18.0 GREENHOUSE GAS EMISSIONS

18.1 BACKGROUND AND METHODOLOGY

Greenhouse gases (GHG) are atmospheric gases which reduce the loss of heat from the earth into space through capturing of radiant heat. While these gases are naturally present in the atmosphere, significant additional amounts are released when fossil fuel based products (like coal, natural gas, and petrol) are burned. Because of the gases ability to capture energy, increased levels of the gases means more heat is captured, resulting in an increase in global surface temperatures (through the 'enhanced' greenhouse effect). The impacts of this temperature increase are expected to include a rise in sea levels, increase in frequency and intensity of severe weather events (flood, drought, etc) and changes in rainfall patterns.

The construction and operation of transmission infrastructure can contribute to these emissions when trees are cleared for access (removal of carbon sink) and where liquid fossil fuels are used to transport materials and equipment for construction and operation. Energy (as both fuel and electricity generated from fossil fuels) is also consumed in the manufacture and production of the materials used in the line construction (steel, aluminium etc), and can be considered to be 'embedded' in the final product.

By recognising these links and considering them in the development phase; some of these contributions can be reduced or eliminated through better planning and design decisions.

In addition to the direct net impact of the development on, and contribution to greenhouse emissions, there are also potential impacts of climate change on the development such as the need to plan for more extremes in weather events . Adaptation and mitigation measures can be selected to manage the changes in environment and stakeholder expectations to determine the success of the development in the medium to long term.

The greenhouse gas footprint of the transmission line was assessed based on vehicle movement data provided by Powerlink and estimates of the value of embedded materials based on similar projects.

18.2 ADAPTATION PLANNING

With regard to the changing physical and political environment (see in Sections 6.2.1 and 6.2.2) there are a number of considerations in the planning of the Project which can help to minimise the risks of adverse impacts. A brief summary of these issues is provided in the below table.

As with any risk management strategies, hazards don't necessarily need to be eliminated, but controlled to within acceptable risk tolerances.

TABLE 18.1 CLIMATE CHANGE RISK AND ADAPTATION SUMMARY

RISK	IMPACT	DESIGN RESPONSE
Flash Flooding	Inundation and high velocity water movements, erosion, access restrictions and material damage.	Any grading of land, drainage system and bunding to take risk into account. Footings to allow for erosion. Rate and nature of degradation of materials. Material selection and maintenance schedule to consider. Access to repairs/ maintenance may be impeded due to weather events. Appropriate response/contingency plans should be developed. Insurance premiums / excess may increase with more frequent severe weather events. Risk management documentation and procedures should be followed to counteract.
Severe Storms & Tropical Cyclones	High wind loading, lightning strike and flash flooding. Cyclones and more particularly storms, may become more intense and move further South more often, impacting the study area.	Design to account for wind loading as necessary (AS/NZS 1170.2:2002 – Structural design actions – Wind actions). Proper grounding of structures. Drainage design to account for severe short term events (as per above).
Temperature Rise	Cyclones and more particularly storms, may become more intense and move further South more often, impacting the study area.	Specifications for materials should account for these issues. Rate and nature of degradation of materials and potential increase in maintenance schedule to be considered.
	Increased bushfire risk and season, destruction of plant as well as overheating of lines, transformers etc.	Firebreaks to be maintained and appropriately sized for conditions and level of acceptable risk.
	Network congestion from increased peak loads associated with air-conditioning use etc. Decreased efficiency transmission and generation facilities.	Design and capacity of infrastructure to include sufficient redundant capacity to account for potential future inefficiencies.
Changing Rainfall Patterns	Changes to ground conditions (wetting and drying cycles) leading to impacts on footings and foundation materials.	Material specifications should account for such potential stresses. Maintenance and testing systems and frequency should be developed with regard to acceptable level of risk.
Legislative response to Climate Change	Distribution patterns for electricity are likely to be effected by both Carbon Pollution Reduction Schemes and Mandatory Renewable Energy Target, favouring renewable and lower intensity capacity.	Transmission network capacity should account for potential future renewable generation sources, such as biogas. Future network planning is to consider the impacts of future renewable generation sources however Powerlink Queensland has no control over the location or type of generation required to supply non-discriminatory access to generators.

18.3 GREENHOUSE GAS FOOTPRINT

Typically Greenhouse Gas (GHG) emissions reporting involves categorisation of the emissions into three 'Scopes' or types of emissions. This helps to delineate emissions with regard to the source and level of control.

These 'Scopes' may be defined as follows:

- Scope 1 emissions are direct, controllable emissions that come from sources owned and controlled by the company (such as fuel-use by vehicles or natural gas consumed on site);
- Scope 2 emissions are indirect emissions that come from the generation of purchased electricity; and
- Scope 3 emissions are a consequence of the activities which are not in the direct ownership or control of the company, but are a result of their use of third party goods and services. Items such as domestic flights, taxis or emissions from the production of consumables such as paper all fit under this category.

Scope 3 emissions are generally reported voluntarily and separately from a company's other emissions, as they will form part of the 'primary' (scope 1 and 2) emissions of another entity.

A preliminary desktop audit has summarised the major project elements as follows:

TABLE 18.2 GREENHOUSE GAS (GHG) SOURCES BY SCOPE

SCOPE 1	SCOPE 2	SCOPE 3
Tree clearing for site preparation. Fuel used in company owned heavy vehicles for site works. Fuel used in company owned light vehicles (for staff transport, delivery of materials etc). Any fuel used for on site generation (industrial lighting etc).	Grid Electricity used in temporary site office.	Domestic flights for staff and management to and from site. Other project consumables (steel, concrete, aluminium etc). Wastes generated as a result of the project. Energy / Emissions embedded in construction materials. Third party site works and vehicle movements.

18.4 VEGETATION CLEARING

The study alignment includes some vegetative cover which will be cleared for construction and there is expected to be a net loss of vegetative-carbon sink due to the transmission line construction.

No comprehensive modelling is currently available for detailed estimation of the scale of the lost carbon sink however broad assessment has been completed.

In terms of clearing along the alignment:

- Approximately 8.5km will be cleared to 40m wide; and
- Approximately 4.5km will be cleared to 60m wide.

The total area to be cleared therefore is 61ha. This assessment does not make allowance for selective clearing or areas where the total easement will not require clearing and should be viewed as a “worst case” scenario.

According to vegetation mapping (refer Figure 10.1), this land is a mixture of Non-remnant / regrowth, Endangered – Dominant and Not of Concern ecosystem. Cleared area has not been specified by ecosystem as it is not material to the GHG calculations at this level of detail. The Flora and Fauna assessment of the site (refer Section 10) found that the vegetation impacted by the clearing was dominated by various eucalyptus species. The area has therefore been assumed to be dry sclerophyll forest for the purposes of this GHG assessment.

The National Carbon Accounting System (NCAS) calculates dry sclerophyll forest to have a carbon sequestration potential of 546 tonnes of CO_2 equivalent per ha. At this rate approximately 33 300 tonnes of lost CO_2 sequestration potential is generated from the project.

18.5 HEAVY VEHICLE FUEL USE

Heavy vehicles (trucks/semi trailers, pilling rig, excavators and cranes etc) will be used to transport materials to and from the site.

It has been estimated that in the region of 71 round trips will be made to and from the site to deliver materials and equipment, and to remove site wastes:

<u>Transmission Line</u>

- 5 Semi trailer deliveries for site clearing machinery (Excavators and Bobcats etc) and 5 trips for collection;
- 40 Concrete Truck deliveries;
- 2 Semi trailer deliveries for reinforcement steel;
- Single Semi trailer delivery for boring machine (plus trip for collection);
- 2 Semi trailer deliveries for cranes (plus 2 trips for collection); and
- 13 Semi trailer deliveries for pre-fabricated structures, plant and equipment for completion.

It has been assumed that all suppliers and materials will be provided from the Toowoomba area (approx 120 km away) with an average travel distance (return trip) of 240 km.

This results in a total heavy vehicle travel distance of 17,040 km for the transmission line development.

The Australian Bureau of Statistics (ABS, 2008) estimate Articulated trucks to consume in the region of 54.6 L of diesel per 100km travelled, and 28.6 L / 100 km for rigid trucks. In total around 5.9 kL of diesel has been calculated for this use.

In addition to the above, some equipment will be used at the site for civil and construction works:

Transmission Line

- Dozer, excavator, roller, bobcat, grader and water truck for 4 weeks for construction of access tracks;
- 2 mulcher tractors, groomer, excavator and dozer for 8 weeks for clearing;
- Boring machine, bobcat, flat tray truck, crane and water truck for 75 days for boring foundations;
- flat tray truck, concrete truck and pump for 25 days for foundation concrete pour;
- 2 cranes for 100 days for tower erection;
- 2 break / winch machines, 4 drum carriers, 2 flat tray trucks, single crane and elevated work platform for 5 weeks for stringing preparation;
- helicopter for stringing prep 5 weeks; and
- helicopter for stringing 2 weeks.

Assuming the site operates for 8 hours per day 5 days per week, 10,040 machine hours are accrued.

According to “Spon's Civil Engineering and Highway Works Price Book” (2005) heavy machinery for site works use in the region of 38 L diesel per hour with 80% capacity usage (leaving around 30L/hour being used). Helicopters were assumed to use 140L/hour of fuel.

In total 297 kL of diesel and 39 kL of aviation fuel where calculated.

The National Greenhouse Accounts (NGA) Factors (June 2009) indicate 2.7 tonnes of CO_2^{-eq} per kL of diesel fuel and 2.2 tonnes of CO_2^{-eq} per kL of aviation gasoline (direct emissions).

Based on these values, the transmission line would contribute 887 tonnes of GHG.

18.6 LIGHT VEHICLE FUEL USE

Private vehicle usage is estimated to vary over the Project schedule. Site staff will be going to and from the site daily from the Dalby area (approximately 75 km away).

Transmission Line

- 1 to 2 4wd's for 4 weeks for construction of access tracks;
- 2 4wd's for 8 weeks for clearing;
- 3 4wd's for 75 days for boring foundations;
- 1 4wd for 25 days for foundation set up;
- 3 4wd’s for 25 days for foundation concrete pour;
- 4 4wd’s for 100 days for tower erection;
- 5 4wd’s for 5 weeks for stringing preparation; and
- 2 4wd's for 2 weeks during stringing.

Using an average return trip distance of 150km, a total of 980 return trips and a total distance of 147 000 km was estimated to be travelled.

ABS (2008) estimate passenger vehicles use 11.1L of petrol per 100km travelled. The testing vehicles where assumed to be light commercial vehicles at 12.5L diesel per 100 km’s. In total around 18.4 kL of fuel is expected to be consumed based on the above assumptions. Approximately 50 tonnes of greenhouse gas are contributed to the footprint from this source.

It should be noted that this number is highly dependent on driver behaviour, location and site conditions, and would need to be closely monitored (through the use of fuel cards, etc) to ensure the appropriate reporting thresholds are observed.

18.7 ELECTRICITY FOR TEMPORARY SITE AMENITIES

No temporary site amenities have been indicated. It is assumed all staff will be Dalby based.

18.8 EMISSIONS SUMMARY

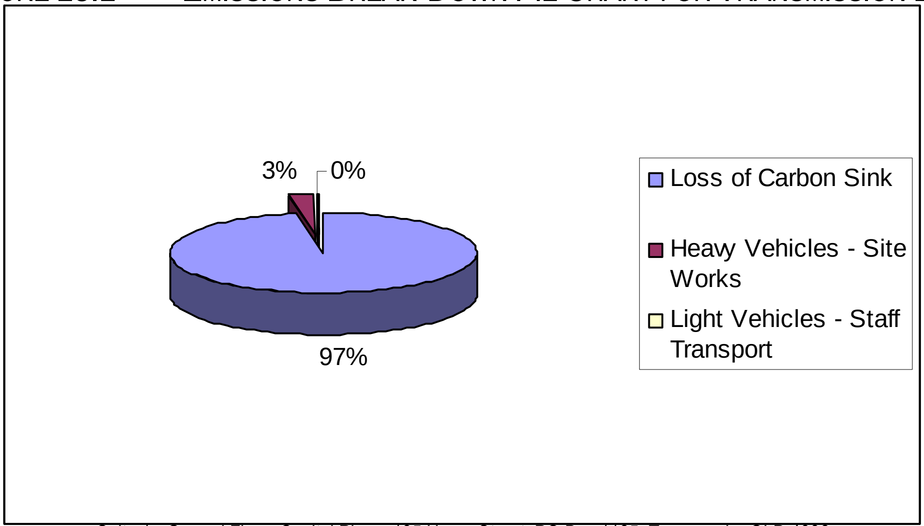
The following table summarises the calculated GHG emissions according to the Scopes that categorises them. Scope 1, or direct emissions is the largest emissions group by an overwhelming margin as Scope 3 emissions are reported by others.

TABLE 18.3 EMISSIONS SUMMARY

	SCOPE 1 (T CO2-E)	SCOPE 2 (T CO2-E)
Loss of Carbon Sink	Transmission Line: 33 300	NA
Heavy Vehicles – Deliveries	NA	NA
Heavy Vehicles – Site Works	Transmission Line: 887	NA
Light Vehicles – Staff Transport	Transmission Line: 50	NA
Totals	34 237 t $CO_2{}^{-e}$	0 t $CO_2{}^{-e}$

This is reinforced by the below chart (Figure 18.1), which illustrate the dominance of the loss of carbon sink to the overall profile.

FIGURE 18.1 EMISSIONS BREAK-DOWN PIE CHART FOR TRANSMISSION LINE



18.9 POTENTIAL IMPACTS

Queensland's 2008 Greenhouse Gas Inventory (available from http://ageis.climatechange.gov.au/) reports total emissions, including those from land use change, to be in the region of 160,264,670 tonnes of CO_2 equivalent, excluding 'embedded' energy in materials consumed. The equivalent emissions for this project would increase this total by around 0.02%.

18.10 MITIGATION MEASURES

18.10.1 Direct GHG Abatement Measures undertaken for the Project

In line with National and State policies, Powerlink has committed to adopting several measures to reduce the project's carbon footprint. The following direct GHG abatement actions will be undertaken:

- Minimising land clearing to areas where it is necessary for operational safety;
- Specifying in procurement contracts for construction and maintenance services:
  - Use of equipment and vehicles with GHG emissions ratings of 5.5 for passenger vehicles and 3.5 for light commercial vehicles, as described in the Australian Design Rules (Motor Vehicle Standards Act 1989) for heavy commercial vehicles;
  - Use of biofuels (e.g. biodiesel, ethanol, or blends) to reduce GHG emissions;
  - Implementation of energy-efficient guidelines for construction work, such as minimal idling time for machinery;
  - Use of local material and staff to minimise transport-related emissions; and
  - Use of recycled materials, such as replacement of cement with fly ash, recycled aggregate, and recycled content in steel.

18.10.2 Other Mitigation Measures

As discussed in Section 22.3, Powerlink was, up until 1 July 2009 when the program ceased to operate, a member of the Greenhouse Challenge Plus and has committed to the following actions as part of the program outlined above:

- Using hybrid vehicles in Powerlink's vehicle fleet ;
- Facilitating car pooling for employees;
- Regularly maintaining vehicles to ensure efficient operation;
- Regularly recycling paper, green waste, metals and oils to reduce the amount of energy required to make new products;
- Independent verification of Powerlink's greenhouse reporting processes to ensure reporting requirements/standards set by the Australian Greenhouse Office are met;
- Including transmission line system losses in Capital Project Assessments; and
- Undertaking SF6 gas management strategies and participating in a national review of SF6 monitoring.

As more cost-effective and viable alternatives become available to reduce GHG emissions and enhance energy efficiency, Powerlink will seek to explore these to find the most efficient and effective method for reducing the Project's carbon footprint.