

Coordinator-General's report

Gladstone Nickel Project

Report evaluating the Environmental Impact Statement,
pursuant to Section 35 of the *State Development and
Public Works Organisation Act 1971 (Qld)*

Released: 15 January 2009

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Coordinator-General's Report – Synopsis

This Report has been prepared pursuant to s.35 of the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act) and provides an evaluation of the Environmental Impact Statement (EIS) process for the Gladstone Nickel Project (GNP) (“the Project”).

Gladstone Pacific Nickel Ltd (GPNL, “the Proponent”) is proposing to build and operate a nickel and cobalt refinery. The Project consists of a high pressure acid leach (HPAL) plant and metals plant (collectively called the refinery) with supporting facilities to be located at Gladstone, Queensland.

The refinery site is approximately 8 km west of the Gladstone central business district, near the intersection of Hanson and Reid Roads in the Yarwun Precinct of the Gladstone State Development Area (GSDA).

The refinery would process ore from a nickel laterite mine near Marlborough, approximately 180 km north-west of Gladstone, together with nickel laterite ores imported from the south-west Pacific region, commencing with New Caledonia. The ore from Marlborough would, in the initial years of operation, be railed to the refinery. However, GPNL proposes that after this initial operational period, the ore from Marlborough will be beneficiated at a plant adjacent to the mine site at Coorumburra and then pumped as a slurry through a pipeline to the refinery. Waste residue from the refinery would be pumped to a Residue Storage Facility (RSF) located in the Aldoga Precinct of the GSDA, located approximately 15 km south-west of the refinery.

Stage 1 of the GNP would produce 63,000 tonnes per year (t/y) of nickel metal and 6,000 t/y of cobalt metal. Stage 2 of the Project would produce double those quantities of metal. GPNL is seeking approvals for both Stage 1 and 2 of the GNP, although it does not currently intend to commence construction of Stage 2 of the Project until Stage 1 has been operational at full capacity for more than twelve months.

The refinery would add substantial value to Australian and imported ores by producing nickel and cobalt metal which would be exported to a growing world market, primarily to meet the increasing demand for stainless steel. The refinery would have a low greenhouse gas footprint and low sulphur dioxide emissions. Several industrial ecology opportunities associated with the Project offer the potential to reduce net air and water emissions in Gladstone. The capital investment required to establish Stage 1 of the GNP is currently estimated at approximately \$4 billion. It would generate significant employment and broaden the economic base of both the Gladstone region and the State. Annual gross revenues from Stage 2 of the GNP are expected to exceed \$3 billion.

An Initial Advice Statement (IAS) was lodged with the Coordinator-General on 21 October 2005 and the Project was declared to be a “significant project for which an EIS is required”, pursuant to s.26(1)(a) of the SDPWO Act, on 10 November 2005. The proposal was declared a “controlled action” under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) on 18 November 2005. Under a bilateral agreement between the Queensland and Australian Governments, the EIS process conducted under the SDPWO Act satisfies the requirements of the EPBC Act and this Report will be used by the Australian Government Minister for the Environment, Heritage and the Arts to make an assessment of the controlled action.

The EIS was advertised in relevant newspapers on 14 April 2007 inviting submissions from the public until 28 May 2007. Following consideration of submissions and consultation with advisory agencies, the Coordinator-General directed GPNL to prepare a Supplementary EIS (SEIS) to address the substantive issues that were raised.



The substantive issues raised in submissions included the following subjects:

- construction and operational workforce accommodation and implications for housing availability and affordability in the Gladstone Region
- barren liquor discharge into Port Curtis, particularly
 - the discharge temperature compared to ambient temperature
 - the volume of the discharge
 - the potential of manganese toxicity to marine organisms and the potential oxidation precipitation and long-term bioaccumulation of manganese or other metals in the local marine environment
 - contaminant load and the nature of the discharge/deposition that will occur in and around the discharge points
- air emissions (especially of sulphur dioxide and air particulates) and odour
- impacts on roads
- environmental effects of the RSF, particularly
 - on the quality of surface and groundwater around the proposed RSF
 - the size, structural integrity and storm-event capacity of the RSF with respect to any potential discharge into Farmer Creek or the Calliope River
 - planning implications with respect to a potential future Castlehope Dam
 - design parameters of individual residue storage cells and groundwater management systems
 - the capacity of the RSF site to service the facility for more than 20 years
- soils and erosion including potential acid sulfate soils along pipeline routes
- pipeline watercourse and wetlands disturbance
- water supply for the Project
- clearing of remnant vegetation
- Environmental Management Plan development.

The SEIS addressing these matters was forwarded to agencies and those who made EIS submissions on 6 February 2008. The SEIS also described substantial revisions to the scope, extent and location of several Project components resulting from community and stakeholder consultation on the EIS and further engineering studies. These changes included:

- a revised refinery layout
- a 5% increase in the scale of nickel and cobalt metal production
- increased consumption of sulphur and limestone
- increased production of solid residue (from 10.8 to 14.3 million dry t/y for Stage 2 of the Project) and sulphuric acid (from 3.3 to 4.6 million t/y)
- the potential export of any excess acid via Fisherman's Landing
- increased usage of fresh water from 10.5 to 30 gegalitres/yr (GL/yr) for Stage 2 of the Project
- elimination of the 'once through' seawater cooling water system at the refinery
- improvements to the barren liquor treatment resulting in reductions in the concentrations of a range of constituents altering the chemistry of the residue and the marine discharge streams

- the nature and position of the marine discharge diffusers
- a preference for rail rather than slurry pipeline transport of Marlborough nickel ore to the refinery for Stage 1 of the Project
- the use of fresh water to be drawn from the Fitzroy River rather than seawater for the slurry transport of Marlborough nickel ore for Stage 2 of the Project and the consequential elimination of the seawater return pipeline between the refinery and the mine
- the use of multiple smaller cells rather than one large cell at the RSF
- export of ammonium sulphate through Barney Point rather than Fisherman's Landing
- introduction of an alternative route for the residue and return liquor pipelines between the refinery and the RSF
- introduction of the option of construction of the refinery using "preassembled modules" (PAMs) rather than "stick build".

Based on additional discussions with key agency regulators and further engineering studies between April and September 2008, GPNL has made several further changes to the Project or commitments to mitigation measures, and these additional changes are described in this Report. These changes supersede the Project descriptions in the EIS and SEIS for those components of the GNP. Details of those changes related to the key issue of marine discharge to Port Curtis are provided in a technical supplement to this Report (*Gladstone Pacific Nickel Refinery – Environmental Assessment of Treated Water Discharge to Port Curtis* (URS, 25 July 2008)', available online with this Report). I consider that the nature and scale of these changes have not warranted further public notification. In summary, these changes include:

- further improvements to the barren liquor treatment systems
- introduction of a seawater mixing and dilution step prior to discharge
- improvements to air emission control systems
- abandonment of the alternative residue pipeline route described in the SEIS in favour of the original route described in the EIS.

A summary description of the Project is included in Appendix A of this Report.

Detailed design elements for some components of the GNP have not been available during the EIS process prior to the finalisation of this Report. Where GPNL has not been able to provide the necessary detail, subsequent assessment and approval of those components will be required directly with the relevant regulatory authority. I consider that the scope and nature of the matters that will require subsequent impact assessment are limited enough to allow me to make sufficient judgement about the cumulative impacts of the GNP and overall acceptability of the Project and proposed mitigation measures. Matters for which additional information and separate approvals will be required outside of this EIS process include:

- cumulative risk assessment of the proposed PAM facility at Fisherman's Landing
- arrangements to transport the Marlborough ore from the mine, over the Bruce Highway, to the loading facility on the North Coast Line (rail) and approvals for that rail facility
- Reid Road crossing arrangements for the new rail siding into the refinery
- limestone transport arrangements to the refinery
- any direct future allocation of water to the Project from the Fitzroy River
- additional RSF locations.

In evaluating the environmental effects of the Project, I have considered: the EIS, SEIS, a range of studies and reports undertaken since the release of the SEIS, draft Environmental Management Plans prepared by GPNL and its technical consultants; public submissions received on the EIS; comments on the EIS and other advice provided by the Commonwealth



Department of Environment, Water, Heritage and the Arts (DEWHA), State and local government authorities (Advisory Agencies); and other relevant information.

Key innovative mitigation measures agreed by GPNL following the release of the SEIS have included:

- submission of a '*Stage 1 Performance Report*' as a pre-condition to proceeding to Stage 2 of the Project which allows for tightening of key air and water emission conditions if environmental benchmarks estimated by GPNL during the EIS process are not met
- establishment of a \$10 million '*Sulphur Dioxide Reduction Strategy*', which may provide for net reductions in air emissions to Gladstone's air as a consequence of the GNP
- establishment of a \$9 million '*Gladstone Social Impact Mitigation Fund*' (G-SIMF), which may provide the catalyst for significant funding from other sources.

Having regard to the above, I consider that the EIS process conducted for the GNP has adequately addressed the environmental and other impacts of the Project and meets the requirements of the Queensland Government for impact assessment in accordance with the provisions of Part 4 of the SDPWO Act.

Therefore, I recommend that the Gladstone Nickel Project, as described in detail in the EIS and SEIS, summarised in section 2 of this Report and covering the key issues of treated wastewater discharge into Port Curtis, air emissions, and social impacts, can proceed, subject to the conditions and recommendations contained in Schedules A to C of this Report.

.....
Colin Jensen
Coordinator-General
Date: 15 January 2009



1. Introduction

This Report has been prepared pursuant to s.35 of the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act) and provides an evaluation of the Environmental Impact Statement (EIS) process for the Gladstone Nickel Project (GNP) (“the Project”). The EIS was conducted by the Proponent, Gladstone Pacific Nickel Ltd (GPNL), and prepared on its behalf by its consultants URS in association with RLMS.

An Initial Advice Statement (IAS) was lodged with the Coordinator-General (CG) on 21 October 2005 and the Project was declared to be a “significant project for which an EIS is required”, pursuant to s.26(1)(a) of the SDPWO Act, on 10 November 2005. The proposal was declared a “controlled action” under the Commonwealth Government *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) on 18 November 2005.

Under a Bilateral Agreement between the Queensland and Australian Governments, the EIS process conducted under the SDPWO Act satisfies the requirements of the EPBC Act. This Report will be used by the Australian Government Minister for the Environment, Heritage and the Arts to make an assessment of the controlled action for the purposes of the EPBC Act.

The objective of this Report is to summarise the key issues associated with the potential impacts of the Project on the physical, social and economic environments at the local, regional, state and national levels. It is not intended to record all the matters which were identified and subsequently settled. Instead, it concentrates on the substantive issues identified during the EIS process.

This Report represents the end of the Queensland Government impact assessment process. Essentially, it is an evaluation of the Project, based on information contained in the EIS, Supplementary EIS (SEIS), submissions made on the EIS and information and advice from Advisory Agencies and other parties, and states conditions and recommendations under which the Project may proceed.

2. Project description

2.1 The Proponent

The Proponent for the Gladstone Nickel Project is Gladstone Pacific Nickel (ACN 104 261 887) (GPNL). GPNL was formed in 2003 as Pearce Matheson Group Pty Ltd (PMG), an Australian private limited company, to pursue the development of the GNP. PMG acquired Marlborough Nickel Pty Ltd (MNPL) from Preston Resources Limited in December 2003. MNPL owns twelve mining leases with associated environmental approvals (MIM 800078102). MNPL is a wholly owned subsidiary of GPNL. GPNL was listed on the London Stock Exchange's Alternative Investment Market (AIM) in March 2005.

To clarify future interpretation of this Report:

- any references in this Report to GPNL can also be read as “the Project Proponent”
- all references in this Report to commitments made by GPNL and conditions and recommendations applying to GPNL for this Project also apply to all parties engaged to construct and/or operate any part of the Project and to any party to which GPNL may assign the GNP.

2.2 The Project


GPNL's vision is to build a major long-life nickel and cobalt refinery at Gladstone, within the Gladstone State Development Area (GSDA). The refinery would produce metal products for export to the global nickel market, which is expanding primarily due to growth in demand for stainless steel. Stainless steel has a number of properties, including corrosion resistance, high-temperature stability, strength, ductility and recyclability that support its sustainable use and generally result in high service life and reduced life cycle impacts compared to other alternative materials. The GNP is aimed at assisting in filling the widening gap between existing global nickel metal production and worldwide demand.

The refinery would treat high grade nickel laterite ores from around the south-west Pacific (commencing with New Caledonia), underpinned by beneficiated ore from its own Marlborough deposits and would produce valuable nickel and cobalt metal products, resulting in a positive effect on Australia's balance of trade. GPNL has estimated that, at the completion of Stage 2, the refinery would have the capacity to produce approximately 8–10% of global nickel demand.

The ore from Marlborough would, in the initial years of operation, be railed to the refinery. However, GPNL proposes that after this initial operational period, the ore from Marlborough would be beneficiated, and the resultant slurried material pumped through a 180 km long pipeline to a fourth- generation high pressure acid leach (HPAL) refinery sited in the Yarwun Precinct of the GSDA.

The refinery incorporates a leach plant to produce an intermediate product, a metals plant for the production of pure nickel and cobalt metal products, and associated infrastructure and services. In addition to slurried ore from Marlborough, nickel ore (and sulphur) would be imported through the Wiggins Island Wharf (WIW), which is to be developed at Wiggins Island, Gladstone, by the Gladstone Port Corporation Limited (GPCL) as part of its proposed Wiggins Island Coal Terminal (WICT) project. The WIW would be a common-user facility, which would allow for nickel ore and sulphur to be imported via “Cape size” vessels. If construction of WIW does not proceed or is delayed, nickel ore and sulphur can be imported through the existing port facilities at Fisherman's Landing.

The refined nickel and cobalt metal would be containerised and transported by rail from the Mount Miller Rail yard adjacent to the refinery to a container shipping terminal in Brisbane and then exported. Upon completion of Stage 2 the refinery would produce 126,000 tonnes per



year of nickel, 12,000 tonnes of cobalt and about 350,000 tonnes of ammonium sulphate (amsul) by-product.

Amsul, produced as a by-product of nickel and cobalt refining, would be exported through the port facilities at Barney Point.

Residue from the refinery would be piped to a Residue Storage Facility (RSF) to be constructed in the Aldoga Precinct of the GSDA, approximately 15 km south-west of the refinery site.

Stage 1 demand for freshwater would be approximately 15 gigalitres per year (GL/y), not including ore slurry water. Detailed optimisation of this water use has yet to be performed and GPNL is confident that Stage 2 will be designed using less freshwater per tonne of nickel produced. Until these studies and designs are completed, the estimated Stage 2 water demand is 30 GL/y. The cooling water would be reused in a closed cooling water circuit which will use cooling towers. Water losses from the system would be primarily from evaporation. 'Blowdown' from the cooling water circuit would be reused in the refinery as much as possible.

It is proposed to start construction of Stage 1 in 2009. Construction is expected to take approximately 2.5 years with the commissioning of Stage 1 operations beginning during the second half of 2011. Depending on market demand, Stage 2 construction could begin in 2013 with Stage 2 operations starting in 2015.

Figure 1 (below) shows the Project components at a regional scale and Figure 2 (below) shows the Project components that are proximate to the Gladstone City environs.

2.3 Project rationale

The world has a growing need for more nickel, primarily due to the increasing demand for stainless steel. Stainless steel has a number of properties that support its sustainable use, including corrosion resistance, high-temperature stability, strength, ductility and recyclability. Most applications of nickel are based on the nickel-containing product having high-corrosion resistance. Coupled with recyclability, this generally results in high service life and reduced life cycle impacts compared to other alternatives.

The majority of world's nickel metal is currently derived from sulphide ore deposits and very few new major deposits have been discovered in recent years. Therefore, the increase in global nickel supplies required to meet expected future world demand will have to come primarily from the development of new nickel laterite projects. The GNP aims to fill part of the forecast widening gap between global nickel metal production and demand.

There are a number of HPAL nickel projects that have been developed throughout the world in recent times, including three in Western Australia and one in the Philippines. Another HPAL refinery in Cuba has been operational since 1959, though it employs more basic process and engineering technology than the recently commissioned plants.

Currently, there are four nickel laterite HPAL projects that are under construction. These are:

- the Goro Project in New Caledonia
- the Ravensthorpe Project in Western Australia and the QNI Yabulu Expansion Project in Queensland
- the Vermelho Nickel Project in Brazil
- the Ambatovy Project in Madagascar.

Given the projected growth in primary metal demand, even after accounting for these projects, there is a significant opportunity for the development of a greenfield nickel refinery in Gladstone.

In summary, GPNL aims to become an active participant in the nickel industry and capture an opportunity in the market by operating a highly competitive nickel refinery in Gladstone.



Production of cobalt has changed from being mainly a by-product of copper production to being a by-product of nickel production and as a primary product. The major uses for cobalt are:

- superalloys for use in gas turbine engines
- catalysts for use in the manufacture of polyester fibres and synthetic textiles for packaging, PET bottles and recording tape
- cobalt in the form of lithium cobalt oxide for use in lithium-ion batteries for hybrid electric vehicles
- rechargeable batteries for use in electronic devices (e.g. mobile phones, digital cameras)
- organic chemicals such as cobalt carboxylates for use as paint and ink driers and to promote the adhesion between the rubber and steel in steel-belt radial tyres.

The GNP would bring to Gladstone a large, capital intensive and long-term processing facility that would produce significant direct and indirect benefits for the Gladstone region, Queensland and Australia.

The refinery will produce nickel and cobalt metal which will be exported to the growing world market, primarily due to the increasing demand for stainless steel, which has a number of properties that supports its sustainable use. The Project will have a positive effect on Australia's balance of trade.

In comparison to other nickel production processes, acid leach refining is not fossil-fuel intensive (it has less than half the greenhouse emissions of other nickel laterite processes). Its greenhouse gas emissions are also low compared to other metal producing industries in Gladstone.

Several industrial ecology opportunities associated with the GNP offer the potential to reduce net air and/or water emissions in Gladstone. The capital investment required to establish Stage 1 of the GNP is currently estimated at approximately \$4 billion. It would generate significant employment and broaden the economic base of both the Gladstone region and the State. Annual gross revenues from Stage 2 of the GNP are expected to exceed \$3billion.

Gladstone is located relatively close to approximately 70% of world's known lateritic nickel reserves, with large deposits located in Australia, New Caledonia, Solomon Islands, Philippines, Indonesia and PNG. Marlborough, together with second tier south-west Pacific laterite deposits means that ore supply risk would be mitigated by locating a refinery in Gladstone. A Gladstone refinery would also allow more extensive ore deposit utilisation as many good deposits cannot justify a refinery in their own right. A refinery capable of processing the region's limonitic ores would most likely remain operational for the long-term.

Figure 1. Gladstone Pacific Nickel Project – regional locality

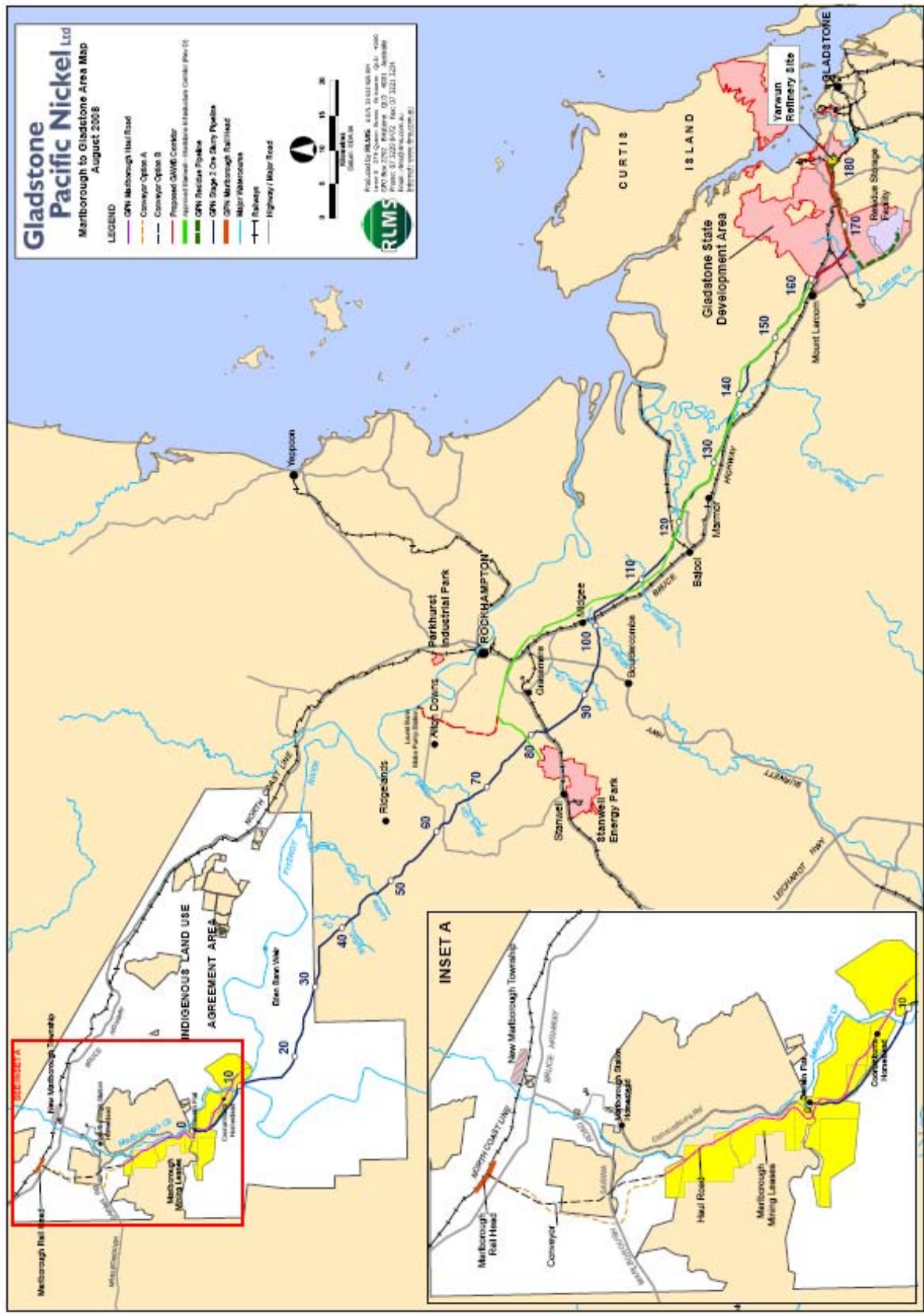
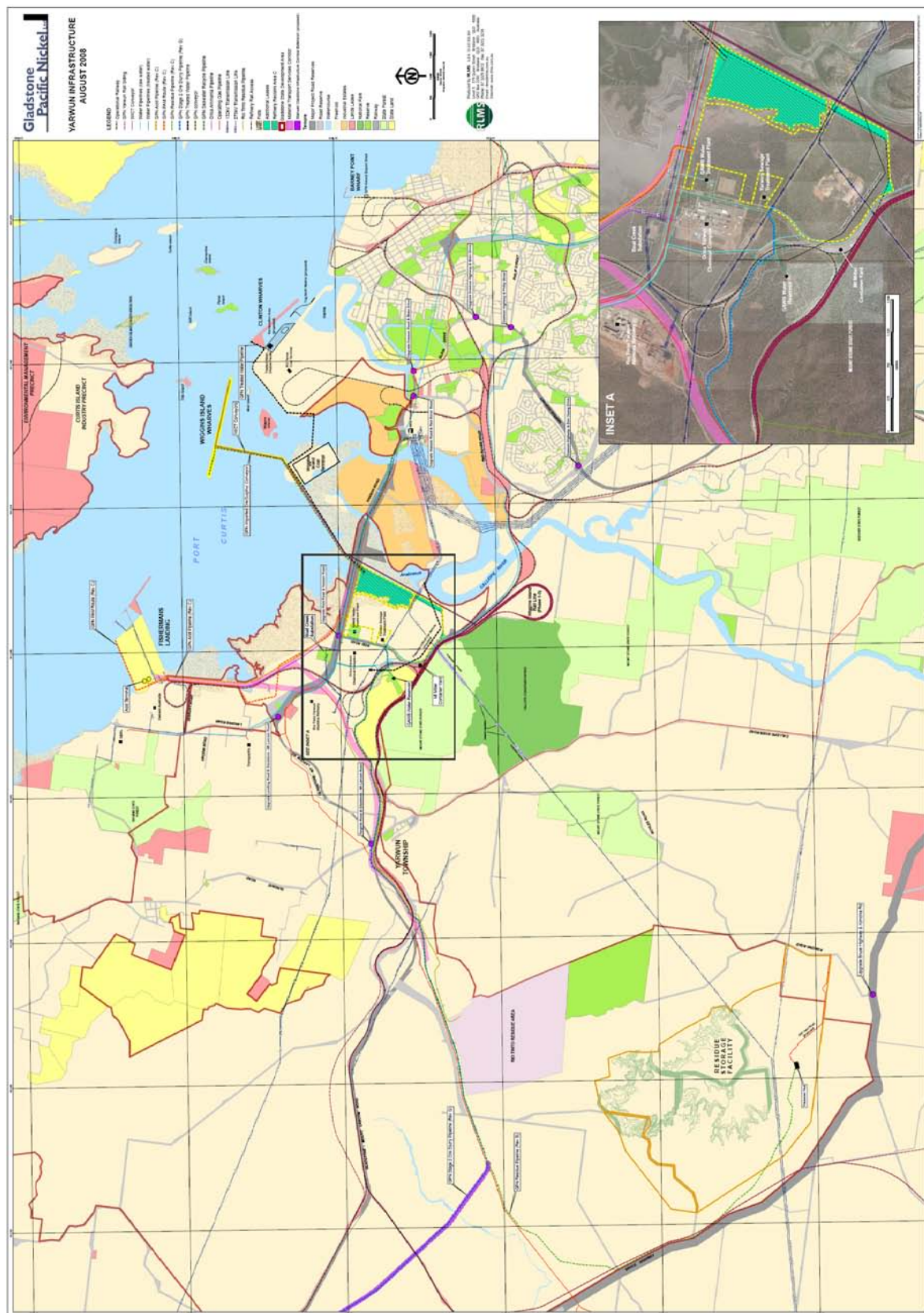


Figure 2. Gladstone Pacific Nickel Project – Gladstone locality



3. Impact assessment process

3.1 Significant project declaration and controlled action

An Initial Advice Statement (IAS) was lodged with the CG on 21 October 2005 and the Project was declared to be a “significant project for which an EIS is required”, pursuant to s.26(1)(a) of the SDPWO Act, on 10 November 2005.

The Project was referred to the Australian Government under the EPBC Act on 1 November 2005 (DEWHA reference number EPBC 2005/2376). The proposal was determined to be a “controlled action” under the EPBC Act on 18 November 2005, the controlling provisions being:

- World Heritage (sections 12 and 15A of the EPBC Act)
- Listed threatened species and communities (sections 18 and 18A of EPBC Act)
- Listed migratory species (sections 20 and 20A of the EPBC Act).

Under a Bilateral Agreement between the Queensland and Australian Governments, the EIS process conducted under the SDPWO Act satisfies the requirements of the EPBC Act. This Report will be used by the Australian Minister for the Environment, Heritage and the Arts to make an assessment of the controlled action for the purposes of the EPBC Act.

3.2 Review and refinement of the EIS terms of reference

A number of Australian, state and local government representatives and other appropriate authorities were invited to participate as Advisory Agencies for the EIS process and to provide comment on the draft terms of reference (ToR).

The Queensland Department of Infrastructure and Planning (DIP), on behalf of the Coordinator-General, coordinated the consultation process between the Proponent, the Advisory Agencies and the public.

An IAS was released for public information and draft ToR were advertised for public comment on 14 January 2006 in the Gladstone Observer, the Rockhampton Morning Bulletin, the Australian and the Courier Mail. Comments were accepted until close of business (CoB) on 14 February 2006. Final ToR were issued to the Proponent on 28 March 2006. Sixteen comments on the ToR were received from:

- Department of Main Roads (DMR)
- Department of Natural Resources, Mines and Water (NRW)
- Department of Primary Industries and Fisheries (DPI&F)
- Department of Housing
- Environmental Protection Agency (EPA)
- Queensland Rail (QR)
- Department of Communities
- Department of Emergency Services

- (the then) Department of Aboriginal and Torres Strait Islander Policy¹
- (the then) Department of Local Government, Planning, Sport and Recreation
- Queensland Treasury
- Calliope Shire Council²
- Fitzroy Shire Council²
- Gladstone City Council²
- Queensland Police Service
- Commonwealth Department of Environment, Heritage and the Arts (now the Department of Environment, Water, Heritage and the Arts (DEWHA))¹.

3.3 Public review of the EIS

The EIS was approved for release and advertised publicly in the Courier Mail, the Australian, the Rockhampton Morning Bulletin, and the Gladstone Observer on 14 April 2007, inviting submissions from the public until CoB on 28 May 2007. The EIS was available for purchase as a CD-ROM for \$10 from the Proponent and was available for free download from the DIP Project website.

The EIS was displayed at:

- Gladstone City and Calliope Shire libraries²
- The Fitzroy Shire Council chambers²
- The State Library of Queensland in Brisbane.

Information on the Project was available via the GPNL and CG's web site and general consultation was undertaken using methods such as agency briefings and community briefings at Gladstone, Yarwun and Mt Larcom.

The following Advisory Agencies and other stakeholders were approached formally to make a submission to the EIS:

- (the then) Department of Aboriginal and Torres Strait Islander Policy¹
- Department of Communities
- Department of Emergency Services
- (the then) Department of Education and Training¹
- Department of Mines and Energy
- (the then) Department of Employment and Industrial Relations¹
- Department of Housing
- (the then) Department of Local Government, Planning, Sport and Recreation¹
- Department of Main Roads
- Department of Natural Resources and Water
- Department of Primary Industries and Fisheries

¹ Agency names may have changed following Machinery-of-Government changes.

² Following Queensland local government amalgamations that took effect on 15 March 2008, the then Gladstone City, Calliope Shire and Miriam Vale Shire Councils merged to become the Gladstone Regional Council (GRC), and the then Fitzroy, Mt Morgan, and Livingstone Shire and Rockhampton City Councils merged to become the Rockhampton Regional Council.

- Department of the Premier and Cabinet
- (the then) Department of State Development, Rockhampton and Gladstone¹
- (the then) Department of State Development, Brisbane¹
- (the then) Department of Education¹
- Queensland Transport
- Environmental Protection Agency
- Queensland Treasury
- Queensland Health
- Queensland Rail
- Queensland Police Service
- Rockhampton City Council²
- Rockhampton Regional Development Ltd
- Livingstone Shire Council²
- Gladstone City Council²
- Gladstone Calliope Aerodrome Board
- Calliope Shire Council²
- Fitzroy Shire Council²
- (the then) Central Queensland Port Authority (now Gladstone Ports Corporation Ltd)
- Central Queensland Institute of TAFE Rockhampton
- Gladstone Economic and Industry Development Board
- Great Barrier Reef Marine Park Authority
- Gladstone Area Promotion and Development Ltd
- Commonwealth Department of Environment and Water Resources.

Copies were sent to the Department of Premier and Cabinet library.

Following the public review of the EIS a total of twenty-one submissions were received from:

- Fitzroy Shire Council²
- Calliope Shire Council²
- Gladstone City Council²
- Department of Communities
- Department of Main Roads
- Department of Natural Resources and Water
- Environmental Protection Agency
- (the then) Department of Local Government, Planning, Sport and Recreation¹
- Department of Primary Industries and Fisheries
- Department of Housing
- (the then) Department of State Development¹
- Queensland Transport
- Queensland Police Service

- Queensland Health
- Queensland Rail
- (the then) Central Queensland Port Authority (now Gladstone Ports Corporation Ltd)
- Department of Emergency Services
- East End Mine Action Group
- three private individuals.

The substantive issues raised in submissions included:

- construction and operational workforce accommodation and implications for housing availability and affordability in the Gladstone Region
- barren liquor discharge into Port Curtis, particularly
 - the discharge temperature compared to ambient temperature
 - the volume of the discharge
 - the potential of manganese toxicity to marine organisms and the potential oxidation, precipitation and long-term bioaccumulation of manganese or other metals in the local marine environment
 - contaminant load and the nature of the discharge/deposition that will occur in the berth pockets of RG Tanna Coal Terminal
- air emissions (especially of sulphur dioxide (SO₂), odour and air particulates)
- impacts on local and state roads, and the national highway
- environmental effects of the RSF, particularly
 - on the quality of surface and groundwater around the proposed RSF
 - the size, structural integrity and storm-event capacity of the RSF with respect to any potential discharge into Farmer Creek or the Calliope River
 - planning implications with respect to a potential future Castlehope Dam
 - design parameters of individual residue storage cells and groundwater management systems
 - the capacity of the RSF site to service the facility for more than 20 years
- soils and erosion including acid sulfate soils along pipeline routes
- pipeline watercourse and wetlands disturbance
- water supply for the Project
- clearing of remnant vegetation
- Environmental Management Plan development.

Copies of all submissions were forwarded to GPNL for its consideration. Following discussions with GPNL and its technical consultants, I determined that preparation of a Supplement to the EIS (SEIS) was necessary.

3.4 Review of the Supplementary EIS

On 6 February 2008 the SEIS was forwarded to Advisory Agencies and respondents to the EIS.

The SEIS described substantial revisions to the scope, extent and location of several Project components resulting from community and stakeholder consultation on the EIS and further engineering studies.



These changes included:

- a revised refinery layout
- a 5% increase in the scale of nickel and cobalt metal production
- increased consumption of sulphur and limestone (to increase process efficiency and productivity)
- increased production of solid residue (from 10.8 to 14.3 million dry t/y for Stage 2 of the Project) sulphur dioxide and sulphuric acid (from 3.3 to 4.6 million t/y)
- the export of any excess acid via Fisherman's Landing
- increased usage of fresh water from 10.5 to 30 gegalitres/yr (GL/y) for Stage 2 of the Project
- elimination of the 'once through' seawater cooling water system at the refinery
- improvements to the barren liquor treatment resulting in reductions in the concentrations of a range of constituents altering the chemistry of the residue and the marine discharge streams
- the nature and position of the marine discharge diffusers
- a preference for rail rather than slurry pipeline transport of Marlborough nickel ore to the refinery for Stage 1 of the Project
- the use of fresh water to be drawn from the Fitzroy River rather than seawater for the slurry transport of Marlborough nickel ore for Stage 2 of the Project and the consequential elimination of the seawater return pipeline between the refinery and the mine
- the use of multiple smaller cells rather than one large cell at the RSF
- export of amsul through Barney Point rather than Fisherman's Landing
- introduction of an alternative route for the residue and return liquor pipelines between the refinery and the RSF
- introduction of the option of construction of the refinery using "preassembled modules" (PAMs) rather than "stick build".

The following agency advised that it was satisfied that all issues had been addressed:

- Queensland Police Service.

The following agencies either provided advice or recommended conditions:

- Department of Natural Resource and Water
- Central Queensland Ports Authority
- Gladstone City Council²
- Calliope Shire Council²
- Department of Main Roads
- Department of Primary Industries and Fisheries
- Queensland Transport
- Environmental Protection Agency
- Queensland Health
- Queensland Rail.

The following private submitters advised that they were satisfied that all issues had been addressed:

- East End Mine Action Group



- two private individuals.

Substantive issues raised in submissions are discussed individually in Section 4 of this Report.

3.5 Changes to the Project after the release of the SEIS

Based on additional discussions with key agency regulators and further engineering studies between April and September 2008, GPNL has made several further changes to the Project or commitments to mitigation measures that are described in this Report. These changes supersede the Project descriptions in the EIS and SEIS for those components of the GNP. Details of those changes related to the key issue of marine discharge to Port Curtis are provided in a technical supplement to this Report (*Gladstone Pacific Nickel Refinery – Environmental Assessment of Treated Water Discharge to Port Curtis* (URS, 25 July 2008)). I consider that the nature and scale of these changes have not warranted further public notification. In summary, these changes include:

- further improvements to the barren liquor treatment systems
- introduction of a seawater mixing and dilution step prior to discharge
- improvements to air emission control systems
- abandonment of the alternative residue pipeline route described in the SEIS in favour of the original route described in the EIS.

More detailed discussion of all Project elements amended after the release of the SEIS is provided in Section 4 of this Report.

4. Evaluation of environmental effects

The SDPWO Act defines 'environment' to include ecosystems and their constituent parts, including people and communities, which encompasses:

- all natural and physical resources
- the qualities and characteristics of locations, places and areas, however large or small, that contribute to their biological diversity and integrity, intrinsic or attributed scientific value or interest, amenity, harmony and sense of community
- the social, economic, aesthetic and cultural conditions that affect, or are affected by, things mentioned above.

'Environmental effects' means "the effects of development on the environment, whether beneficial or detrimental". These effects can be direct or indirect, of short, medium or long-term duration and cause local or regional impacts.

This section outlines the major environmental effects identified in the EIS, the SEIS, submissions on the EIS and consultation with stakeholders. Where appropriate, it provides my commentary to assist the reader to understand an issue and to explain the rationale supporting any:

- conclusions that I reach
- recommendations that I make on approval conditions aimed at mitigating any potential adverse impacts of the Project that have been identified.


EPA is the responsible agency for aspects of the GNP that are Environmentally Relevant Activities (ERAs) pursuant to the *Environmental Protection Act 1994* (EP Act). Environmental authorities required for ERAs are obtained through the Integrated Development Assessment System (IDAS) under the *Integrated Planning Act 1997* (IPA). Approval conditions for ERAs are provided in Schedules A1 – A5 of this Report.

Material change of use (MCU) applications under the SDPWO Act are required for both the nickel refinery and the RSF. As both of these facilities occur on the Gladstone State Development Area (GSDA), the 'Development Scheme' for the GSDA replaces the 'Planning Scheme' for Gladstone Regional Council local government area. The Coordinator-General is the Assessment Manager for all MCU applications for the GSDA. In this Report, I have set conditions that must attach directly to the MCU approvals for the refinery (Schedule C1) and RSF (Schedule C2), but the ERA environmental authority conditions recommended by EPA for the refinery (Schedules A1 and A2) and RSF (Schedule A3) will be set directly by EPA under the EP Act.

The refinery, RSF and pipelines will require environmental authorities from the EPA for both construction and operation in accordance with the provisions of the EP Act (Schedule A5). The ERAs for the nickel ore slurry pipeline will be associated with the proposed pipeline infrastructure Mining Lease (ML). Where GPNL opts for the pipeline to exit the ML area and locate within the Stanwell-Gladstone Infrastructure Corridor State Development Area (SGICSDA), conditions would be associated with an environmental authority under the EP Act that is separate from the ML. I have also set some conditions that would apply to the ore slurry pipeline (Schedule C3). These would attach to the ML or an MCU for the pipeline within the SGICSDA, depending upon its location.

MCU approvals for all of the linear infrastructure entering or leaving the refinery on the GSDA (including all pipelines) will be included within the refinery MCU and my conditions (Schedule C1) will apply. ERA environmental authority conditions for the residue slurry and return liquor pipelines between the refinery and the RSF are provided in Schedule A4.

The acid pipeline, seawater intake pipeline, waste water discharge system, and ore / sulphur import conveyor from Wiggins Island Wharf all occur mostly within the GSDA, and also partly



on Strategic Port Land over which the Gladstone Ports Corporation Limited (GPCL) is the IPA Assessment Manager. GNP infrastructure proposed to be located on Strategic Port Land does not require an MCU approval under IPA, but does require GPCL approval. My conditions attached to this infrastructure (Schedule B) are provided as recommendations to GPCL.

GPNL has existing environmental authorities and a Mining Lease (ML) for its Marlborough mine. Some aspects of the mine licences may be amended as GPNL refines its mine, ore beneficiation and ore transport plans. Such potential amendments to existing approvals on the ML are outside the scope of this Report.

Other specific authorities, licences, permits and approvals required for the GNP are described in this Report, and I have made recommendations for these approvals where appropriate.

4.1 Performance criteria for progression to Stage 2

By any definition, the proposed Gladstone Nickel Project (GNP) will be a very large undertaking and it will process substantial quantities of materials. As outlined in my discussions elsewhere in Section 4 of this Report, I consider that the potential pollutants that the refinery will produce are likely to be present in acceptably low concentrations. Nonetheless, these materials would be entrained in large quantities of liquid, solid and air waste streams.

My detailed consideration of the environmental impacts of these waste streams and approval conditions and recommendations required to manage them for both Stage 1 and 2 of the GNP are provided in:

- Section 4.2, for discharge of treated waste water to the marine environment
- Section 4.3, for discharge of air emissions
- Section 4.8, for solid residue storage.

The task of assessing the potential impacts of the emissions from the GNP is heavily reliant on the predictions of technical models. While most individual elements of the Project would utilise well understood technologies that are in common operation around the world (e.g. the acid plants), the resource input characteristics and the total combination of process technologies proposed for this Project are not precisely replicated anywhere else in the world.

The Minara Resources nickel refinery in operation at Murrin Murrin in Western Australia utilises a high pressure acid leach (HPAL) process that is similar to that proposed for the GNP. The EPA considered the performance of that refinery in its evaluation of the EIS for the GNP. Nonetheless, the Murrin Murrin facility is sited at an inland location some distance from residential areas (in the goldfields well north of Kalgoorlie), its lateritic nickel ore has some different characteristics, and it uses bore water rather than seawater, so comparisons with the GNP can only be approximate.

While GPNL will be bound by its environmental authority conditions, many measures of performance of the Project described in the EIS documentation will not be secured by simply adhering to the authority conditions. For example, GPNL will be bound to ensure that the concentration of constituents in the waste water discharged to Port Curtis are less than the discharge criteria at the diffusers specified in the Environmentally Relevant Activity (ERA) environmental authority conditions in Tables 2, 3 and 4 of (sub)Schedule C of Schedule A2. However, despite additional requirements specified in the (sub)Schedule C, ERA environmental authority conditions are set for GPNL to undertake:

- a validation of diffuser performance (C19 – C22)
- a comprehensive receiving environment monitoring program (C31), incorporating both a near-field monitoring program (C32 – C34) and a far-field monitoring program (C35 – C40)

- direct toxicity assessments (C23 – C30)
- a containment and release reduction strategy (C38 – C40).

Those conditions do not obligate GPNL to achieve any defined standards, and approvals for Stage 2 of the Project are not linked to the results of these programs for Stage 1 of the Project.

Similarly, GPNL would be bound by the air emission release criteria outlined in Tables 2 and 3 of (sub)Schedule B of Schedule A2, and it must undertake the emission verification program described in Condition B28 of (sub)Schedule B of Schedule A2. However, the ERA conditions by themselves do not obligate GPNL to achieve any defined results for air quality monitoring conducted off the refinery site and approvals for Stage 2 of the Project defined by the ERA conditions are not linked to the results of broader air monitoring during Stage 1 of the Project or the outcomes of the emissions verification reporting process.

Consequently, I consider that, given the large scale of the GNP, it is at least theoretically possible that the environmental impacts of the Project could fall outside of the range predicted by the EIS documentation, whilst still being 100% compliant with the ERA environmental authority conditions. Therefore, I also consider that it is reasonable to require:

- an analysis of the measured operational performance of Stage 1 of the Project near full operating capacity against the predictions in the EIS documentation
- a capacity to reduce the ERA emissions conditions for the GNP must be preserved if the broader environmental impact of Stage 1 of the Project is demonstrated, following full operation, to be substantially greater than forecast by GPNL during the EIS process.

The 'performance parameters' should be derived from those reported in the EIS, SEIS, this Report, or subsequently as established through any Change Report process under Division 3A of Part 4 of the SDPWO Act. Division 3A deals with changes to a project requested by a project proponent.

I consider that preserving a capacity to amend ERA emission conditions subject to an evaluation of measured performance should be made by the EPA. Such an evaluation should not be made until Stage 1 of the Project has been operational at more than 80% of the forecast Stage 1 nickel metal output capacity of 63,000 tpa for at least 12 months.

A capacity for EPA to amend ERA emission conditions for the GNP should not affect GPNL's right to request specific changes to the Project under section 35D of the SDPWO Act.

I further consider that, if the GNP is able to meet or exceed the forecast environmental performance standards, then the emission conditions stated in this Report should not be altered for a 'reasonable period of time'. I consider that such a reasonable time period could be ten years from the commencement of construction of Stage 1 of the Project.

In recommending an approach that preserves the capacity to amend ERA emission conditions subject to performance review, I note that I also considered the alternative option of not allowing conditions to be altered, but instead requiring approval for Stage 2 to be contingent upon Stage 1 operational performance. However, I did not recommend this alternative because:

- it would be a less certain and reasonable condition for GPNL
- EPA's powers under the EP Act allow for operating conditions to be amended subject to technical reports
- while that option would prevent Stage 2 from proceeding, it would not address the potential issue of unsatisfactory environmental performance of Stage 1 of the Project.

The 'performance parameters' to be considered by EPA would be specifically restricted to:

- the air and water emissions from the Project and the monitoring measurements of the fate of those emissions in the surrounding environment (see Sections 4.2 and 4.3 of this Report)

- residue leachate releases (if any) to groundwater and surface waters at the Residue Storage Facility (RSF – see Section 4.8 of this Report).

In addition to adherence to the emission criteria specified in the ERA environmental authority conditions (Schedules A1, A2 and A3 of this Report), measured levels for other performance parameters should not exceed the predicted values in the EIS documentation by more than 30% unless they represent an insignificant impact to the environment. The list of performance parameters to be measured and the benchmarks to be achieved are to be agreed with EPA within twelve months of the date of this Report, and should generally aim to measure of the impact of the GNP on the water, air and land environments in Port Curtis, around the refinery site and at the RSF. A list of parameters that I consider should be included in the '*Stage 1 Performance Report*' is provided in Condition 1.1 below.

I consider that it is reasonable to set a fixed time period over which the conditions that apply to Stage 2 of the GNP should not be altered, because a compromise is required between:

- providing GPNL with an adequate period of certainty with respect to project planning and financing
- allowing for advances in technology or environmental standards that would dictate tighter emission or other controls.

For the GNP, the four-year currency period for this Coordinator-General's Report set under section 35A(1)(a) still applies, but my rationale for setting a ten-year period from commencement of construction of Stage 1, over which the Stage 2 environmental authority conditions specified in this Report should not be altered (subject to achievement of the required benchmarks in the *Stage 1 Performance Report*), is as follows:

- GPNL advises that at least two years is required to complete construction of Stage 1 of the Project
- GPNL advises that commissioning of the refinery and other Stage 1 Project elements and ramp-up to full production may take up to three years from completion of construction
- at least 12 months of data collection is required after the refinery reaches at least 80% of full production to provide for a reasonable performance review and this period is unlikely to commence sooner than three to five years from commencement of construction
- a period of review of the Stage 1 Performance Report may take around six months, and this would be followed by a further corporate planning, and financial close period before Stage 2 construction could commence
- a longer period of monitoring may be justified if the twelve months data at above 80% production proves inconclusive
- given that a period of four to six years from commencement of construction may be reached before GPNL could make a commitment to proceed to Stage 2, and that this period could be extended by many factors such as changed global market conditions over that period, I consider that a further holding period of about four years for the Stage 2 conditions is necessary
- the likelihood of technology improvements or other changes to environmental standards beyond ten years appears to be too great to hold the Stage 2 conditions specified in this Report for longer than that period.

My recommendation that Stage 2 environmental authority conditions be held in place for up to ten years does not obviate the need to ensure that there is adequate capacity at the RSF to store residue (discussed in Section 4.8.4 of this Report) and does not override Condition 8.1 which addresses that matter.

As a consequence of the above considerations, I recommend that the following condition, governing a capacity to amend the ERA emission conditions in Schedules A1, A2 and A3 of this Report, be attached to any MCU approval for the nickel refinery.

Condition 1.1

- (a) A *Stage 1 Performance Report* must be submitted to the Coordinator-General and the EPA. The *Stage 1 Performance Report* must be supported by at least twelve months of data describing the operational performance of the GNP with respect to:
 - (i) the air and water emissions from the Project and the monitoring measurements of the fate of those emissions in the surrounding environment and
 - (ii) residue leachate releases to groundwater and surface waters at the Residue Storage Facility (RSF).
- (b) The *Stage 1 Performance Report* cannot be submitted until data is available for at least twelve months of operations of Stage 1 of the GNP at more than 80% of the Stage 1 nickel metal output capacity of 63,000 tonnes per annum.
- (c) The parameters to be included in the *Stage 1 Performance Report* must be set by EPA in consultation with GPNL within twelve months of the date of this Report and reported to the Coordinator-General and should include:
 - (i) concentrations in solution of the constituents specified in Table 3 of Section 4.2 of this Report in Port Curtis in both the near-field discharge plume and far-field environments (at sampling locations agreed with EPA)
 - (ii) concentrations in solution and in marine sediments of heavy metals (specified by EPA) in Port Curtis in both the near-field and far-field environments (at sampling locations agreed by EPA)
 - (iii) temperature and pH of the marine discharge plume in the near-field environment
 - (iv) monthly dust deposition and nickel, cobalt, chromium and total metals concentration in dust deposition measured near to the south-east boundary of the refinery site
 - (v) hourly and daily average total suspended particulates (TSP), air particulates with a diameter less than ten micrometres (PM10), measured near to the south-east boundary of the refinery site
 - (vi) hourly and daily average air sulphur dioxide (SO₂), oxides of nitrogen (NO_x) and hydrogen sulphide (H₂S) measured near to the south-east boundary of the refinery site, compared to the predictions provided during the Environmental Impact Statement (EIS) process using the Gladstone Airshed Modelling System (GAMS)
 - (vii) hourly and daily average air SO₂ and NO_x measured at the EPA monitoring station at Clinton compared to the GAMS predictions provided in the EIS documents
 - (viii) permeability of the dewatered residue
 - (ix) groundwater levels around and down gradient of the RSF at sites agreed by EPA (in consultation with the Department of Natural Resources and Water) and
 - (x) for residue leachate at the RSF, and surface and groundwater at the RSF (at monitoring sites agreed with EPA): pH, electrical conductivity, total dissolved solids (TDS), dissolved metals (arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, and zinc) and the major ions (sodium, magnesium, calcium, potassium, chloride, sulphate, fluoride and bicarbonate).
- (d) The *Stage 1 Performance Report* must be accompanied by the following items specified in Schedule A2 of this Report:
 - (i) reports generated as part of the Air Emission Verification Study required by Condition B28 of (sub)Schedule B (of Schedule A2)
 - (ii) the Diffuser Validation Report specified in Condition C22 of (sub)Schedule C

- (iii) reports generated by Direct Toxicity Assessments undertaken in accordance with Conditions C23 – C30 of (sub)Schedule C
 - (iv) reports generated in accordance with the Near-Field Receiving Environment Monitoring Program specified in Conditions C32 – C34 of (sub)Schedule C
 - (v) reports generated in accordance with the Far-Field Receiving Environment Monitoring Program specified in Conditions C35 – C37 of (sub)Schedule C
 - (vi) the Containment and Release Reduction Report specified in Condition C40 of (sub)Schedule C and
 - (vii) a summary of the main findings of the reports in (i) to (vi).
- (e) The benchmarks to be achieved for each parameter in the Stage 1 Performance Report must be set by EPA in consultation with GPNL within twelve months of the date of this Report and should generally not exceed the predicted values, resulting from the operation of the GNP, as provided by the Proponent in the EIS documentation by more than 30%, unless they represent an insignificant impact to the environment.
 - (f) Subject to the Stage 1 Performance Report demonstrating the achievement of benchmarks in accordance with Condition 1.1(e), and without changing the application of section 35A of the SDPWO Act, the operating conditions for Stage 2 of the GNP as set out in this Report, unless otherwise altered under Division 3A of Part 4 of the SDPWO Act, will not change for at least ten years from the date of commencement of above-ground civil works construction of Stage 1 of the refinery at Yarwun.
 - (g) If the Stage 1 Performance Report demonstrates that any of the performance benchmarks have not been achieved in accordance with Condition 1.1(e), then EPA may tighten the relevant emission conditions in Schedules A1, A2 and A3 of this Coordinator-General's Assessment Report, subject to the Coordinator-General's approval, so that the required benchmark performance for those parameters can be met.
 - (h) If EPA sets new emission conditions in accordance with Condition 1.1(g), then GPNL has six months from the date that it receives written notification of an amended condition to comply with that amendment.
 - (i) The Coordinator-General may, upon written application from GPNL, extend the period of compliance with an amended condition required under Condition 1.1(h).
 - (j) To remove any potential uncertainty, Condition 1.1 does not override Condition 8.1, which relates to longevity of storage capacity at the nominated RSF site.


4.2 Treated wastewater discharge into Port Curtis

4.2.1 Origin and characteristics of barren liquor waste

The EIS documents described the production of barren liquor at the nickel refinery and the subsequent management of that waste. This section summarises the information presented in those documents.

When metals are removed from the process liquor in the high pressure acid leach (HPAL) process, the resulting barren liquor is dominated by calcium (Ca – from the neutralising limestone and lime), magnesium (Mg – leached from the lateritic ores), sulphates (SO₄) from the sulphuric acid) and some chlorides (Cl – from the seawater). Not all of this liquor can be reused in the process because the high content of these salts would cause a build-up of scale and hinder the nickel/cobalt (Ni/Co) leaching process. Consequently, part of the barren liquor will be a waste stream from the refinery.

The treatment of the barren liquor takes place in the final neutralisation step of the refinery process which precipitates residual metals from solution. To ensure any soluble chromium is



removed, the slurry is first contacted with hydrogen sulphide to reduce any hexavalent chromium (Cr^{6+}) to trivalent chromium (Cr^{3+}). Limestone is added to neutralise acid and then lime slurry to ensure that adequate precipitation of the heavy metals is achieved. Precipitation of soluble manganese (Mn) is enhanced by controlled oxidation using a mixture of air and sulphur dioxide (SO_2).

Following removal in the refinery of metals for recovery as Ni and Co products, most of the barren liquor will be recycled to wash valuable metals from the barren residue solids (in a counter-current washing circuit). The excess will be combined with solid residues from the leach plant and neutralised and treated, as described above, before being pumped to the Residue Storage Facility (RSF) for long term storage. The solid residue slurry will be thickened before being discharged to the RSF. Liquor separated in the thickener and liquor decanted from the RSF will be combined in return liquor tanks, pumped back to the refinery, checked for permit compliance, and subsequently discharged to Port Curtis.

The general properties of the barren liquor would be similar to seawater, except for greatly increased concentrations of Mg, and SO_4 ions, reduced concentrations of Cl ions, and small amounts of other metals such as Ni, Co, Mn, cadmium (Cd), Cr, zinc (Zn), aluminium (Al) and iron (Fe).

Although the actual amounts of many metals in the barren liquor per unit of volume would be small (e.g. <3.3 milligram per litre (mg/L) for Ni, Co, Cd, Cr and Zn combined), the concentrations of those metals would be much higher than ambient seawater in Port Curtis unless further treated and/or diluted (refer to Table 3.1 of the technical supplement *Gladstone Pacific Nickel Refinery – Environmental Assessment of Treated Water Discharge to Port Curtis* (URS, 25 July 2008).

The cooling and waste water discharge systems for the refinery were very substantially reengineered following the release of the EIS. Therefore, the data presented in the EIS for those elements of the Project have been almost completely superseded by the SEIS. Several significant modifications to the barren liquor discharge systems have also been agreed by GPNL since the release of the SEIS.

The waste water discharge to Port Curtis that was assessed in the EIS was a combination of RSF return liquor, boiler blowdown, cooling water blowdown and reject water from the water treatment plant. Given the proposed replacement of the 'once through' seawater cooling water system with a closed freshwater circuit, the cooling water component of the discharge to Port Curtis has been eliminated.

In addition to the very large reduction in discharge water volume described in the SEIS, new test work assumed increased use of reagents and incorporation of the SO_2 /air treatment process for Mn removal. This enabled further reductions in the concentrations of most constituents in the barren liquor to be identified in the SEIS. For example, the undiluted Mn and Co concentrations reported in the EIS as 130 mg/L and 0.1 mg/L respectively, were reported in the SEIS as 100 mg/L and 0.7 mg/L. Subsequent to the SEIS, additional laboratory test work enabled further significant reduction of metals concentrations (Mn – 10 mg/L and Co – 0.1 mg/L).

The SEIS also reported that 'blowdown' from the freshwater cooling system will be reused in the process as much as possible and will not be discharged as originally reported in the EIS.

Conclusion

Notwithstanding the consideration of appropriate water quality objectives discussed in Section 4.2.3 below, the high concentrations of ions in the barren liquor relative to seawater dictate that further treatment or dilution of the liquor is required prior to discharge to avoid potential environmental harm.

4.2.2 Alternatives to barren liquor discharge to Port Curtis

4.2.2.1 Alternatives to discharge

Several alternatives for disposing of the barren liquor were investigated in the EIS, including pond solar evaporation, forced evaporation and membrane technology. These alternatives were not considered to be viable by GPNL because:

- while the use of seawater improves efficiency of the HPAL process, it makes the commercial scale separation of useful products from the barren liquor more difficult
- if these products could be separated, availability and access to potential markets for the by-products (mostly sodium, magnesium and calcium sulphate and chloride crystals) was not considered to be viable
- those crystals are highly soluble and mobile, and would thus create other potential environmental issues related to safe storage
- solar evaporation in ponds would require more than 4,000 hectares of suitable land, which is not available near Gladstone
- while forced evaporation reduces the land area required, GPNL considered that the capital and operating costs (especially heating costs) would not be viable
- laboratory test work demonstrated that membrane technology or micro-filtration was not technically feasible due to the very high total dissolved solids content in the liquor.

Conclusion

Notwithstanding the treatment alternatives discussed in Section 4.2.2.2 below, I am satisfied that there are no technically and commercially viable alternatives to discharging the treated barren liquor to the marine environment currently available to GPNL.

4.2.2.2 Alternative treatments prior to discharge


GPNL has considered the following alternatives for the treatment of the barren liquor before discharge to Port Curtis:

- removal of metal salt contaminants by additional lime neutralisation
- removal of manganese salts through oxidative precipitation with SO₂
- reuse for neutralisation of alumina refining residues and subsequent reuse of process water in the refinery following neutralisation.

Process redesign undertaken by GPNL after the release of the original EIS proposed increased use of lime and limestone to raise the pH of the barren liquor to remove (by precipitation) a larger proportion of the Mg and Mn. However, the efficacy of this approach diminishes rapidly above pH 6.5 as increasing amounts of lime tends to precipitate more of the common Mg cations (which are not considered a contaminant in the marine environment because of their natural abundance) and less of the smaller amounts of Mn cations (which, above a certain concentration, may be more problematic in the marine environment). Nonetheless, optimisation of this method of treatment is the one proposed to be used by GPNL, as it cannot currently be guaranteed that the alternative treatment options are viable.

GPNL also intends to apply the second of the treatment options, oxidative precipitation of Mn with an air and SO₂ mix. However, there are limitations to the application of this technology, as excess use of SO₂ and air to further reduce Mn could result in the re-leaching of Cr back into solution.

The use of barren liquor in the neutralisation of alumina refinery residues appears to offer enormous potential to reduce or eliminate the liquid waste streams from both the proposed nickel refinery and the Yarwun Alumina Refinery (and/or Queensland Alumina Limited (QAL) or some other future alumina refinery in the locality). As described in the EIS, laboratory



assessments have indicated that this potentially very elegant industrial ecology opportunity could:

- neutralise the acidic waste stream of the nickel residue with the alkaline waste stream of the alumina residue
- use the sodium (Na) rich / Mg-depleted alumina refinery water to precipitate the Mg and Mn rich nickel refinery water, allowing clean water to be returned to the HPAL process in the nickel refinery and eliminating or significantly reducing barren liquor discharge to Port Curtis.

Other potential benefits of this alumina refinery water approach may be:

- reduction in consumption of neutralisation reagents leading to lower residue storage volume
- improved residue solids disposal characteristics
- less greenhouse gas emissions per unit of metal production by displacing the neutralisation reagents
- reduced size and amount of residue processing infrastructure (e.g. dams, pipelines, thickeners, personnel etc.)
- reduction or elimination of seawater required for neutralisation of alumina refinery residue
- the local alumina refiners approaching zero liquid discharge.

GNPL has initiated a high level testing and development program which will be progressed during the detailed design phase of the GNP. Subject to agreement between an alumina refiner and GNPL, pilot-scale work could be undertaken during Stage 1 operations using process liquors.

Considerable test work would be required to ensure that appropriate levels of operational stability would prevail in the event that residue systems are linked. The pilot test work would need to demonstrate operational sustainability, as well as mutual commercial advantage. Consequently, the timeframe for this work would preclude this approach being applied to start-up Stage 1 approvals. However, systems identified and designed early in the life of Stage 1 of the GNP could then either be retrofitted to Stage 1 and/or applied to Stage 2.

I note that the relative physical proximities of both the proposed GNP refinery to the Rio Tinto Alumina Refinery in the Yarwun precinct of the GSDA and the proposed GNP RSF to the Rio Tinto 'red mud dams' in the Aldoga precinct of the GSDA, make the Rio Tinto facility the ideal candidate for GNPL to progress testing of these respective waste streams. I also note that GNPL and Rio Tinto have made some progress in early discussions on this matter.

GNPL is considering further amending the current process design in order to improve the process efficiency by treating the barren solution independently from the residue as this could overcome some of the issues raised above. GNPL is also performing additional laboratory-scale testing of SO₂/air treatment of the slurry to arrive at better control of Mn and Cr behaviour.

Conclusion

I conclude that future improvements to the treatment technologies that could be applied to the barren liquor offer such significant potential to reduce metal ion concentrations in the discharge stream that they should be vigorously pursued by GNPL. In particular, mixing of GNP and alumina refinery residues and/or waste waters appears to offer such potential to significantly reduce treated process liquor discharge to Port Curtis from both the GNP and an alumina refinery, that it is reasonable to require pursuit of this option as a condition of approval of the GNP.

Therefore, the obligation of GNPL to pursue the investigation of alumina refinery waste co-treatment is described in Condition 2.1 below. That condition attaches to any 'material change of use' (MCU) development approval issued for the GNP refinery.

As the refinery is located on GSDA land, the Coordinator-General is the entity responsible for management of the GSDA and has jurisdiction for this condition.

All conditions to be attached to the MCU approval for the refinery are presented in Schedule C1 of this Report.

I recognise that a successful outcome to pilot testing of GNP and alumina refinery waste streams will not only be dependent upon the technical success of pilot trials, but also upon the cooperation of a commercial third party (the alumina refinery owner) who is not bound by the conditions in this Report.

Condition 2.1

- (a) Prior to the completion of detailed design of the nickel refinery for Stage 1 of the Project, GPNL must provide evidence of reasonable endeavour to establish an agreement to undertake pilot testing of GNP and alumina refinery waste co-treatment with an alumina refinery owner in the Gladstone region.
- (b) Subject to the completion of an agreement in accordance with Condition 2.1(a), GPNL must commence the pilot test program described in that agreement within two years of the commencement of operation of the nickel refinery.
- (c) Subject to the successful technical completion of the pilot test program described in Condition 2.1(b), GPNL must, within one year of that completion, provide evidence of its reasonable endeavour to establish an agreement to undertake an ongoing operational-scale alumina refinery and GNP waste co-treatment program with that alumina refinery owner. Such a program could apply to Stage 1 and/or Stage 2 of the GNP.
- (d) Subject to the completion of an agreement in accordance with Condition 2.1(c), GPNL must commence the co-treatment program described in that agreement within two years, if the co-treatment program is applied to Stage 1 of the nickel refinery, or at the commencement of operation of Stage 2 of the nickel refinery, if the co-treatment program is applied only to Stage 2.

4.2.3 Establishment of Water Quality Objectives (WQOs)

4.2.3.1 Constituents other than Manganese (Mn)

The water quality objectives (WQOs) for the treated water discharge have been developed from ANZECC (2000) guidelines, from ambient seawater concentrations, and in one instance (Mn) from specific research (in accordance with ANZECC guidelines). The fundamental principle of the approach used in selecting the WQOs is that the process involves an appreciation of the potential risks that these concentrations present to the marine environment, including of the risk of bioaccumulation.

The Queensland EPA considers the proposed WQOs to represent chronic toxicity trigger levels and these terms are used interchangeably in this Report.

Table 1 shows the WQOs that GPNL proposes to adopt for its discharge to Port Curtis, compared to the undiluted barren liquor concentrations. The footnotes to Table 1 indicate the method of derivation of each WQO. Further explanation of the derivation of these WQOs is provided in section 5 of the technical supplement *Gladstone Pacific Nickel Refinery – Environmental Assessment of Treated Water Discharge to Port Curtis* (URS, 25 July 2008).

Table 1. Water Quality Objectives for discharge to marine environment proposed by GPNL

Constituent	Water Quality Objective (µg/L) ¹	Treated barren liquor concentrations (µg/L)
Nickel	7 ²	560
Cobalt	1 ³	100
Manganese	140 ⁴	10,000
Cadmium	0.2 ⁵	20
Chromium ³⁺	27.4 ³	2,500
Chromium ⁶⁺	4.4 ³	440
Zinc	15 ³	40

1 – Toxicity trigger values - the concentration at which point ecotoxicological effects begin to be observed in some biota or undesirable human health effects can develop.

2 – ANZECC/ARMCANZ (2000) - *Guidelines for Fresh and Marine Water Quality*, Chapter 3 (the 99% species protection level, recommended for 95% species protection due to capacity to bioaccumulate)

3 – ANZECC/ARMCANZ (2000) - *Guidelines* (95% species protection level)

4 – Based on special research undertaken by CSIRO (refer to URS, 2008)

5 – ANZECC/ARMCANZ (2000) - *Guidelines* (where shellfish may be used for human consumption)

GPNL has not provided WQOs for the following elements:

- Fe – ANZECC/ARMCANZ (2000) has not derived an Australian toxicity trigger value for Fe due to a lack of toxicity data but a Canadian guideline of 300 µg/L is presented as an interim indicative level until additional data are established. Ten years of baseline data for Port Curtis show a median level for Fe of 90 µg/L and GPNL has proposed that this baseline information be used for determining future impacts of Fe in marine discharge. The *Queensland Water Quality Guidelines 2006* support this approach.
- Al – ANZECC/ARMCANZ (2000) identifies a protection level of 0.5 µg/L for dissolved aluminium because only 'low reliability data' are available. Ten years of baseline data for Port Curtis show a median level for Al of 73 µg/L. As for Fe, GPNL has proposed that Al baseline information be used for determining future impacts of Al in marine discharge.
- Mg, Ca, Cl and SO₄ – these ions are abundant in seawater and GPNL has proposed that, therefore, no WQOs are required.

EPA has advised that although SO₄ is present in high concentration in the barren liquor, it is not expected to be toxic to marine organisms, transform to other oxidation states in the seawater or influence the precipitation of the metals.

By achieving the above WQOs close to the diffuser discharge pipe, GPNL considers that there will be no significant effect on local marine flora, fauna and human health and, by extension, the local recreational and commercial fishing activities.

EPA has advised that in the absence of any direct toxicity testing of the proposed discharge liquor to quantify the cumulative toxicity of mixtures of dissolved metals, the derivation of the WQOs described in Table 1 are in accordance with the ANZECC/ARMCANZ (2000) Guidelines and are appropriate to apply at the commencement of the GNP. However, EPA has recommended that direct toxicity assessments of the barren liquor be conducted as early as possible after the commencement of the operation of the GNP so that 'high reliability' trigger levels, relevant to the receiving environment and the multiple-toxicant nature of the proposed discharge can be derived and applied to environmental authority conditions.

It should be noted that while the proposed concentration of toxicants in the discharge will be required to be within levels that are not likely to have a significant effect on marine flora and fauna, the longer-term effects and potential for bioaccumulation have not been fully assessed.

Conclusion

Based upon the advice of EPA, and the information provided by GPNL, I conclude that:

- the WQOs defined in Table 1 above for Ni, Co, Cd, Cr³⁺, Cr⁶⁺ and Zn are appropriate to apply to the GNP initially
- direct toxicity assessments should be undertaken as specified by EPA in conditions (C23) to (C30) of Schedule A2 of this Report for the operation of the Gladstone Nickel Refinery.

4.2.3.2 Additional research conducted on the Manganese (Mn) WQO

A considerable amount of attention has been devoted during the EIS process to the study of the fate in the marine environment of Mn contained in the barren liquor. This attention has been driven by:

- the high concentration of Mn in the barren liquor relative to the ambient seawater
- the likelihood that the discharge concentration would exceed the ANZECC/ARMCANZ (2000) trigger value
- the potential of Mn in solution to oxidise and precipitate as small suspended manganese dioxide (MnO₂) or manganese oxyhydroxide (MnOOH) particles in the seawater
- the potential of those particles to:
 - attract other metals in solution
 - settle on the seafloor and accumulate at particular parts of Port Curtis
 - consequently, cause Mn to bioaccumulate to toxic levels in marine organisms.

The ANZECC/ARMCANZ (2000) criteria only include a 'low reliability' trigger value for Mn in marine waters. In these circumstances, the ANZECC guidelines describe a methodology to derive a more reliable WQO based on specific local conditions. Investigation of the oxidation of dissolved Mn and precipitation and potential settling of Mn compounds was also required.

GPNL engaged the Centre for Environmental Contaminants Research, CSIRO Land and Water, and the Centre for Environmental Management at the Central Queensland University to undertake the relevant literature reviews, desk-top studies and preliminary laboratory and field studies. The details of the outcomes of these reviews and studies are provided in the appendices to the technical supplement *Environmental Assessment of Treated Water Discharge to Port Curtis* (URS, 25 July 2008).

The Mn trigger value derived by CSIRO to protect 95% of species can be considered a "moderate reliability" guideline under the ANZECC/ARMCANZ (2000) criteria as it has been derived from sufficient data on acute toxicity. The majority of trigger values nominated by ANZECC/ARMCANZ (2000) are moderate reliability trigger values. A high reliability trigger value can only be derived from specific chronic toxicity testing, which is not commonly undertaken. The derived moderate reliability trigger value for Mn in solution is 140 µg/L (if coral data are included), or 340 µg/L (without coral data).

The available data suggest that Mn is one of the least toxic metals to marine biota. However, no data on the toxicity of Mn to seagrasses and mangroves were available. For this reason, a conservative trigger value of 140 µg/L is proposed as the WQO for Port Curtis. EPA has accepted use of this WQO for Mn.

Assessment of Mn oxidation rates in the laboratory under controlled incubation conditions over a 6-week period used waters from Port Curtis containing ambient suspended sediment supplemented with added inorganic Mn. The study showed that, for the Mn-spiked seawater samples, complete oxidation and precipitation of the added dissolved Mn occurred within 21 days. The estimated half-life of dissolved Mn was between 10–11 days and this was relatively independent of suspended solids load in the water. Based on the results of this investigation, a half-life of 10 days for Mn was used by GPNL in the revised modelling of the refinery's discharge to Port Curtis.

Conclusion

Based upon the advice of EPA, and the information provided by GPNL, I conclude that the WQO defined in Table 1 above for Mn is appropriate to apply to the GNP.

4.2.4 Proposed future studies and monitoring by GPNL

4.2.4.1 PhD research program

To better understand the long term consequences of discharge of barren liquor to the marine environment, GPNL is funding a PhD research program at Central Queensland University. This program is investigating the dynamics of trace metals in Port Curtis under naturally occurring environmental conditions, and the bioaccumulation potential and toxicity of trace metals in biota. The research program consists of the following two phases:

- Initial laboratory assessments that will investigate:
 - the binding capacity of manganese oxides for trace metals under various simulated natural conditions (pH and dissolved oxygen)
 - the bioaccumulation of trace metals in biota (oysters, prawns etc.) and passive sampling devices
 - environmental harm to biota through toxicity testing
 - the light reducing properties and settling rates of the aggregates.
- Field studies and/or mesocosms (simulations of field conditions) that will subsequently be undertaken to validate the results of the laboratory studies.

I support this research effort and expect that it will assist in informing the Stage 1 Performance Report.

4.2.4.2 Port Curtis Integrated Monitoring Program (PCIMP)

GPNL has become a full member of the Port Curtis Integrated Monitoring Program (PCIMP). Through this membership GPNL is participating in:

- biological monitoring (water quality and oyster metal concentrations)
- intertidal (mangrove and sediment) monitoring
- seagrass monitoring
- other Mn-specific studies related to potential toxicity in the marine environment.

I endorse the continued participation of GPNL with the PCIMP.

4.2.4.3 Other monitoring committed by GPNL and required by environmental authority conditions

GPNL has committed to the following studies and monitoring programs, details of which are provided in both section 8 of the technical supplement *Gladstone Pacific Nickel Refinery – Environmental Assessment of Treated Water Discharge to Port Curtis* (URS, 25 July 2008), and the conditions attached to environmental authorities required to operate the refinery (Schedule A2 of this Report):

- an ongoing program of monitoring of contaminants released to Port Curtis
- a program of direct toxicity assessments (DTAs) of wastewater discharge that is to be conducted as:
 - confirmation DTA, performed quarterly during the first year of operation
 - routine DTA performed either 6-monthly, annually or biannually, dependent on previous DTA results and toxicant concentrations trends in the waste water
 - event-based DTA, if trigger levels are exceeded

- an additional confirmation DTA, whenever any process changes could lead to an increase in toxicological properties of the discharge water
- a receiving environment monitoring program that samples both:
 - the near-field environment within 300 m of the diffusers
 - the far-field environment more broadly in Port Curtis.

Conclusion

Conclude that the ongoing program of monitoring and studies proposed by GPNL and conditioned to the ERAs (Schedule A2 of this Report) would be adequate to:

- provide the information required to establish and maintain the environmental management systems for the marine discharge
- ensure that the performance of the discharge system prevents environmental harm including to the values of the Great Barrier Reef World Heritage Area, and to listed threatened species and communities of migratory species in Port Curtis.

4.2.5 Proposed discharge methodology and release concentrations

Considerable effort has been devoted during the EIS process to the examination of the method of discharge to Port Curtis to ensure:

- acceptable concentration of the discharge waters (below acute toxicity levels for each constituent)
- acceptable mixing of those discharge waters in a small zone around the diffusers, so that the concentration of constituents fall below chronic toxicity levels within a very small area, and the WQOs are met.

Discussions with EPA and GPNL following the release of the SEIS have resulted in further discharge system design modifications. At least ten different combinations of release locations and release infrastructure designs have been evaluated. The discharge options considered and the final discharge configuration proposed by GPNL are described in sections 2 and 3 respectively of the technical supplement *Gladstone Pacific Nickel Refinery – Environmental Assessment of Treated Water Discharge to Port Curtis* (URS, 25 July 2008).

In summary, the discharge design relies on at least 10:1 dilution with seawater in mixing tanks immediately prior to discharge through diffusers. Due to concerns raised by EPA about the potential for limited dispersion provided by tidal currents around tide change events, GPNL has also agreed to undertake 20:1 dilution for a 30 minute period either side of and during each tide change (i.e. for four hours per day). The treated water from the refinery would be pumped to the Treated Water Dilution Pit located at the Clinton Industrial Estate (approximately 4.8 km from the Refinery – see Figure 3). The 1.6 m diameter diluted treated water discharge pipeline will run from the pit, around the edge of the RG Tanna complex to the Clinton Wharf (approximately 3 km) to a diffuser line to be laid on supports on the seabed floor on the south side of the Clinton Wharf jetty. The components of the discharge system used for each Stage would consist of:

- an 1,150 m³ mixing tank, constructed as a pit located near to the seawater intake point on the east side, and near the mouth of, of the Calliope River
- a 2 m diameter seawater intake dilution pipe (designed such that the intake velocity is close to that of tidal flow)³

³ The intake velocity from the intake dilution pipe to the dilution pit is calculated by GPNL to be approximately 1 m/s. Maximum tidal velocities in Port Curtis range between 0.5 and 1.2 m/s.



- a 1.6 m diameter discharge pipe extending on the sea floor 250 m into Port Curtis with 70 diffuser ports that are 240 mm in diameter and spaced at 2.5 m intervals over the final 175 m of the pipe
- discharge at an average water depth of 9.5–10.0 m at an average velocity of 3 m/sec and an average volume of 2,440 L/port/hour.

The Clinton Wharf location is favoured by GPNL because:

- the main channel flows provide superior flushing characteristics for removal of discharge from Port Curtis
- that area is already modified and disturbed by dredging, wharf and marina operations and rock walls which extend from the eastern side of the Calliope River mouth to Auckland Inlet
- it is further from sensitive receivers such as seagrass environments than other potential locations
- the GPCL and the Harbour Master have confirmed that this location will not interfere unduly with shipping or marina operations.

As an additional protection measure, a screen would need to be fitted to the large seawater intake pipe to help prevent entrainment of marine animals.

Table 2 provides GPNL's estimates of the marine discharge concentrations at the diffuser in comparison to the WQOs or ambient seawater concentrations.

Conclusion

I conclude that:

- the methodology for dilution of the barren liquor and discharge to Port Curtis is acceptable, provided that the conditions set by EPA and detailed in Schedule A2 of this Report are applied
- although the dilution strategy substantially reduces the concentration of the barren liquor constituents in the discharge waters, those concentrations remain above the WQOs and/or ambient seawater indicator levels, so further significant and rapid reductions in a relatively small mixing zone around the diffusers are required (as described below).

As the concentration of some metals in the discharge remain up to ten times the WQOs at the diffuser port, a close examination of the dispersion of the discharge waters in the zone around the diffuser pipes, and more broadly throughout Port Curtis, is essential.

Figure 3. Seawater and treated water infrastructure

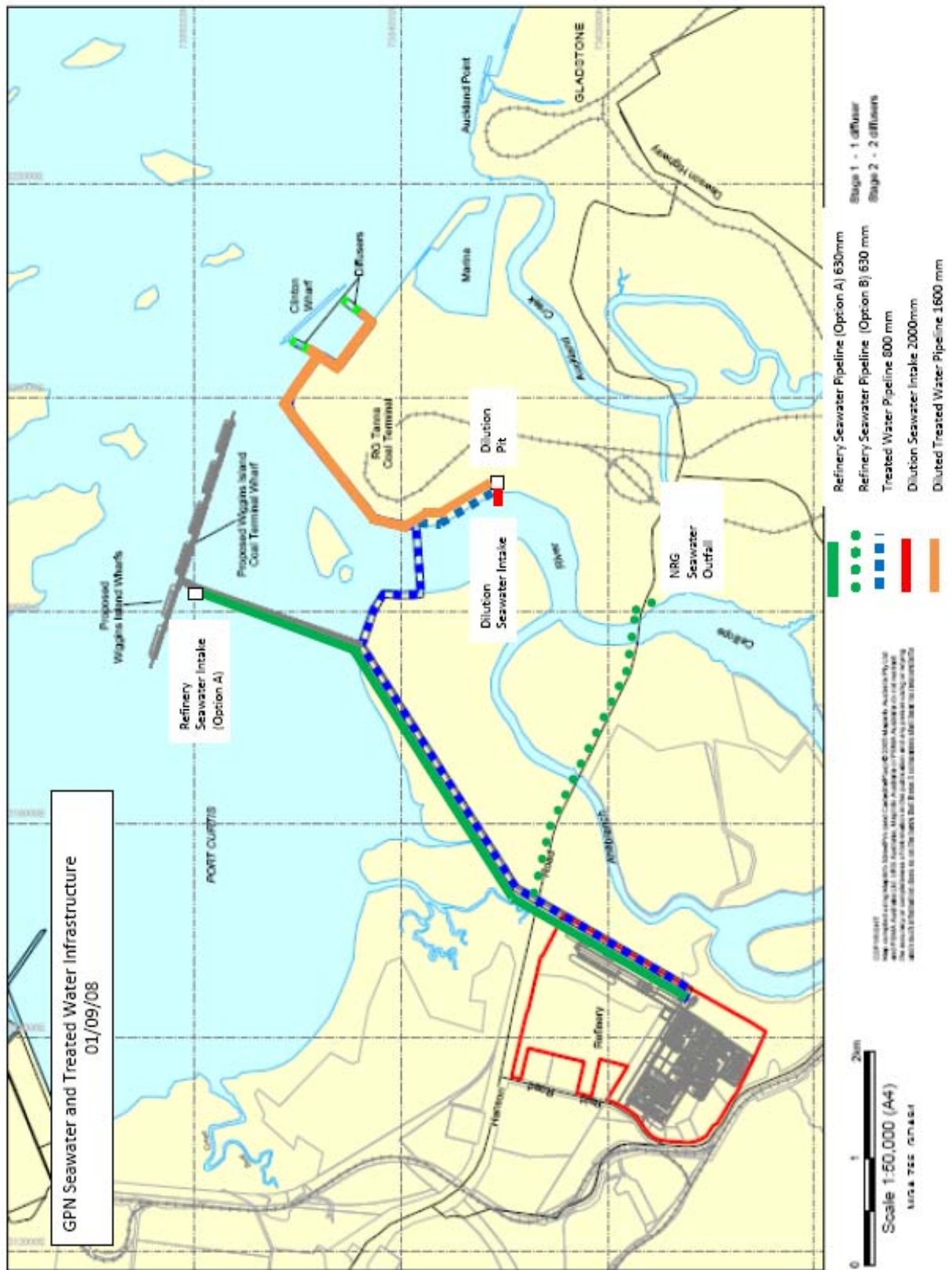


Table 2. Release concentrations at the diffuser compared to the WQOs or median ambient seawater concentrations

Constituent ¹	Water Quality Objectives or ambient concentrations (µg/L) ²	Release concentrations at 10:1 dilution (µg/L) ³	Release concentrations at 20:1 dilution (µg/L) ³
WQO			
Nickel	7	57	29
Cobalt	1	10	5
Manganese	140	1010	510
Cadmium	0.2	2	1
Chromium ³⁺	27.4	250	175
Chromium ⁶⁺	4.4	44	22
Zinc	15	4.5	2.5
Ambient			
Iron	90	390	240
Aluminium	73	273	173
Magnesium	1,290,000	3,080,000	2,815,000
Calcium	411,000	478,000	444,500
Chloride	19,400,000	20,608,000	20,004,000
Sulfate	2,688,000	9,320,000	6,008,000
Discharge rates (m3/hr)			
Stage 1	n/a	17,100	17,100 ⁵
Stage 2 ⁴	n/a	34,200	34,200 ⁵

1 – Al, Ca, Cl, Mg and Mn all occur commonly in seawater and so dilution concentrations of these elements are less than the heavy metals.

2 – WQO for Ni, Co, Mn, Cd, Cr and Zn, and ambient Port Curtis seawater concentration for Fe, Al, Mg, Ca, Cl and SO₄.

3 – 10:1 dilution would apply for 20 hours per day, and 20:1 dilution would apply for 4 hours per day (for 30 minutes either side of each tide change).

4 – A second dilution pit would be used for Stage 2.

5 – 20:1 dilution would be achieved by halving the rate of barren liquor input (compared to 10:1 dilution) rather than doubling the rate of seawater input.

4.2.6 Fate of the discharge in the marine environment

GPNL has undertaken an extensive assessment of the likely distribution of the proposed treated water discharge to Port Curtis. The assessment was based on the application of dispersion models at two scales of investigation:

- Near-field models – which assessed impacts in the mixing zone in the immediate vicinity of the diffusers over time scales of minutes to hours
- Far-field models – which assessed impacts throughout the whole of Port Curtis beyond the initial mixing zone over time scales of months to one year.

4.2.6.1 At the discharge point (Clinton Wharf)

GPNL engaged BMT WBM to undertake modelling of the dispersion of the constituents in the refinery's effluent in the near-field environment around the diffuser pipes at Clinton Wharf. The predictive modelling applied:

- first, a 'CORMIX' 1-dimensional steady-state model (reported in the EIS and SEIS)
- subsequently, a Computational Fluid Modelling (CFD) 3-dimensional analysis (reported in detail in the technical supplement *Gladstone Pacific Nickel Refinery – Environmental Assessment of Treated Water Discharge to Port Curtis* (URS, 25 July 2008)).

CORMIX modelling relied on interaction with the RMA-11 far-field model (see Section 4.2.6.2 of this Report). Near-field pollutant concentrations were modelled at a range of ambient tidal velocities from 0.16 to 1.0 m/s. CORMIX model results were not regarded as reliable at tidal velocities of less than 0.16 m/s.

The CFD model was adopted to provide a more robust assessment of the near-field plume dynamics very close to the discharge ports that was not possible because of the limitations of the CORMIX model. The CFD modelling enabled a more detailed spatial and temporal examination of the dynamics of the discharge plume emanating from each diffuser port. It also allowed an examination of plume behaviour under very low tidal velocity conditions (less than or = 0.1 m/s).

The near-field modelling showed that WQOs would be met within very short distances of the diffusers. For Stage 1 of the Project, all WQOs would be achieved at a distance of 0.3 m from the diffuser (at 1.0 m/s ambient tidal velocity) and 2.2 m from the diffuser (at 0.16 m/s tidal velocity). For Stage 2 of the Project, all WQOs would be achieved at a distance of 0.2 m from the diffusers (at 1.0 m/s tidal velocity) and 5.9 m from the diffusers (at 0.16 m/s tidal velocity).

Table 3 shows the modelled estimates for the total maximum near-field concentrations of the marine discharge for Stage 2 of the Project (at a tidal velocity of 0.25 m/s) in comparison to the WQOs or ambient seawater concentrations. Those estimates allow for both residual mixing back of far-field ambient concentrations and interaction with the Stage 1 diffuser. The results illustrate that the concentrations fall comfortably below the WQOs and approximate ambient seawater concentrations for the other discharge constituents.

The CFD modelling showed that there would be small areas within the core of the effluent plume where concentrations will be in excess of the WQOs for a short time. However, these concentrations are not representative of the bulk down-current concentrations in the near-field zone as they do not occur throughout the entire water column. The CFD modelling also showed that:

- the plumes emanating from the individual diffuser ports would not overlap (at the 1.25 m mid-point) within the first 5 m of the diffuser pipe
- all plumes would be diluted to <20% of the discharge concentration within a horizontal distance of 1 m from the diffuser port at all tidal velocities
- the slower the tidal velocity, the greater the vertical height of distribution of each diffuser plume, and therefore, the greater volume of water in that column for mixing. At 1 m/s tidal velocity the plume would rise <2 m before being swept horizontally, but at 0.1 m/s tidal velocity, the plume would spread over almost 6 m in a vertical column before being swept horizontally
- the 20:1 pre-discharge dilution, combined with the larger vertical rise of the discharge plume, would combine to produce acceptable dispersion characteristics at very low tidal velocities around the tidal change times.

GPNL contests that the contaminants in the discharge would remain in dissolved form in solution and would not precipitate in any measurable quantity to subsequently settle and thus contaminate sediment or the marine environment around Clinton Wharf. Further discussion of the potential for longer-term contamination of marine sediments in Port Curtis is provided in Section 4.2.6.3 below.

Table 3. Modelled estimates for the total maximum near-field concentrations of the marine discharge for Stage 2 of the Project (at a tidal velocity of 0.25 m/s) compared to the WQOs or median ambient seawater concentrations

Constituent	Water Quality Objectives or ambient concentrations (µg/L) ¹	Max near-field concentration at 0.25 m/s tidal velocity (µg/L) ²
WQO		
Nickel	7	1.52
Cobalt	1	0.28
Manganese	140	25.7
Cadmium	0.2	0.06
Chromium ³⁺	27.4	4.7
Chromium ⁶⁺	4.4	1.0
Zinc	15	0.6
Ambient		
Iron	90	95.5
Aluminium	73	76.6
Magnesium	1,290,000	1,322,800
Calcium	411,000	412,300
Chloride	19,400,000	19,422,000
Sulfate	2,688,000	2,809,200

1 – WQO for Ni, Co, Mn, Cd, Cr and Zn, and ambient Port Curtis seawater concentration for Fe, Al, Mg, Ca, Cl and SO₄

2 – Estimates incorporate both residual mixing of far-field ambient concentrations and interaction between the Stage 1 and Stage 2 diffusers. Model estimates are for the 10:1 pre-discharge dilution scenario. The model for the 20:1 dilution scenario, when tidal velocities are generally <0.1 m/s, predict lower concentrations than shown in Table 3.

Conclusion

I conclude that the concentration of constituents in the discharge waters should reach acceptable levels within a short distance of the diffuser pipes. The conditions for the operation and monitoring of the discharge, detailed in Schedule A2 of this Report, would be adequate to prevent harm to biota in the near-field environment around Clinton Wharf. Consequently, I further conclude that there would be no harm to World Heritage values or listed (threatened or migratory) species and communities in the near-field as result of the waste water discharge.

4.2.6.2 In the broader Port Curtis marine environment

The tool used by GPNL to model the potential impacts on the broader Port Curtis marine environment (far-field) is a three-dimensional finite element advection dispersion model (run in two-dimensional mode), developed by Resource Modelling Associates (known as RMA-11). Given the level of industrial and shipping activity in and around Gladstone, there is a considerable amount of background data on tidal and other current movements in Port Curtis. Consequently, the tidal models for Port Curtis are well established and appear robust. The RMA-11 model was calibrated and validated following new data collection between April and May 2006.

The model network extends over an area of some 635 square kilometres, incorporating the Port of Gladstone and the main inter-tidal areas between Curtis Island and the mainland.

The model extent includes all the predominant tidal flows into Port Curtis, being the main ocean entrance at the eastern model boundary, the North Channel between Facing Island and Curtis Island, and through the Narrows. The tidal tributaries, including Calliope River, Auckland Inlet, South Trees Inlet and the Boyne River, have also been incorporated into the model.

The application of RMA-11 to the GNP assumed a 'half-life' of ten days for precipitation of Mn from solution and zero precipitation for the other discharge constituents.

A representation of the output from the RMA-11 model, drawn from the technical supplement *Gladstone Pacific Nickel Refinery – Environmental Assessment of Treated Water Discharge to Port Curtis* (URS, 25 July 2008) is provided in Figure 4. It depicts the 6-hourly maximum concentrations of non-Mn 'tracers' in Port Curtis for Stage 2 of the GNP. The green colours around the RG Tanna Coal Terminal illustrate a zone in which the concentrations of constituents are estimated to be between 0.05% and 0.10% of the discharge concentrations. In practical terms, this means that the discharge constituents would generally be diluted to well below (1–29%) Port Curtis ambient seawater concentrations.

The pale blue colours outside of that zone show tracer constituents at concentrations of between 0.02% and 0.05% of the discharge concentrations. At that rate of dilution, concentrations of Cr³⁺ would be less than ambient seawater, and the other constituents of interest arising from the discharge would be less than 0.4–15% of seawater concentrations.

The RMA-11 model predicts concentrations of Mn ions in solution would be slightly lower than depicted in Figure 4, due to a small amount of slow oxidation of that element in the seawater. The maximum far-field concentrations for Stage 2 of the GNP, based on the RMA-11 modelling, are provided in Table 4.

Table 4. Modelled estimates for the maximum far-field concentrations in Port Curtis for Stage 2 of the Project compared to the WQOs and median ambient seawater concentrations

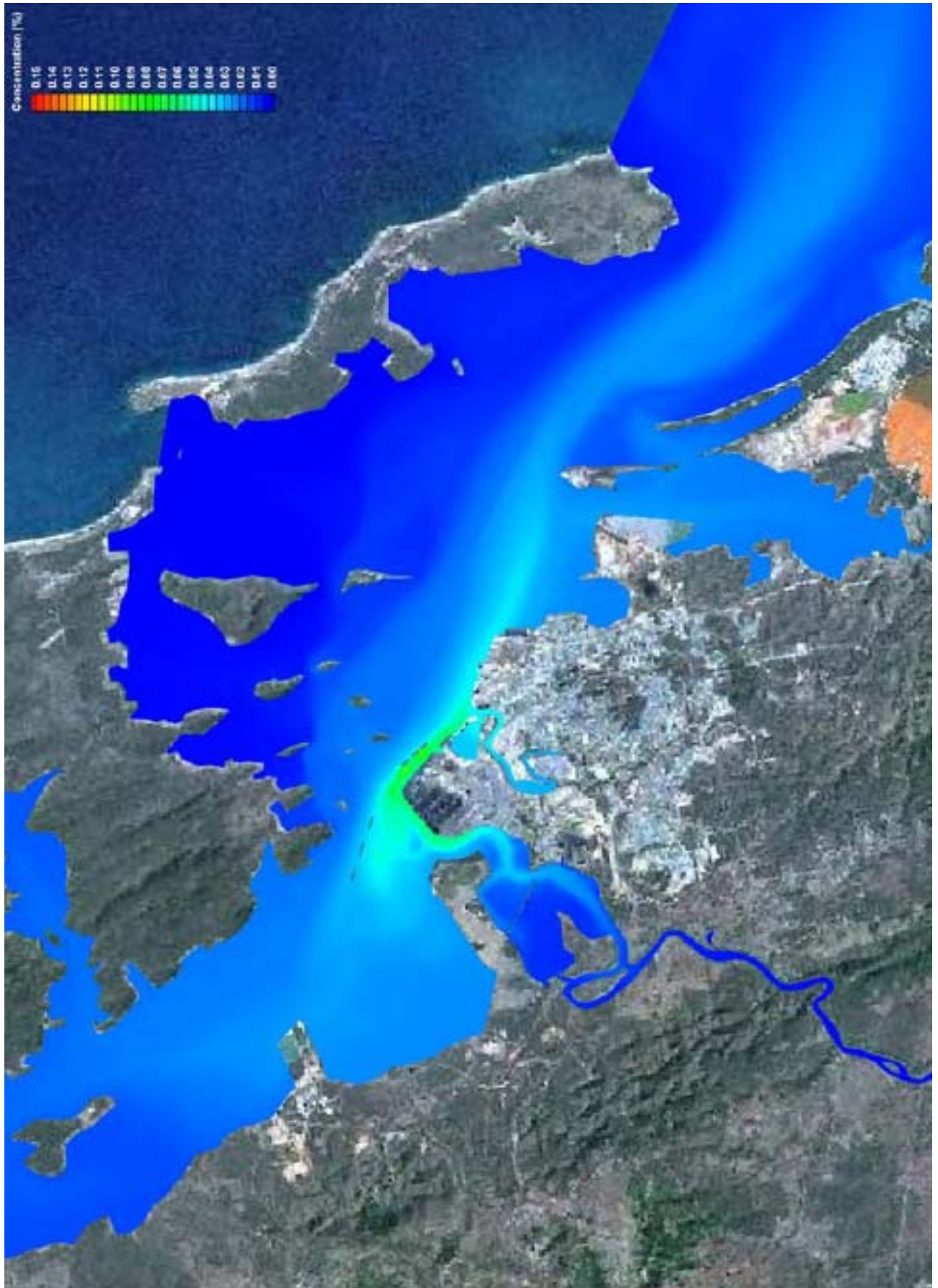
Constituent	Water Quality Objectives (µg/L)	Max far-field concentration (µg/L)	Ambient seawater concentrations (µg/L)
Nickel	7	0.53	0.5
Cobalt	1	0.1	0.1
Manganese	140	8.1	7.6
Cadmium	0.2	0.02	0.02
Chromium ³⁺	27.4	0.27	0.15
Chromium ⁶⁺	4.4	0.17	0.15
Zinc	15	0.5	0.5

Conclusion

I conclude that dispersion within Port Curtis should cause the key constituents of the discharge waters to dilute to near ambient concentrations. The conditions set by EPA for the operation and monitoring of the discharge, detailed in Schedule A2 of this Report, would be adequate to prevent environmental harm in Port Curtis and the broader marine environment. Consequently, I further conclude that there would be no harm to World Heritage values or listed (threatened or migratory) species and communities inside or outside of Port Curtis as result of the waste water discharge.



Figure 4. Modelled 6-hourly maximum 'tracer' concentrations of marine discharge constituents (other than Mn) in Port Curtis for Stage 2 of the Project



4.2.6.3 In-marine sediments in Port Curtis

While the fate of the constituents in solution in the marine discharge on the waters of Port Curtis appears to have been adequately examined by GPNL, there remains some debate about whether the potential impact of this discharge on marine sediments has been adequately addressed. Such an impact could conceivably arise from:

- the oxidation of metals ions in solution, which may subsequently precipitate as small particles and settle on the sea floor or be trapped by marine plants
- the direct consumption of metals in solution by marine organisms and their subsequent bioaccumulation
- the presence of micro or nano particles in suspension in the marine discharge not accounted for in GPNL's studies or
- the direct adsorption of metal ions from solution onto marine sediments at the sediment-water interface of the benthic environment (potentially assisted by biological oxidation by micro-organisms such as bacteria).

Except for Mn (refer also to Section 4.2.3.2 above), GPNL has not conducted specific investigations of the potential impact of metals in the marine discharge on sediments in Port Curtis. GPNL has argued that such a detailed consideration of the potential sediment impact is not warranted because either:

- metals of potential concern (e.g. mercury and selenium) would not be present in detectable concentrations in the nickel ore, residue solids or the barren liquor and therefore could not pose any credible threat to the environment
- quantities of micro or nano particles of metals of potential concern suspended in the marine discharge would be insignificant
- the key metals of interest other than Mn (Ni, Co, Cd, Cr and Zn) are not expected to oxidise or precipitate at any appreciable rate before being flushed from Port Curtis by tidal currents
- as the concentration of those five elements in solution will dilute to approximately ambient levels within a short distance of the discharge, their rates of exchange with sediments are expected to be similar to that occurring naturally in Port Curtis
- due to the nature of the surrounding geology and soils, the levels of natural input to Port Curtis of some of these constituents (e.g. Ni, Co and Mn) from natural drainage is relatively high compared to inputs from the GNP as indicated by the measured metals concentrations in Port Curtis estuaries and sediments and
- specific studies undertaken for Mn demonstrate that its rate of oxidation and precipitation as MnO₂ particles is either too slow to add significantly to sediments in Port Curtis, and/or the small particles thus formed would remain in suspension and be flushed from Port Curtis by tidal currents.

In addition to the Mn studies summarised above (Section 4.2.3.2) and described in more detail in the technical supplement *Gladstone Pacific Nickel Refinery – Environmental Assessment of Treated Water Discharge to Port Curtis* (URS, 25 July 2008), GPNL has investigated the potential of enhanced biological oxidation at the sediment-water interface by commissioning Central Queensland University to conduct experiments using benthic corer reactors. Those experiments demonstrated rapid oxidation of Mn on sediments collected from a mangrove-lined tidal mudflats and a seagrass bed in Port Curtis (Mn half-lives of 19 and 32 hours observed in two reactors). While these experiments were conducted at Mn concentrations 29 times higher than the proposed GNP discharge concentrations, subsequent modelling predicted tidal mudflat surface sediment concentrations of 7–9 µg/L at the proposed discharge concentration of the GNP (which would dilute a further 10 times within 6 m of discharge point). The rapid oxidation was attributed to the activity of bacteria in the sediments.

No interpretation has been provided by GPNL of the potential relative significance of:

- the more rapid oxidation of Mn on mudflat surface sediments to GPNL's discharge generally
- the 7–9 µg/L concentration at the sediment surface or
- the potential accumulation of MnO₂ on sediment surfaces over time.

I note that background concentrations of Mn in Port Curtis sediments reported in the EIS range from 100–1500 mg/kg.

GPNL has provided no information about the potential application of the results of its Mn studies to the oxidation, precipitation and bioaccumulation of other metals of interest in its discharge waters. However, I note that further research commissioned by GPNL (refer to Section 4.2.4.1 above) will address this issue.

GPNL has not presented a fully comprehensive assessment of the potential for long-term trace metals contamination of sediments in Port Curtis arising from the marine discharge of its refinery waste as the mechanism is extremely complex. Such an assessment would require the consideration of the physico-chemical properties of each metal in relation to the Port Curtis sediments, especially with respect to oxidation rates, suspended particle formation and the fate of those particles.

Conclusion

Despite there being less than ideal information about the potential accumulation of discharged metals in Port Curtis marine sediments, I consider that:

- there is sufficient validity to the reasons provided by GPNL (see six dot-points in this section above) that significant impact on those sediments will not occur
- the monitoring, validation, sampling, direct toxicity assessments (summarised in Section 4.2.4.3 of this Report) and additional research (summarised in Sections 4.2.4.1 and 4.2.4.2 of this Report) committed to be undertaken by GPNL, or specified in the conditions outlined in Schedule A2 of this Report, will be sufficient to address the potential impact of the GNP on these sediments and, if necessary, identify appropriate corrective actions well in advance of any potential significant impact
- consequently, there would be no harm to World Heritage values or listed (threatened or migratory) species and communities inside or outside of Port Curtis as result of precipitation and accumulation of metals in sediments.


4.3 Air emissions

4.3.1 General background on air quality in Gladstone

Air quality in Gladstone has been a matter of considerable public discussion and community concern during the last few years. Debate about air quality has ranged across a number of potential point sources and air parameters, and recent public attention has especially focussed on the management of coal dust at the city's two existing coal terminals (RG Tanna and Barney Point).

Amongst the responses of the Queensland Government during 2008 to this community concern has been the establishment of the 'Clean and Healthy Air for Gladstone (CHAG) Project', which is being jointly managed by the Environmental Protection Agency (EPA) and Queensland Health (QH). The CHAG Project aims to gain a better understanding of air pollution in the Gladstone area and to identify any potentially associated risks to public health.

Community consultation associated with the CHAG Project has further heightened public awareness about air quality issues and there has been some concern about licensing a new large scale industrial project such as GNP that will contribute to air emissions in Gladstone before the outcomes of the CHAG Project are well understood.



During the EIS process, GPNL has adequately conveyed that it understands the sensitivity of the community about any new large-scale industrial project that will add to air emissions, such as sulphur dioxide (SO₂). GPNL has made numerous statements both in the EIS documents and in the media about its commitment to the implementation of world's best practice design, construction and management to keep all project emissions well within relevant guidelines.

To reinforce its corporate responsibility in this regard, GPNL has committed to both its participation in the CHAG Project and the implementation of any action items arising out of the CHAG Project. GPNL has also agreed to participate in future benchmarking studies (similar to ones conducted already for NRG's Gladstone Power Station and the Boyne Aluminium Smelter).

The CHAG project may take more than two years to generate substantial new air quality initiatives that will make a practical difference to some air quality parameters in Gladstone. In the meantime, the Queensland Government has an obligation to administer and enforce the existing environmental regulations, while at the same time work with all project proponents and operators of existing industrial facilities to ensure that all practicable measures are implemented to avoid, minimise and mitigate air pollution.

4.3.2 Scope of air emissions, and the proposed monitoring and mitigation regime

The EIS and SEIS considered air quality impacts of the GNP in relation to the current air quality in the Gladstone air shed due to existing industrial sources. The expected air emissions from the refinery operations were quantified and assessed in relation to relevant emission standards and best-practice design. The standards are essentially derived from the *Environmental Protection (Air) Policy 1997* (EPP (Air)) and the National Environmental Protection Measures (NEPM). Where appropriate, I have also considered the health based guidelines for air quality provided by the World Health Organisation (WHO).

The estimates for air emissions from the proposed refinery were sourced from a combination of engineering design calculations by Aker Kvaerner Australia (engineers for the GNP), GPNL's own engineers, and information from other nickel projects utilising similar process technologies.

Air emissions from the refinery would include sulphur dioxide (SO₂), sulphur trioxide (SO₃), oxides of nitrogen (NO_x), carbon dioxide (CO₂), nickel ore and sulphur dust, and very small quantities of hydrogen sulphide (H₂S), sulphuric acid mist, and particulates of cobalt (Co), nickel (Ni), cadmium (Cd) and mercury (Hg). It is possible that concentrations of some of the heavy metals in the ore will be below detectable limits (particularly mercury and cadmium).

GPNL submitted data showing information for each proposed point source emission at the refinery forecasting variability, rates used in modelling and proposed control technologies (refer to Appendix D of this Report).

Annual monitoring of in-stack emissions (and other release points identified in the EIS) would be conducted to determine the levels of pollutants released from the operation of the refinery. While metals air particulates will initially be monitored, it is proposed that any pollutants that are below detection limits for two successive years will be not be tested in subsequent annual test programs unless the refinery feed source changes. The results of the annual stack tests will be included in annual reporting to the EPA.

Of the pollutants listed above, the potential air emissions from the refinery identified during the EIS process as being of most significant potential concern were:

- SO₂ from the refinery acid plants
- dust from the handling of the nickel ore, sulphur pellets (prill or pastille) and limestone
- H₂S gas and odour from the neutralisation plant, the H₂S plant and the nickel dryer.

Air emissions from the refinery will be subject to environmental authorities issued by the EPA under the *Environment Protection Act 1994*. In the case of the nickel refinery, those conditions would attach to any approval that may be granted for a MCU for the refinery site

under the *Sate Development and Public Works Organisation Act Act 1971*. The conditions to be attached to those environmental authorities have been derived after careful consideration of information presented in the EIS, SEIS and extensive communications between GPNL, DIP and EPA since the finalisation of the SEIS. I am satisfied that those conditions, provided in Schedules A1 and A2 of this Report, will satisfactorily avoid, minimise or mitigate the impacts of the GNP on the air environment.

The remainder of discussion in Section 4.3 of this Report focuses on those matters:

- that attracted particular attention during the EIS process
- for which new technical information has become available since the release of the SEIS
- for which process or technology changes have been made to the GNP since the release of the SEIS or
- for which I consider that additional explanation of the issues and/or recommended environmental authority conditions is warranted.

4.3.3 Sulphur dioxide (SO₂) emissions

4.3.3.1 Source of SO₂ emissions

The nickel refinery would use a High Pressure Acid Leach (HPAL) process. The sulphuric acid used in this process would be produced on site from imported sulphur pellets. Stage 1 of the GNP would require two acid plants. Two more acid plants would be required for Stage 2 of the Project. The acid plants emit small amounts of SO₂.

Amongst the advantages of producing the sulphuric acid on the refinery site is that the main chemical reaction in the process is strongly exothermic, which means that it produces large quantities of excess heat. GPNL would use this heat to meet its own steam and electricity needs (through co-generation) for the refinery, plus export excess electricity to the grid. The acid plants therefore provide several environmental benefits, including a very low 'greenhouse footprint' for the refinery process.

4.2.3.2 Environmental guidelines and existing SO₂ levels around Gladstone


Existing Environmental Protection Policy (EPP (Air)) and National Environmental Protection Measure (NEPM) air quality goals for SO₂ are provided in Table 5.

Table 5. Existing EPP (Air) and NEPM air quality goals for SO₂

Averaging period	EPP (Air) quality goal		National Environment Protection Measure (NEPM) – ppm
	(µg/m ³)	(ppm)	
10-minute	700	0.25	n/a
1-hour	570	0.20	0.20
24-hour	100	0.04	0.08
annual	60	0.02	0.02

EPA's *'Ambient Air Quality in Queensland'* Annual Summary and Trend Reports over 2001 to 2005 have shown average 1-hour, 24-hour and annual SO₂ levels at Gladstone to be consistently below the EPP and NEPM air quality goals.

Clinton is the closest Gladstone suburban area to the proposed nickel refinery. The nearest houses at Clinton are more than 3.5 km south-east of the refinery property boundary. The prevailing wind direction would blow refinery stack emissions away from Clinton on most days. Air quality at Clinton is influenced by emissions from NRG's Gladstone Power Station, which is located south-east of the refinery site and just north of that suburb.



Results of ambient air quality monitoring at Clinton over the period 2001–2005 are that annual and 24-hour average air quality EPP goals for SO₂ are not exceeded, and the 1-hour goal is exceeded in only slightly more than 0.1% of all measurements (from more than 30,000 measurements per year).

Conclusion

Although SO₂ is an air quality parameter of interest in Gladstone, the ambient air quality evidence indicates there is no need to prohibit the establishment of additional SO₂ emitting industry at the refinery site, provided that adequate emission controls are put in place.

4.3.3.3 The limitations of current Gladstone Airshed Modelling System (GAMS)

The Gladstone Airshed Modelling System (GAMS) is a complex numerical model which allows users to simulate local and regional scale air shed behaviour. It can be used to simulate the effects of changes in industrial emissions and/or meteorological conditions. The GAMS is used by project proponents and regulators seeking to model the potential impacts of expanded or new industrial facilities.

Like all models, the interpretation and application of GAMS has its limitations. GAMS limitations include:

- a relatively low level of accuracy for prediction of ground level SO₂
- the inclusion of all currently licenced/authorised industrial facilities in Gladstone even though several of these (e.g. the Aldoga Aluminium Smelter) have not been and may not ever be built
- the assumption that all of the industrial facilities will pollute to the maximum extent of their authorised capacities at precisely the same time, even though most of these facilities operate at well below those limits almost all of the time
- 'worst case' predictions of air concentration levels at any particular location in Gladstone at any point in time also assume worst case weather conditions (e.g. wind blowing directly from the industrial facility directly towards the sensitive receptor), which may itself be a low probability event.

These later three assumptions incorporated into GAMS, combined with the low level of precision around the model estimates can combine to produce some distorted outcomes.


For example, GAMS predictions reported in the SEIS were that the maximum 24-hour ground level SO₂ concentration in the north-west corner of the Clinton residential area (closest to the nickel refinery) accounting for both the GNP and other currently licenced/authorised industry in Gladstone would be 97 µg/m³ (compared to the EPP goal of 100 µg/m³). The contribution of the nickel refinery to this number is estimated by GPNL to be less than 5 µg/m³. Results of ambient air monitoring at the Clinton air station show that even 1-hour spikes in SO₂ exceed 30 µg/m³ less than 0.1% of the time, and the actual ambient 24-hour average SO₂ concentration rarely exceeds 20 µg/m³ and is generally well below 10 µg/m³.

Conclusion

While the GAMS provides a useful tool to simulate the effects of changes in industrial emissions and/or meteorological conditions around Gladstone, it is inherently conservative. Therefore, caution needs to be applied in the interpretation of the results obtained from the GAMS.

4.3.3.4 Modelled SO₂ levels produced by the acid plants and special conditions

The SO₂ modelling results reported in the SEIS have been subject to extensive consultation between EPA and GPNL since the release of that document. While EPA has been able to readily advise of suitable conditions to be applied to air emission management at the



proposed refinery for Stage 1 of the Project, some additional special measures have been deemed necessary with respect to some aspects of SO₂ emissions for Stage 2 of the Project.

Additional information sought by EPA about SO₂ emissions after the release of SEIS included:

- acid plant elemental sulphur to sulphuric acid conversion efficiencies
- release profiles around shut-downs and start-up of the acid plants
- air shed monitoring proposals
- the relative contribution of sulphuric acid mist
- odour arising from SO₂ emissions.

Acid plant conversion efficiencies

The efficiency of conversion of elemental sulphur to sulphuric acid in acid plants is critical to the rate of SO₂ emission from those plants. In the SEIS, GPNL committed to achieving a 99.85% conversion efficiency for each of the two acid plants for Stage 1 of the Project. The original EIS was based on 99.80% conversion efficiency.

Based on advice from two significant international acid plant suppliers (Monsanto and Outotec) and an independent expert in acid plants (Mr Bob Sneyd), GPNL has provided the following additional information in support of its efficiency commitments:

- since 1999, the European Sulphuric Acid Association and the European Fertilizer Manufacturer Association (EFMA) has documented that best available techniques (BAT) in sulphuric acid production with additional catalyst usage should achieve a minimum of 99.80% efficiency for a new acid plant
- a draft EFMA document proposes that BAT efficiency be raised to between 99.85%-99.90% for new plants
- the UK Integrated Pollution Prevention and Control (IPPC) BAT publication 'Guidance for the Inorganic Chemicals Sector' (UK Environment Agency, 2004) recommends that 99.90% efficiency should be achieved
- there are currently several operating acid plants around the world with design conversion efficiencies of above 99.85%, and in at least three countries (Spain, India and Germany), these efficiencies are guaranteed by the supplier
- most acid plants are now designed with a safety margin to enable SO₂ emission guarantees to be provided by the supplier
- standard designs generally allow for 10% extra catalyst input to enable plant emissions to be further improved.

Based on this information and its own technical reviews, GPNL has now committed to achieving a 99.90% conversion efficiency for each of the third and fourth acid plants added for Stage 2 of the Project. This improved efficiency would be achieved by using a higher quantity of catalyst. This would result in a 30% reduction in SO₂ emissions from those plants relative to the two Stage 1 plants. Consequently, GPNL has committed to a 30% lower maximum stack emission rate for the Stage 2 acid plants of 27 grams per second (g/s) compared to the proposed Stage 1 authorised limit of 38 g/s. This commitment is incorporated into air emission condition B(18) of Schedule A2.

Conclusion

I consider that the acid plant conversion efficiencies proposed by GPNL are achievable and reasonable, and the additional measures proposed to improve conversion efficiency for Stage 2 of the Project are acceptable.

While I accept the emission standards recommended by the EPA for SO₂, I expect GPNL to implement the most efficient SO₂ conversion technology available at the time of construction of Stage 1.

Acid plant start-ups

The EIS described that there is a likelihood of higher emissions of SO₂ release over a 12 to 24 hour period following acid plant start-up events. While maintenance shutdowns of the acid plants are scheduled by GPNL at 18 month intervals, other shutdowns may occur, especially during the first two years of operation when the refinery is forecast to be running at 50–80% capacity and acid production rates may exceed utilisation rates. GPNL's proposed capacity to store and export excess acid would provide capacity to buffer against acid plant shutdowns.

Information provided by GPNL after the finalisation of the SEIS suggests that the extent and longevity of SO₂ releases around start-up events would not cause ground-level ambient concentration to rise above EPP (Air) guideline levels.

Since the release of the SEIS, GPNL has obtained additional advice from acid plant suppliers, its independent acid plant advisor and its own technical reviews that well managed and operated acid plants can achieve normal operating compliance levels within four to six hours of start-up. The UK IPPC publication advises that the maximum loss of conversion efficiency over a five-hour start-up period should be less than 1.0%. Based on this collective advice, GPNL has now committed to the following measures to manage start-ups and mitigate consequential SO₂ emission spikes:

- starting-up only one acid plant at a time
- maintaining catalyst bed temperatures high enough (> 420°C) prior to introducing sulphur to ensure adequate catalyst activity
- achieving the BAT of 99.85% conversion within five hours of each start-up
- reducing sulphur load through each plant by up to 50% during start-up to achieve an emission rate of 130 g/s during that five-hour period.

Environmental authority conditions B(19) and B(20) respectively of Schedule A2 have been applied to set the maximum sulphur release during start-ups and confine start up conditions to five hours.

Environmental authority condition B(21)(a) of Schedule A2 has been applied to prevent more than one acid plant start-up occurring at the same time during Stage 2 of the GNP.

Environmental authority condition B(21)(b) of Schedule A2 has been applied to prevent acid plant start-ups during Stage 2 of the GNP when wind conditions are unfavourable for emission drift over the Orica industrial site located just to the north-west of the refinery site. This would prevent start up of a fourth acid plant under wind conditions that occur on about 18% of the year (this allows for start-up to be initiated virtually every day of the year after 10 am and before 8 pm).

GPNL has agreed to avoid acid plant start-ups when the prevailing wind is towards Clinton, where practicable. In light of the available technical information, I consider that it would not be reasonable to require this as a condition.

Conclusion

I consider that the measures proposed by GPNL and incorporated into environmental authority conditions would adequately mitigate the potential air emission impacts arising from acid plant start-up events at the refinery.

Acid mist

A summary of information on sulphuric acid mist control provided by GPNL to EPA after the finalisation of the SEIS, and measures that will be adopted by GPNL are presented in Appendix B of this Report. Some of this information is supported by advice provided by an experienced acid plant manager. On the basis of the information provided by GPNL in the EIS documents and in Appendix B, I am satisfied that there is very limited risk that acid mist emissions would be a problem for the GNP following initial commissioning of the refinery.

GAMS results

The annual average SO₂ level at Clinton arising from a combination of both Stage 2 of the GNP and industrial background contributions is predicted to be only 20% of the EPP guideline value. Similarly, the highest 0.1% of GAMS estimates at Clinton arising from both the refinery and maximum background industrial activity for both the 1-hour and 10-minute averaging periods reach only 88% and 76% respectively of the EPP guideline values.

Conclusion

I consider that there appears to be no technical basis with respect to SO₂ emissions to withhold environmental authority conditions for Stage 2 of the GNP.

4.3.3.5 Additional cooperative measures to improve air quality in Gladstone

Despite the fact that GPNL can comply with reasonable environmental guidelines for the release of emissions to the atmosphere, the GNP is large, and it is acknowledged that total quantities of air emissions will remain of concern to some members of the community. Consequently, there is recognition that government, industry and the community should look at all opportunities to work together to reduce the more significant sources of air pollution in Gladstone. Limited available resources should be devoted to outcomes that will deliver the largest, earliest and most cost-effective air quality outcomes.

As an example of this, EPA's 2008 benchmarking study⁴ of black coal fired power stations showed that NRG's Gladstone Power Station produces about 28,000 tonnes per year (t/yr) of SO₂ emissions. This is lower than the mean SO₂ emission rates for other benchmarked power stations in Australia and the USA reported in the study. Nonetheless, this figure is considerably higher than the maximum 1,225 t/yr for each of the two acid plants for Stage 1 of the GNP and the 825 t/yr for each of the two acid plants for Stage 2 of the GNP (in the unlikely event that those plants emit to the maximum extent permitted by proposed environmental authority conditions). Total GNP refinery SO₂ emissions cannot exceed 4,100 t/yr at Stage 2 of the Project (see Schedule A2, Condition (B23)).

While it may be technically possible to invest further large capital amounts into the GNP to achieve relatively marginal and diminishing improvements in the proposed performance of the GNP acid plants, more efficient use of available capital may be achieved by deployment towards emission control technologies at other Gladstone industrial sites (such as the NRG Power Station).

In support of this approach, GPNL has committed to the following measures aimed at achieving a net reduction in SO₂ air concentrations in Gladstone as a consequence of the GNP:

- GPNL commits, at the commencement of construction of Stage 1 of the Project, AUD\$5 million or up to 50% of the capital cost (whichever is less) of an SO₂ reduction project or scheme identified by EPA, DIP and/or GPNL itself that will reduce by 2,500–5,000 t/yr the SO₂ emissions emitted to the Gladstone airshed.
- GPNL also commits, at the commencement of construction of Stage 2 of the Project, a further AUD\$5 million or up to 50% of the capital cost (whichever is less) of an SO₂ reduction project or scheme that will reduce by a further 2,500–5,000 t/yr the SO₂ emissions emitted to the Gladstone airshed.

⁴ Campin, D. (2008): *Benchmarking NRG Gladstone Emissions to Australian, European Union, Japanese and USA Black-Coal Fired Power Stations*. Report for the Clean and Healthy Air for Gladstone Program (CHAG) for the Queensland Environmental Protection Agency, Brisbane.

Source: http://www.epa.qld.gov.au/environmental_management/air/clean_and_healthy_air_for_gladstone/reports/

- If a suitable Gladstone SO₂ reduction project or scheme cannot be identified during Stage 1 of the Project, then GPNL will retain its funds and provide AUD\$10 million or up to 50% of the capital cost (whichever is less) of an SO₂ reduction project or scheme that will reduce by 5,000–10,000 t/annum the SO₂ emissions emitted to the Gladstone airshed.

I consider that it is reasonable that GPNL retain its SO₂ reduction strategy funds rather than pay them into a trust account as suggested for the Gladstone Social Impact Mitigation Fund (G-SIMF – refer to section 4.11.3.2 of this Report).

GPNL's SO₂ reduction program offer will remain available for at least 13 years (up to five years after commencement of the operation of Stage 2 of the Project). I consider that if such a program could succeed, then it is likely that a candidate project would be identified by GPNL, EPA or CG within that time period.

If successfully implemented, the net impact of this commitment of GPNL would be a 2,500–5,000 t/yr net reduction in SO₂ emissions to the Gladstone airshed as a consequence of the Project.

In deriving this strategy, GPNL, CG and EPA acknowledge that, for it to be successful, the cooperation of at least one other industry owner would be required. While the NRG Power Station has been used in the discussion above to illustrate a point, it provides only one of several opportunities that could be explored.

CG and EPA have initiated discussions with relevant parties to explore the opportunities of such a cooperative approach to emission reductions in Gladstone. I acknowledge that GPNL's enthusiasm to develop and deliver such a strategy is reflective of its commendable enthusiasm to proactively pursue other industrial ecology opportunities arising from this Project.

Conclusion

GPNL's proposed SO₂ reduction strategy presents a potential opportunity to achieve large scale industrial development whilst simultaneously reducing the amount of a key air pollutant.

4.3.4 Dust and air particulates

While construction activities for the GNP at each of its Project sites have the potential to generate localised air particulate (dust) issues, I generally consider that the dust minimisation and mitigation measures proposed in the EIS, SEIS and the draft outline Environmental Management Plans should be adequate.

At the RSF during the operational phase, the residue will be deposited in a slurry form so dust generation should not be an issue. GPNL will adopt the advanced residue management practice of "mud farming" where specialised earthmoving equipment (twin-archimedes screw tractor) is used to control and accelerate the residue dewatering process. By using mud farming to control the dewatering process, the potential for uneven drying and dust generation will be minimal. This is achieved by maintaining the minimum operational residue areas, high moisture loss across the full profile of the residue layer, and the high surface roughness and hence lower wind speeds at the evaporating surface.

Upon cessation of residue deposition into the RSF, GPNL will undertake to re-profile the RSF surface to provide a well graded surface that promotes surface runoff and prevents ponding. Construction of a low-permeability cap across the final landform surface will be completed and this cap will limit the infiltration of water and provide a suitable medium for establishing vegetation.

Consequently, the discussion of dust in this Report focuses predominantly on dust management of the operation of the Project at the refinery site.

Additional information sought by EPA about dust emissions after the release of SEIS included:

- source of background dust information

- further details on the contribution of metals (especially mercury, cadmium, nickel and cobalt) to air particulates
- justification for the 90% emission control factors applied to dust control at the refinery site.

4.3.4.1 Nickel ore stockpile

GPNL reported after the release of the SEIS that modelled results for background dust levels presented in the EIS and SEIS were biased by the very conservative use of the maximum available air particulate reading available for the region (93 micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) for particulates less than 10 μm diameter (PM_{10}) over a 24-hour average period).

The EIS indicated that the nickel ore would contain 35% moisture, so this provides initial mitigation of dust in the handling of the ore at Wiggins Island, in covered conveyor transport to the refinery and subsequent management of ore stockpiles at the refinery.

The use of the 90% control factor for the imported ore is also based on the 35% moisture content of this ore. As GPNL does not require the material to be dry for processing, and as such there is no conflict with production objectives, optimal dust suppression using water will be applied.

If the 90% control factor was reduced to 50%, the increase in the potential estimated dust emissions would be of the order of 60%. However, modelling indicates that even this would not cause the Queensland EPP (Air) dust guidelines to be exceeded.

GPNL has not been able to determine a precise 'dust extinction moisture content' for this material, but estimates it to be in the range of 6–10%. However, GPNL contends that this information would not assist the evaluation of the potential dust impact of the ore stockpile at the refinery site because the moisture content of that stockpile would never approach that level.

GPNL has agreed to adhere to tighter PM_{10} 24-hour average dust criteria than the $150 \mu\text{g}/\text{m}^3$ required by the current EPP (Air). The standards applied to the GNP for PM_{10} are those provided by the National Environmental Protection Measures (NEPM Air) goals and the World Health Organisation (WHO). The $50 \mu\text{g}/\text{m}^3$ PM_{10} limit will be at the refinery boundary and appropriate monitoring devices will be installed to measure a range of air quality parameters, including dust deposition, total suspended particulates, and PM_{10} .


Conditions (B1) to (B12) in Schedule A2 of this Report apply to dust management at the GNP refinery site.

4.3.4.2 Metals in air particulates

Emission estimation and dispersion modelling of mercury, cadmium, cobalt, nickel and metal particulates reported in the EIS was undertaken using the maximum concentration guidelines from the NSW Department of Environment and Climate Change. GPNL adopted this approach because it has obtained little information on these contaminants from operating HPAL plants. Data on metals particulates in nickel refinery air emissions at other comparable facilities are not publicly available. In any case, these metal emissions are dependent on a combination of the refining process and the ore used in the process.

GPNL does not expect any air emissions of mercury or cadmium. As reported in Table 1.3.2 of Appendix B of the SEIS, tests on the ore material indicate that the mercury content is below detection limits, and there are very low trace concentrations of cadmium. Any cadmium is likely to end up in the solid residue material. Consequently, environmental authority conditions are set 'below detection level' for mercury and cadmium air particulate emissions at the refinery. Detection limits suggested by GPNL for cadmium and mercury were $1.7 \mu\text{g}/\text{m}^3$ and $3.8 \mu\text{g}/\text{m}^3$ respectively. A nil detection limit for cadmium and mercury in sinter furnace release limits is incorporated into Table 3 of environmental authority Condition (B17) in Schedule A2 of this Report.

Nickel and cobalt would clearly be significant components of the material that the GNP would process. Air emissions of these two metals would primarily come from the sinter furnace stacks of the final production phase. While reliable information about the potential emissions



from the sinter furnaces is not available, EPA has requested the furnace release limits provided in Table 3 of environmental authority Condition (B17) in Schedule A2 of this Report.

GPNL has identified that there may be a chromium (Cr) concentration of 3,000–4,000 ppm in the imported ore. GPNL forecasts that this will end up in the solid residue after the ore processing. The Cr in the ore is in the Cr III form (as predominantly chromite minerals) which is not considered to present human or animal health risks. GPNL has committed that the Cr VI form, which is a potential carcinogen, will not be present in the solid ore. The Cr VI, reported as present in trace amounts in the marine discharge in Section 4.1 of this Report, is created during the refining process.

Conclusion

On the basis of the information provided by GPNL in the EIS documents, and to EPA after the finalisation of the SEIS, the environmental authority conditions in Schedule A2 and the commitments made by GPNL, I am satisfied that the risk of dust emissions at the GNP refinery site will be adequately prevented, monitored and/or mitigated.

4.3.5 Hydrogen sulphide (H₂S)

The principal source of hydrogen sulphide (H₂S) emissions would be the nickel dryer, the neutralisation plant and the H₂S plant. H₂S, also known as ‘rotten-egg gas’, has received attention because of its unpleasant odour at relatively low concentrations.

Emission rates for H₂S and odour were modelled in the EIS and SEIS. These results show that odour impacts from the refinery operations are expected to be well below the EPA’s odour guideline at all locations on the modelling grid. GPNL has indicated that it would control upset conditions and releases during operation of the hydrogen sulphide plant through a regenerative thermal oxidiser. GPNL has committed that this would eliminate odorous compounds.

The requirement for GPNL to install H₂S thermal oxidisers is incorporated into environmental authority Condition B15 (Schedule A2).

GPNL reported in section 8.7.7 of the SEIS that:

- the nickel dryer is expected to release only very small quantities of H₂S (only 20 µg/s per stack), which is much lower than the neutralisation plant
- emissions to air from the H₂S plant, due to emergency de-pressurisation of the plant, process plant vent gases and relief valve discharges, are directed to the H₂S vent scrubber and then to the plant vent regenerative thermal oxidiser
- the regenerative thermal oxidiser is also the back-up control device in the event of a failure of the scrubber
- these control measures ensure that H₂S gas cannot be released from the H₂S plant, as it is all combusted to SO₂ prior to release
- all sources of H₂S from the refinery were included in the revised air emission modelling reported in the SEIS.

Following the release of the SEIS, EPA sought additional information about:

- Emission data for all emission points
- H₂S emission controls
- plant commissioning and management processes, especially associated with the H₂S plant.

A summary of information on these matters provided subsequently by GPNL to EPA is presented in Appendix C of this Report. Some of this information is supported by advice provided by an experienced H₂S plant operator/manager at the QNI Refinery at Yabulu in north Queensland and an experienced H₂S plant engineer.

In addition to this information about air emissions, GPNL also provided information to demonstrate that there will be almost no harmful emissions from the HPAL process itself because the pre-leach and atmospheric leach tanks are sealed and vent to a knockout pot in which seawater sprays scrub out acid mist.

Conclusion

On the basis of the information provided by GPNL in the EIS documents, and to CG after the finalisation of the SEIS (summarised in Appendix C), the environmental authority conditions in Schedules A1 and A2 and the commitments made by GPNL, I am satisfied that there is very limited risk that H₂S emissions and associated odour issues would be a problem for the GNP following initial commissioning of the refinery.

4.4 Flora and fauna impacts

Clearing of vegetation during construction is likely to cause the only significant impact to flora and fauna from the GNP.

Vegetation clearing for the GNP will be required for the construction of the nickel refinery, the Residue Storage Facility (RSF) and the various resource pipelines. The exact footprint of all clearing areas for each parts of the Project will not be accurately defined until detailed designs have been completed and applications have been lodged for clearing permits under the Queensland *Vegetation Management Act 1999* (VM Act). However, the vegetation areas to be disturbed by each of the broad project components have been documented in the EIS and SEIS and these are shown in Table 6 below according to the listed Regional Ecosystem (RE) categories defined in the VM Act.

GPNL's EIS documents report that no REs listed as endangered under the VM Act and no vegetation communities protected under the Commonwealth EPBC Act will be cleared during the construction of the Project. Approximately 244 ha of REs listed as of concern under the VM Act would be cleared. A further 728 ha of REs listed as not of concern under the VM Act will also be cleared. Area estimates for the pipeline corridors assume a 35 m clearing width (as illustrated in Figure 2.3.3 of the EIS).

Table 6. Proposed vegetation clearing for the GNP by VMA¹ Regional Ecosystem

VM Act Regional Ecosystem vegetation category	Project component				VM Act category total (ha)
	Refinery area (ha)	RSF ² area (ha)	Pipelines		
			Length (km)	Area ³ (ha)	
Other ⁴	5	691	118	411	1108
Not of concern	28	501	57	200	728
Of concern	60	124	17	60	244
Endangered	0	0	0	0	0
Total affected area	93	1316	192	610	2080

1 – VMA - *Vegetation Management Act 1999*

2 – RSF - Residue Storage Facility

3 – Assumes clearing width of 35 m

4 – Includes modified grassland, non-remnant regrowth and completely cleared

Vegetation communities are listed as of concern REs under the VM Act if the remnant vegetation for the community is 10–30% of its pre-clearing extent across the bioregion; or more than 30% of its pre-clearing extent remains and the remnant extent is less than 10,000 ha.

The GNP would straddle two bioregions defined under the VM Act. The proposed refinery, acid pipeline, preassembled modules (PAMs) facility and seawater intake and discharge pipelines would fall within the Southeast Queensland Bioregion. The RSF and most of the Marlborough ore slurry and residue pipelines would fall within the Brigalow Belt and New England Tablelands Bioregion.

Habitat of 18 endangered, vulnerable or rare (EVR) fauna species listed under the *Nature Conservation Act 1992* (NC Act) or the EPBC Act could be directly affected by the GNP. The vast majority of these occur along the proposed route of the ore slurry pipeline. Only one of these fauna species, the Capricorn yellow chat bird is listed as endangered.

4.4.1 Refinery site

4.4.1.1 Terrestrial flora

Vegetation communities

The refinery site supports remnant vegetation, modified pastoral grasslands, non remnant shrubby regrowth, and intertidal flats. Vegetation at the refinery site has a long history of disturbance including grazing, fires, weed invasion and quarrying activities. I accept that, given the high degree of previous disturbance, the overall ecological integrity of the remnant vegetation communities on the site has been strongly compromised and development for industrial purposes is an appropriate land use.

There are no vegetation communities listed as endangered conservation status under the VM Act on the refinery site. Four communities on the refinery site are listed as being of concern under the VM Act. The Regional Ecosystems represented by these communities (RE 11.3.4 and RE 12.3.1) are all *Eucalyptus tereticornis* forest or woodland associations.

The area of the refinery site documented in the EIS to be cleared, was changed in the SEIS because of changes in the layout of the refinery and the inclusion of a rail spur. The currently proposed clearing area for Stage 1 and 2 of the GNP is almost 90 ha. Approximately 60 ha of the cleared area would involve of concern vegetation.

The EIS and SEIS describe practices to be implemented during clearing to minimise:

- disruption of existing vegetation / habitat connectivity
- disturbance to riparian and other retained remnant vegetation
- erosion and sedimentation.

The EIS documents indicate that the remnant vegetation in the refinery site does not represent a significant pathway of habitat connectivity within the corridor system at a regional scale. Such regional connectivity is provided by woodland communities that persist on the ridgelines to the west of the refinery site and protected in the Beecher and Mount Stowe State Forests and the Calliope Conservation Park (see Figure 8.5.2 of the EIS). Collectively, these reserves have been declared a State Wildlife Corridor under the *Nature Conservation Act 1994* (NC Act).

Connectivity of habitat at the local scale to the east is provided by mangrove communities and mudflats along the Calliope River but is ultimately limited by Gladstone City and its surrounding urban development.

Clearing of the refinery site would largely result in the permanent loss of that vegetation, despite limited opportunity to re-establish some vegetation around the periphery of the site to improve visual amenity and reduce wind.

Despite the request of NRW in its submission on the EIS, GPNL has chosen not to provide:

- specific information to directly address the 'Performance Requirements' in Part S of the '*Regional Vegetation Management Code for Southeast Queensland Bioregion*' (NRW, 20 November 2006)
- a detailed spatial plan of the proposed clearing application area
- adequate detail on the method of clearing.

I consider that, from the information provided by GPNL in the EIS and SEIS, it is likely that GPNL's clearing proposals for the refinery site would either broadly comply with NRW's Vegetation Management Code requirements or could be adapted to comply. Nonetheless, in the absence of the detailed information required by NRW, I consider that GPNL should make a formal vegetation clearing application under the VM Act to NRW in accordance with IPA requirements in conjunction with its 'operational works' application for the nickel refinery, as described in Recommendation 4.1 of this Report. I recommend to NRW in its consideration of this application that it takes into account the information presented by GPNL during this EIS process and my conclusion that GPNL's clearing proposals on the refinery site are acceptable.

Detailed clearing plans have also not been provided by GPNL during the EIS process for any limited cleared associated with the construction of either:

- the acid pipeline or the preassembled module (PAM) corridor from the refinery to Fisherman's Landing or
- the seawater intake and discharge pipelines between the refinery and Wiggins Island Coal Terminal (WICT) and Clinton Wharf (refer to Section 4.2 of this Report).

Part S of the '*Regional Vegetation Management Code for Southeast Queensland Bioregion*' adopts 2 ha as its minimum area threshold for several matters pertaining to remnant vegetation for significant projects. Therefore, I consider that it would be reasonable for GPNL to be exempt from submitting an application for a vegetation clearing permit for any of those Project components for which the area of remnant vegetation to be cleared is less than two hectares.

It is possible that clearing approvals for the seawater intake and discharge pipelines may fall within the scope of approvals obtained by GPCL for the WICT project.

Recommendation 4.1

- (a) Prior to construction of the refinery, GPNL will apply for a permit to the Department of Natural Resources and Water under section 3.2.1 of the *Integrated Planning Act 1997* for operational works (clearing native vegetation assessable under IPA Schedule 8) to ensure that the requirements of the *Vegetation Management Act 1999* are met.
- (b) The application described in (a) is to be accompanied by a detailed spatial plan of the proposed clearing application area, details on the method of clearing, and a detailed analysis of how the proposed clearing will meet the performance requirements of Part S of the '*Regional Vegetation Management Code for the Brigalow Belt and New England Tablelands Bioregion*' (NRW, 20 November 2006).
- (c) If clearing of more than two hectares of remnant vegetation is required for the acid pipeline, seawater intake and discharge pipelines, or the preassembled module (PAM) corridor components of the GNP, then (a) and (b) will also apply to those Project components.

I note that the likely permanent loss of approximately 60 hectares of vegetation that is of concern under the VM Act warrants the provision of an environmental offset by GPNL. I also note the highly disturbed nature of that vegetation and its lack of regional importance for habitat connectivity. Detailed requirements with respect to the location and type of offset required should be made by NRW after it has considered the applications described in Recommendation 4.1 above.

Individual plant species

None of the species identified in the refinery fauna survey (EIS Appendix K) are listed as threatened under the Queensland *Nature Conservation (Wildlife) Regulation 1994* (NC Regulation) or the EPBC Act.

4.4.1.2 Terrestrial fauna

Detailed information on fauna data sources used and fauna surveys undertaken for the refinery site in May and June 2006 are reported in section 8.6 of the EIS.

A total of 93 native and five introduced vertebrate species were recorded during field surveys. Native species included three amphibian, 12 reptile, 61 bird and 17 mammal species.

No fauna species listed in the EPBC Act were recorded on the refinery site. No endangered, critically endangered or rare fauna species as listed in the NC Regulation is known or expected to occur at the refinery site.

GPNL contends in the EIS that, while the clearing associated with the refinery's construction will remove a significant proportion of the fauna habitat presently on the site, the fauna species recorded there are generally common and widespread in the region.

EPA's essential habitat map for the vulnerable wallum froglet (*Crinia tinnula*) shows some essential habitat on the refinery site. However, I am satisfied from information presented in section 8.6(13) of the SEIS that there is no essential habitat of the wallum froglet on the site.

Two species listed as migratory birds under the EPBC Act have been observed in the north-east corner of the refinery site, but this is within the area for which filling approval (including Australian Government approval) for the WICT project has already been granted.

Powerful owl

One species classified as vulnerable under the NC Regulation, the powerful owl (*Ninox strenua*), was recorded within the refinery site. All observations of the powerful owl were within the open forest area in the south-east of the survey area adjacent to the Calliope River, outside of the proposed clearing areas.

GPNL contends in the EIS that, as the potential foraging habitat for powerful owls at the refinery site is a small component of a wider foraging area, which would include the adjacent Mount Stowe State Forest and Calliope Conservation Park, local populations are not likely to be significantly affected by the construction of the refinery.

The powerful owl was found to be present at a number of sites in open forest habitat at or near the refinery site. Habitat where the powerful owl was recorded was dominated by tall eucalypts and corymbias (*E. tereticornis*, *E. crebra* and *C. citriodora*). It is possible that mature canopy trees to the south of the refinery site support hollows suitable as nest sites for this species. These habitats supported moderate numbers of prey species for the owl during the survey period, including flying-fox, common ringtail possum and common brushtail possum.

Any loss of old growth trees used as nesting sites would cause a loss of local habitat and may affect some individuals. To minimise such effects GPNL proposes to:

- identify any potential habitat or nesting trees for the powerful owl (e.g. large senescent trees with suitable hollows) prior to clearing
- where such trees are present, they will be inspected for breeding pairs or chicks (breeding is in winter)
- if breeding pairs or chicks are present, the clearing of such trees will be avoided, until the chicks have left the nest
- within the retained vegetation surrounding the cleared refinery area, areas of open forest with old growth habitat features (e.g. large hollow trees suitable as nesting sites) will be identified and retained where possible.

4.4.1.3 Aquatic ecology

The refinery site is located adjacent to the Calliope River and a number of small, unnamed ephemeral gullies drain the site directly into the adjacent estuarine system. During the May–June 2006 survey period:

- the refinery site did not support any non-estuarine surface water
- a number of dead long-finned eels (*Anguilla reinhardtii*) were observed at a single dry freshwater dam on the site.

No subsequent aquatic ecology survey of the refinery site undertaken during wetter periods has been reported by GPNL.

Most of the intertidal and supratidal communities on the refinery site will be filled by the GPCL during the construction of the proposed WICT project. However, there may be a small area (3.7 ha) of these communities that might be filled as part of the Project.

The construction of the acid pipeline, seawater intake and discharge pipelines, or the PAM corridor may also involve disturbance to small areas of marine plants or the construction of temporary waterway barriers. Directional drilling and other construction techniques described in the EIS may limit disturbance of marine plants and may negate the requirement for temporary waterway barriers.

GPNL will be required to make an application to the Department of Primary Industries and Fisheries (DPI&F) to clear these marine plants in accordance with the requirements of Section 123 of the *Fisheries Act 1994*. As for the vegetation clearing permits (refer to Section 4.4.1.1 of this Report), these operational works development applications for disturbance of marine plants should be made in accordance with IPA requirements in conjunction with the operational works applications for the refinery or other linear infrastructure directly associated with the refinery when the detailed design information for these components becomes available.

Recommendation 4.2

- (a) Following the detailed design phase and prior to construction of the refinery, GPNL will apply for approvals to the Department of Primary Industries and Fisheries for any marine plant disturbance and temporary waterway barriers required for construction of the refinery.
- (b) If disturbance to more than “threshold areas” (as defined in s.123 of the *Fisheries Act 1996*) of marine plants are required for the acid pipeline, seawater intake and discharge pipelines, or the preassembled module (PAM) corridor components of the GNP, then (a) will also apply to those Project components.

4.4.2 Residue Storage Facility (RSF) site

4.4.2.1 Terrestrial flora

In summary, the EIS concluded that vegetation at the RSF site is composed predominantly of remnant vegetation, modified pastoral grasslands and non-remnant shrubby re-growth. The site has a high degree of disturbance due to grazing, thinning, frequent fires, and exotic weed invasion. The majority of vegetation in the RSF site is currently grazed and exhibits degraded ground cover and mid-strata.

An area of up to approximately 1,316 ha will be cleared as a result of the construction of the RSF. Several hundred hectares of currently cleared land on the western slopes of the RSF site may not be required or may not be suitable for residue storage and may be available for rehabilitation to natural vegetation and subsequent protection and management by GPNL.

At the completion of use of each residue storage cell (up to 25 years after commencement of operation, native grasses and shrubs would be planted to stabilise the surface. However, the need to maintain the integrity of surface and sub-surface water management systems on

those cells means that they would be unlikely to ever be returned to a pre-settlement condition.

None of the plant species identified in the survey of the RSF area (EIS Appendix K) are listed as threatened species under the NC Regulation or the EPBC Act.

Only one of the twelve vegetation communities present of the RSF site (Table 9.9.3 of the EIS) is identified as having of concern conservation status as listed under the VM Act. This occurs as *Eucalyptus tereticornis* tall woodland on an alluvial plain near the middle of the site. Approximately 124 ha of this vegetation community would be cleared for the residue storage infrastructure. This represents almost all of that community on the RSF property and about 0.8% of its extent in the surrounding Mount Morgan Ranges sub-region.

Remnant vegetation of the RSF site does not represent a significant pathway of habitat connectivity within the corridor system at a regional scale. Regional connectivity is currently represented in a limited capacity by the narrow-leaved ironbark (*E. crebra*) dominated woodland communities that persist on ridgelines to the east of the RSF site. Vegetation connectivity to the south of the site has been removed by very extensive clearing on neighbouring properties.

GPNL has committed to the implementation of strict erosion and sedimentation control procedures during the construction of the RSF to ensure that downstream aquatic ecosystems are not impacted and riparian vegetation is not unduly effected.

As for the refinery site (refer to Section 4.4.1.1 above) GPNL has not provided specific information to directly address the 'Performance Requirements' in Part S of the '*Regional Vegetation Management Code for the Brigalow Belt and New England Tablelands Bioregion*' (NRW, 20 November 2006). While GPNL has provided detailed designs for the first three residue storage cells, this has not yet been accompanied by detailed spatial plans of the proposed clearing application area.

I consider that, from the information provided by GPNL in the EIS and SEIS, it is likely that GPNL's clearing proposals for the refinery site would either broadly comply with NRW's Vegetation Management Code requirements or could be adapted to comply. Nonetheless, in the absence of the detailed information required by NRW, I consider that GPNL should make a formal vegetation clearing application under the VM Act to NRW in accordance with IPA requirements in conjunction with its operational works application for the RSF, as described in Recommendation 4.3 of this Report. I recommend to NRW in its consideration of this application that it take into account the information presented by GPNL during this EIS process and my conclusion that GPNL's clearing proposals on the refinery site are acceptable.

Recommendation 4.3

- (a) Following the detailed design phase and prior to construction of the residue storage facility, GPNL will apply for a permit to the Department of Natural Resources and Water under section 3.2.1 of the *Integrated Planning Act 1997* for operational works (clearing native vegetation assessable under IPA Schedule 8) to ensure that the requirements of the *Vegetation Management Act 1999* are met.
- (b) The application described in (a) is to be accompanied by a detailed spatial plan of the proposed clearing application area, details on the method of clearing, and a detailed analysis of how the proposed clearing will meet the performance requirements of Part S of the '*Regional Vegetation Management Code for the Brigalow Belt and New England Tablelands Bioregion*' (NRW, 20 November 2006).

I consider that the likely permanent loss of approximately 124 hectares of vegetation that is of concern under the VM Act warrants the provision of an environmental offset by GPNL. Despite the highly disturbed nature of that vegetation and its lack of regional importance for habitat connectivity, the justification for an environmental offset is reinforced by the impact of clearing of the RSF site on habitat for three bird species of conservation significance (the powerful owl, the squatter pigeon and the black-chinned honey eater – refer to Section 4.4.2.2 below). Therefore I recommend that the provision of a suitable offset become a requirement of the granting of approval for the RSF under IPA (Recommendation 4.4 below). Detailed

requirements with respect to the location and type of offset required should be made by NRW after it has considered the applications described in Recommendation 4.3 above.

With respect to the nature of the required environmental offset, I recommend to GPNL and NRW that priority be given to the rehabilitation and protection of:

- *Eucalyptus tereticornis* woodland on the RSF site where soil conditions are suitable or
- other vegetation communities that may eventually provide potential habitat for the powerful owl, the squatter pigeon or the black-chinned honey eater.

Recommendation 4.4

- (a) The RSF must include a requirement for GPNL to provide an environmental offset consistent with the *Vegetation Management Act 1999* for the loss of 124 hectares of *Eucalyptus tereticornis* woodland on site.
- (b) The location, size, type and management arrangements for the offset in (a) will be determined by the Department of Natural Resources and Water following consideration of the clearing permit application described in Recommendation 4.3 of this Report.
- (c) A decision on the nature of the offset in (a) should consider the potential to re-establish *Eucalyptus tereticornis* woodland or other vegetation communities that may provide potential habitat for the powerful owl, the squatter pigeon or the black-chinned honey eater.

4.4.2.2 Terrestrial fauna

Detailed information on fauna data sources used and fauna surveys undertaken for the RSF site in May and June 2006 are reported in section 9.10 of the EIS.

A total of 106 native and five introduced vertebrate species were recorded during field survey. Native species included seven amphibian, 17 reptile, 63 bird and 19 mammal species.

No endangered or critically endangered fauna species as listed in the NC Regulation is known or expected to occur at the RSF site.

Threatened species known to occur on the RSF site are:

- the squatter pigeon (*Geophaps scripta*) – vulnerable under both the NC Regulation and the EPBC Act
- the powerful owl (*Ninox strenua*) – vulnerable under the NC Regulation
- the black-chinned honeyeater (*Melithreptus gularis*) – rare under the NC Regulation.

Clearing of the RSF area will remove habitat for the squatter pigeon and GPNL offers the following information on that likely impact:

- Squatter pigeons are relatively common within the RSF area and are not considered to be an 'important population' in the context of the EPBC Act guidelines.
- There will be some capacity for the squatter pigeons impacted by the clearing to relocate and survive in adjacent habitats on the RSF or adjacent properties. GPNL has committed to re-establishing habitat within the RSF on suitable areas not required for RSF infrastructure.
- The population of squatter pigeons in the region is strongly established and any impacts incurred from the loss of habitat associated with the RSF are not considered critical to the survival of the species.

The powerful owl is known to occur broadly across the region. The loss of potential foraging habitat may impact powerful owls that currently forage in the vicinity of the RSF. GPNL contend however that this area is relatively small in the regional context and represents only a small component of the powerful owl's wider foraging area.

Large areas of suitable habitat for the black-chinned honeyeater occur in the local area.



A single bird species, the rainbow bee-eater (*Merops ornatus*), listed as a migratory species under the EPBC Act, was identified on the RSF site. GPNL contend that this species is common and does not require specific habitat management measures.

None of the habitats present within the RSF study area are suitable for migratory wetland or shorebirds.

Adapting GPNL's own commitments in relation to management strategies for the powerful owl, the squatter pigeon and the black-chinned honey eater and their habitats within the RSF (contained in section 9.10.7 of the EIS), I consider that GPNL should:

- preserve and rehabilitate known or likely habitats for these three species on land controlled by GPNL adjacent to the RSF footprint area
- protect potential roost or nesting trees for the powerful owl on land controlled by GPNL adjacent to the RSF footprint area
- during construction of the RSF
 - utilise already established access tracks where possible
 - position 'lay down' areas for materials, plant and equipment outside of the RSF footprint area to avoid disturbance to retained potential roost or nesting trees
- monitor and control declared pest animals and non-declared animals in Project areas adjacent to the RSF footprint area
- contribute to any regional monitoring and assessment program for these three species within the GSDA, in conjunction with government and other land users.

Commitment by GPNL to these measures can be incorporated into the environmental offset for vegetation clearing required by Recommendation 4.4 above.

The following six other fauna species (four birds and two mammals) present on the RSF site are listed as near threatened and protected under specific action plans produced by the Australian Government:


- Australian bustard (*Ardeotis australis*)
- Speckled warbler (*Chthonicola sagittata*)
- Grey-crowned babbler (*Pomatostomus temporalis*)
- Barking owl (*Ninox connivens*)
- Squirrel glider (*Petaurus norfolcensis*)
- Yellow-bellied glider (*Petaurus australis*).

As these six species are largely associated with open forest and woodland habitats on the RSF site, particularly in alluvial areas, I consider that the protection and offset measure described above for the powerful owl, the squatter pigeon and the black-chinned honey eater should also be adequate to mitigate impacts of the Project on these species.

4.4.2.3 Aquatic ecology

The majority of the RSF site drains to the south (Figure 9.11.1 of the EIS). Unnamed ephemeral creeks and drainage lines provide headwaters for Farmer Creek, which flows into the Calliope River. A small part of the north end of the RSF site provides headwaters for Police Creek, which drains north into Larcom Creek. Larcom Creek flows into the Calliope River several kilometres upstream of the Farmer Creek junction. Further discussion of surface and groundwater impacts of the RSF are provided in Section 4.8 of this Report.

Aquatic ecology field surveys conducted for the EIS on and downstream of the RSF site and other data sources used are summarised in section 9.11 of the EIS and detailed in Appendix L of the EIS. The surveys were conducted near the end of an extended dry period and consequently identified a lower number and variability of aquatic species than other data



sources predicted. GPNL has not indicated that it conducted additional surveys during subsequent wetter periods.

Five fish species were identified in a dam on the RSF property and one fish species was identified in Farmer Creek, south of the RSF property. No fish were found in a dam at the north end of the property. The macroinvertebrates identified were mostly from those families adapted to ephemeral stream conditions and known to be tolerant of poor water quality, including common forms of pollution.

The fish species recorded are generally common and widely distributed in eastern Australia. None of the fish species recorded in surveys are listed as endangered, vulnerable or poorly known. No species occurring in the area are listed in the NC Act or the EPBC Act under any category, and examination of existing data conducted for the EIS indicated that the likelihood of such fishes occurring in the area is low.

I agree with the conclusions in the EIS that:

- While the streams draining the RSF site have conservation value only at a local level, they do contribute to the ecological processes in the area by providing seasonal habitat to aquatic species, and movement, refuge and food corridors for terrestrial fauna such as birds, reptiles, and amphibians.
- Nonetheless, the streams are highly degraded by loss of vegetation and cattle grazing and their removal to residue storage will not have any significant environmental impacts.

Management strategies proposed by GPNL in the EIS on property controlled by GPNL adjacent to the RSF footprint to protect surface water quality in the RSF area and downstream aquatic habitats include:

- management and retention of any existing riparian vegetation
- active control of erosion and sedimentation within the RSF study area
- prevention of flows of any residue material or contaminated water into the downstream aquatic system
- management of surface and stormwater runoff from the RSF
- monitoring of downstream water quality.

I conclude that, considering the level of potential impact, and the measures described above or detailed in Section 4.8 of this Report, no special conditions or recommendations are required with respect to the protection of aquatic ecology values of the GNP on the RSF site.


4.4.3 Ore slurry and residue pipelines

This section covers impacts on flora and fauna of:

- the 180 km slurry pipeline proposed to transport ore from the nickel beneficiation plant site at Coorumburra near Marlborough to the refinery at Yarwun (Figures 7.4.1 and 7.4.2 of the EIS)
- the 27 km pipelines required to transport residue from the refinery to the proposed RSF and the parallel return liquor pipeline required to transport recovered liquor from the RSF to the refinery (Figure 7.4.2 of the EIS).

The easternmost 13.5 km of the residue pipelines into the refinery would run parallel with the slurry pipeline. In this section, the clearing disturbance width of the pipelines would be approximately 50 m. Where the residue and slurry pipelines diverge west of this point, the clearing width for each corridor would be 35 m.

Flora and fauna information in the main EIS and SEIS documents on the section of residue pipelines, from their point of divergence with the ore slurry pipeline corridor to the RSF, is inadequate. However, some of this information is presented in Appendix D3 of the EIS.



Flora and fauna matters related to the seawater intake and discharge pipelines and the acid pipeline are covered in Section 4.4.1 of this Report. GPNL has not yet provided sufficient detail to enable the impacts of limestone transport to the refinery to be assessed.

The alternate residue pipeline corridor described as the 'preferred option' in section 2.11 and Figure 2.3 of the SEIS, which runs along Calliope River Road and Boyles Road, has now been abandoned by GPNL. The route for the residue and return liquor pipelines now reverts to that described in the EIS. This is the 27 km route in the GSDA multi-user corridor north of the RSF, then running just east of the Bruce Highway (also illustrated in Figure 1.1.3 of the EIS).

Although GPNL's current intention is to initially transport the Marlborough Nickel ore to the Yarwun refinery by rail from a siding near Marlborough, it also intends to secure approvals to construct the slurry pipeline at some point in the future, probably for Stage 2 of the Project. GPNL has applied for a Mining Lease (ML for mine infrastructure) to secure the corridor. A Mining Lease application was submitted in March 2007 (application number 80134). Cultural heritage surveys are yet to be undertaken, and an Indigenous Land Use Agreement (ILUA) and landholder compensation agreements will also be required. A detailed EMP will also be required.

On May 19 2008 (after the completion of EIS field studies for the GNP) the Stanwell-Gladstone Infrastructure Corridor ("multi-user corridor") was declared as a State Development Area. One of the aims of this corridor is to facilitate the co-location of linear infrastructure through this area. South of the township of Midgee (about 100 km south of Coorumburra), the route of GPNL's slurry pipeline comes close to and in some case overlaps with the Stanwell-Gladstone Infrastructure Corridor State Development Area (SGICSDA).

In the SEIS, GPNL indicated its intention to locate its slurry pipeline entirely within the multi-user corridor, but wishes to secure approvals for its identified ML route in case future problems arise with respect to its use of the multi-user corridor. Despite the considerable overlap, GPNL's EIS and this Assessment Report apply only to the slurry pipeline route defined by the ML application. Now that the multi-user corridor has been gazetted, GPNL will be required to fulfil its commitment to use the multi-user corridor. Some additional impact assessment work would be required for GPNL to locate into the multi-user corridor. The commercial and other arrangements for GPNL's use of that multi-user corridor are yet to be determined. Refer to Section 4.10: Other pipeline site matters, for additional discussion.

4.4.3.1 Terrestrial flora

The pipeline routes have been selected to avoid or minimise (where avoidance has not been possible due to other constraints) impacts to protected vegetation and significant ecological communities. The pipeline alignment avoids all REs considered to be endangered and minimises the fragmentation of intact remnant vegetation as far as possible.


The proposed pipelines routes do not transect any REs listed as endangered under the VM Act. However, five REs transected by these pipelines are listed as of concern under the VM Act and constitute 60 ha of the approximate 670 ha of total affected vegetation that will be cleared for pipelines (see Table 6 above).

There are no vegetation communities protected under the Commonwealth EPBC Act transected by the proposed alignments.

Two significant flora species are located along the pipelines route. These are:

- black ironbox (*Eucalyptus raveretiana*) which is listed as vulnerable under the NC Regulation and the EPBC Act
- zamia palm (*Macrozamia serpentina*) which is listed as endangered under the NC Regulation.

While the route has been realigned to avoid the zamia palms, such a realignment to completely avoid the black ironbox at five creek crossings is not possible. It is estimated that up to 15 mature black ironbox and up to 40 juveniles will need to be cleared at five creek crossings. Information about these removals is provided in Table 7.4.4 of the EIS.



For each of these creek crossing points, black ironbox is the dominant canopy tree along the creek banks and more than 100 trees occur immediately upstream and downstream. Given the efficient regeneration capacity of this tree species, it is expected that, over the longer term, the potential impacts will be reversed through natural regeneration. Consequently, GPNL contends that the impact of clearing on this species is low.

GPNL anticipates that up to 25 m of the pipeline corridors width may be allowed to regenerate naturally with local species after post-construction stabilisation works, the management of any rehabilitated corridor area would depend upon the tenure arrangements in each part of each corridor. GPNL will undertake regeneration of ironbark if natural regeneration does not occur.

In the event that a Mining Lease is issued for a slurry pipeline from the Marlborough mine, then native vegetation clearing within the ML does not require a development permit as it is exempt under the *Integrated Planning Act 1997* for a 'specified activity' (i.e. a mining activity or a petroleum activity as defined under the *Environmental Protection Act 1994*). (see also Section 4.6.2.1).

4.4.3.2 Potential marine plant impacts

The proposed alignment of the slurry pipeline transects areas containing marine plants (protected under the *Fisheries Act 1994*) at up to four locations.

In its submission on the EIS, the DPI&F advised that development approvals will be required for any marine plant disturbance and temporary waterway barriers required for the construction of these pipelines. DPI&F will undertake detailed assessment of these applications to ensure that waterway crossing techniques are appropriate to individual sites and all impacts are justified and minimised.

As outlined in section 7.3.4.3 of the EIS, detailed Water Crossing Management Plans and procedures will be developed during the detailed design phase of the Project. During this phase, GPNL will liaise with the relevant regulatory agencies, including NRW, DPI&F and EPA, with respect to the design of the crossings, and obtain the relevant permits and approvals under the *Water Act 2000*, *Fisheries Act 1994* and/or *Coastal Protection and Management Act 1995* depending on the crossing location.


4.4.3.3 Terrestrial fauna

To minimise potential impacts, the pipeline alignments have been modified to avoid all high and medium priority habitat areas. Some low priority habitats areas will be disturbed.

Of the 45 species classified as either endangered, vulnerable and/or rare (EVR), and identified as potentially utilising preferred habitat within the proposed pipelines corridors, 18 are considered to have the potential to be impacted by the proposed pipeline due to potential effects on preferred habitat. A more detailed summary of each EVR species identified as potentially utilising habitat within the alignment of the proposed pipelines, and potential impacts on these species is provided in Table 7.5.4. and Appendix D of the EIS.

One bird species, the Capricorn yellow chat (*Epthianura crocea macgregori*), has the potential to be significantly impacted. Potential habitat for the Capricorn yellow chat occurs near to where the pipeline would cross Raglan Creek. The yellow chat is critically endangered under the EPBC Act and endangered under the NC Regulation. A special area plan has been developed to ensure that any potential impacts on the yellow chat from the ore slurry pipeline construction would be minimal.

The Capricorn yellow chat was the only EPBC Act-listed species that was considered to have the potential to be significantly impacted from construction of the pipeline through the impacts to preferred habitat – rank vegetation surrounding lagoons and creeks. The Capricorn subspecies of the yellow chat was believed to occur only on Curtis Island near Gladstone, until two additional small populations were discovered in 2003/04 on the mainland in the 12 Mile Creek – Raglan Creek area of the Fitzroy River delta, and at Toorilla Plain north of Rockhampton. The habitat of the yellow chat is shallow saline and freshwater drainage lines connected to tidally influenced wetlands, including samphire and inundated sedgeland.



In Section 7.5.8.3 of the EIS, it was concluded that pipeline construction has the potential to impact on the yellow chat through direct disturbance causing birds to leave the site or reduce breeding activity (e.g. noise, dust or lights associated with construction activities) and physical disturbance of habitat (e.g. clearing of wetland vegetation upon which chats may be dependent). Indirect impacts may also occur if control measures are inadequate during crossings of creeks due to erosion and sedimentation of downstream habitat or through loss of emergent vegetation upon which chats depend for food and shelter.

The hydrology of the area also appears to be an important factor to the chats breeding cycle and loss or reduction of downstream flows due to pipeline construction could seriously impact on yellow chat habitat through changes in productivity (providing the basis of food chains for breeding chats) or changes to vegetation structure and floristics upon which chats depend for shelter and nesting. Where sites are dependent on overland flows for inundation, there is potential for disturbance by small alterations in surface topography associated with pipeline infrastructure construction (trenches and access roads) and on-going pipeline maintenance requiring road access.

Upon completion of the field investigation, GPNL altered the pipeline route to reduce the potential for impacts to the yellow chat. An additional field inspection of the proposed alignment corresponding to the potential habitat of the yellow chat was completed in August 2006. As part of this investigation, confirmed and potential habitat associated with the pipeline alignment was identified. These habitats were categorised as:

- high priority – defined as sites where breeding has been confirmed
- medium priority – defined as sites where yellow chats have been observed but at which the breeding status is uncertain and few numbers were present
- low priority – defines sites at which chats have not been found but have appropriate vegetation structure such as emergent sedges or grasses (e.g. key species supporting breeding listed above plus *Typha*, *Carex* and *Eleocharis*).

As a result, an alternate alignment between kilometre point (KP) 126 and KP 137 has been proposed, which moves the proposed route west and reduces the potential impacts on rank vegetation surrounding the lagoons and creeks and potential habitat for the yellow chat. This alignment is upstream of all high and medium priority sites, but would disturb some low priority sites.

As outlined in Section 4.4.3.2 above, GPNL would develop detailed Water Crossing Management Plans and procedures during the detailed design phase of the Project.

Conclusion

I am satisfied from the material presented in the EIS and SEIS that a route for the corridor has been chosen to minimise clearing of remnant vegetation, while taking into account other factors such as proximity to homesteads, issues of property management, cultural heritage, and economic costs and benefits.

As a result of the provisions made by GPNL in the management commitments and Environmental Management Plans, I am satisfied that adequate measures are specified to ensure that flora and fauna impacts would be minimized and managed in the construction of the Project.

Nonetheless, I find that the construction of the pipeline across sensitive waterways could adversely impact upon riparian vegetation, water quality and increase erosion. These impacts would be temporary in nature for the duration of the construction program

The implementation of the controls identified in the Water Crossing Management Plan should mitigate these potential impacts. Therefore I recommend that GPNL consult with the EPA and NRW to approve this Plan. This Plan must be implemented in its entirety.

I recommend that the mitigation plans provided in the Water Crossing Management Plan are audited independently by the EPA, NRW and DPI&F, wherever relevant, to ensure that there

is compliance with these Plans and that the mitigation strategies are effective to achieve their objectives.

I consider that the commitments given in the EIS sufficiently address mitigation of impacts on flora and fauna. However, in order to ensure that full effect is given to these commitments, I recommend that the following requirement be attached to any approval applied to the Project:

Recommendation 4.5

During the detailed design phase and prior to construction of the ore slurry and residue pipelines, the proponent will apply for a permit under section 3.2.1 of the *Integrated Planning Act 1997* for operational works (clearing native vegetation made assessable under IPA Schedule 8). This will ensure that the purposes of the *Vegetation Management Act 1999* are met. Such an application would be assessed against Part S of the *Regional Management Code for Brigalow Belt and New England Tablelands Bioregions*. This application will be accompanied by a detailed analysis of how the proposed clearing will meet the performance requirements of the relevant regional management codes. It will also include a detailed spatial plan of the proposed clearing application area and details on the method of clearing.

Recommendation 4.6

- (a) Development approvals must be obtained for any marine plant disturbance and temporary waterway barriers required for construction of the pipeline prior to construction.
- (b) All waterway crossings are to be designed in line with the DPI&F policy '*FHG 001 Fish Passage in Streams; Fisheries Guidelines for Design of Stream Crossings*' (1998).
- (c) DPI&F will undertake detail assessment of the applications in (a) to ensure waterway crossing techniques are appropriate to individual sites and all impacts are justified and minimised.


4.5 Acid sulfate soils

Acid sulfate soils (ASS) are a characteristic feature of low lying coastal environments in Queensland, particularly where landform elevations are below 5m AHD (Australian Height Datum). ASS are comprised of iron sulphides generally in the form of pyritic material that is a product of the natural interaction between iron rich organic matter and sulphate rich seawater present in anaerobic low energy estuarine environments. Undisturbed, these soils are generally present in an anaerobic state within the subsurface profile (below the water table) of Holocene marine muds and sands in the form of 'potential acid sulfate soil' (PASS). Actual acid sulfate soils are the oxidised (disturbed) form, which may occur as the result of natural or anthropogenic disturbance from changes in groundwater levels and/or exposure to oxygen (Powell, B. & Ahern, C.R. (1999): *Nature, Origin and Distribution of Acid Sulfate Soils: Issues for Queensland*, NRW, Brisbane).

ASS in an undisturbed environment may have a pH of neutral or slightly alkaline and no visual appearances indicating its acidic potential. However, when exposed to air either by direct excavation or by indirect changes to the surrounding water table, pyritic material inherent in the soil matrix is oxidised by sulphur oxidising bacteria leading to the formation of sulphuric acid. Following rainfall, sulphuric acid associated with soil oxidation can then be released into surface runoff and receiving waters and mobilised in groundwater, resulting in mortality of aquatic flora and fauna and deterioration in ecosystem health as well as impacts on structures and existing infrastructure.

The proposed nickel ore slurry pipeline route only disturbs land below 5 m AHD at creek crossings within the Inkerman Creek and Raglan Creek areas. All linear infrastructure between the refinery and Port Curtis (pipelines and conveyors) traverses areas below 5 m AHD and may disturb PASS.

If PASS are disturbed (for example through excavation) and appropriate control measures are not in place, leachate containing sulphuric acid and metal contaminants can be released into the environment. This leachate has the potential to adversely affect the natural and built environment and human health.



Measures to mitigate potential impacts from ASS are summarised below (refer also to the draft EMPs contained in section 14.8 of the EIS for additional information).

To mitigate potential impacts, GPNL has committed to:

- Conduct a targeted survey of the routes where there is the potential to disturb PASS or ASS and include the results as an input into the design of the crossings. The investigation, sampling and analysis will be carried out with reference to *Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils* (Department of Natural Resources and Mines, 1998).
- Where necessary, clearly identify all areas of ASS and include these locations on alignment sheets.
- Where necessary, incorporate ASS management procedures into the EMP including measures to:
 - minimise the time trench spoil is stockpiled
 - neutralise trench spoil with lime
 - contain runoff from stockpile areas in holding ponds or bunded areas
 - dispose of trench water only after analysis
 - re-bury soil below the water table
 - compact backfill to prevent acid leachate migration.

NRW, in its advice on the EIS stated that ASS management procedures should also include verification testing of potential or actual ASS post-liming and prior to re-burial. GPNL acknowledged that the ASS management plan will include verification testing of potential or actual acid sulfate soils post-liming and prior to re-burial.

NRW also identified that permits may be required for certain river crossings. GPNL acknowledges the advice from NRW and, where necessary, such approvals will be sought from the relevant water service providers.

As outlined in section 7.3.4.1 of the EIS, all watercourses crossed by the proposed pipelines have been assessed in the field to determine the optimum crossing points, and refinements have been made during the field component of the water and ecological studies to further refine the proposed crossing locations.

The initial crossing points for all watercourses were selected on the basis of the following criteria:

- minimise the extent of clearing of riparian vegetation
- avoid permanent and semi-permanent waterholes
- avoid unstable and/or steep, incised banks
- avoid bends in the channel and confluences with other channels.

GPNL has committed to horizontal directional drilling at a number of significant watercourses including the Fitzroy River, Calliope River, Neerkol Creek, Raglan Creek and potentially Inkerman Creek, with the remainder being crossed via open cut.

Approvals for the nickel ore slurry pipeline will attach to a Mining Lease (ML), or a MCU if the pipeline is located outside of the ML. Within the State Development Areas, conditions for linear infrastructure, other than ERA environmental authority conditions, will be attached to the MCU approval for the refinery. On Strategic Port Land (e.g. Fisherman's Landing and near Clinton Wharf), approvals for linear infrastructure will be administered by GPCL.

Conclusion

In order to ensure that the impacts of the Project on ASS are adequately managed, I state the following condition to apply to all Project components that may disturb PASS/ASS:

Condition 5.1

- (a) A site specific acid sulfate soils (ASS) Management Plan must be developed to meet standards acceptable to the Department of Natural Resources and Water prior to any disturbance occurring onsite.
- (b) The ASS Management Plan must be developed by consultants experienced in large-scale development projects containing ASS and include a commitment to be onsite during excavation and treatment activities.
- (c) The ASS management plan will include verification testing of potential or actual ASS post-liming and prior to re-burial.

I nominate the Environmental Protection Agency as the responsible authority for this condition.

4.6 Water supply

4.6.1 Use of seawater

The EIS indicated that seawater would be used at the refinery for cooling, at the mine for beneficiation of the ore, and in the pipeline for transport of ore slurry from the beneficiation plant to the refinery. The total seawater intake for Stage 2 was described in the EIS as being approximately 240 gigalitres per year (GL/y) and 140 GL/y for Stage 1. The majority of this water was intended to be used for once through cooling purposes and then returned to Port Curtis, with other refinery wastewater.

However, GPNL's subsequent analysis of the energy consumption and construction costs of piping such large amounts of seawater to and from Port Curtis, along with the impact of return water temperature to the seawater in Port Curtis, resulted in a re-assessment of a seawater cooling option. The capital and operating costs were such that this form of cooling could not be justified when compared to the alternative of freshwater cooling towers. Not having to pump seawater to the Marlborough mine means that only one pipeline would be constructed between the mine and the refinery instead of two. Seawater would continue to be used in the refining process.

The SEIS described that the seawater usage of the Project would be reduced to 8GL/y (Stage 2), and this would be extracted via a 400 mm diameter pipeline from the Calliope River near its junction with the Anabranh, approximately 500 m to the east of the refinery


Subsequent to the release of the SEIS, GPNL made two further amendments to the proposed use of seawater for the Project:

- Consultation with NRW and DPI&F indicated that the Calliope River extraction location near to the Anabranh would be unsuitable. Therefore, GPNL has relocated the intake point to the Wiggins Island Wharf (WIW) structure (see Figure 1 in Section 4.2.5 of this Report).
- The introduction of the seawater dilution step prior to the release of treated waste water to Port Curtis (summarised in Section 4.2.5 of this Report and detailed in section 3 of the technical supplement *Gladstone Pacific Nickel Refinery – Environmental Assessment of Treated Water Discharge to Port Curtis* (URS, 25 July 2008)) will use almost 300 GL/y of seawater at Stage 2 of the Project.

Gladstone Ports Corporation Limited and the Gladstone Harbour Master have provided their approval for the physical locations of infrastructure required to deliver these amendments.

Total seawater usage for Stage 2 of the GNP would therefore be approximately 308 GL/y (300 for dilution plus 8 for refinery HPAL processes).

GPNL is investigating the potential to use warm seawater from NRG's Gladstone Power Station discharge as a superior intake option for the 8 GL/y currently proposed to be drawn from the WIW structure. This alternative would reduce the temperature effect on NRG's discharge on the Calliope River and save the energy required to heat raw seawater.



While there would be significant environmental benefit in sourcing the water from the power station, and I encourage such an outcome, my evaluation of the GNP is independent of the outcome on that matter.

4.6.2 Use of freshwater

The EIS outlined that the raw water for the refinery will be supplied by the Gladstone Area Water Board (GAWB). It also stated that the initial raw water demand during Stage 1 of the Project would be approximately 5.4 GL/y and this would increase to an ultimate raw water demand of approximately 10.5 GL/y during Stage 2.

The freshwater needs of the GNP were increased substantially following amendments to the refinery process design after the release of the EIS, particularly the replacement of seawater cooling with freshwater cooling towers. As this water is recycled through the system, losses from the system would be primarily from evaporation. Blowdown from the cooling water circuit would be reused in the refinery as much as possible.

According to the SEIS, Stage 1 demand for freshwater is now estimated to be approximately 15 GL/y. Detailed optimisation of this water use has yet to be performed and GPNL is confident that Stage 2 will operate using less freshwater per tonne of nickel produced. Until these studies and designs are completed, the estimated Stage 2 demand is set at 30 GL/y. These estimates represent 0.23 ML/t of nickel produced. This compares favourably with the main HPAL plant in Australia (Minara Resources) which uses water at 0.3 ML/t Ni. The HPAL plant currently under construction in New Caledonia (Goro Nickel) is forecast to use water at 0.3 ML/t Ni.

GPNL has confirmed that GAWB is in a position to supply the 15 GL/y for Stage 1 from a supply point near to the refinery site. I am satisfied that supply from GAWB for Stage 1 of the Project can occur under normal commercial arrangements and no impact assessment on this supply is required. No such confirmation of water supply arrangements for Stage 2 of the GNP currently exists.

As discussed elsewhere in this Report, GPNL initially plans to rail ore from Marlborough to the refinery. GPNL has stated its intention to install the slurry pipeline for Stage 2 of the Project and source raw water for the slurry pipeline directly from the Fitzroy River. The total volume of water required to run the slurry pipeline depends upon the ratio of Marlborough ore to imported ore to be used in the refinery.

Discussions between GPNL and Fitzroy River Water (a business unit of the Rockhampton Regional Council), have confirmed that a substantial take of new water would probably require the raising of the Eden Bann Weir, located south-east of the proposed Marlborough Mine, or some other new water impoundment measure. Such amended or new impoundment structures would be subject to separate environmental approvals.

GPNL holds existing environmental approvals for the Marlborough Nickel project, which includes a water intake and pipeline from the Fitzroy River. This held as Environmental Authority Permit number MIM800078102, valid from 28 August 2003. This is a Non-Standard Environmental Authority (Mining Activities) under the EP Act. The volume of water proposed by the 1998 EIS Supplement for the Marlborough Nickel project to be extracted from the Fitzroy River was 10 GL/y.

In October 2008 correspondence with DIP, GPNL has confirmed that:

- the current estimate of the maximum amount of beneficiated nickel ore that would be transported by slurry pipeline during Stage 2 of the Project would be 2.7 million tonnes per annum (mtpa)
- applying a 20% solids concentration in the pipeline, the maximum annual water use in the slurry pipeline would be approximately 10.8 GL
- as there would be approximately 0.5 GL/y of water sourced in the ore feed, the net maximum volume of water required to run the pipeline would be 10.3 GL/y

- at the refinery, the slurry goes through a thickening process and up to 3.1 GL/y of water would be recovered
- thus, with the introduction of the slurry pipeline, the total maximum Stage 2 requirement for freshwater at the refinery would fall from 30.0 to 26.9 GL/y, while the total freshwater usage of the GNP would rise to 37.7 GL/y
- while an environmental authority under the EP Act is held for the operation of the mine, there are no conditions in this authority related to the take of water from the Fitzroy River (or any other source)
- GPNL does not have any water allocation under the *Water Act 2000*
- GPNL has not held extensive discussions with GAWB about any possible implications of the future construction of the slurry pipeline for GAWB's overall water resource planning or GAWB's current consideration of its 30 GL/y 'Gladstone – Fitzroy Water Pipeline' (which is also a 'significant project' under section 26(1)(a) of the SDPWO Act).

If GPNL proceeds with the construction of the ore slurry pipeline, it would need to either purchase the required 10.3 GL/y from another water entitlement holder or secure its own allocation. The Fitzroy Basin Water Resource Plan and Resource Operations Plan may be able to accommodate a separate allocation to GPNL of the scale required for the slurry pipeline, but that matter cannot be resolved during this EIS process. Similarly, it cannot be determined at this stage whether:

- the lower Fitzroy River system is capable of supporting the 10.3 GL/y allocation required for the slurry pipeline, plus the 30 GL/y proposed for the Gladstone – Fitzroy Water Pipeline, plus other potential future water demands on that system or
- the viability of the proposed Gladstone – Fitzroy Water Pipeline would be impacted (positively or negatively) by the approximately parallel development of GPNL's ore slurry pipeline.

The EIS process for the GNP has not considered the environmental implications of a take of up to 10.3 GL/y of water directly from the Fitzroy River.

Conclusion

I am satisfied that the take of up to 308 GL/y of seawater for the GNP can proceed without significant environmental impact.

The supply of up to 15 GL/y of freshwater from GAWB for Stage 1 of the GNP is a commercial arrangement that does not require approvals under this EIS process. Extension of this or other commercial supply arrangements for up to 30 GL/y for Stage 2 of the GNP could also proceed without further impact assessment being required. Nonetheless, given the large scale of that water usage, I encourage GPNL to pursue rigorous water use efficiency measures to minimise its freshwater requirements.

The supply of up to an additional 10.3 GL/y (gross) or 7.7 GL/y (net) from the Fitzroy River for the nickel ore slurry pipeline may require new water allocations to be secured, and therefore separate environmental assessment. Consequently, notwithstanding that I am satisfied that the ore slurry pipeline itself can be constructed as proposed by GPNL without unacceptable environmental impact, I cannot recommend approval to proceed with this component of the Project until the source of water for that pipeline has been separately identified and approved.

4.7 Road impacts

4.7.1 Scope of potential road impacts

The roads and intersections in the Gladstone Regional Council area likely to be impacted by the GNP are shown in Appendix A of Appendix F of the SEIS.

Potential impacts of the GNP on traffic and road infrastructure may arise from:

- the construction of the refinery in the Yarwun precinct of the GSDA and the connecting pipeline and conveyor infrastructure, which includes:
 - the conveyor from the Wiggins Island Coal Terminal (WICT) for the imported ore and sulphur pellets
 - pipeline or rail infrastructure to deliver the limestone
 - the preassembled modules (PAMs) facility at Fisherman's Landing, the 16 m wide PAM corridor between there and the refinery (shown in Figure 2.7 of the SEIS), and the movement of up to 1,000 tonne PAM units along the corridor
 - the residue slurry pipelines from the refinery to the Residue Storage Facility (RSF)
 - the treated waste water pipelines from the RSF and the refinery to Clinton Wharf
 - the seawater intake pipes from Wiggins Island to the refinery and from the Calliope River mouth to the Clinton Wharf dilution facility
 - the rail siding and unloading facilities at the refinery site
 - the acid export pipelines from the refinery to Fisherman's Landing;
- the construction of the RSF
- the construction and maintenance of the ore slurry pipelines from the Marlborough mine to the refinery
- the construction and maintenance of the haul road or conveyor for the beneficiated nickel ore from the Marlborough mine to a rail loading facility adjacent to the 'North Coast Line' near Marlborough
- the operation of the refinery, which includes the road transport of almost 800,000 tpa of materials at Stage 2, including approximately:
 - 372,000 tpa of ammonium sulfate product (amsul) from the refinery via Hanson Road, Glenlyon Drive and the Port Access Road to an export facility at Barney Point in purpose-built B-double trucks
 - 132,000 tpa of nickel and cobalt metal product in 20 tonne containers to QR's Mt Miller Rail Yard, which is located directly across Reid Road at the south-west corner of the refinery site
 - 285,000 tpa of lime input to the barren liquor waste treatment process, which GPNL has indicated will most likely be sourced from Cement Australia's plant near Fisherman's Landing and be transported in B-double pressurised tankers via Hanson Road.


My consideration of the impacts of the refinery operation on road use is provided in Section 4.7.3 of this Report.

The impact of all construction activity on roads during the EIS has considered the movement of materials, equipment and people, including the transport of personnel associated with construction worker accommodation. My consideration of road impacts associated with a proposed construction worker accommodation village are discussed in the 'Socio-economic impacts' section of this Report (Section 4.11).

The impacts of construction of the sulphur and ore loading facilities at Wiggins Island on traffic and road infrastructure requirements were partially incorporated into the EIS process for the WICT project. My Assessment Report for the WICT project, dated 7 January 2008, is available online at:

<http://www.dip.qld.gov.au/projects/energy/coal/wiggins-island-coal-terminal.html>

The proposed refinery site is bounded by Hanson Road to the north and Reid Road to the west and south (between the North Coast Railway and the site). Vehicular access to the site,



for both construction and operational traffic, will only be available from Reid Road. GPNL proposes that all construction and operational traffic would enter and exit from Reid Road.

Hanson Road is a designated haulage route for B-double trucks and is a state-controlled road managed by the Department of Main Roads (DMR). Reid Road is a local road within the GSDA managed by the Gladstone Regional Council.

The traffic impact assessment that formed part of the EIS for the GNP was updated in the SEIS to reflect Project design changes and to address comments raised by DMR and the Calliope Shire Council on the EIS.

4.7.2 Transport matters not covered in the EIS

I consider that the road transportation arrangements and road impacts proposed by GPNL for the Project are generally acceptable with the application of both the mitigation measures proposed by GPNL and the conditions and recommendations that I have set out below. However, insufficient detail has been provided during the EIS process on four transportation elements of the Project. Therefore, separate approvals will be required when sufficient detail about these elements become available. These elements are:

- ore transport facilities from the Marlborough mine, a maximum 38 km north, to a proposed rail loading facility
- a rail loading facility for the ore adjacent to the North Coast Line on the north side of the Bruce Highway, approximately 5 km west of the New Marlborough Township
- arrangements for the rail spur line entering and leaving the Wiggins Island / RG Tanna Coal Terminal railway just south of the Mt Miller Rail Yard and crossing Reid Road to the refinery site
- rail or slurry pipeline transport for the limestone supply to the refinery.

The first three of these matters are discussed in further detail in Section 4.7.2.1, while the limestone transport issue is discussed in Section 4.7.2.2.

While matters relating to general approvals for GPNL's proposed preassembled modules (PAMs) facility at Fisherman's Landing are discussed in Section 4.9.5, matters related to the associated PAM corridor from Fisherman's Landing to the refinery site, including the proposed PAM route crossings of Hanson Road, are discussed in Section 4.7.4.2.

4.7.2.1 Transport of the ore from the mine to the refinery

Up to 2.7 mtpa of ore will be transported from the Marlborough mine to the refinery at Stage 2 of the GNP. While GPNL has sought approval for a slurry pipeline from Marlborough mine to the refinery, its intention is to initially transport the ore by rail. GPNL proposes to move the ore from the mine to the rail loading facility by either conveyor or by truck. A significant proportion of the distance between the mine and the railway (22 km) is across GPNL's own Mining Lease (ML), so approval for this component can be obtained by an amendment to that ML in consultation with the Department of Mines and Energy (DME) under the *Mineral Resources Act 1989* and an amendment to the mine environmental authority under the *Environmental Protection Act 1994* in consultation with the EPA. The remaining distance (16 km) is likely to require approvals under IPA.

If road transport from the mine to the rail line is to be used, then this may be undertaken by either the construction of a new private road, or use of appropriately upgraded local roads. Regardless of which ore transport option is chosen, close consultation will be required with the Rockhampton Regional Council and impacted landholders.

As the ore must cross the Bruce Highway, close consultation will also be required with the DMR and approval of the Chief Executive of DMR will be required under section 50 of the *Transport Infrastructure Act 1994* (TIA).

Any infrastructure construction and operation works inside of the North Coast Line rail corridor will require the approval of Queensland Transport (QT) under the TIA and would necessitate consultation with Queensland Rail Network Access.

I am advised that the site proposed by GPNL for the rail loading facility is predominantly cleared, but a detailed assessment of existing environmental values of the site and potential impacts has not been provided in the EIS documents or submitted separately to me.

I consider that approvals for this component of the GNP should be sought under IPA rather than as a project change under Division 3A of Part 4 of the SDPWO Act.

Conclusion

It is acceptable that transport arrangements for nickel ore from the Marlborough mine to the proposed rail loading facility and the loading facility itself are resolved outside of this EIS process. Ore transport infrastructure and corridor approvals should be sought from DME and EPA on the ML and from Rockhampton Regional Council, DMR, QT and EPA outside of the ML.

4.7.2.2 Limestone transport to the refinery

The nickel refinery will use up to 2.2 mtpa of limestone for Stage 2 of the GNP. There are several options within the Gladstone Region for the supply of limestone to the Project, and GPNL has not finalised supply and transportation arrangements.

GPNL also intends to source approximately 285,000 tpa of lime, this may potentially come from Cement Australia's cement plant near Fisherman's Landing. My consideration of the proposed road transport of lime from Fisherman's Landing to the refinery is provided separately in Section 4.7.3.

Currently, limestone is railed from both Cement Australia's East End mine and Unimin's Taragoola mine to Cement Australia's cement plant. A disused limestone slurry pipeline also exists from the East End mine to the cement plant and this could be recommissioned or replaced and extended.

I consider that rail or slurry pipeline transport of the limestone would be acceptable in principle and not finalising proposals for this component of the Project should not compromise the viability of the GNP. However, no limestone transport proposal has been presented in the EIS documentation, so I can make no specific recommendation about approvals for this component of the GNP. Nonetheless, I consider that:

- the quantity of limestone required by the GNP is too great to allow road transport of that resource to the refinery when its potential impact on road congestion, safety and public amenity is taken into account
- given concerns expressed by some members of the community in the vicinity of the East End Mine about the impacts of limestone mining on surrounding groundwater aquifers, it would be strongly preferable if any slurry transport of limestone from that location did not result in any net removal of water from the mine.

Any new limestone slurry pipeline may require approvals from DME and EPA (on Cement Australia's MLs), and under IPA (east of the MLs). Unless limestone slurry water is sourced from and then recycled to the mine, a separate slurry water source would also be required. My separate consideration of water supply arrangements for the GNP is presented in section 4.6 of this Report.

As for the Marlborough nickel ore transport to a proposed rail loading facility, I consider that subsequent approvals for transport of limestone to the refinery need not be undertaken as a project change under Division 3A of Part 4 of the SDPWO Act.

Conclusion

I consider that it is acceptable that future transport arrangements for the supply of limestone to the refinery are resolved outside of this EIS process. However, the quantity of limestone required by the GNP is too great to be transported by road. Therefore, I set the following condition that is to be attached to the MCU approval for the refinery and I bring this condition to the attention of the relevant agencies (DMR, DME, EPA and the Gladstone Regional

Council) responsible for any subsequent approvals required for limestone supply to the GNP refinery.

Condition 7.1

The supply of limestone to the GNP refinery should not allow road transport of the limestone.

4.7.3 Specific operational impacts of the refinery

Some detail about the road transport of materials supporting the operation of the refinery is provided in Table 7. Further details of the road impacts of the GNP are provided in Appendix F of the SEIS.

Table 7. Operational road use details for the transport of lime to the refinery, and amsul and metal from the refinery

Resource input & production statistics	Lime input ¹		Amsul output ²		Ni + Co metal output ³		Total	
	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
Quantity ('000 t/yr)	142	285	186	372	69	138	373	795
Quantity (t/day)	390	781	510	1,019	189	378	1,089	2,178
Truck capacity (t)	40		40		20		n/a	
Truck loads/day	10	20	13	25	10	19	33	64
Truck movements/day	19	39	25	51	19	38	63	128
Hours/day allowed for truck movements	24		12		24		n/a	
Truck movements/hour	0.8	1.6	2.1	4.2	0.8	1.6	3.7	7
Minutes/truck	72	37	28	14	76	38	16	8

1 – via Hanson Road from Cement Australia plant near Fisherman's Landing

2 – via Hanson Road east to the Port Access Road to Barney Point (as defined in Figure 2.6 of the SEIS)

3 – across Reid Rd to the Mt Miller Rail Yard adjacent to the refinery site

At Stage 2 of the GNP, there would be approximately 128 heavy vehicles movements per day in and out of the refinery involved with the transport of almost 800,000 tpa of lime, amsul and metal products.

4.7.3.1 Transport of the nickel and cobalt metal from the refinery

As nickel and cobalt metal would be transported only a short distance across Reid Road from the refinery site to the Mt Miller Rail Yard, these 38 container truck movements per day are not considered further in this Report. Nickel and cobalt metal are conventionally loaded into drums before being placed into shipping containers. Therefore, conveyor transport to the Rail Yard over Reid Road is not considered viable because drum and container loading could not be adequately controlled in the rail yard.

4.7.3.2 Lime transport to the refinery

Cement Australia is the major supplier of lime in the Gladstone region and will possibly supply GNP. GPNL proposes that the lime sourced from Fisherman's Landing would be transported along Hanson Road in B-double pressurised tankers with pneumatic loading and unloading. I consider that there should be no special restrictions placed on the movement of the lime transport trucks because:

- this section of Hanson Road is entirely within a major industrial precinct

- the lime transport has been considered in the road and intersection upgrade requirements applied by DMR, discussed in Section 4.7.4 of this Report, and I have recommended GPNL contribute to the costs of those upgrades.

If GNP sources lime from another supplier it is acceptable that transport arrangements for the lime supply are resolved outside of this EIS process. Approvals in relation to road use (e.g. hours of operation) and transport infrastructure should be sought from Gladstone Regional Council and/or DMR, as applicable.

4.7.3.3 Amsul transport to Barney Point

Gladstone Ports Corporation Limited (GPCL) has advised that facilities for the loading of ammonium sulphate (amsul) onto ships are unlikely to be established at Fisherman's Landing during the first few years of operation of the GNP. Therefore, GPNL and GPCL have agreed to ship the amsul through largely existing facilities at Barney Point. These arrangements are summarised in section 2.14 of the SEIS and the route for the transport of the amsul from the refinery is shown in Figure 2.6 of the SEIS. This follows an identified heavy vehicle route through central Gladstone onto the Port Access Road. This activity will involve approximately 25 truck movements per day for Stage 1 of the Project and approximately 51 truck movements per day for Stage 2 of the Project.

The longer-term objective of GPCL, the Gladstone Regional Council, DMR and the Gladstone Economic and Industry Development Board (GEIDB) is that heavy vehicle movements generated by industry on the GSDA should not traverse central Gladstone where this can be avoided.

Given the potential for the amsul transportation to impact upon the amenity of central Gladstone, I consider that restrictions on the hours of operation of this haulage activity should be imposed. Haulage should generally be restricted to daylight hours and avoid Sundays. Gladstone Regional Council is probably in the best position to monitor the impact of amsul transportation on businesses and the community along the haul route.

Recommendation 7.2

GPNL must:

- (a) consult with GRC regarding haulage hours in consultation with GPNL. I have incorporated these requirements into Condition 7.3 to be attached to the MCU approval for the refinery
- (b) relocate its amsul export operation from Barney Point to Fisherman's Landing as soon as suitable facilities can be established there following the completion of GPCL's currently proposed Fisherman's Landing expansion. While this could coincide with a commitment by GPNL to Stage 2 of the GNP, there are too many external contingencies to mandate in this Report the precise timing of such a transfer of amsul facilities.

Condition 7.3

Haulage of ammonium sulphate (amsul) to Barney Point Wharf must be restricted to twelve hours per day, six days per week, nominally between 6 am and 6 pm Monday to Saturday, unless otherwise agreed between GPNL and the Gladstone Regional Council.

4.7.3.4 Other refinery transport movements

In addition to the heavy vehicle movements outlined in Table 7 of this Report, Table 5.2 of Appendix F of the SEIS describes the other miscellaneous materials transported by road to or from the refinery. These other materials include sulphuric acid plant filter residue, flocculent, caustic and miscellaneous solid wastes. GPNL has estimated that, collectively, these miscellaneous materials will add an average of just over eight vehicle movements per day to roads around the refinery during the operation of Stage 1 of the GNP and just over 14 vehicle movements per day during the operation of Stage 2 of the Project. I consider that these numbers of vehicle movements are too low to warrant any special mitigating measures.

The other major road impact from the operation of the refinery would be the movement of employees and contractors to and from the site. The SEIS estimates that these would total

approximately 1,100 vehicle movements per day (i.e. 550 staff vehicles arriving plus 550 staff vehicles leaving each day) for Stage 1 of the GNP and approximately 1,400 vehicle movements per day for Stage 2 of the Project. These are relatively large numbers compared to the materials transport vehicle numbers, and they would be concentrated around shift change times (two or three times per day). GPNL has indicated that it would consult with local industries in order to design shift change times that would reduce traffic effects in the local area.

I consider that it would be difficult for GPNL to coordinate bus services for its refinery operational workforce as that workforce may live across the broader Gladstone Region. Furthermore, GPNL's workforce numbers have been incorporated by DMR into its road upgrade requirements (refer to Section 4.7.4 below). Therefore, I have not set a condition or recommendation in relation to this matter. Nonetheless, I recommend that GPNL investigate the feasibility of:

- pooled transport options, including buses, for the daily commute between the refinery and home
- setting daytime shift changes at the refinery to avoid other peak road transport times on Hanson Road and the arterial roads feeding the eastern end of Hanson Road.

4.7.4 Gladstone regional roads impacted by the refinery and RSF

4.7.4.1 Upgrades to state-controlled roads in the Gladstone Region

The measures discussed in this section have been agreed between GPNL and DMR and aim to ensure that expected traffic impacts of the construction and operation of the GNP on the surrounding road network will be adequately mitigated. The roads in the Gladstone Region likely to be impacted by the GNP are shown in Appendix A of Appendix F of the SEIS.

I am advised that DMR and GPNL have consulted adequately with Gladstone Regional Council and its predecessors with respect to the proposed bring forward of each intersection upgrade between the state-controlled and local roads mentioned in this section.

Hanson Road – Reid Road intersection

Construction of the refinery would generate substantial new traffic volumes, necessitating the upgrade of the existing T-intersection of Hanson Road and Reid Road at the commencement of construction to a single circulating-lane roundabout. According to DMR's 2007 traffic projections, the current intersection form would fail by 2015 without the GNP. Consequently, GPNL would be responsible for a 'bring forward contribution' of 26% of the value of required works to construct a single circulating lane roundabout. Analysis undertaken by GPNL and DMR has shown that a single lane roundabout would operate adequately in the interim, with a dual circulating lane roundabout ultimately required by 2026. Subsequently upgrading the intersection to a dual circulating lane roundabout would provide adequate traffic capacity for the design life and would be consistent with any future duplication of Hanson Road. It would also be consistent with DMR's current planning for a potential future grade separated, dual circulating lane roundabout at this location to accommodate the additional traffic requirements of other potential significant developments in the region.

Condition 7.4

GPNL must provide DMR a contribution equivalent to 26% of the cost of upgrading the Hanson Rd – Reid Rd intersection to a single-circulating lane roundabout standard, in accordance with DMR's '*Road Planning and Design Manual*' before commencement of construction of the GNP.

Hanson Road – Red Rover Road intersection

DMR has advised that the additional traffic demands of the refinery may require the existing single-lane roundabout at the Hanson Road – Red Rover Road intersection to be upgraded to a dual-lane roundabout after 2022. However, as the certainty around this estimate 14 years

from now is relatively low, and GPNL's 2002 bring forward contribution would be relatively small, I have decided not to set a condition on this matter.

Hanson Road – Blain Drive intersection

DMR has advised that the Hanson Road – Blain Drive – Alf O'Rourke Drive intersection would need to be upgraded by 2012 to mitigate the impacts of the refinery traffic. While the impact of the GNP could be compensated by the provision of a bypass lane from the southern leg, DMR recommends that the requirements for additional lanes on carriageways approaching the intersection mean a dual circulating lane roundabout form would be more appropriate. GNP traffic brings forward the required upgrade works by twelve years, with a bring forward responsibility to GPNL of 42% of the value of the works in 2007.

Condition 7.5

GPNL must provide DMR a contribution equivalent to 42% of the cost of upgrading the Hanson Road – Blain Drive – Alf O'Rourke Drive intersection to a dual circulating lane roundabout standard, in accordance with DMR's *'Road Planning and Design Manual'* before commencement of construction of the GNP.

Dawson Highway – Blain Drive intersection

Traffic associated with the GNP will trigger the requirement to upgrade the intersection of the Dawson Highway with Blain Drive and Herberton Street from a dual-circulating lane to a signalised dual-circulating lane roundabout standard by 2013. DMR has estimated that, without the GNP, this intersection would require an upgrade by 2018. Though metering (traffic lights) of only the western and northern legs would be required to cater for GNP traffic through to the design horizon, it is believed that signalisation works on all four legs could be undertaken soon, that is, prior to the commencement of GNP. A bring forward responsibility of 18% of the value of the works in 2007 has been calculated. However, GPNL will liaise with DMR to determine their exact contribution prior to the commencement of any construction.

Condition 7.6

GPNL must provide DMR a contribution equivalent to a maximum of 18% of the cost of upgrading the Dawson Highway – Blain Drive – Herberton Street to a signalised dual-circulating lane roundabout standard, in accordance with DMR's *'Road Planning and Design Manual'* before commencement of construction of the GNP. The exact contribution will be negotiated between GPNL and DMR prior to the commencement of any construction.

Bruce Highway – Koncina Road intersection


Road access to the RSF would be from the Bruce Highway at Koncina Road, with a new private road off Koncina Road. The RSF road – Koncina Road intersection would be approximately 600 m north-east of the Bruce Highway intersection. GPNL's RSF road would run approximately 1.3 km west and north-west from the Koncina Road intersection to the RSF. While road traffic generated by the day-to-day operation of the RSF would be relatively light, construction of the RSF, which would be conducted in phases over the life of the GNP, would require access by oversize vehicles carrying heavy plant and B-double materials haulage trucks.

DMR has advised that the Bruce Highway – Koncina Road intersection would need to be upgraded to a fully channelised intersection with appropriate lanes to safely accommodate turning B-double trucks in all relevant directions. GPNL would need to:

- meet the full cost of this intersection upgrade as well as the upgrade of the relevant section of Koncina Road to the intersection with the RSF private road
- consult with both DMR and the Gladstone Regional Council about the design and timing of the upgrades and obtain appropriate approvals for the works.

Recommendation 7.7

- (c) GPNL must obtain prior approval for the design and construction of the Koncina Road – Bruce Highway intersection from DMR under section 33 of the *Transport Infrastructure Act 1994*.

- 
- (d) The design of that intersection must be in accordance with DMR's '*Road Planning and Design Manual*' and be prepared in consultation with the Gladstone Regional Council.
 - (e) The construction of that intersection upgrade must be completed prior to the commencement of substantial construction works on the RSF.

Recommendation 7.8

- (a) GPNL must obtain prior approval from the Gladstone Regional Council for the design and construction of the Koncina Road – RSF Private Road intersection and the upgrade of Koncina Road between that intersection to the Bruce Highway.
- (b) The intersection and Koncina Road upgrade works must be in accordance with Gladstone Regional Council's requirements.
- (c) Those works must be completed prior to the commencement of substantial construction works on the RSF.

4.7.4.2 Infrastructure crossings of Hanson Road

The detailed designs of some infrastructure elements of the GNP crossing Hanson Road are not yet available. I accept that for a project of this scale and complexity, it is reasonable that detailed engineering designs be made available for approval prior to the commencement of construction rather than during the EIS process. I am satisfied that the information provided during this EIS process has been sufficient to assess the impacts of the road crossing proposals.

The GNP would require the following linear infrastructure items to cross Hanson Road at the north-east corner of the refinery site:

- the nickel ore and sulphur conveyor
- the preassembled module (PAM) corridor
- the seawater intake and waste water discharge pipelines underpass of Hanson Road.

Recommendation 7.9

- (a) GPNL must consult with DMR Central District office as early as possible in the detailed design stage of the GNP to:
 - (i) establish DMR's specific requirements for all linear infrastructure crossings of Hanson Rd and
 - (ii) obtain all necessary approvals under section 50 of the *Transport Infrastructure Act 1994* to carry out works on state-controlled roads, which involves certification of the designs of all structures by a registered professional engineer, and provision of a Road Use Management Plan (RMP) for the proposed conduct of the works.
- (b) Prior to the commencement of use of any item of linear infrastructure that crosses Hanson Road, GPNL must provide DMR with 'as constructed' plans of that item.

4.7.5 Other general road matters

While specific elements related to road impacts and proposed road upgrades around the refinery and RSF are discussed above, there remains a need to set a number of general conditions to cover road use by the GNP. These general conditions are especially required to cover the construction of the linear infrastructure elements of the GNP (e.g. pipelines, conveyors and rail and electricity connections) for which detailed engineering designs and detailed plant and materials transport logistics plans are not currently available.

I consider that GPNL should consult with the DMR Central District office, for state-controlled roads, and the Gladstone and/or Rockhampton Regional Council (depending upon location of the works), for local roads, as early as possible in the final design phase of the GNP to:

- provide precise details of intended usage of each road for the haulage of materials and equipment for the construction of the refinery, Residue Storage Facility (RSF), and all linear infrastructure of the GNP
- where necessary, identify any additional upgrades required to ensure that road infrastructure is of an adequate standard to support that construction haulage that are not identified elsewhere in this Report or provided in commitments made by GPNL
- adequately mitigate the impacts of this haulage through the implementation of agreed RMPs in accordance with DMR and Gladstone and/or Rockhampton Regional Council standards and policies, prior to commencement of each phase of construction of each component of the GNP.

Therefore, in order to ensure that road and traffic impacts are properly managed, I set the following conditions and recommendations to be attached to the MCU approval for the refinery:

Condition 7.10

Prior to commencement of any construction works on the Project, GPNL must:

- finalise the 'Pavement Impact Assessment' (PIA) in accordance with the Department of Main Roads' (DMR's) '*Guidelines for Assessment of Road Impacts of Development*' and
- pay DMR the contribution to mitigate pavement impacts identified in the PIA.

Condition 7.11

Prior to commencement of any construction works on the Project, GPNL must:

- prepare a 'Road Use Management Plan' (RMP) and a 'Road Impact Assessment' (RIA) for all use of state-controlled roads for each phase of construction of the Project that considers the standard of the road network, access conditions, hours of operation, dust control and safety, in accordance with the current requirements of the Department of Main Roads (DMR) and.
- submit the RMP and RIA for approval by the Manager of DMR's Central District Office.

Recommendation 7.12

Prior to commencement of any construction works on the Project, GPNL must, for construction involving permanent works within a state-controlled road reserve, obtain prior approval to undertake those works in accordance with section 50 of the *Transport Infrastructure Act 1994*, and upon completion of each phase of construction, submit 'as constructed plans' to the Central District Office of DMR.

Condition 7.13

Prior to commencement of any construction works on the Project, GPNL must:

- prepare a 'Road Use Management Plan' (RMP) and a 'Road Impact Assessment' (RIA) for all use of local roads for both the Rockhampton and Gladstone Regional Councils for each phase of construction of the Project that considers the standard of the local road network, access conditions, hours of operation, dust control and safety, in accordance with the current standards and policies of the relevant local government
- submit the RMP and RIA for approval by the relevant local government and
- upon completion of each phase of construction involving permanent works within a road corridor, submit 'as constructed plans' to the relevant local government.

4.8 General Residue Storage Facility site matters

4.8.1 RSF location and site details

It is proposed that residue from the refinery be piped to a Residue Storage Facility (RSF) located in the south-west corner of the Aldoga precinct of the GSDA, approximately 15 km south-west of the refinery site. A map of the RSF study area and the downstream catchment to the Calliope River is provided in Figure 3.

The south-west corner of area proposed for use by the RSF drains into Farmer Creek, and the south-east corner drains through an unnamed valley and into Six Mile Creek south of the RSF. No permanent freshwater systems are present within the RSF study area. Farmer Creek and Six Mile Creek flow through grazing land, under the Bruce Highway and join on the property 'Fairview' before discharging into the Calliope River. The Calliope River is the largest permanent freshwater system in the region.

The northern cadastral boundary of the RSF study area includes a very small area of the Police Creek catchment, which flows north-west into Larcom Creek. Larcom Creek flows into the Calliope River, more than ten kilometres north-west of the Farmer Creek junction. The Rio Tinto Yarwun Alumina Refinery 'red-mud' residue dams are also located within the Larcom Creek catchment. No surface waters or groundwater from the proposed RSF operation are expected to flow into this catchment.

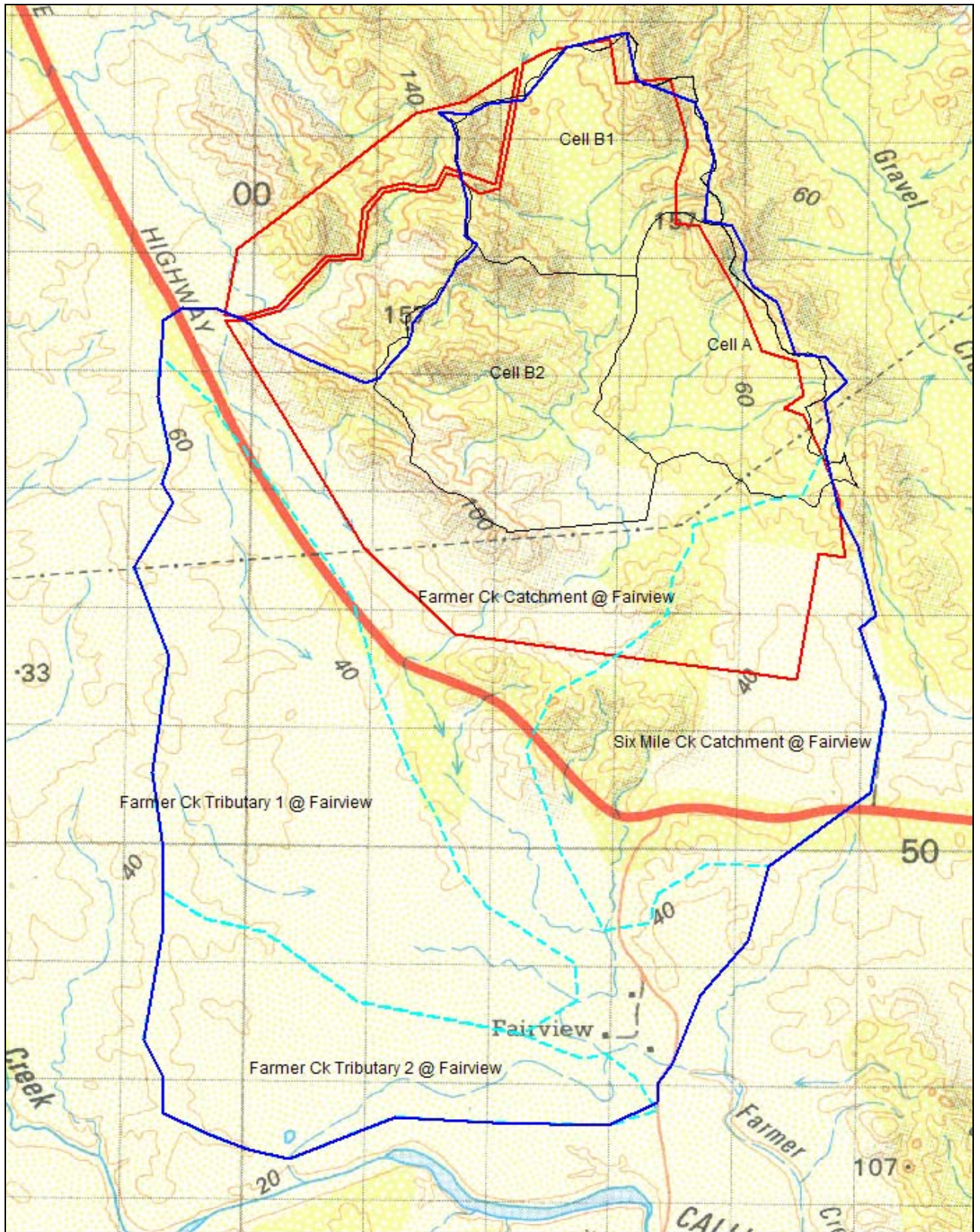
Gravel Creek drains the sub-catchment to the east of the RSF study area. It is proposed that a spillway on the east side of the RSF discharge some surface water into this sub-catchment as a result of vary rare rainfall events. Gravel Creek discharges into the Calliope River several kilometres downstream of the Farmer Creek junction.

Groundwater in the vicinity of the RSF site occurs mainly within bedding and fractures of the regional sedimentary bedrock units. There are some minor limestone intrusions into the RSF study area, but mapping the extent and precise nature of these intrusions would require a very intensive drilling program. The groundwater flow velocities calculated in the EIS range from 0.013 metres per year (m/y) to 1.3 m/y, not allowing for preferential flow pathways along rock fractures or faults.

While the potential for preferential flow pathways for bedrock aquifers cannot be completely discounted in the RSF study area, the rock formations are variably fractured, and the extent of high hydraulic conductivity fracture zones appears to be quite limited.

Alluvium layers within the RSF study area are not considered to support significant aquifers, because of their shallow depth, lack of thickness and discontinuity.

Figure 3. RSF study area and downstream catchment to the Calliope River



4.8.2 Characteristics and fate of RSF seepage

4.8.2.1 Characteristics of the residue and seepage water

The EIS documents describe that the nickel refinery residue will be placed onto the RSF site sub-aerially in thin layers as wet, viscous, silt-sized particles. GPNL predicts that:

- each thin layer of residue would compact as it dries and have a very low permeability
- although the dried surface residue would crack, temporarily increasing its permeability, subsequently deposited residue layers would seal these cracks.

Geochemical characterisation of the residue solid undertaken by GPNL predicts that:

- the residue would be non-acid forming
- the concentration of metals in the residue would be generally within applied environmental and health based investigation guideline levels for soils, although concentrations of chromium, manganese and nickel would be elevated above Queensland Environmental Investigation Levels (EILs) and NEPC Health Investigation Levels (HILs)
- although marginally sodic, it would be generally cohesive and unlikely to disperse.

Characterisation of the leachate derived from the residue solid undertaken by GPNL indicates that RSF seepage would:

- be moderately saline, with approximately double the salinity of local groundwater (measured as total dissolved solids (TDS))
- have elevated sulphate concentrations (double Australian and New Zealand Environment Conservation Council (ANZECC, 2000) livestock drinking water guideline levels)
- have magnesium levels about double local groundwater, calcium levels more than five times local groundwater (but about half the ANZECC livestock water guideline), and sodium levels about half of local groundwater
- as indicated by the major cation and anion analysis, the residue salts would probably be dominated by magnesium and calcium sulphates
- have concentrations of other metals that are generally low and comparable to or less than those metals concentrations in local groundwater, with the exception of:
 - manganese, which would be well above the ANZECC irrigation water guidelines for long-term irrigation (greater than 100 years), but below that guideline for short term irrigation (up to 20 years)
 - nickel and chromium, but these would be both below all applied guideline values for drinking water and livestock water
- have concentration of soluble metals within EPA hazardous dam acceptance criteria.

GPNL estimated that, although the liquor solution would contain concentrations of soluble chloride which exceed the hazardous dam acceptance criteria, the leachate from the residue solids would not exceed drinking water criteria or existing groundwater concentrations for chloride.

Conclusion

I conclude from this analysis that:

- there is potential for leachate from the RSF to raise salinity and calcium, magnesium and manganese sulphate levels in local surface and ground waters above a desirable level if movement of that water is not adequately controlled

- if managed correctly, those sulphate salts present a low risk of environmental or human health harm in their own right and offer a ready chemical marker for water monitoring and management around the proposed RSF.

4.8.2.2 Characteristics of other refinery wastes to be stored at the RSF

GPNL indicated in the EIS that it may also store relatively small quantities of three other nickel refinery waste products at the RSF. Following a request from EPA for further characterisation of these wastes, GPNL has provided the following additional information based on the use of mixed New Caledonian ores:

- Autoclave scale – this material would be of a very similar nature to the main process residue and would not represent any additional environmental risk to the RSF operations. The approximate quantity of these waste products will be 200 t/yr.
- Lime slaker grit – this material is basically silica quartz, an inert, non-hazardous material (sometimes used for road base). It will be coarse in nature (no fines) due to the screening of the lime. The quantities involved would be too small to alter the permeability or average chemical characteristics of the residue in storage. Approximate quantity depends on the quality of the lime and is approximately 8,600 t/yr.
- Zinc sulphide – This material may be sold for zinc recovery rather than deposited at the RSF. The quantity will be approximately 1,320 t/yr. If it is not on-sold, then it would be trucked to the RSF. In any case, it represents less than 1% of the quantity of solids passing to the RSF.

Conclusion

EPA has accepted that the placement of autoclave scale, lime slaker grit and zinc sulphide at the RSF would not significantly alter the management or performance of the RSF and no additional approval conditions need to be attached to the environmental authorities for the RSF to account for the placement of those waste products at the RSF. I concur with this assessment.

4.8.2.3 Characteristics of groundwater movement at the RSF study area

The EIS documents predict the following behaviour of the residue leachate seepage at the RSF:

- the majority of the seepage would occur through the base of the RSF into the bedrock aquifer
- the rate of seepage would slowly increase annually as the depth of residue (and driving head) in the RSF increases, and during this time the seepage to the alluvial aquifer would be minimal
- once residue deposition ceases and the top of the RSF is covered with a low permeability layer, the seepage rate to the bedrock aquifer would reduce as the phreatic surface (the interface between the saturated and unsaturated zones) in the RSF slowly drops
- post closure, there would be an initial increase in seepage to the alluvial aquifer as the phreatic surface moves towards the intercept trenches, but this would gradually reduce over time as the volume of water stored in the RSF reduces
- assuming the maximum calculated travel time for groundwater in the bedrock of 9.9 m/y and a minimum distance of 5 km to the Calliope River (assuming that the bedrock aquifer flows towards the river, the aquifer is continuous, and that the Calliope River is a gaining river at this location), it would take approximately 500 years for any RSF water seeping through the bedrock aquifer to reach the river (although this time would be reduced if sufficiently connected preferential flow paths exist via fault or fractures in the bedrock)
- in the unlikely event that seepage was to occur through the alluvium for the length of Farmer Creek, the travel time to the Calliope River would be:

- in the order of 500 years if the alluvium is consistently like that at monitoring bore RSF17 shown on Figure 9.1 of the SEIS (silty sand and sandy clay)
- an order of magnitude or two shorter if the alluvium is consistently like that at monitoring bore RSF13 (sorted sandy and gravely alluvium).

EPA and the Department of Natural Resources and Water (NRW) have both indicated that the seepage rates and the movement of that seepage in the groundwater may be higher than estimated by GPNL.

Other RSF issues raised by EPA following the release of the SEIS include:

- the source of rehabilitation cover material to ensure the 1.7 metres coverage of all storage cells proposed by GPNL
- the need to identify further details in relation to the:
 - precise location of the groundwater monitoring bores
 - nature of the monitoring, reporting and management program for those bores
 - the potential contribution of the process liquor storage to head pressure and therefore seepage rates.

Conclusion

I conclude from this analysis that, seepage of residue leachate into groundwater at the proposed RSF site would be limited, and the rate of groundwater movement of that seepage water is likely to be very low. However, there is enough variability in the characteristics of the underlying bedrock and alluvium to necessitate that a comprehensive groundwater monitoring and management system be implemented that is aimed at detecting and preventing any potentially contaminated seepage water spreading beyond the RSF.

4.8.2.4 Proposed seepage water management system

GPNL proposes a RSF seepage management system described in the SEIS to ensure that there will be no surface expression of seepage down-gradient of the RSF. This system may be summarised as incorporating:

- a cut-off trench within the foundation along the alignment of the containment embankments to the depth of the bedrock
- a collection system to intercept any seepage that does occur through or under the embankments and to return the seepage to the RSF impoundment
- in areas where shallow, hard bedrock is encountered, the collection trench would be replaced with extraction wells if required
- a network of alluvial and bedrock aquifer monitoring bores to be positioned at strategic locations around the downstream perimeter of the RSF approximately 100 m from the toe of the embankments, which could also be used as recovery bores to collect seepage and return it to the RSF
- at closure of each RSF cell, construction of a low permeability cover across the surface; which would decrease the amount of future source water available to seep through the RSF.

Improvements to the proposed RSF water management systems agreed by GPNL as a consequence of post SEIS interaction with EPA include:

- maintaining the seepage collection and management system until it can be demonstrated that seepage has stopped, rather than just for 25 years as originally proposed
- construction of the seepage collection trench to a depth beyond the bottom of the alluvium, rather than simply to 5 m depth as originally proposed
- agreement on the principles guiding the location, number and depth of the monitoring bores, including:

- alluvial bores to the full depth at each aquifer that intersects each of the cells
- bedrock monitoring bores which intersect the Mount Alma Formation and Rockhampton Group aquifers in areas of preferential groundwater flow to the depth of the first water bearing zone or 50 m depth, whichever is the lesser
- initiation of the monitoring program prior to the operational phase and continued for the life of the RSF and after closure until all impacts have been mitigated
- use of the pre-operational phase monitoring to further characterise the natural variability in the groundwater system and to establish trigger levels of key parameters
- quarterly analysis of groundwater samples for the following constituents:
 - water level
 - pH, electrical conductivity and TDS
 - the dissolved metals – arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, vanadium and zinc
 - the major ions – sodium, magnesium, calcium, potassium, chloride, sulphate, fluoride and bicarbonate
- an annual review of the monitoring program to evaluate the effectiveness of each monitoring location to assess where new locations and modifications to the monitoring program may be needed, and to evaluate what impacts may be occurring
- conduct of a special monitoring round in the event of a significant environmental incident.

Conclusion


With respect to the proposed water management system at the RSF, I conclude that, notwithstanding the conclusion drawn below in Section 4.8.3 of this Report regarding a potential Castlehope Dam, the general seepage water management system proposed by GPNL appears capable of detecting and, if necessary, preventing unacceptable down-gradient contamination of surface water or groundwater. This management system, together with the environmental authority conditions provided in Schedule A3 for the RSF, especially for the environmentally relevant activity (ERA) 75(b) – Waste Disposal, under the *Environmental Protection Regulation 1998*, are sufficient to protect against environmental harm from the construction and operation of the RSF for at least the first three planned cells (A, B1 and B2).

4.8.3 Implications for the RSF of a potential Castlehope Dam on the Calliope River

As part of its responsibilities for the planning of the long-term water supplies in regional Queensland, the NRW has identified a number of long term future potential water storage locations.

In the Gladstone region, one such potential future water storage location is referred to as the Castlehope Dam on the Calliope River. The most likely site of the impoundment wall for this Dam is approximately 7–8 km south of GPNL's proposed RSF. The Queensland Government does not intend to proceed with the development of the Castlehope Dam in the foreseeable future. Nonetheless, NRW's long term scenario planning for future water supply to Gladstone identifies Castlehope as one of several potential options that could be pursued in future decades.

Planning by the Gladstone Area Water Board (GAWB) has identified a water pipeline from the Fitzroy River, desalination and further raising of Awoonga Dam as the most likely future supply enhancement options to be considered for Gladstone over the next 5–30 years. Despite GAWB's analysis, at the present time, NRW cannot categorically rule out ever pursuing a Castlehope Dam option. Therefore, impact assessment for the GNP must consider any potential interaction between the RSF and such a future dam.



Investigation of the potential interaction of the Gladstone Nickel Project and a potential Castlehope Dam did not commence until NRW raised the matter following its review of the EIS.

A larger dam size option (maximum 35 m full supply level (FSL)) would inundate the Bruce Highway and land to the north of the Highway, potentially conflicting with the effective and efficient use of the southern portion of the RSF area between the first three storage cells and the 'Lot 4 Boundary' on the southern edge of the proposed RSF). Possible realignment of the Bruce Highway above the 35 m FSL would further restrict the RSF area available to GPNL.

Potential problems arising from that inundation include:

- the maximum utilisation of the RSF site is required by GPNL to ensure sufficient capacity for residue volumes for at least 20 years if Stage 2 of the Project proceeds (the RSF capacity issue is discussed in greater detail in Section 4.8.4 of this Report)
- unacceptable interference with:
 - the structural integrity of any RSF retention structures
 - any buffer zone required below the retention structures for environmental controls and monitoring.

A brief, unpublished, pre-feasibility study undertaken by NRW in early 2008 indicated that a 'saddle dam' constructed near to the current location of the Bruce Highway as a means of ensuring appropriate separation of Castlehope Dam water from the Bruce Highway and the RSF may be viable. However, NRW is concerned that this could restrict water between the saddle dam and the RSF during larger flood events.

GPNL has agreed that, before any residue storage cell is constructed in the 'Lot 4 Boundary' area, approval must be obtained from both EPA and NRW to the proposed design and location within this area. Once the initial first and/or second cells become operational, better knowledge will be available about leachate characteristics, seepage volumes and groundwater transport rates down-gradient of the RSF.

A delayed consideration of approval of a fourth residue storage cell means that the capacity of the RSF to support commencement of Stage 2 of the Project cannot be currently guaranteed. The implications of this are discussed in more detail below in Section 4.8.4 of this Report.

Conclusion

I conclude that, although:

- there is considerable uncertainty about whether Castlehope Dam will ever be built
- any longer term future decision to build a dam would need to take into account the realities of existing land uses and infrastructure at that time
- based on the discussion in sections 4.8.1–4.8.2 above, any down-gradient contamination of surface water or groundwater arising from the RSF appears to be extremely unlikely,

it would nonetheless be prudent to consider the future possibility of a Castlehope Dam in planning for the RSF. Such planning should, if possible, provide for the:

- location of all necessary RSF water management systems within the 'Lot 4 Boundary' area
- adequate management of surface water flows during storm and flood events in the area between the RSF facilities and either Castlehope Dam impoundment waters or other dam structures built to limit inundation towards the RSF area.

Consequently, I support the view that no approval be issued for the use of the 'Lot 4 Boundary' area south of the RSF-A and B2 cells for residue storage until EPA has reviewed the early operational performance of the RSF.

4.8.4 RSF capacity considerations

The original EIS outlined plans for a single cell RSF with a total storage capacity of twenty five years. The residue at the RSF was to be contained behind a series of embankments placed between areas of high ground forming the valley in which the RSF is located.

Review of the proposed single-cell design of the RSF facility was undertaken for the SEIS. A multi-cell, compartmentalised design is now proposed to replace the initial larger single-cell design. This design has also been influenced by the potential future possibility of a Castlehope Dam (refer to Section 4.8.3 of this Report). The concept design includes three cells (A, B1 and B2 – refer Figure 2.4 of the SEIS) which will occupy a smaller area than the previous single-cell design.

The revised design has included improvements to construction design, spillway location, seepage monitoring and management. The new design provides benefits of practicality and long term sustainability as it will:

- reduce construction earthworks by approximately 33%, which will reduce traffic associated with construction
- reduce the spatial extent of the catchment area taken up by the RSF and the extent of vegetation clearing at any one time
- provide protection from overflows in almost all scenarios with a probability of one event in every 500 to 1000 years
- facilitate earlier progressive rehabilitation
- enable the results of early RSF performance monitoring to be used to improve design and management procedures for future stages.

The filling strategy proposed for the increased production rate includes filling multiple cells at once to allow sufficient time for residue settlement and consolidation to enable upstream rises to be established.

The residue generation rate reported in the EIS was 5.4 million dry tonnes per year (Mdt/y) for Stage 1 production, increasing to 10.8 Mdt/y for Stage 2 production. However, due mainly to the refinery's increased acid generation and limestone consumption, the residue production rate reported in the SEIS has increased by 30% to 7.05 Mdt/y for Stage 1, rising to 14.1 Mdt/y for Stage 2 by 2015. The capacity of the currently proposed smaller multi-cell design is roughly 129 Mdt, or 132 million cubic metres (Mm³) based on a residue dry density of 0.98 t/m³ which is the final density in cell and is used for calculating final volumes. Consolidation occurs quite rapidly after deposition and the time to reach final density can be reduced by mud farming (50 days in winter and 90 days in summer). The total 20 and 25 year production is expected to be approximately 244 and 314 Mdt respectively.

Given the increased rate of production of residue and the smaller initial area now proposed for the RSF compared to the original EIS, the total capacity of the RSF would be reached within approximately twelve years if Stage 2 of the refinery commenced at the earliest possible opportunity (2015) and the refinery operated at full capacity for that twelve year period. If Stage 2 of the GNP does not proceed, then by GPNL's estimates, there is sufficient capacity in RSF cells A, B1 and B2 for almost 20 years of operation at near full refinery production capacity.

The SEIS states that GPN's strategy for residue storage beyond twelve years is to establish further RSF cells in the existing land area know as the 'Lot 4 Boundary', which is south of cells A, B1 and B2 (refer to Figure 9.7 of the SEIS). Investigations undertaken by GPNL have indicated that this area may be capable of storing an additional 117 Mdt, which is enough for an further 9 years of Stage 2 operation.

Conclusion

I concluded in Section 4.8.3 above that the southern area of 'Lot 4 Boundary' land area should not be approved for residue storage until EPA and NRW have reviewed the

operational performance monitoring data for the RSF. I further consider that, for a minerals processing project of this type and scale, solid waste storage arrangements should be secured for at least 20 years.

The southern area of the 'Lot 4 Boundary Area' likely has enough capacity for Stage 1 and a phased Stage 2 for approximately 19 years of Project operation (including the use of cells A, B1 and B2). A design for the increased storage area requires approval from the EPA and NRW before proceeding. If the use of this area is unacceptable due to the potential future presence of Castlehope Dam high water levels, then an alternative area (or areas) will have to be identified within the GSDA, investigated, approved and constructed to accept residue as of year 12 of production.

If analysis of RSF performance by EPA indicates that the 'Lot 4 Boundary' area cannot be utilised for residue storage, then DIP will work proactively with GPNL within an appropriate timeframe to identify another suitable storage site of at least similar volumetric capacity to the conceptual fourth cell at the current RSF site.

If the EPA concludes that GPNL's use of the southern area of the Lot 4 boundary for residue storage is not acceptable, then DIP will work proactively with GPNL, within an appropriate timeframe, to identify another suitable storage site of at least similar volumetric capacity to the conceptual fourth cell at the current RSF site.

Condition 8.1

- (a) Stage 2 of the Project cannot commence until sufficient residue storage capacity for a minimum 20 years operation of the nickel refinery has been secured.
- (b) Use of the RSF site between storage cells 'RSF-A' and the 'Lot 4 Boundary' (both defined in Figure 9.7 of the SEIS) for the storage of refinery residue is subject to the approval of the EPA following review of all relevant RSF operational and groundwater monitoring data for at least the first two years of operation of the RSF.
- (c) If sufficient additional residue storage capacity on the RSF site cannot be approved by the EPA, then an alternative suitable storage site of sufficient capacity will be required.

4.8.5 Potential reduction of water yield at Fairview

The owner of the Fairview property holds licences to draw water from both the Calliope River and Farmer Creek. The Farmer Creek water licence is for 120 megalitres per year (ML/y) (Licence 37290U) (Calliope River Basin, Resource Operations Plan, NRW, May 2008). The owner of Fairview has submitted that the RSF will have a large negative impact upon both the quality and quantity of water available for harvest from Farmer Creek.

In accordance with my conclusion in Section 4.8.2.4 above, I consider that the probability of contamination of surface or groundwater at Fairview is very low. However, there is a high likelihood that the RSF will have a modest impact on flows in Farmer Creek.

As each RSF cell is constructed, it will remove a portion of the Farmer and Six Mile Creek catchments which would reduce Farmer Creek flows at Fairview. This loss of catchment area would last for the operational life of each cell. The SEIS indicates that current designs for RSF cells A, B1 and B2 would result in approximately 20% of the total catchment area of Farmer Creek and Six Mile Creek at Fairview being withdrawn.

Once the cells are full, GPNL intends to cover and rehabilitate them and allow surface runoff to discharge. For storage cells B1 and B2, which represent about 14% of the Farmer Creek catchment area at Fairview, this runoff would be returned back into Farmer Creek, thus restoring this portion of the pre-RSF flows. As GPNL proposes to discharge overland flow of the rehabilitated RSF-A over the spillway into the adjacent Gravel Creek catchment, the 6% of catchment area represented by that cell would not be returned to Farmer Creek or Six Mile Creek. The quantification of this potential impact could only be achieved through a detailed investigation of the downstream landholder's water storage and management regime.

As discussed in sections 4.8.3 and 4.8.4 above, use of the land between RSF-A and the 'Lot 4 Boundary' for residue storage, is still subject to further analysis and future approvals. A fourth storage cell in that area may reduce the catchment flowing into Farmer Creek at

Fairview by an additional 11%. Planning for a possible fourth cell in this area will need to provide a precise estimate of this catchment reduction.

I note that:

- GPNL is in discussions with the landholder to arrive at a mutually acceptable outcome. However as a minimum, GPNL commits to providing compensation for any water shortfall (up to 100% of the licenced offtake of 120 ML per year) experienced as a result of GPNL's upstream influence on the water catchment. The quality of water linked to this provision should be appropriate to the planned use of the water currently described as "agricultural" in the Water Resource Operations Plan for the Calliope River Basin (May 2008).
- If Castlehope Dam is ever built in the location currently forecast by NRW, then the storage water would inundate most of the Fairview property.

Conclusion

I conclude that the conditions provided by EPA for ERA required for the RSF (Schedule A3), and the measures described above, will ensure that the GNP will not contaminate surface water or groundwater at Fairview. However, the Project will reduce water flows in Farmer Creek and GPNL will need to enter into a compensation agreement, as discussed above.

In accordance with s.39(1)(a) of the SDPWO Act, the water compensation agreement is described in Condition 8.2 below. That condition attaches to any MCU approval issued for the RSF. As the RSF is located on GSDA land, in accordance with s.39(6)(a) of the SDPWO Act, I nominate the entity responsible for management of the GSDA as having jurisdiction for this condition. At the time of this Report, that entity is the Coordinator-General.


Condition 8.2

- (a) Within six months of commencement of construction of the RSF, GPNL must provide a system of delivery and storage of water to the Fairview property.
- (b) Unless otherwise agreed by both GPNL and the owner of Fairview, the physical point of accessibility of that water on the Fairview property should be near to that currently available under water licence 37290U.
- (c) The quality of water provided by GPNL should at least meet cattle livestock drinking water standards as defined by the Australian and New Zealand Environment Conservation Council (ANZECC) in 2000.
- (d) The quantity of water delivered annually should be the shortfall up to a maximum of the existing Fairview water licence harvest volume.
- (e) The provision of water by GPNL to Fairview should continue until the area of rehabilitated land contributing to the Farmer Creek catchment at Fairview is returned to at least 95% of the pre-RSF level.
- (f) This water compensation requirement may be terminated if:
 - (i) both GPNL and the holder of Fairview Farmer Creek water harvesting licence reach a mutually agreed alternative arrangement or
 - (ii) the Fairview property at the junction of Farmer Creek and the Calliope River becomes inundated by the construction of an impoundment on the Calliope River.

4.9 Other refinery site matters

4.9.1 Powerlines

The refinery site presently has a number of high-voltage transmission lines that traverse it. Before any construction that could interfere with the powerlines can commence, it is necessary that these powerlines are removed from the site and relocated along an alignment



that is satisfactory to DIP and approved by Powerlink. Therefore I state the following condition to be attached to the MCU approval for the refinery:

Condition 9.1

GPNL must obtain approval from Powerlink and enter into a contract with Powerlink for the re-siting of all high-voltage transmission lines that currently traverse the refinery site.

4.9.2 Drainage

The terrain of the refinery site comprises mainly a gently undulating and inclined colluvial/alluvial outwash plain which has a general surface elevation of approximately RL 20 m descending to below RL 5 m AHD with an overall surface slope (1–3%) in an east-north-east direction towards Hanson Road. A dominant hill with an elevation of about RL 70 m AHD occurs in the south-west corner of the site and GPNL proposes to use material from this hill as fill over some of the lower parts of the site. Near-level alluvial plains occur in the eastern sector of the site adjacent to the Calliope River.

Drainage within the site is ill-defined, reflecting generally low surface runoff conditions and high infiltration rates within the surface and upper soil layers.

The refinery site is in the Calliope River catchment. The site is adjacent to the main channel and anabranch of the Calliope River at the river mouth before it flows into Port Curtis. Refinery infrastructure will be located at its closest between 300–500 m from a sharp meander of the river.


Stockpile areas for sulphur and imported ore will be constructed to the east of the main refinery site. These will be contained within hardstand areas and connected via open channel drains to dedicated retention (settlement) ponds. The pastille/prill sulphur product stored in the stockpiles will be quality controlled to ensure minimal dust content. This will reduce the potential for mobilisation of particulates in runoff from this stockpile.

The principal water quality risk associated with runoff from sulphur stockpiles will be the potential impact on pH of the stormwater collecting in the ponds. Runoff from the imported-ore stockpile could contain contaminants including suspended solids and minor concentrations of heavy metals.

GPNL has indicated that all runoff from the sulphur stockpile will be collected and screened before passing to settlement ponds and subsequently re-used as make-up process water in the refinery. The imported-ore stockpile runoff will also be collected in a dedicated settlement pond and will be re-used in the refinery. The design of ponds for all stockpiles will be to contain all runoff from a 5-minute, 100-year ARI rainfall intensity storm and with sufficient volume to contain the equivalent of a 12 hour 100-year event storm (approximately 320 mm rainfall).

In the event of a storm greater than the design standard of 1-in-100 years, the stockpile ponds will overflow. However, most of the contamination and sediment from the stockpiles will be in the initial runoff and will flow into and be retained within the ponds. Subsequent runoff, which will overflow once the ponds are full, is likely to be less contaminated. Furthermore, during a rainfall event that could lead to such an uncontrolled discharge, the intensity of rainfall falling on land around the refinery would be of a similar magnitude and would provide significant dilution of the overflow waters from the stockpile ponds. In such a rare extreme rainfall event, the overflows from the ponds would be unlikely to constitute a significant environmental risk.

Prior to amalgamation, Gladstone City Council and Calliope Shire Council both expressed concern about flood risks on the refinery site, especially associated with banded ore storage areas. They requested that an approval condition be that the stockpile areas be appropriately sealed and banded to minimise any water quality impacts arising from a 1-in-100 flood event. I consider that all stormwater management issues have been adequately covered by conditions C4 – C7 of (sub)Schedule C in Schedule A2 of this Report.



The Gladstone City Council submission also expressed concern about ponding on site and the consequential risk of forming breeding grounds for mosquitoes and other biting insects. Therefore I state the following condition to be attached to the MCU approval for the refinery:

Condition 9.2

GPNL must consult with Gladstone Regional Council during the detailed design phase regarding the design of the drainage and stormwater management systems. A management plan should be prepared and submitted to Council detailing the design, construction and operational measures that will be put in place to prevent ponding of water that could form a breeding ground for mosquitoes and other biting insects.

4.9.3 Visual impacts

Section 10.13.10 of the EIS concluded that the overall visual impact of the refinery would be low to medium. Nonetheless, GPNL stated that it would initiate a number of measures to further limit that impact. Gladstone City Council requested that specific mitigation measures be put in place as a condition of approval that emphasise screening of the refinery from Hanson Road. Therefore I state the following condition to be attached to the MCU approval for the refinery:

Condition 9.3

The mitigation measures in Section 10.13.10 of the EIS aimed at screening of the plant from Hanson Road must be fully implemented within twelve months of commencement of operation of the refinery.

4.9.4 Waste management

Section 4.10 of the EIS noted that the Gladstone City Council Waste Transfer Station will be utilised for construction and operational wastes (both recyclable and land filled waste). Overall quantities of waste streams are outlined in Section 4.7.1 of the EIS.

The Gladstone City Council expressed concern about the volume of waste from the GNP that is likely to pass through its Waste Transfer Station. The Council advised that during other large construction projects in the region, the Transfer Station has operated at maximum capacity and the ability of the service to manage increased volumes is of concern. The Council is supportive of proactive waste management measures being employed to reduce the impacts on the transfer station capacity and landfill capacity and life.

Section 4 of the EIS states that a Waste Management Plan will be prepared for the construction and operation of the Project. Gladstone City Council requested that this plan be submitted to Council.


Therefore I state the following condition to be attached to the MCU approval for the refinery:

Condition 9.4

- (a) GPNL must prepare a Waste Management Plan for the construction and operation of the Project, and this plan must be submitted to the Gladstone Regional Council for review prior to the commencement of construction.
- (b) The Waste Management Plan must document the intended use of the Gladstone Regional Council waste facilities.

4.9.5 PAM transport

GPNL is currently pursuing an option of a preassembled modules (PAMs) facility at Fisherman's Landing and a PAM corridor from there to the refinery (Figure 2.7 in the SEIS). My further consideration of the PAM strategy, with respect to its impact on construction employment numbers, is presented in section 4.11.2.2 of this Report.



The PAM corridor route would cross Hanson Road at one place, just east of the Gladstone Area Water Board (GAWB) Reid Road waste water treatment plant (refer to Figure 2.7 of the SEIS).

The PAM corridor also traverses the DIP-controlled GSDA and GPCL-controlled Strategic Port Land. Existing infrastructure interests intersected by the proposed PAM corridor include:

- Gladstone Regional Council (local roads)
- Ergon Energy (electricity distribution)
- Powerlink (electricity transmission)
- QT and QR Network Access (rail line to Cement Australia)
- Telstra and other telecommunications providers
- GAWB (water infrastructure)
- Cement Australia (cement plant and rail line)
- Rio Tinto (pipelines and conveyors)
- Orica (ammonia gas pipeline and ammonia tank)
- DPI&F (crossing of Boat Creek)
- DIP (GSDA management and infrastructure coordination)
- GPCL (Strategic Port Land).

Other potential direct interest in the PAM route that may arise from other (currently known) projects proposed in the area may include:

- QER Ltd (shale oil demonstration project)
- the various and rapidly evolving LNG proposals in Gladstone, especially at Fisherman's Landing.

In addition to DMR, GPNL will need to submit its detailed engineering designs to DIP and GPCL for approval, following demonstrated consultation with each of these entities. Therefore, in order that the potential impacts of the construction and operation of the PAM corridor can be properly managed, the following condition must be attached to the MCU approval for the refinery.

Condition 9.5

- (a) GPNL must consult with all relevant entities listed in Section 4.9.5 of this Report as early as possible in the detailed design stage for the preassembled module (PAM) corridor to:
- (i) establish each entity's specific requirements for the PAM corridor
 - (ii) obtain all necessary approvals from the Chief Executive of the Department of Main Roads (DMR) under sections 50 and 62 of the *Transport Infrastructure Act 1994* to carry out works on state-controlled roads, which involves certification of the designs of all structures by a registered professional engineer, and provision of a Road Use Management Plan for the proposed conduct of the works
 - (iii) obtain material change of use development approval from the Coordinator-General (for the Gladstone State Development Area land) and Gladstone Ports Corporation Limited (GPCL) approval (for Strategic Port Land).
- (b) Prior to the commencement of use of the PAM corridor, GPNL must provide DMR, the DIP and GPCL with 'as constructed' plans.

In order that the impacts of constructing a PAM corridor are adequately managed, I state the following conditions to be attached to the MCU approval for the refinery on GSDA land and to be adopted by GPCL on Strategic Port Land:

Condition 9.6

- (a) GPNL must undertake a cumulative risk assessment of the potential PAM facility at Fisherman's Landing in full consultation with all of the existing and proposed relevant users of the Fisherman's Landing facility, including, but not limited to the entities listed in 4.9.5 of this Report.
- (b) The methodology to be followed for the risk assessment is to be agreed by Gladstone Ports Corporation Limited, the CHEM Unit of the Department of Emergency Services, and the Department of Infrastructure and Planning.

4.9.6 Groundwater effects of the East End Mine

The East End Mine Action Group (EEMAG) made both submissions during the EIS process and several separate representations to Department of Infrastructure and Planning staff on the effects of the East End limestone Mine on water table levels in the surrounding vicinity of that Mine. EEMAG has been asserting for many years that the dewatering of the Mine is adversely affecting the water table and the availability of bore water over a large area around the East End Mine. EEMAG has sought to relate my assessment of the EIS for the GNP to the groundwater issue around the East End Mine.

The East End Mine is currently owned and operated by Cement Australia. At the time of writing this Report, GPNL has not entered into any agreement with Cement Australia to source limestone from this mine for the refinery. Despite the large size and relative proximity of the East End Mine to the refinery, GPNL has a range of other apparently feasible options for limestone to the Project.

The broader issue of transport of limestone to the refinery is discussed in section 4.7.2.2 of this Report. In that section I noted that, if limestone was transported from the East End Mine to the GNP refinery, and if a slurry pipeline was used, then it would be preferable that such an operation did not result in any net removal of water from that Mine. However, such an option is not currently part of the GNP, so I cannot provide a condition or recommendation on that matter.

General conclusion for the refinery site

I consider that the general impacts of the construction and operation of the refinery for the GNP can be adequately mitigated with the application of:


- the conditions recommended in this section and elsewhere in this Report
- the conditions in Schedule A4 of this Report provided by the EPA that must be attached to environmental authorities for ERAs at the refinery.

4.10 Other pipeline site matters

The GNP pipelines are:

- the nickel ore slurry pipeline from the mine at Coorumburra near Marlborough to the refinery at Yarwun
- the residue pipeline from the refinery to the RSF at Aldoga and the parallel return liquor pipeline from the RSF to the refinery
- the seawater intake pipeline from the proposed Wiggins Island Wharf structure to the refinery
- the wastewater discharge pipeline from the refinery to the dilution pit on the western side of the R.G. Tanna Coal Terminal and from the dilution pit to the discharge point at Clinton Wharf (refer to Figure 1 in section 4.2.5 of this Report)
- the acid pipeline from the refinery parallel to PAM corridor to Fisherman's Landing.

Detailed field investigations were completed during the preparation of the EIS and an assessment made of the potential impacts. Mitigation measures have been proposed by



GPNL to minimise identified potential environmental impacts which would be incorporated into the planning, construction and operational phases of the Project. Other than flora and fauna matters (section 4.4.3 of this Report) and acid sulfate soils matters (section 4.5 of this Report), the main potential impacts of the pipelines identified during the EIS process were:

- increased flooding and erosion effects, especially associated with topsoil loss and disturbance and the resultant reduction in the quality of nearby surface water and groundwater
- disturbance and loss of good quality agricultural land
- disturbance to watercourses.

The proposed pipeline routes generally traverse open country consisting of undeveloped or broadly farmed areas that are sparsely populated. Areas of most concern include:

- wetlands and flood prone areas, where pipeline exposure may occur
- pipeline crossings of roads, tracks, rivers, creeks, rail lines, electricity easements, water main easement, and gas pipelines, where the Project pipelines are not buried
- industrial areas within the GSDA where there is the potential for third party contact with the pipelines.

Activities or events that have the potential to impact on the integrity of the pipeline if appropriate risk controls are not in place include:

- exposure to tidal wetlands causing corrosion to the pipeline, where tidal influences may cause erosion and subsequent resultant forces on the pipelines
- rivers exposing the pipeline and causing external corrosion and possible floatation
- erosion of river/creek beds
- maintenance activities on roads rail lines, power lines, buried services, fences and drainage ditches
- earth movement caused by heavy vehicles and trains on roads and rail lines
- induced currents in the pipeline arising from close proximity to high voltage power lines or electrified rail lines causing the anti-corrosion cathodic protection of pipelines to fail.

No high level environmental risks of the construction and operation of the pipelines were identified in the EIS. I am satisfied that, with the adoption of the conditions provided by EPA that must be attached to the environmental authorities for ERAs associated with the pipelines in Schedules A4 and C3 of this Report, the medium and lower level environmental risks associated with the GNP pipelines can be adequately managed.

GPNL proposes to design the pipelines in accordance with the relevant sections of AS 2885 Pipelines – Gas and Liquid Petroleum. This should ensure pipeline integrity equivalent to a natural gas pipeline. The specific control measures will be determined during the detailed design phase of the Project. GPNL has committed to complete further detailed risk assessments of all proposed pipelines as part of its detailed pipeline design processes.

The spread of weeds is always a matter requiring special attention during the construction and operation of any linear infrastructure. The Gladstone City Council expressed concern about potential weed spread during the construction of the various Project pipelines and requested that a management plan to control and limit the spread of weeds be put in place prior to the commencement of construction.

During the EIS process Queensland Rail expressed concern about pipelines been laid close to and in parallel to electrified rail corridors and also the installation of pipelines under rail lines using under-boring techniques. Pipelines that are installed in parallel to electrified rail corridors may need cathodic production in order to avoid any induced current occurring in the pipes.

Conclusion

I am satisfied from the material presented in the EIS and SEIS that the risks associated with the construction and operation of the pipelines are at the low end of the risk spectrum. I find that during the construction of the pipeline the impacts would be temporary in nature only for the duration of the construction program.

Therefore I recommend that GPNL consult with the the Environmental Protection Agency (EPA), Department of Natural Resources and Water (NRW), Department of Main Roads (DMR), Queensland Rail (QR), the relevant local government and the Gladstone Ports Corporation Ltd (GPCL) during the detail design phase of the pipelines in order that satisfactory risk assessments are undertaken and that relevant control measures be implemented prior to the commencement of construction.

In addition to the conditions, provided by the EPA, in Schedule A5 to be attached to the mining lease for the nickel ore slurry pipeline and in Schedules A1 and A2 for the other pipelines connected to the refinery, I require the following two conditions also be attached to those approvals:

Condition 10.1

GPNL must prepare a Weed Management Plan for each pipeline in consultation with the relevant weed management officers of the Department of Primary Industries and Fisheries and the Gladstone Regional Council or Rockhampton Regional Council.

Condition 10.2

- (a) GPNL must consult with Queensland Rail and Powerlink on the design parameters for pipeline rail crossing under-boring and crossing of high voltage power line corridors.
- (b) GPNL must implement the measures agreed by Queensland Rail and Powerlink to ensure safe and effective preservation of the integrity of rail infrastructure and the cathodic protection of each pipeline.

4.11 Socio-economic impacts


Potential social and economic impacts of the GNP may arise from both its construction and operation. Matters examined during the EIS process that have received submissions mostly relate to:

- construction worker accommodation
- impacts on local businesses
- ongoing impacts on the accommodation and social services in the Gladstone and Rockhampton Regions arising from the population increase associated with the direct and indirect operational workforce of the GNP.

The EIS used the Queensland Government's 'Gladstone Growth Management Initiative Model (2002)', to predict indirect or flow-on employment effects associated with large projects in Gladstone. Several submissions on the EIS questioned both the currency and some of the assumptions applied to the model, particularly the proportion of the workforce that would be recruited locally (44% at the peak of construction of Stage 1, rising to 56% after completion of construction of Stage 1).

With respect to the methodology used in the EIS to assess employment and other social impacts of the GNP, I consider that:

- while the updated data presented in the SEIS (e.g. drawing on the 2006 census rather than 2001 census) may change some of the details of the social impacts
- recruitment to the GNP from local sources would increase the likelihood that other local businesses would then subsequently recruit from outside of the region, so the population inflow effect of the GNP stated in the EIS may be conservative,



the general methodology of the analysis is nonetheless broadly acceptable; and the results of the analysis are suitable for me to draw my conclusions and recommend mitigation measures about the social impacts of the Project on the Gladstone Region.

4.11.1 Construction worker accommodation

4.11.1.1 Need for construction worker accommodation

The main construction period for each stage of the GNP could span just over two years and may extend to up to three years. Based on a construction methodology that does not use importation of preassembled modules (PAMs), it is expected that the construction of Stage 1 of the GNP would involve a workforce peaking at approximately 2,600 during the middle six-months. After this peak, construction numbers would steadily decrease. For Stage 2 of the GNP, the construction workforce would peak at approximately 1,750 persons. GPNL estimates that the peak construction workforce would reduce to 2,000 if it pursues a PAM construction strategy. Further discussion of the PAM option is provided in section 4.11.2.2 below.

Estimates provided in the EIS (Table 10.5.3) were that additional indirect employment generated by the GNP would peak at about 750 for Stage 1 of the Project and 850 for Stage 2. GPNL estimates that the proportion of flow-on employment generated by the GNP would rise from approximately 21% at the commencement of the Project to about 40% by the time that Stage 2 becomes fully operational.

Given regional demographic information and estimates of local and imported workforce provided in the EIS, this direct and indirect construction workforce would cause a population increase in the Gladstone Region of about 3,100 at the peak of Stage 1 construction and about 2,700 at the peak of Stage 2 construction when partners and families of workers are included.

Earliest current estimates are that construction of the Project could commence late 2009 and peak in late 2011. The time period between the completion of construction of Stage 1 of the Project and the commencement of construction of Stage 2 is not currently known, but GPNL estimates that the minimum period would be about three years. On this basis, it is now unlikely that construction of Stage 2 of the GNP would commence prior to mid 2015 or peak prior to mid 2016.


Each construction phase will have a large requirement for skilled trades people, labourers and professionals. The Gladstone Region has a relatively high proportion of people in these occupations with appropriate qualifications, so GPNL should be able to recruit a proportion of its workforce locally or use existing local contractors.

Based on information supplied in the EIS, the forecast size of the construction camp committed by GPNL (458 people) and the proportion of the construction workforce that GPNL forecast would use the construction camp (only 28%), the GNP appeared likely to place an unacceptable burden on the short-term rental market in Gladstone (a shortfall of approximately 1200 units).

Prior to amalgamation, both the Gladstone City and Calliope Shire Councils expressed concerns about the cumulative demand of proposed major projects on housing availability in the region.

To overcome the accommodation shortfall, GPNL stated its intention to implement a multi-faceted strategy which aims to:

- ensure that adequate housing is made available to accommodate the Project's construction workforces
- stimulate the creation of new housing that will add to the permanent housing stock of the region
- address concerns related to the potential impact of a large transient workforce during the construction period of the GNP, including impacts on lower income households.



GNPL's accommodation strategy for the provision of new low-cost housing infrastructure, outlined in Section 10 of the EIS and updated in section 13 of the SEIS, included:

- direct financial support to the Community Rent Scheme (CRS) through Anglicare (\$20/week for 68 units of accommodation (i.e. equivalent to the total CRS stock at December 2007) for each of the two peak years of construction – a total commitment by GNPL of up to \$142,000)
- the development of additional cabins at the Lake Awoonga Caravan Park
- support for a third party to develop a new relocatable home sub-division near the Carrara Homestead, after the workers' village is no longer required (using the infrastructure developed for the workers' village), which could also eventually be available for low cost housing.

GNPL proposes to use a workers' village to accommodate its single or unaccompanied construction workforce. GNPL would prefer to support an accommodation village owned and operated by a third party and potentially shared with other Gladstone major project proponents. However, GNPL has committed to the development of its own construction worker accommodation village in the absence of access to a suitable third-party facility.

At the time of the finalisation of this Report, proposals from third parties for two such facilities at Carrara are being considered by State and local authorities. One proposal is for a 20 hectare site adjacent to the Calliope Heritage Village on the south side of the Bruce Highway. The other proposal is for a site off Calliope River Road, north of the Bruce Highway. The approvals processes for both of these proposals are outside of the scope of this Report.

I note that:

- While there is currently a surplus of rental accommodation in Gladstone, this situation could be subject to rapid change with the commencement of construction of one new major project.
- While GNPL's commitment to support the CRS is commendable, it is based on data derived from the construction of stage 1 of the Comalco (now Rio Tinto) Yarwun Alumina Refinery (YAR1), which is now several years old, and housing rental prices have risen significantly since that time.
- The scale of the CRS commitment is small relative to the scales of both the capital value of the GNP and the demands of the Project on rental accommodation in Gladstone.
- The cumulative impact of construction workforces of large projects in the Gladstone Region during the proposed period of construction of the GNP is likely to be much greater than during the YAR1 construction.
- General awareness of affordable housing problems and the scale of those problems appears to be higher now than five years ago.
- Community expectations with respect to all levels of government working together with industry to address accommodation, social infrastructure and other community services issues in resource communities and industrial centres like Gladstone have risen sharply in recent years.
- Low income households appear to be amongst the most impacted part of the community during phases in the cycle in which rental accommodation availability is tightening and rents are rising.
- Other than its commitment to support construction worker accommodation facilities, which is a significant cost, the direct commitment to improving affordable housing stocks in Gladstone provided in the EIS and SEIS was low.
- GNPL has more recently made considerable upward revisions to its estimates of the proportion of unaccompanied external workers that would be appropriately housed in a construction worker accommodation village.

- While I have considered the option of requiring GPNL to make a significant direct contribution to the provision of affordable housing and other rental accommodation in Gladstone (beyond the commitments described in the EIS or SEIS), I recognise that such an action may inappropriately distort the Gladstone housing market if new rental accommodation was built at the wrong time and/or at the wrong scale.

After the release of the SEIS, GPNL committed to adopt the following measures to mitigate the potential impacts of the construction of the Project on the short term rental and affordable housing markets in Gladstone:

- increasing the size of the GNP construction camp to accommodate a peak of up to 1,500 Project workers
- requiring at least 75% of the construction workforce to be accommodated at that camp
- pursuing the option of a PAM construction methodology to reduce the size of the construction workforce
- GPNL making substantial contributions to the establishment and ongoing operation of a new 'Gladstone Social Impact Mitigation Fund' (G-SIMF) aimed at addressing the social (including affordable housing) and community services impacts of major projects in the broader Gladstone Region (refer to section 4.11.3.2 below for further details).

GPNL estimates that adoption of the four-point approach outlined above would reduce the demand for short-term rental units to less than 500 at the peak of construction and some resources from the G-SIMF may be available to address that matter. I consider that, collectively, these measures should sufficiently mitigate the housing and other social impacts of the GNP.

It is impossible to forecast with any degree of accuracy the general social and economic conditions that will prevail in the Gladstone Region at the time of the construction of Stage 2 of the GNP (after 2015), especially with respect to housing and workforce availability. Therefore I consider that it would be prudent to require a review of the construction worker accommodation proposals of GPNL for Stage 2 of the Project well before that construction commences. Such a review would be able to apply lessons learned from the accommodation strategies adopted for Stage 1 of the GNP.

Conclusion

Given the likely capacity constraints in regional accommodation supply to meet the cumulative demands that will be generated by the proposed construction of several major projects in Gladstone over the next few years, I consider that it is necessary for GPNL to support the development of specialist single-persons accommodation in the region in accordance with the parameters agreed with DIP following the release of the SEIS. Therefore I require that the parameter governing the provision of such accommodation should be a condition attached to the MCU approval for the refinery.

Condition 11.1

- (a) Prior to the commencement of each phase of construction of Stage 1 and 2 of the Project, GPNL must ensure the provision of specialist accommodation within the Gladstone Region local government area for at least 75% of the GNP construction workforce with a permanent place of residence outside of the Gladstone Region, and engaged in Project construction activities within the Gladstone Region.
- (b) Within 18 months of commencement of operation of the nickel refinery, GPNL must present a report to the Coordinator-General, the Department of Housing and the Gladstone Regional Council which both reviews the outcomes of its Stage 1 construction accommodation strategy and makes recommendations about improvements to that strategy that it commits to adopt for construction of Stage 2 of the Project, unless otherwise directed by the Coordinator-General.

4.11.1.2 Location and design of construction worker accommodation

I note that:

- Use of the GSDA for construction worker accommodation is not currently supported by the Gladstone Economic and Industry Development Board (GEIDB) or planning undertaken by DIP
- The former Gladstone City Council did not support the location of a single persons quarters within that local government area.
- A desire within government, the community and industry to improve the standard of temporary construction worker accommodation in Queensland, especially in resource communities, has led to the development of the new draft standard by Building Codes Queensland, which is expected to be subject to a final round of public review before being finalised in 2009 and enforced under section 67 of the *Building Act 1975*.
- While there may be some longer-term advantages in the provision of temporary accommodation and/or associated infrastructure that could later be adapted for more permanent low-cost accommodation, some sites suitable for construction camps may not be suitable for permanent residential development.

The specific location, design and size of a construction worker accommodation village would be subject to IPA development approvals separate from the GNP approvals. In general terms however, I consider that such an accommodation village, or combination of specialist temporary construction worker accommodation facilities, should:

- be located within the Gladstone Region local government area for workers engaged in GNP construction activities in the Gladstone Region
- be of sufficient aggregate size to accommodate almost all of the unaccompanied GNP construction workforce recruited from outside of the Gladstone Region at each phase of construction for both Stage 1 and Stage 2 of the Project
- be in place at the commencement of each phase of construction.

Conclusion

The location and design of the construction workers village will be subject to separate approvals under IPA and generally outside of the scope of this Report. Nonetheless, in the interest of ensuring that the village is built to an adequate standard, I recommend that the following condition be attached to any MCU approval that might be made for any construction worker accommodation village:

Condition 11.2

All construction worker accommodation provided for the Gladstone Nickel Project must comply with the 'Queensland Development Code Part MP 3.3, *Temporary Accommodation Buildings and Structures*' (2008 draft until the code is finalised).

4.11.1.3 Road and traffic impacts around the construction camps

In general terms, the road and traffic impacts of the construction workforce entering and leaving the main GNP construction sites in the Gladstone Region have been considered by GPNL, DMR and local government and this consideration has been incorporated into my discussion and conditions presented in Section 4.7 of this Report. However, as the details about the location of the construction worker accommodation have not yet been provided by GPNL, no specific assessments have been made of the road, traffic and community amenity impacts of the construction workforce entering and leaving the accommodation camp (or camps).

GPNL has committed, where practicable, to transport construction workers between the accommodation camp(s) and the construction worksites by buses. This would significantly reduce both safety risks associated with worker fatigue, and traffic congestion and loss of public amenity on the roads between the camp(s) and each construction site.

Conclusion

In the absence of specific information about the accommodation village proposals to be used for the GNP, I consider it necessary that this Report establish some guidance for the future consideration of development applications for such a facility. Therefore I recommend that the following conditions be attached to any MCU approval that might be made for any construction worker accommodation village.

Condition 11.3

- (a) Any development application submitted to the Gladstone Regional Council for a construction worker accommodation village to be used by GPNL must be accompanied by a 'Road Use Management Plan' (RMP) and a 'Road Impact Assessment' (RIA) (to ensure that traffic generated by the proposed workers village is investigated and the traffic impacts resulting from the village mitigated to the satisfaction of Council for all local roads and the Department of Main Roads for all state-controlled roads that will be directly affected by the construction and operation of the village and the transport of workers resident there to GNP construction sites.
- (b) The RMP and RIA must be submitted prior to the commencement of construction of the refinery and should conform with the current requirements of DMR.
- (c) The RMP and RIA must consider the standard of the road network, access conditions, hours of operation, dust control, noise and safety for each phase of construction, in accordance with the current requirements of DMR and the current standards and policies of the Gladstone Regional Council.

Condition 11.4

GPNL must provide bus transportation services for the movement of the majority of its construction workforce resident in any temporary accommodation village to and from Project construction sites.

4.11.2 Impacts of the Project on local businesses


The large demand for workers required by the GNP may affect the ability of other businesses in the area to attract and retain staff, particularly smaller businesses. Previous experience suggests that smaller businesses can have difficulty in competing against larger firms to attract and retain staff. This may be partly attributed to the capacity of larger firms to provide more attractive employment conditions than smaller firms.

Some measures proposed by GPNL to address these potential impacts are outlined in Sections 4.11.2.1 and 4.11.2.2 below.

4.11.2.1 Local Industry Participation Plan

GPNL has described its intention to develop an employment policy which promotes the use of the local workforce for the construction phase. The centrepiece of this strategy would be the development of a 'Local Industry Participation Plan' which would also cover technology transfer, job creation and skills development. GPNL intends that this Plan would commit to:

- ensuring potential local suppliers are provided with information in an equitable and timely manner
- adopting design and procurement strategies to maximise local participation
- ensuring local firms are provided with opportunities to supply under the same terms, standards and conditions as interstate or overseas businesses
- ensuring contracts are awarded on the basis of the most competitive proposal, which includes due consideration of non-cost factors such as reliability, maintainability, servicing etc.
- incorporating performance measurements and feedback mechanisms.



It is also intended that the Plan include strategies such as GPNL registering its skilled workforce requirements with Rockhampton Regional Development Limited's Central Queensland Jobs Register (CQ Jobs). This Register aims primarily at recruiting workers locally but also provides opportunities for regional and interstate workers to apply for positions they are appropriately skilled to fill.

Conclusion

I conclude that implementation of GPNL's Local Industry Participation Plan would provide a reasonable means of reducing some of the potential negative impacts and capturing some of the potential positive impacts of the GNP on businesses in the Gladstone Region.

4.11.2.2 Proposed use of preassembled modules (PAMs)

One initiative that GPNL is considering that would significantly reduce the Gladstone-based component of the construction workforce, is the modularisation of plant for construction of the refinery. Preassembled modules (PAMs) would be constructed outside of the region and imported through the Port of Gladstone. Amongst other advantages of a PAM strategy identified by GPNL, the construction workforce required to assemble on-site modules made elsewhere would be significantly less than the alternative of building everything on site.

Approvals considerations arising out of the PAMS strategy are discussed in section 4.9.5 of this Report.

An initial engineering study of project modularisation undertaken by GPNL indicated that the peak construction workforce could be reduced from 2,600 to 2,000. This has the potential to significantly mitigate potential housing and other social impacts during the construction period.

The existing PAM facility has the potential to be utilised by several major projects in Gladstone. In addition to its proximity to the Targinnie precinct of the GSDA, the proposed PAM transfer corridor from Fisherman's Landing to the Refinery would connect to the GSDA 'Materials Transport Services Corridor' and could therefore service the Aldoga precinct.

There is also some potential that a PAM import facility could be modified in the future to export PAMs manufactured in Gladstone, as is the case at the Australian Marine Complex Common User Facility in West Australia. Therefore, such a PAM facility could become a local employment generator in Gladstone, rather than a means of reducing the size of the construction workforce during a peak labour and skills demand period.

Despite these potential broader advantages, the PAM facility is a GPNL proposal that does not have the formal support of the Queensland Government and it is not strictly part of the GNP being assessed in this Report.

GPNL has identified a site for a PAM facility on the north side of Fisherman's Landing and a corridor route from there to the nickel refinery site, in consultation with key industry and government stakeholders (Figure 2.7 of the SEIS). Assessment of the PAM facility itself on Strategic Port Land at Fisherman's Landing is not a formal part of this EIS process and would be subject to separate approvals through GPCL.

My consideration of matters associated with the potential impacts of PAM transfer corridor on road impacts and cumulative risk assessment of a PAM facility at Fisherman's Landing is provided in Section 4.9.5 of this Report.

Conclusion

While assessment of the PAM facility is outside the scope of this Report, I conclude that, from a socio-economic impacts perspective, PAMs is likely to provide some benefit to the Gladstone community in reducing peak demand on temporary construction worker accommodation during the next few years. Furthermore, PAM infrastructure could support further economic development and employment opportunities for Gladstone in the longer term.

4.11.3 Social impacts of the operation of the Project

The earliest current estimate for commencement of employment of the operational workforce is first quarter of 2012 for Stage 1 and early 2016 for Stage 2. The reliability of the estimate for commencement of Stage 2 is very low. Stage 1 would employ a full-time equivalent (FTE) workforce of approximately 530 people. Stage 2 operational FTE would rise to a total of approximately 600 people. Outside of construction activity, additional indirect employment generated by the GNP is expected to be in the vicinity 235 FTEs for Stage 1, rising to approximately 295 FTEs for Stage 2 (Table 10.5.3 of the EIS).

4.11.3.1 Longer-term housing impacts

Given regional demographic information and estimates of local and imported workforce provided by GPNL in its EIS, this direct and indirect employment in the operation of the Project would bring an additional non-construction population to the Gladstone Region of slightly more than 600. GPNL has estimated that this would create demand for an additional 275 units of accommodation in the Gladstone Region for Stage 1 and an additional 65 units of accommodation for Stage 2 on top of background organic growth (more than 2,000 units over a five year period) and additional growth caused by other large industrial projects proposed for Gladstone.

Although there is currently some spare capacity in the Gladstone housing market, it is debatable whether the maximum rate of development of new permanent housing in the region (estimated by GPNL in its EIS to be 50 units per month) is capable of meeting this demand without the adoption of additional strategies. Funds from the G-SIMF could be directed to the provision of additional affordable housing if a need arises.

4.11.3.2 Impacts on social and community services

While the EIS reported adequate hospital and other medical infrastructure facilities in the Gladstone-Rockhampton Regions to cope with current requirements and projected growth:

- as for the rest of regional Australia, there is a shortage of medical practitioners
- little attention was given in the EIS or SEIS of the capacity of the Gladstone hospital or the emergency services to cope with a large-scale industrial accident.

The estimated peak in demand for school places from both direct and indirect imported workers with accompanying children due to the GNP will be for approximately 295 students in 2009 for Stage 1 and 250 in 2014 for Stage 2. School facilities within Gladstone appear capable of absorbing this impact.

During the operation of the refinery, an ongoing program of skills enhancement would need to be provided. This would be a combination of specific in-plant training plus more generalised skills instructions at off-site locations. In addition, an apprenticeship and/or traineeship program would need to be implemented by an internal program and in close consultation with existing local and regional technical training institutions.

Additional childcare demand can be expected from the Project-induced population increase and additional facilities may be required to handle the demand for childcare services in certain age groups.

GPNL's discussions with local government have indicated that there are adequate sporting and recreation facilities available to accommodate the expected increase in population arising from the GNP.

I consider that while the potential impacts of the GNP itself on social and community services in the region are acceptable in isolation, the cumulative impact of major projects proposed for Gladstone region on these services continues to receive insufficient analysis. Nonetheless, the balance of responsibility between the three levels of government, non-government organisations and industry to provide community and social services in resource communities and resource processing industrial centres such as Gladstone remains a difficult public policy area. Consequently, the concept of setting firm conditions requiring individual project

proponents to address 'their share' of the cumulative impacts on community services is problematic.

While many corporations volunteer direct financial contributions to support community services, there is both no agreed formula for calculating the scale of such contributions or an agreed mechanism to capture such contributions should a mandatory system be imposed.

4.11.3.2 Proposed Gladstone Social Impact Mitigation Fund (G-SIMF)

To address the potential impacts of the GNP on short term rental accommodation (refer to section 4.11.1 of this Report), the longer term housing market and ongoing community and social services in the Gladstone Region, GPNL and DIP have jointly developed the following proposal to establish a 'Gladstone Social Impact Mitigation Fund' (G-SIMF):

- At the date of financial close on commitment to construct Stage 1 of the Project, GPNL will contribute AUD \$3M to the G-SIMF and a further AUD \$3M on each of the second and third anniversaries of the date of financial close (a total of AUD \$9M).
- Thereafter, GPNL will contribute AUD \$500,000 per year to the G-SIMF provided that the earnings of the GNP after taxation, depreciation and amortisation allowances exceed \$500,000 in that year.
- The size of GPNL's contributions to the G-SIMF are nominally based on 0.15% of the total capital cost of Stage 1 and 2 of the Project expended in the Gladstone Region (for the \$9M starting contribution) and 0.08% of the forecast annual operating expenditure of Stage 1 of the Project (for the subsequent \$500,000/yr contribution). Contributions for Stage 2 of the Project have been incorporated in this contribution.
- The G-SIMF would initially be held in trust by the GEIDB while an appropriate structure is established to manage the Fund and allocate money to particular projects or programs.
- The G-SIMF may be transferred to another entity or a new entity may be created for its management.
- A management structure for the G-SIMF that allows for both a decision making body dominated by corporate contributors and community representatives and an advisory body dominated by government representatives.
- Membership of the G-SIMF decision body could include a senior representative of:
 - GPNL
 - GEIDB or a GEIDB nominee
 - other future corporate contributors to the Fund (above a minimum threshold to be determined)
 - the Gladstone Regional Council
 - at least two prominent independent representatives of the Gladstone regional community.
- Membership of the G-SIMF advisory body could include:
 - the Departments of Communities; Housing; Education Training and the Arts; Tourism, Regional Development and Industry; Child Safety; and Emergency Services
 - Queensland Health
 - Disability Services Queensland
 - GEIDB (if not present on the decision body)
 - at least one community services organisation representative from the non-government sector.
- While GPNL prefers that chairmanship of the G-SIMF decision body be a contributing corporate member, I suggest that chairmanship should be drawn from either the Gladstone Regional Council or a suitably qualified community representative.
- While the scope of projects or programs to be supported by the G-SIMF are yet to be determined, I consider that the Fund should:



- be directed towards the mitigation of cumulative social impacts created by the establishment of major industrial projects in the Gladstone and neighbouring regions
- be allocated at a sufficient scale to achieve measurable project results within a three-year period rather than be widely dispersed over a large number of small projects
- not generally be made available for the conduct of studies, technical research or environmental monitoring, as these would be funded from other sources
- not replace core funding of other Queensland Government programs
- not be made available as sponsorships of sporting or recreational clubs or environmental groups
- not contribute to large infrastructure projects that are traditionally funded by the governments such as school or hospital building programs and main roads
- seek opportunities, where appropriate, to attract other public and private funding sources.
- Examples of projects or programs that GPNL and I consider may be suitable candidates for G-SIMF support include (not in priority order):
 - upgrading of capacity or facilities or the provision of new services at the Gladstone Hospital or other medical centres in the region, including support for the recruitment of medical specialists and other practitioners
 - improvement in the capacity or standard of childcare facilities in the region
 - improvement in the capacity or standard of facilities or support services for the elderly or people with disabilities or their carers in the region
 - enhancement of education, training, apprenticeship and other skills programs aimed at enhancing the size and quality of the pool of people qualified to work in Gladstone's industrial enterprises
 - rental support schemes for low-income individuals or families
 - the provision or maintenance of affordable housing.
- It is envisaged that allocation of money from the G-SIMF will be made at regular intervals and be made at least partly in response to its advertised calls for submissions for funding.

The GEIDB and the Gladstone Regional Council have initiated a social infrastructure audit of the Gladstone Region that, together with a reference group of relevant regional stakeholders, and community consultation, will identify social infrastructure priorities or improvements required to services associated to social infrastructure. This reference group will:



- undertake an audit to identify the current gaps in social infrastructure in the region
- create a model to study the effects of industry on social infrastructure
- provide guidance on funding priorities for social infrastructure spending.

In establishing the G-SIMF, I am aware that this may create at least the perception of a precedent in terms of both:

- the requirement for other proponents of major new industrial projects to contribute at a similar scale to the Fund
- communities in other industrial centres in Queensland having raised expectations of benefiting from similar initiatives.

My assessment of the EIS for the GNP and the recommendations and outcomes that emerge from that assessment must be seen as particular to the GNP. While I view the proposed rapid industrial expansion of Gladstone and the cumulative social impacts arising from that expansion as a special case, the joint G-SIMF proposal by GPNL and I is not inconsistent with the Queensland Government's new 'Sustainable Resource Communities Policy'. I further consider that it is appropriate to encourage:

- proponents of other major new industrial projects in Gladstone to consider making contributions of a similar magnitude to the G-SIMF (on a proportion of capital and operational expenditure basis) as that agreed by GPNL

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- proponents of existing major industrial projects in Gladstone to contribute to the G-SIMF (although on a modified and reduced basis relative to GPNL's contribution)
 - the voluntary adoption of a model akin to the G-SIMF in other regions where significant cumulative social impacts of major industrial projects may be reasonably foreseen.

Notwithstanding these views, I reinforce that, under the Part 4 process of the SDPWO Act, the EIS for each 'significant project' must be assessed on its own merits and the most appropriate social impact mitigation strategy for any project may be somewhat different to the outcome for the GNP.

While I consider that it may not be unreasonable to require that the G-SIMF be established and operated according to the above parameters as a specific condition of the MCU approval for the GNP, there are matters related to governance of the G-SIMF and the treatment of the G-SIMF with regard to taxation and excise issues that cannot be resolved within the current timeframes. Therefore, I record that:

- I recommend that GPNL and DIP proceed with the voluntary establishment and operation of the G-SIMF
- I have not set more specific (and arguably less effective) conditions on approvals for this Project to address particular social impacts because I respect GPNL's commitment to implement the G-SIMF in cooperation with the relevant stakeholders.

Conclusion

The potential significant social impacts that may be caused by the GNP can be effectively mitigated by the implementation of the measures described in this Report, especially the establishment of the construction worker accommodation village and the implementation of the G-SIMF. While I have set conditions relating to the construction village, I am relying on GPNL to implement their G-SIMF under voluntary arrangements.

5. Environmental Management Plans

Draft Environmental Management Plans (EMPs) have been prepared by GPNL for the refinery, pipelines and RSF, and these are included in the EIS.

Potential environmental issues requiring management and monitoring have been identified during the impact assessment process as detailed in this EIS. The strategic-level EMP outlined in the EIS integrates the environmental management commitments made throughout the impact assessment study. It describes the environmental management procedures that GPNL and its contractors will use to construct and operate all components of the GNP.

This strategic EMP relates to the construction and operational phases of the pipelines, refinery and RSF and will be used as the basis for detailed EMPs. The appropriate time to prepare the detailed EMPs is during the detailed design stage when more accurate information is available to detail the specifics of the proposed management procedures. It is likely that the EMPs will be incorporated into an Integrated Environmental Management System in accordance with the requirements of the *Environmental Protection Act 1994* (EP Act).

Separate construction and operation EMPs will be required for each of the refinery, the RSF and the nickel ore slurry pipeline. All EMP matters for other linear infrastructure entering or leaving the refinery should be part of the refinery construction and operation EMPs.

The EMP identifies and describes the environmental values and potential impacts that may be caused by Project and define critical environmental values which are to be protected through the consent conditions of the environmental authority. Commitments are proposed and identified including environmental protection objectives, standards, measurable indicators and control strategies (i.e. to demonstrate how the objectives will be achieved).

The aim or purpose of the EMP is to detail the actions and procedures to be carried out during the implementation phase of the Project in order to mitigate adverse and enhance beneficial environmental and social impacts. The environmental studies and consultation conducted as part of the EIS have identified the potential construction and operational impacts of proceeding with the Project.

The objectives of the EMPs are to provide:

- the Project management team with evidence of practical and achievable plans to ensure that the Project's environmental requirements are complied with
- a series of integrated plans for monitoring, assessing and controlling potential impacts
- local, state and Commonwealth authorities with a framework to confirm compliance with conditions and requirements
- the community with evidence that the GNP will be managed in an environmentally acceptable manner.

Requirements of all relevant environmental legislation, government, the community and other stakeholders can be incorporated into the each detailed EMPs.

Environmental authority conditions will require GPNL to address environmental issues such as water quality, air quality, noise, and waste management. Contingency planning will be incorporated into the detailed EMPs (covering for example stormwater and waste minimisation).

GPNL will construct the pipelines in accordance with the Australian Pipeline Industry Association's Code of Environmental Practice – '*Onshore Pipeline Construction*'.

Following the issue of environmental authorities, licences and/or permits under relevant legislation, the detailed EMPs will be amended to incorporate the environmental conditions imposed as part of such approvals.



GNPL will be responsible for implementing all of the EMPs.

The EMPs are dynamic documents. They will be reviewed regularly and revised as the Project progresses to construction and through to operations. Revisions will include, but not be limited to:

- inclusion of final organisational structures for construction and operational staff and the allocation of responsibilities in line with the organisational structure
- inclusion of relevant approval conditions arising from the Project's approval and subsequent permits, authorities and/or licences
- review of the operations EMP at the end of the construction phase.

Additional revisions will occur on an as-needs basis, including revisions to address items identified during incident investigations, inspections or audits.

GNPL will be responsible for regular review of the environmental management system to achieve continuous improvement in environmental performance.

The EMPs will address the proposed mitigation measures, record environmental commitments and establish the framework to ensure they are implemented during each stage of the Project. In effect, the EMPs become the key reference documents in that they convert the undertakings and recommendations of the environmental studies into sets of actions and commitments to be followed by the designers, constructors and future operators of the proposed Project.

The EMPs will also serve as the benchmarks for measuring the effectiveness of environmental protection and management. This can be achieved by specifying the monitoring, reporting and auditing requirements, with nominated responsibilities and timing to ensure the necessary mitigation measures are met. The EMPs also make provision, as appropriate, for unforeseen events by outlining corrective actions which may be implemented in these situations.

The effective implementation of the EMPs will ensure:

- that GNPL honours the commitments it has made in the EIS, SEIS; and correspondence with members of the public and advisory agencies
- the effective management of environmental impacts of the GNP.

Therefore I state the following two conditions to be applied to each component of the GNP (and repeated in each of Schedules B, C1, C2 and C3):

Condition 12.1

GNPL must undertake construction in accordance with a Construction Environmental Management Plan (CEMP) approved to the satisfaction of the Environmental Protection Agency (EPA).

Condition 12.2

GNPL must undertake operation in accordance with a Operations Environmental Management Plan (OEMP) approved to the satisfaction of the Environmental Protection Agency (EPA).

6. Matters of National Environmental Significance

6.1 Project assessment and approvals

If a project involves an action which will or is likely to have an impact on matters of 'National Environment Significance (NES matters) as defined by the EPBC Act, then it may be declared a 'controlled action'. A project involving a controlled action requires the approval of the Commonwealth Minister for Environment, Heritage and the Arts or a delegate of that Minister.

A referral of the GNP was submitted by GPNL to the (then) Commonwealth Department of Environment and Heritage under the EPBC Act on the 26 October 2005. The Project was declared a controlled action on 18 November 2005 pursuant to section 75 of the EPBC Act. The Part 3, Division 1 controlling actions of relevance to the Project are:

- World Heritage (sections 12 and 15A of the EPBC Act)
- Listed threatened species and communities (sections 18 and 18A of EPBC Act)
- Listed migratory species (sections 20 and 20A of the EPBC Act).

In accordance with the Bilateral Agreement between the Australian and Queensland Governments, a project involving a controlled action may be considered for approval under section 133 of the EPBC Act once the Minister or delegate has received the Coordinator-General's EIS Evaluation Report prepared in accordance with section 35 of the SDPWO Act. This Report fulfils that requirement for the GNP.

This section of the Report summarises my evaluation of the potential impacts of the GNP on the controlling provisions (being the NES matters) under the EPBC Act.

I consider that the only potential impacts of the GNP on NES matters may arise from:

- discharge of treated waste water from the nickel refinery to Port Curtis and the subsequent impact on the marine environment of the adjacent Great Barrier Reef World Heritage Area (GBRWHA)
- the construction of the refinery, pipeline and residue storage and other associated infrastructure, resulting in subsequent potential harm to plant species or vegetation communities or animal species listed under the EPBC Act.

My comprehensive consideration of the likely impacts of the marine discharge is provided in section 4.2 of this Report. That consideration is supported by the information provided by GPNL in the technical supplement *Gladstone Pacific Nickel Refinery – Environmental Assessment of Treated Water Discharge to Port Curtis* (URS, 25 July 2008). That technical report also provides a specific summary of marine World Heritage values potentially affected by the GNP.

Information presented in the EIS and SEIS relating to both the existing values of threatened flora species and communities and threatened and migratory fauna species, and the potential impacts of the Project on those values, has been compiled into Appendix E of this Report. I have also presented my consideration of the impacts of the GNP on non-marine flora and fauna in Section 4.4 of this Report.

6.2 Findings and conclusions

6.2.1 General

The proposed Project is located adjacent to important wetlands around Port Curtis and the 'Narrows' and on land and marine systems in close proximity to the GBRWHA. The refinery and residue storage area are located within the Calliope River catchment, which is important to the function and health of Port Curtis and associated wetlands.

It is unlikely that the Project will have a significant impact on the health of this ecosystem if the appropriate mitigation and management measures described elsewhere in this Report are implemented.

This being the case it follows that the EPBC Act listed threatened and migratory species, and the diversity of marine and estuarine ecosystems and feeding and breeding habitats for seabirds, marine reptiles and marine mammals that contribute to the World Heritage values of the GBRWHA will also be unaffected.

After considering the detail provided in sections 4.2 and 4.4 and Appendices A and E of this Report, I am satisfied that the impacts on NES matters have been adequately addressed.

The impacts of the Project have been evaluated in accordance with the SDPWO Act and I am satisfied that the requirements of the Queensland Government for impact assessment have been met. Accordingly, I recommend that the Project can proceed subject to the conditions contained in Schedules A to C of this Report.

6.2.2 Findings and conclusions on World Heritage values

As summarised in Table E1 of Appendix E, the construction of the proposed GPN refinery and associated infrastructure is unlikely to have any impact on the geomorphic, aesthetic or heritage values of the GBRWHA. Potential impacts of the GPN proposal on the ecosystems of the Port Curtis region may affect the ecosystem values of the GBRWHA, however the level of impacts is unlikely to be significant, as discussed below.

As discussed in Sections 4.1 and 4.2 and Appendices A and E of this Report, with respect to the potential impact of the treated marine discharge on World Heritage values I conclude that:

- The concentration of constituents in the discharge waters should reach acceptable levels within a short distance of the diffuser pipes, and the conditions provided by EPA for the operation and monitoring of the discharge, detailed in Schedules A1 and A2 of this Report, should be adequate to prevent environmental harm in the near-field environment.
- Dispersion within Port Curtis should cause the key constituents of the discharge waters to dilute to near ambient concentrations and the conditions provided by EPA for the operation and monitoring of the discharge, detailed in Schedules A1 and A2 of this Report, should be adequate to prevent environmental harm in Port Curtis and the broader marine environment.
- Despite there being less than ideal information about the potential accumulation of discharged metals in Port Curtis marine sediments:
 - there is sufficient information to support the view that significant impact on those sediments will not occur
 - the monitoring, validation, sampling, direct toxicity assessments and additional research committed to be undertaken by GPNL, or specified in the conditions outlined in Schedules A1 and A2 of this Report, will be sufficient to address the potential impact of the GNP on these sediments and, if necessary, identify appropriate corrective actions well in advance of any significant potential impact.

My more specific conclusions in relation to the potential impacts of the release of waste waters to Port Curtis are summarised specifically below.

6.2.2.1 Discharge of Waste Water to the Port Curtis

I consider that there is unlikely to be any significant impact arising from the release of refinery waste water on the values of the GBRWHA, or the listed migratory or threatened species or communities under the EPBC Act, and I summarise the basis for that finding as follows:

Derivation of the Water Quality Objectives (WQOs)

- The WQOs presented in section 4.2.3.1 of this Report (especially Table 1 footnotes) and in section 4.2.3.2 for Manganese, were derived from the ANZECC guidelines and therefore I consider them to be acceptable.
- The WQOs are at a level for each constituent in solution at which no harm to marine biota will occur in the short or long term, so achievement of the WQOs would result in no harm to the biota that contribute to the values of the GBRWHA.
- To be sure that no harm to marine biota would occur, GPNL must also undertake the program of direct toxicity assessments (DTAs) specified as environmental authority conditions (C23) to (C30) of Schedule A2 of the this Report that will either validate or amend the WQOs as required by the ANZECC DTA procedures. This requirement is summarised in section 4.2.4.3 of this Report.
- Environmentally Relevant Activity (ERA) environmental authority conditions under the Queensland *Environmental Protection Act 1994* (EP Act) are enforced by the Queensland Environmental Protection Agency (EPA). Under the EP Act, GPNL would be obliged to immediately report any exceedences or breaches of environmental authority conditions and to take immediate corrective actions to restore compliance with operating conditions. If compliance cannot be restored, then the refinery would be obliged to cease operation until compliance could be assured.

Levels of pollutants likely to result in the receiving waters

The concentrations of pollutants that will be discharged to Port Curtis are provided in Table 2 of section 4.2.5 of this Report. Table 2 also shows the discharge rates, which enables the quantities of discharge constituents to be calculated for any given period of time. From the information presented during the EIS process, I consider that the range of constituents in the discharge waters described in Table 2 is adequate to assess any potential environmental impacts of the refinery waste waters.

The predictive models summarised in section 4.2.6.1 of this Report indicate that maximum concentrations of constituents in the discharge plumes would be less than the WQOs within 0.3-5.9m of the diffuser outlets (depending upon tidal velocity and Stage of the Project). Table 3 in section 4.2.6.1 shows that, at a low tidal velocity for Stage 2 of the Project, the concentrations of the discharge constituents would either approach ambient sea water concentrations or would be less than 25% of the WQO within the near-field mixing zone. Under most other circumstances the discharge concentrations are lower than shown in Table 3 in the mixing zone.

To provide additional protection:

- Condition C17 of Schedule A2 requires that there "... be no discharge of any toxic substance in any amount or concentration, either alone or in combination with substances already in the receiving water or discharge that are likely to cause acute toxicological effects to biota."
- Condition C18 of Schedule A2 requires that there "... be no discharge of any toxic substance in any amount or concentration, either alone or in combination with substances already in the receiving water or discharge, that are likely to cause chronic toxicological effects to biota outside of the approved mixing zone in the receiving environment." Condition C18 also stipulates that the approved mixing zone is defined as not more than 3 metres from each diffuser port for the Stage 1 of the Project and not more than 6 metres from each diffuser port for Stage 2

- Conditions C19 to C22 of Schedule A2 require an extensive program to validate the performance of the diffusers against the predictive models, and take corrective actions if dilution of the waste discharge is less than predicted by the models.

With regard to the far-field environment of Port Curtis outside of the small near-field mixing zone, information in section 4.2.6.2 of this Report summarises modelling of the distribution of metals from the refinery being:

- at 0.05%-0.10% of the discharge concentration (i.e. well below all WQOs) in the confined zone from the mouth of the Calliope River, around the RG Tanna Coal Terminal and Clinton Wharf, to the mouth of Auckland Creek
- well below 0.05% of the discharge concentration in an area immediately outside of that location
- at ambient seawater concentrations in most of the 635 square kilometre area of Port Curtis included in the model.

Potential long-term accumulation of metals

From my consideration of the potential long-term impact of possible precipitation, sedimentation and/or bioaccumulation of metals in the waste discharge, summarised in section 4.2.6.3 of this Report, I conclude that:

- some metals of potential concern (e.g. mercury) would not be present in detectable concentrations in the nickel ore, residue solids or the barren liquor and therefore could not pose any credible threat to the environment
- quantities of micro or nano particles of metals of potential concern suspended in the marine discharge would be insignificant
- with the possible exception of manganese, the key metals of interest in the waste water discharge (nickel, cobalt, cadmium, chromium and zinc) are not expected to oxidise or precipitate at any appreciable rate before being flushed from Port Curtis by tidal currents
- as the concentration of those metals in solution would dilute to approximately ambient levels within a short distance of the discharge, their rates of exchange with sediments are expected to be similar to that occurring naturally in Port Curtis
- due to the nature of the surrounding geology and soils, the levels of natural input to Port Curtis of some of these constituents (e.g. nickel, cobalt and Manganese) from natural drainage is relatively high compared to inputs from the GNP
- specific studies undertaken for Mn demonstrate that its rate of oxidation and precipitation is either too slow to add significantly to sediments in Port Curtis, and/or the small particles thus formed would remain in suspension and be flushed from Port Curtis by tidal currents
- the monitoring, validation, sampling and DTAs (summarised in Section 4.2.4.3 of this Report) and additional research (summarised in Sections 4.2.4.1 and 4.2.4.2 of this Report) committed to be undertaken by GPNL, or specified in the conditions outlined in Schedule A2 of this Report, will be sufficient to address the potential impact of the GNP on these sediments and, if necessary, identify appropriate corrective actions well in advance of any potential significant impact.

I further consider that, as any environmental harm that could result from the accumulation of metals in sediments or marine organisms would take years (or potentially decades) to manifest, the monitoring program would identify any potential future problem with sufficient time to take corrective actions before any measurable harm could occur.

Consequently, there would be no harm to World Heritage values or listed (threatened or migratory) species and communities inside or outside of Port Curtis as a result of precipitation and accumulation of metals in Port Curtis.

Response actions if discharge monitoring results are outside the predicted range

Conditions specifying monitoring of water discharge to the Port Curtis receiving environment of relevance to the values of the GBRWHA, listed threatened species and communities and migratory species are specified in:

- ERA environmental authority conditions for the refinery in Schedule A2 of this Report as:
 - C11 to C16 for monitoring of releases from the diffuser pipes
 - C31 to C37 for monitoring in the release, near-field broader far-field Port Curtis environments
- Condition 1.1 (described in section 4.1 of this Report).

As described above, non-compliance with release conditions requires immediate mandatory reporting, immediate corrective actions and cessation of waste water release until compliance can be assured.

For conditions C31 to C37:

- the 'background environmental investigations' on which the REMP will rely would include all documentation presented as part of the EIS process and Port Curtis Integrated Monitoring Program (PCIMP) monitoring reports
- the applicable environmental values and WQOs to be achieved will be derived from the values described in section 4.2.3.1 of this Report, the ANZECC Water Quality Guidelines (including the Chapter 3 Sediment Quality Guidelines), and the DTAs required by conditions C23-C30, moderated by the information available from background studies
- triggers for corrective actions will need to be specified in the each monitoring plan
- corrective actions if monitoring results exceed the trigger levels specified in each monitoring plan will be enforced by the EPA
- under the EP Act, the EPA can enforce a cessation of the release of waste water to the marine environment if corrective actions are unsuccessful.

Condition 1.1 builds on the requirements of the ERA monitoring conditions and provides an additional requirement to review the environmental performance of Stage 1 of the Project after it has been fully operational for two years and provides EPA with the capacity to further amend operating conditions before Stage 2 of the Project could proceed to construction.

I note that the waters of Port Curtis carry high levels of natural sediment. Also, Port Curtis has already been subject to significant human disturbance. Additional planned industrial development of the area, especially large scale channel dredging to accommodate a higher volume of shipping, will further modify Port Curtis. While the general industrial expansion of Gladstone can be managed without environmental harm to World Heritage values, and threatened or listed migratory species, it cannot be done without physical modification to the main shipping channels near to Wiggins Island and the RG Tanna Coal Terminal. It appears that this same area will define the extent of any measurable potential impact of the GNP on the marine environment.

Although a number of EPBC Act listed fauna species, including marine turtles, dugong and international migratory bird species are known to inhabit and/or frequent Port Curtis. It is unlikely that the Project will disturb behaviour patterns due to the loss and/or degradation of ecosystem health.

6.2.3 Findings and conclusions on listed species and communities

As discussed in Section 4.4 and Appendix E of the is Report, only one plant species on the entire GNP area, black ironbox (*Eucalyptus raveretiana*), is listed under the EPBC Act (as vulnerable). Up to a total of 15 mature specimens and 40 juveniles could be cleared across five creek crossings along the ore slurry pipeline route if this ore slurry pipeline is built as proposed by GPNL for Stage 2 of the Project.

Given the small scale of the removal, the abundance of this tree species either side of the pipeline corridor and its regenerative capacity, I consider that this impact is acceptable in the short term and likely to be insignificant over the longer term.

No fauna or flora species or ecological communities listed under the EPBC Act occur on the refinery site.

Only one fauna species on the RSF site, the squatter pigeon (*Geophaps scripta*), is listed under the EPBC Act (as vulnerable) and I consider that measures proposed by GPNL, as outlined in Section 3.2.2.4 of Appendix E of this Report, to protect and re-establish vegetation on the RSF site adjacent to the residue storage cells should sufficiently mitigate the impact of the Project on the pigeon.

No flora species or ecological communities listed under the EPBC Act occur on the RSF site.

The route of the ore slurry pipeline that GPNL proposes to construct if Stage 2 of the Project proceeds has been chosen to generally avoid significant impact on flora and fauna species and ecological communities listed under the EPBC Act. The habitat of only one species listed as critically endangered under the EPBC Act, the Capricorn yellow chat bird (*Epthianura crocea macgregori*), would be disturbed (near Raglan Creek). This disturbance would be limited to locations where the chats have not been found. The final alignment of the pipeline will be determined during detailed design to specifically avoid sensitive environmental areas. During this detailed design phase, GPNL will develop a detailed Water Crossing Management Plan (as outlined in Section 4.4.3.2 of this Report). I am satisfied that the pipeline construction methods described in the EIS, including the use of boring and/or horizontal directional drilling wherever appropriate, and the construction environmental management plans that would be implemented by GPNL, would sufficiently mitigate the relatively modest and temporary impact of the pipeline on the chat habitat.

I also consider that measures described in the EIS documents and in this Report with respect to watercourse crossings, erosion control and acid sulfate soil management (see Section 4.5 of this Report) during the construction of all pipelines will be sufficient to prevent any impact on listed species.

7. Conclusion

Having regard to the documentation provided during the EIS process for the Gladstone Nickel Project, I am satisfied that the requirements of the Queensland Government, and the Commonwealth requirements under the *Environment Protection and Biodiversity Conservation Act 1999*, for impact assessment in accordance with the SDPWO Act have been met. The EIS process has provided sufficient information to allow an informed evaluation of potential environmental impacts which could be attributed to the Project. Careful management of the key construction and operational activities should ensure that any potential environmental impacts will be minimised or avoided.

Gladstone Pacific Nickel Ltd (GPNL) has made commitments throughout the EIS and SEIS. These commitments include actions beyond those required to meet statutory approvals and their implementation will enhance the mitigation of potential adverse environmental impacts of the Project. Further, the Proponent has developed detailed EMPs to address specific environmental issues identified during the EIS process associated with each element of the Project.

In reaching a conclusion on the acceptability or otherwise of the management of potential impacts of the Project I have considered these Project Commitments and EMPs.

Thus, on the basis of the information provided, including advice from Advisory Agencies, I am satisfied that the adverse environmental impacts associated with the Project are able to be addressed through:

- implementation of the Project generally in accordance with the arrangements described in the EIS, SEIS and the Project Commitments nominated therein
- finalisation and implementation of appropriate Environmental Management Plans
- attachment of conditions listed in Schedules A1 to A5 of this Report (pursuant to s.47C of SDPWO Act) as conditions for development approvals under the *Environmental Protection Act 1994* (pursuant to s.49(1) of SDPWO Act).

I consider that, on balance, there is a strong overriding economic development benefit to be derived from the Project that would accrue to Gladstone, the Central Queensland region, the State and Australia. Therefore, I recommend that the Project, as described in detail in the EIS and SEIS and summarised in Section 2 of this Report, can proceed, subject to the conditions contained in Schedules A to C of this Report.

In the event of any inconsistencies between the EIS documents and the recommended requirements in this Report, the recommended requirements in this Report prevail.

Copies of this Report will be issued to:

- GPNL, in accordance with section 35(5)(a) of the SDPWO Act
- the Minister responsible for the *Mineral Resources Act 1989*, in accordance with section 45(2)(a) of the SDPWO Act, for conditions relevant to the nickel ore slurry pipeline located within the corridor area for Mining Lease Application number 80134
- the EPA Minister, in accordance with section 49(2) of the SDPWO Act, for conditions applicable to any environmental authority required for the nickel ore slurry pipeline located within the corridor area for Mining Lease Application number 80134
- the Gladstone Ports Corporation Limited in accordance with section 40 of the SDPWO Act, as Assessment Manager for approvals required over Project components on Strategic Port Land at Wiggins Island, Clinton Wharf and Fisherman's Landing
- the Environmental Protection Agency, in accordance with section 53 of the SDPWO Act, with respect to recommended conditions to be attached to environmental authorities for Environmentally Relevant Activities under the *Environmental Protection Act 1994*



- the Department of Main Roads and the Department of Natural Resources and Water, in accordance with section 53 of the SDPWO Act
- Gladstone Regional Council and Rockhampton Regional Council, in accordance with section 53 of the SDPWO Act
- the Australian Government Minister for the Environment, Heritage and the Arts to make an assessment of the controlled action for the purposes of the EPBC Act.

In accordance with section 35(5)(b) of the SDPWO Act, a copy of this Report will also be made available to the public on the Department of Infrastructure and Planning web site at: <http://www.dip.qld.gov.au/projects/mining-and-minerals/nickel/gladstone-pacific-nickel-refinery.html>.

8. Acronyms, abbreviations and glossary

AHD	Australian Height Datum
AIM	Alternative Investment Market (London Stock Exchange)
Al	Aluminium
Amsul	Ammonium sulphate
ANZECC	Australian and New Zealand Environment Conservation Council
ARI	Average Recurrence Interval (rainfall)
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASS	Acid sulfate soils (under SPP 2/02)
Barren liquor	Process “liquor” (i.e. slurry) originating from seawater that is unable to be reused in the refinery process (also referred to in the EIS as “return liquor” as it is returned to the refinery from the RSF).
BAT	Best available techniques
CAMBA	China Australia Migratory Bird Agreement
CCRCMP	Curtis Coast Regional Coastal Management Plan
CFD	Computational Fluid Modelling
CG	The Coordinator-General of the State of Queensland
CHAG	Clean and Healthy Air for Gladstone Project
CoB	Close of business
CEMP	Construction Environmental Management Plan
CO ₂	Carbon dioxide
CRS	Community Rent Scheme
Ca	Calcium
Cd	Cadmium
Cl	Chlorine and chlorides
Co	Cobalt
Cr ³⁺	Trivalent chromium
Cr ⁶⁺	Hexavalent chromium
DA	Development approval (under IPA)
DEWHA	(Commonwealth) Department of Environment, Water, Heritage and the Arts
DPA	Dugong Protection Area
DIP	Department of Infrastructure and Planning
DME	Department of Mines and Energy
DMR	Department of Main Roads
DPI&F	Department of Primary Industries and Fisheries
DTA	Direct toxicity assessment



EFMA	European Fertilizer Manufacturer Association
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPA	(Queensland) Environmental Protection Agency
EP Act	<i>Environmental Protection Act 1994</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cwlth)
EPP	Environmental Protection Policy
EEMAG	East End Mine Action Group (Inc.)
EIL	Environmental Investigation Level
ERA	Environmentally Relevant Activity (under the EP Act)
EVR	Endangered, vulnerable and/or rare species
FFMP	Far-field monitoring program
FHA	Fish Habitat Area (under the <i>Fisheries Act 1994</i>)
FTE	Full-time equivalent
FSL	Full supply level
Fe	Iron
GAMS	Gladstone Airshed Modelling System
GAWB	Gladstone Area Water Board
GBR Coast MP	Great Barrier Reef Coast Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GBRWHA	Great Barrier Reef World Heritage Area
GEIDB	Gladstone Economic and Industry Development Board
GNP	Gladstone Nickel Project (“the Project”)
GPCL	Gladstone Ports Corporation Limited
GPNL	Gladstone Pacific Nickel Ltd
GQAL	Good Quality Agricultural Land (under SPP 1/92)
GRC	Gladstone Regional Council
GSDA	Gladstone State Development Area
G-SIMF	Gladstone Social Impact Mitigation Fund
ha	Hectare (10,000 m ²)
HIL	Health Investigation Level
HPAL	High pressure acid leach
HPZ	(Marine Park) Habitat Protection Zone
H ₂ S	Hydrogen sulphide
Hg	Mercury
IAS	Initial Advice Statement
IDAS	Integrated Development Assessment System (IPA Chapter 3)
ILUA	Indigenous Land Use Agreement
IPA	<i>Integrated Planning Act 1997</i>



JAMBA	Japan Australia Migratory Bird Agreement
KP	Kilometre point
Limestone	Calcium carbonate
MCU	Material change of use (under IPA)
ML	Mining Lease
MNES	Matters of National Environmental Significance (under the EPBC Act)
MNPL	Marlborough Nickel Pty Ltd
Mg	Magnesium
Mn	Manganese
MnOOH	Manganese oxyhydroxide
MnO ₂	Manganese dioxide
NC Act	<i>Nature Conservation Act 1994</i>
NC Regulation	<i>Nature Conservation (Wildlife) Regulation 1994</i>
NEPM	National Environmental Protection Measure
NEPC	National Environment Protection Council
NFMP	Near-field monitoring program
NRW	(Queensland) Department of Natural Resources and Water
Ni	Nickel
NO _x	Oxides of nitrogen
OEMP	Operations Environmental Management Plan
PAMs	Preassembled modules
PCIMP	Port Curtis Integrated Monitoring Program
pH	Power of hydrogen (the measure of the acidity or alkalinity of a solution)
PIA	Pavement Impact Assessment
ppm	Parts per million
QAL	Queensland Alumina Limited
QH	Queensland Health
QR	Queensland Rail
QT	Queensland Transport
RE	Regional Ecosystem
REMP	Receiving environment monitoring program
RIA	Road Impact Assessment
RL	Relative level (elevation)
RMP	Road Use Management Plan
ROP	(Water) Resources Operation Plan (<i>Water Act 2000</i>)
ROW	(Pipeline) Right of way
RSF	Residue Storage Facility
SDPWO Act	<i>State Development and Public Works Organisation Act 1971</i>
SEIS	Supplementary Environmental Impact Statement



SGICSDA	Stanwell-Gladstone Infrastructure Corridor State Development Area
SO ₂	Sulphur dioxide
SO ₃	Sulphur trioxide
SO ₄	Sulphate
SO _x	Oxides of sulphur
SPP	State Planning Policy
TDS	Total dissolved solids
TIA	<i>Transport Infrastructure Act 1994</i>
ToR	Terms of Reference
UK IPPC	United Kingdom Integrated Pollution Prevention and Control
VM Act	<i>Vegetation Management Act 1999</i>
WHO	World Health Organisation
WICT	Wiggins Island Coal Terminal
WIW	Wiggins Island Wharf
WQO	Water Quality Objective
WRP	Water Resource Plan (<i>Water Act 2000</i>)
Zn	Zinc