrix 8
7. VEHICLE FLEET, DELIVERY VOLUMES, AND LOGISTICS PROGRAMME 8
    7.1 Estimated Delivery Trips (Full 400 MWac + BESS Cluster) 8
    7.2 Cycle Time and Phased Scheduling 9
8. EXTERNAL ROUTE RISK ASSESSMENT AND MITIGATION MATRIX 9
9. CONCLUSION AND IMMEDIATE NEXT STEPS 9

LIST OF FIGURES

Figure 3-1: Regional and Local Access Corridor — Mokopane (ex-JHB/PTA) to Project Site 3
Figure 3-2: Local Access and Site Vicinity Satellite Map — Eskom Borutho Substation 4
Figure 5-1: Gillimberg Cluster Detailed Access Route and Facility Layout Alignment 6

LIST OF TABLES

Table 3-1: Total External Access Route Summary 4
Table 6-1: Internal Site Road Hierarchy and Geometric Design Criteria 7
Table 6-2: Preliminary Internal Traffic Risk Evaluation Matrix 8
Table 7-1: Estimated Equipment Delivery Trips (Full 400 MWac + BESS Cluster) 8
Table 8-1: External Route Risk Assessment and Mitigation Matrix 9

1. INTRODUCTION

This report documents the route planning and transport assessment for the proposed Gillimberg Cluster, comprising the Planets and BBR Energy Facilities (2 × 200 MWac ground-mounted solar PV installations integrated with Battery Energy Storage Systems [BESS]). The development footprint is situated approximately 46 km west of Polokwane and 40 km north of Mokopane in Limpopo Province, spanning the administrative boundary between the Waterberg District Municipality (Mogalakwena Local Municipality) and the Capricorn District Municipality (Polokwane Local Municipality).

The objective of this assessment is to define the external and internal access corridors and evaluate the geometric, structural, and regulatory capacity of the road network across the Implementation (pre-construction), Construction, and Operational phases. Findings are based on desktop GIS alignment modeling and engineering capacity estimates, intended to guide detailed topographical route surveys, authority engagement, and permitting.

1.1 Assessment Overview and Parameters

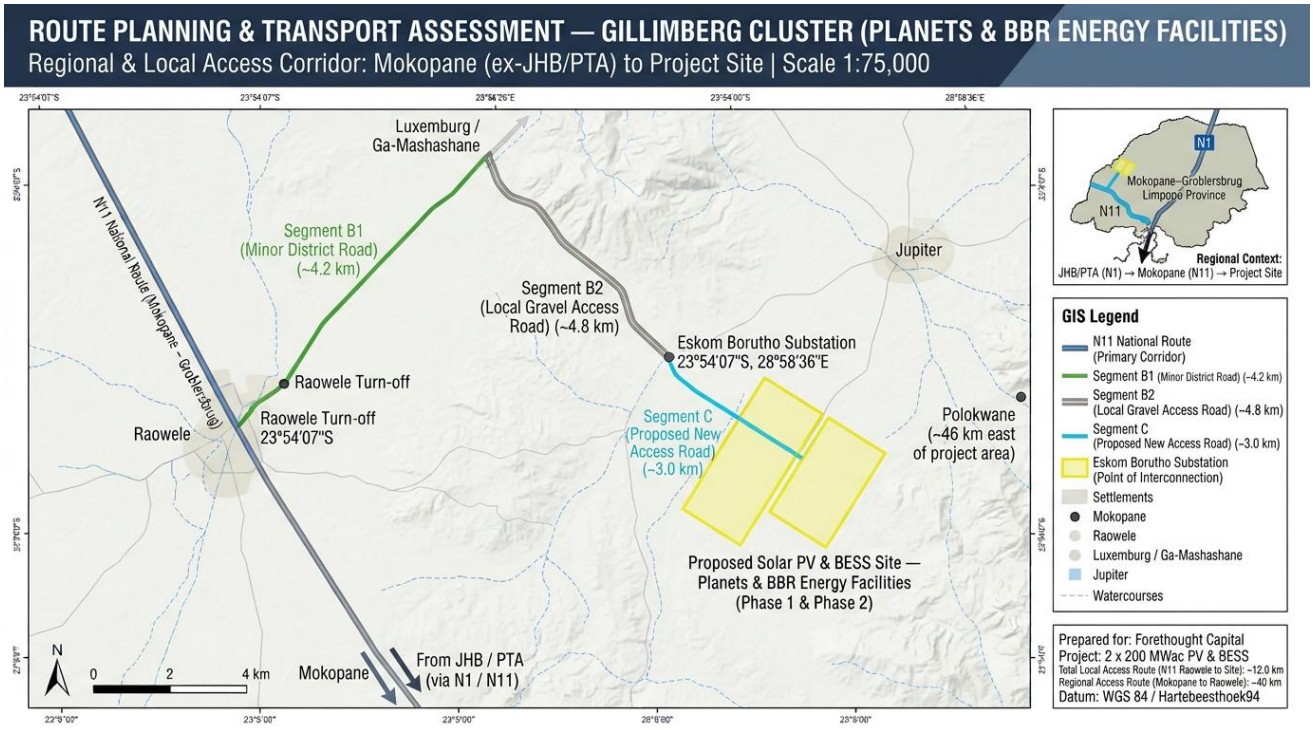
- **Project Cluster:** Planets Energy Facility (200 MWac + BESS) and BBR Energy Facility (200 MWac + BESS), developed across phased footprints.
- **Geographical Context:** ± 46 km west of Polokwane / ± 40 km north of Mokopane, Limpopo Province.
- **Administrative Jurisdiction:** Mogalakwena Local Municipality (Waterberg DM) and Polokwane Local Municipality (Capricorn DM).
- **Point of Interconnection:** Eskom Borutho Substation.
- **Designated Access Corridor:** N11 National Route (Mokopane–Groblersbrug), branching east at the Raowele turn-off onto a minor road towards Luxemburg / Ga-Mashashane, continuing via a local gravel road to Eskom Borutho Substation, and terminating via a new purpose-built access road to the project sites.

2. SITE LOCATION AND REGIONAL CONTEXT

Regional freight and abnormal load movements to the Gillimberg Cluster rely on the N11 National Route, a primary north–south arterial corridor linking Mokopane (and the N1 corridor further south) to the Groblersbrug border post. Project traffic exits the N11 at the Raowele junction onto an existing minor gravel road running northeast towards Luxemburg / Ga-Mashashane, before turning southeast onto a local gravel access road leading to the Eskom Borutho Substation. From the substation perimeter, a new engineered access road will extend eastward to the Planets and BBR project boundaries.

3. ROUTE DESCRIPTION, GEOMETRY, AND DISTANCE ASSESSMENT

Alignment distances were derived from GIS route vertices using great-circle (haversine) segment calculations. These figures reflect horizontal centerline distances and require field verification via physical centerline staking and geometric surveying prior to civil works.



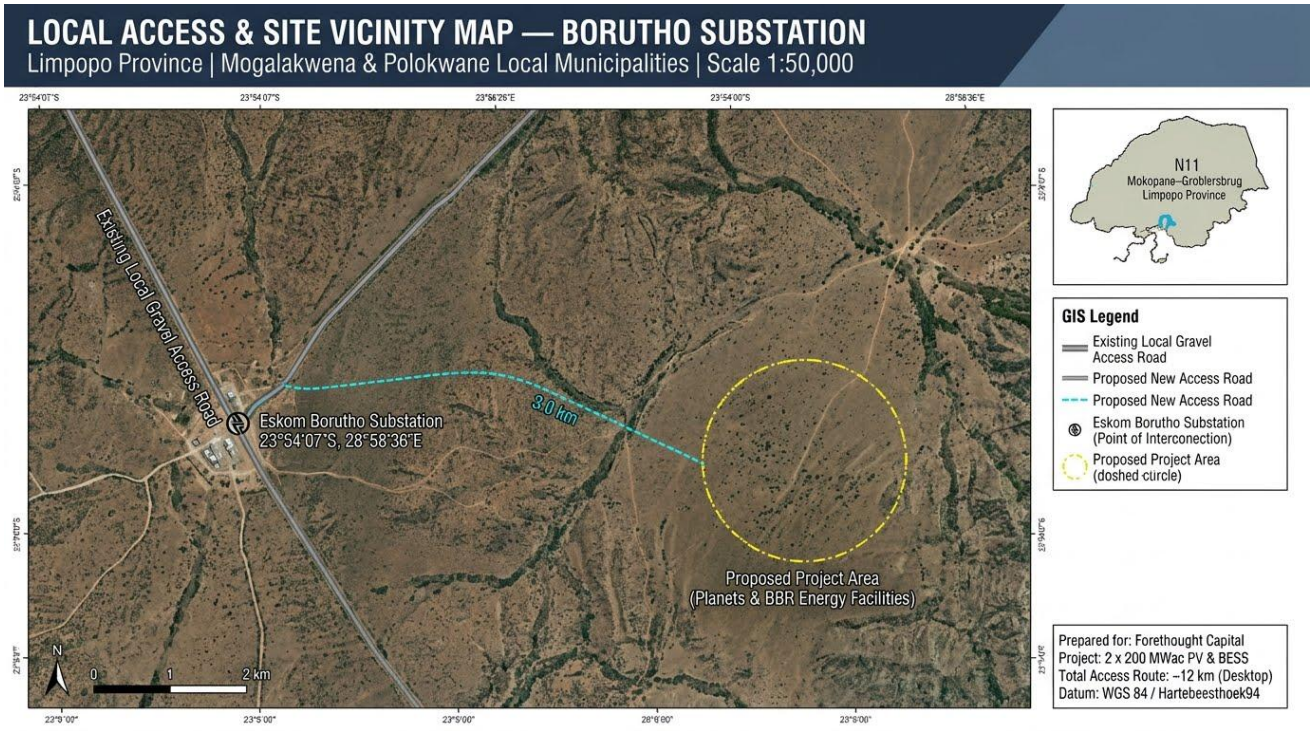
3.1 Route Breakdown by Segment

- **Segment A — Regional Trunk Route (N11 National Route):** Surfaced national arterial road managed by SANRAL, connecting Mokopane to the Raowele intersection.
- **Segment B — Existing Minor and Local Gravel Roads (Raowele Turn-off to Eskom Borutho Substation):** Approximately 9.0 km of existing unpaved district and local road. The alignment proceeds northeast from Raowele towards Luxemburg / Ga-Mashashane (~4.2 km) before executing a sharp right-hand deflection southeast towards Eskom Borutho Substation (~4.8 km), traversing minor seasonal drainage lines.
- **Segment C — Proposed New Access Road (Eskom Borutho Substation to Project Sites):** Approximately 3.0 km of greenfield access road extending east from the substation perimeter across undeveloped terrain and a watercourse crossing to the western boundary of the Planets and BBR footprints.

3.2 Total External Route Summary

Route Segment	Road Classification	Surface Type	Approx. Length
Segment A: N11 Corridor (Mokopane to Raowele)	National Route (SANRAL)	Surfaced (Asphalt)	Regional
Segment B1: Raowele Turn-off towards Luxemburg / Ga-Mashashane	Minor District Road	Unpaved Gravel	~4.2 km
Segment B2: Luxemburg / Ga-Mashashane Turn-off to Borutho Substation	Local Access Road	Unpaved Gravel	~4.8 km
Segment C: Borutho Substation to Planets & BBR Sites	Proposed Project Road	Engineered Gravel	~3.0 km
TOTAL LOCAL ACCESS ROUTE (N11 Turn-off to Site Boundary)	—	—	≈ 12.0 km

Note: An effective one-way haulage distance of 15.0 km (30.0 km round trip) is applied in Section 7 for logistics cycle-time modeling to incorporate internal site distribution haulage and passing-bay delays.



4. EXTERNAL ROAD NETWORK AND ROUTE PLANNING ASSESSMENT

4.1 N11 National Route and Raowele Intersection

- **Structural Capacity:** The N11 is constructed to national heavy-freight pavement standards and accommodates legal interlink combinations as well as permitted abnormal loads.
- **Intersection Geometry:** The existing N11 / Raowele junction is an unsignalized rural T-junction lacking dedicated deceleration lanes or wide turning bell-mouths. Turning movements by 22 m interlink trucks and multi-axle abnormal trailers present rear-end conflict and edge-break risks.
- **Engineering Requirement:** AutoTURN swept-path verification and a formal SANRAL Road Access / Intersection Upgrade design (incorporating bell-mouth widening and temporary shoulder tapers) must be executed prior to construction mobilisation.

4.2 Existing Gravel Access Road (Raowele – Luxemburg / Ga-Mashashane – Borutho Substation)

- **Pavement Condition:** Currently a low-volume rural gravel road (6.0 m to 7.0 m carriageway width) exhibiting localized corrugations, rutting, and thin wearing-course gravel. In its current state, it cannot sustain high-frequency 28–34 tonne axle loads without rapid subgrade failure.
- **Horizontal Deflections:** Includes two restrictive horizontal curves—most critically the sharp deflection near Luxemburg / Ga-Mashashane—where existing inner radii are insufficient for extended abnormal load trailers.
- **Drainage Infrastructure:** Relies on shallow side drains and small-diameter pipe culverts susceptible to overtopping and washouts during summer rainfall events (November–March).

- **Settlement Interface:** Passes directly adjacent to residential properties in Raowele and near Luxemburg / Ga-Mashashane, creating sensitive dust, noise, and pedestrian exposure zones.

4.3 Proposed New Access Road (Eskom Borutho Substation to Project Site)

- **Design Standard:** Because Segment C (~3.0 km) is a new alignment, it will be engineered from inception for 90+ tonne gross vehicle mass (GVM) abnormal loads and all-weather heavy construction traffic.
- **Geometric & Pavement Criteria:** Minimum 8.0 m carriageway width, imported G5/G6 gravel wearing course compacted to 95–98% Mod AASHTO, maximum longitudinal grade of 8%, minimum horizontal curve radius of 35 m, and reinforced concrete box culverts at the main drainage crossing.

5. EXTERNAL TRANSPORT ASSESSMENT BY PROJECT PHASE

5.1 Implementation (Pre-Construction / Mobilisation) Phase

This phase covers geotechnical drilling, topographical staking, environmental walkdowns, perimeter fencing, and establishment of contractor camps and laydown yards using LDVs, 4×4 vehicles, flatbed drill rigs, and light earthmoving plant.

- **Route Readiness Actions:** Execute the physical abnormal load route survey, finalize way-leaves and Road Use Agreements with SANRAL, Limpopo Department of Public Works, Roads and Infrastructure (LDPWRI), Mogalakwena LM, and Polokwane LM, and complete Segment B upgrades and Segment C construction ahead of primary equipment deliveries.

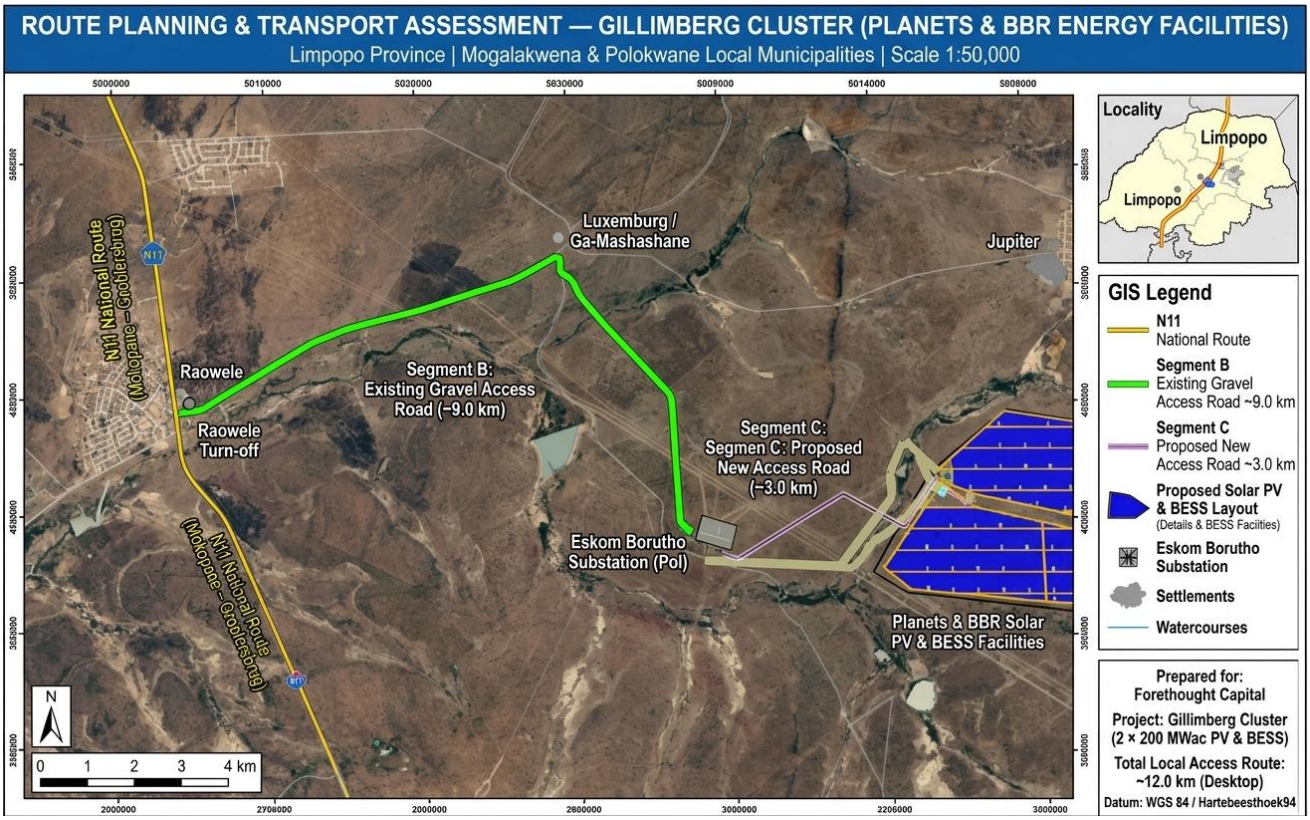
5.2 Construction Phase

Peak freight and workforce movements occur during construction. Deliveries across the Planets and BBR footprints will be staggered to prevent queuing along the single-lane gravel corridor.

- **Typical Freight Fleet:** 22 m interlink trucks for PV modules and trackers; low-bed and skeletal trailers for 2.5 MW central inverters and containerized BESS enclosures (30–40 t); multi-axle hydraulic modular trailers with traffic escorts for main power transformers (60–90 t); and 10–20 m^3 tippers for bulk aggregates and civil materials.
- **Workforce Transport:** Scheduled buses and minibus taxis operating daily shifts from Polokwane, Mokopane, Raowele, and Jupiter.
- **Corridor Controls:** Construct 50 m × 3.5 m formal passing bays at 1.0 km intervals along Segments B and C, enforce 30 km/h speed limits through settlements, restrict heavy haulage during school peak hours (06:30–08:00 and 13:30–15:00), and maintain continuous water/chemical dust suppression.

5.3 Operational Phase

Operational traffic drops to fewer than 15–20 light vehicle movements per day across both facilities, comprising O&M LDVs, panel-washing water bowsers, and infrequent heavy crane/low-bed access for major component replacement. An annual Operational Road Maintenance Plan will preserve all-weather emergency access over the 25+ year design life.



6. PRELIMINARY INTERNAL TRAFFIC ASSESSMENT AND RISK EVALUATION

Once construction and operational vehicles enter the Planets and BBR project boundaries at the terminus of Segment C, traffic transitions from a linear corridor to a distributed internal site network. Because the Gillimberg Cluster spans two adjacent 200 MWac solar PV arrays and BESS compounds, uncoordinated internal movements between laydown yards, inverter stations, substation bays, and active trenching zones introduce distinct geometric, geotechnical, and operational hazards.

6.1 Internal Road Hierarchy and Geometric Design Criteria

To segregate heavy freight from light site supervision vehicles and emergency plant, the internal road network is classified into three functional tiers:

Internal Road Tier	Function & Coverage	Minimum Width	Wearing Course & Compaction	Design Speed
Primary Spine / Main Haul Road	Links Segment C entry to main laydown yards, BESS compounds, and O&M buildings	7.5 m – 8.0 m (two-way)	150 mm G5 gravel wearing course on ripped/compacted in-situ subgrade (95% Mod AASHTO)	30 km/h
Secondary Feeder / Array Roads	Internal collector grid serving inverter/transformer stations and block perimeters	5.0 m – 6.0 m (single-lane + passing bays)	150 mm engineered local gravel / G6 wearing course (93% Mod AASHTO)	25 km/h
Perimeter & Firebreak Tracks	Security patrol, fence inspection, and emergency fire-fighting access	4.0 m cleared track	Graded and compacted in-situ material with localized drainage cross-falls	20 km/h

6.2 Internal Traffic Generation and Circulation Zones

- **Main Gatehouse and Security Staging Area:** Must incorporate an off-road staging apron capable of holding at least four 22 m interlink trucks simultaneously to prevent tailbacks onto Segment C during security inductions and waybill verification.
- **Central Laydown and Container Storage Yards:** Designed as one-way drive-through loops with minimum 25 m inner turning radii so interlink and skeletal trailers can offload without executing blind reverse maneuvers.
- **BESS and Substation Heavy-Haul Pads:** Require reinforced crane hardstands and turning aprons engineered for high outrigger bearing pressures (> 250 kPa) during offloading of 35–40 t BESS enclosures and 60–90 t transformers.
- **PV Array Block Access:** Tracker pile installation and module distribution will utilize tractor-drawn trailers or telehandlers operating along array corridors, restricted to one-way loop circulation within active mechanical installation blocks.

6.3 Internal Traffic Flow and Conflict Interface Analysis

- **Inter-Facility Crossover Traffic (Planets vs. BBR):** Shared use of the primary spine road by two independent EPC workforces during overlapping construction phases creates peak shift-change congestion at the central bifurcation junction.
- **Trenching and Cable-Laying Crossings:** Open MV/DC cable trenches crossing secondary array roads fragment internal circulation and force ad-hoc vehicle detours onto uncompacted soils.
- **Pedestrian and Mechanical Plant Interface:** High concentrations of ground crews assembling torque tubes and mounting modules operate immediately adjacent to reversing telehandlers, forklifts, and flatbed delivery vehicles.
- **Dust Plume Visibility Loss:** Dry winter conditions in Limpopo generate dense fugitive dust along unsealed internal tracks, reducing sight distances below stopping thresholds at blind array corners.

6.4 Preliminary Internal Traffic Risk Evaluation Matrix

The matrix below evaluates internal site traffic risks using a standard likelihood-by-consequence engineering rating prior to and following implementation of site traffic controls:

Risk ID & Hazard Description	Location / Activity	Initial Risk	Engineering & Operational Controls	Residual Risk
INT-01: Reversing collisions between telehandlers/trucks and ground crews	PV array blocks & laydown yards	High	Enforce one-way drive-through loops; install physical pedestrian walkways; require dedicated banksmen and white-noise reversing alarms on all mobile plant.	Low
INT-02: Crane or abnormal trailer tip-over due to subgrade settlement	BESS compounds & substation pads	High	Conduct plate-load/DCP bearing capacity tests prior to lift; construct engineered G5/G4 crane pads with certified compaction records.	Low
INT-03: Congestion and head-on collisions on single-lane array roads	Secondary feeder roads	Medium	Implement strict one-way clockwise block circulation; construct passing bays every 300 m; enforce two-way VHF radio protocols.	Low

Risk ID & Hazard Description	Location / Activity	Initial Risk	Engineering & Operational Controls	Residual Risk
INT-04: Vehicle drop-off or collapse into open MV/DC cable trenches	Road-trench crossings	High	Install steel trench plates rated for 35 t axle loads at active crossings; erect rigid Jersey barriers and solar-powered amber warning beacons.	Low
INT-05: Loss of visibility due to fugitive dust on haul roads	Primary spine & feeder roads	Medium	Enforce 20–30 km/h speed limits via in-vehicle telemetry; deploy dedicated water bowsers with biodegradable dust binders on continuous rotation.	Low
INT-06: Stormwater washout and vehicle bogging during summer cloudbursts	Low-lying internal drainage lines	Medium	Provide 3% cross-fall camber on all internal gravel roads; install mitre drains every 50 m and concrete drift slabs at seasonal overland flow paths.	Low

7. VEHICLE FLEET, DELIVERY VOLUMES, AND LOGISTICS PROGRAMME

Equipment delivery estimates below are scaled for the complete Gillimberg Cluster (2 × 200 MWac = 400 MWac total PV capacity plus BESS), alongside single-facility figures for phased implementation.

7.1 Estimated Delivery Trips (Full 400 MWac + BESS Cluster)

Equipment Category	Vehicle Configuration	Payload / Unit	Single Facility (200 MWac)	Full Cluster (400 MWac + BESS)
Solar PV Modules (700,000 units @ 570 Wp)	Interlink / Flatbed (34 t)	~868 modules	~404 trips	~808 trips
Central Inverters (160 units @ 2.5 MW)	Flatbed / Low-bed	1 unit / truck	80 trips	160 trips
BESS & PCS Containers (~180 units)	Low-bed / Skeletal Trailer	1 unit / truck	~90 trips	~180 trips
Main Power Transformers (4 units + acc.)	Abnormal Multi-Axle Low-bed	1 unit / convoy	4 trips (2 + 2)	8 trips (4 + 4)
Balance of Plant (~11,000 t civil/tracker)	Flatbed / Tipper (28 t)	~28 t / truck	~197 trips	~394 trips
TOTAL LOADED TRIPS	—	—	~775 trips	~1,550 trips
TOTAL VEHICLE MOVEMENTS (Inbound + Outbound)	—	—	~1,550 movements	~3,100 movements

7.2 Cycle Time and Phased Scheduling

- **Effective Haul Distance:** 15.0 km one-way (N11 Raowele junction to internal laydown yard; 30.0 km round trip).
- **Truck Cycle Time:** Approximately 2.0 hours per round trip (30 min inbound at 30 km/h, 30 min offloading/staging, 30 min outbound, and 30 min buffer).

- **Daily Dispatch Cap:** Inbound heavy freight will be capped at 25–35 trucks per day (3–4 trucks per hour) to prevent queuing at the N11 junction and internal gatehouse.
- **Programme Phasing:** Deliveries will be distributed across a 10–16 month construction programme, staggering Planets and BBR civil works by 2–3 months to avoid overlapping peak earthworks and module haulage.

8. EXTERNAL ROUTE RISK ASSESSMENT AND MITIGATION MATRIX

Identified External Route Risk	Corridor Segment	Phase	Engineering and Operational Mitigation
High-speed turning conflicts on N11	N11 / Raowele Junction	Construction	Secure SANRAL Way-leave/Access Permit; construct temporary deceleration/turning tapers and deploy traffic flagmen for abnormal loads.
Insufficient turning radii for abnormal trailers	Raowele turn-off & Luxemburg / Ga-Mashashane bend	Construction	Complete AutoTURN swept-path analysis; widen inner curve radii and relocate overhead utility lines prior to transformer/BESS haulage.
Subgrade shear failure and severe rutting	Segment B (9.0 km gravel road)	Construction	Re-rip, shape, import G5 gravel wearing course, compact to 95% Mod AASHTO, and deploy continuous grader maintenance.
Seasonal flooding and culvert washout	Drainage crossings on Segments B & C	Construction & Operation	Execute hydrological/hydraulic sizing; upgrade pipe culverts to reinforced concrete box culverts.
Dust nuisance and pedestrian exposure	Raowele & Luxemburg / Ga-Mashashane	Construction	Enforce 30 km/h speed limits via GPS tracking; apply dust palliatives; prohibit heavy freight during school commuting hours.
Opposing truck conflicts on single-lane gravel	Segments B & C	Construction	Construct formal 50 m passing bays every 1.0 km and enforce two-way radio dispatch control from the N11 turn-off.

9. CONCLUSION AND IMMEDIATE NEXT STEPS

The Gillimberg Cluster (Planets & BBR Energy Facilities) possesses viable regional freight connectivity via the N11 National Route, branching at Raowele towards Luxemburg / Ga-Mashashane and connecting via Eskom Borutho Substation. While the N11 arterial meets heavy-haul standards, the 9.0 km existing gravel road requires geometric widening, culvert upgrades, and wearing-course strengthening, and the 3.0 km new access road together with the internal site road hierarchy must be engineered prior to peak construction.

1. Topographical and Swept-Path Survey: Commission a land surveyor and traffic engineer to peg the 12.0 km external alignment, survey culvert invert levels, and verify AutoTURN swept paths at the Raowele and Luxemburg / Ga-Mashashane deflections.
2. Road Authority Engagement: Initiate formal pre-application consultations with SANRAL (N11 junction), LDPWRI, and the Mogalakwena and Polokwane Local Municipalities.
3. Early Works Civil Package: Incorporate Segment B rehabilitation, passing bays, Segment C new road construction, and the internal primary spine road into the Early Works Civil Contract ahead of main PV and BESS equipment deliveries.