4.0 Waste Management

4.1 Introduction

Waste management will be an integral component of the Gladstone Nickel Project (GNP) operations. The production of nickel and cobalt is a continuous process that incorporates extensive waste minimisation strategies in its design (refer Section 4.3). Gladstone Pacific Nickel Ltd (GPNL) commits to reducing waste production through recovery, re-use and recycling and through encouraging efficient utilisation of resources. GPNL aims to promote best practice disposal of waste products both on-site through appropriate maintenance of waste disposal areas such as the Residue Storage Facility (RSF) and off-site through utilising environmentally responsible waste management contractors.

The main waste streams generated from the refinery's operations have been identified and are summarised in Figures 4.1.1 and 4.1.2.

4.2 Legal Requirements

4.2.1 Government Policy

Under the *Environmental Protection Act 1994* (EP Act) waste generators, transporters and receivers must comply with the *Environmental Protection (Waste Management) Policy (EPP Waste Management) 2000* and the *Environmental Protection (Waste Management) Regulation 2000.* The objective of the Policy is to achieve "ecologically sustainable development" in relation to waste management. The policy sets a framework for this to occur which includes:

- Adoption of the waste management hierarchy.
- Assigning responsibility for waste management.
- Outlining specific mechanisms for waste management planning.
- Outlining state government responsibilities for waste management.
- Implementing a review system for the policy.

The regulation sets specific requirements for the management of regulated waste, waste disposal facilities, waste management by local government, and litter control.

4.2.2 Waste Definitions

The EP Act defines "waste" as anything that is:

- Left over, or an unwanted by-product, from an industrial, commercial, domestic or other activity; or
- Surplus to the industrial, commercial, domestic or other activity generating wastes.

The *Environmental Protection Regulation 1998* defines "general waste" as waste other than regulated waste. Regulated wastes are defined in Schedule 1 of the *Environmental Protection (Waste Management) Regulation 2000* as 'non-domestic' waste (which is defined in Schedule 7 of the Regulation).

The *Environmental Protection Policy (Waste) 2000* defines "regulated waste," as any waste:

- That contains a significant quantity and concentration of a hazardous contaminant; or

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Figure: 4.1.1 | Rev. A | A4

Title: LEACH PLANT - WASTE MANAGEMENT SCHEMATIC

180 KM SLURRY PIPELINE TO GLADSTONE

ACID LEACHING CIRCUIT

CCD WASHING / NEUTRALISATION CIRCUITS

MIXED SULPHIDE PRODUCT

Gladstone
PIPELINE
Marlborough Mine
High Mg Ore
Low Mg Ore
Holding Tanks
Imported Ore
Stockpile Imported Ore
Heaters
HPAL
Steam
Autoclaves
Flash Vessels
Sulphuric Acid Plant
Sulphuric Acid (98%)
Steam
Residue Storage Facility
Disposal by Licenced Contractor
Residue Storage Facility
Residue Storage Facility
Lime Plant
Limestone
FINAL NEUTRALISATION
Lime
Final Neutralisation Tanks
Flocculant
COUNTER CURRENT DECANTATION
Residue Slurry
ENHANCED SAPROLITE NEUTRALISATION
Sulphuric Acid
Steam
Limestone
Neutralisation Tanks
Limestone
SOLUTION NEUTRALISATION
Flocculant
Hydrogen Sulphide
MIXED SULPHIDE PRECIPITATION
Filter Press
Hydrogen Sulphuric Incinerator
Process Vent Gases
Power Station
Port Curtis
Natural Gas
Residue Storage Facility
Residue Storage Facility
Barren liquor disposal to Port Curtis

A1 Air Emissions (Stack)
L1 Liquid Waste
S1 Solid Waste

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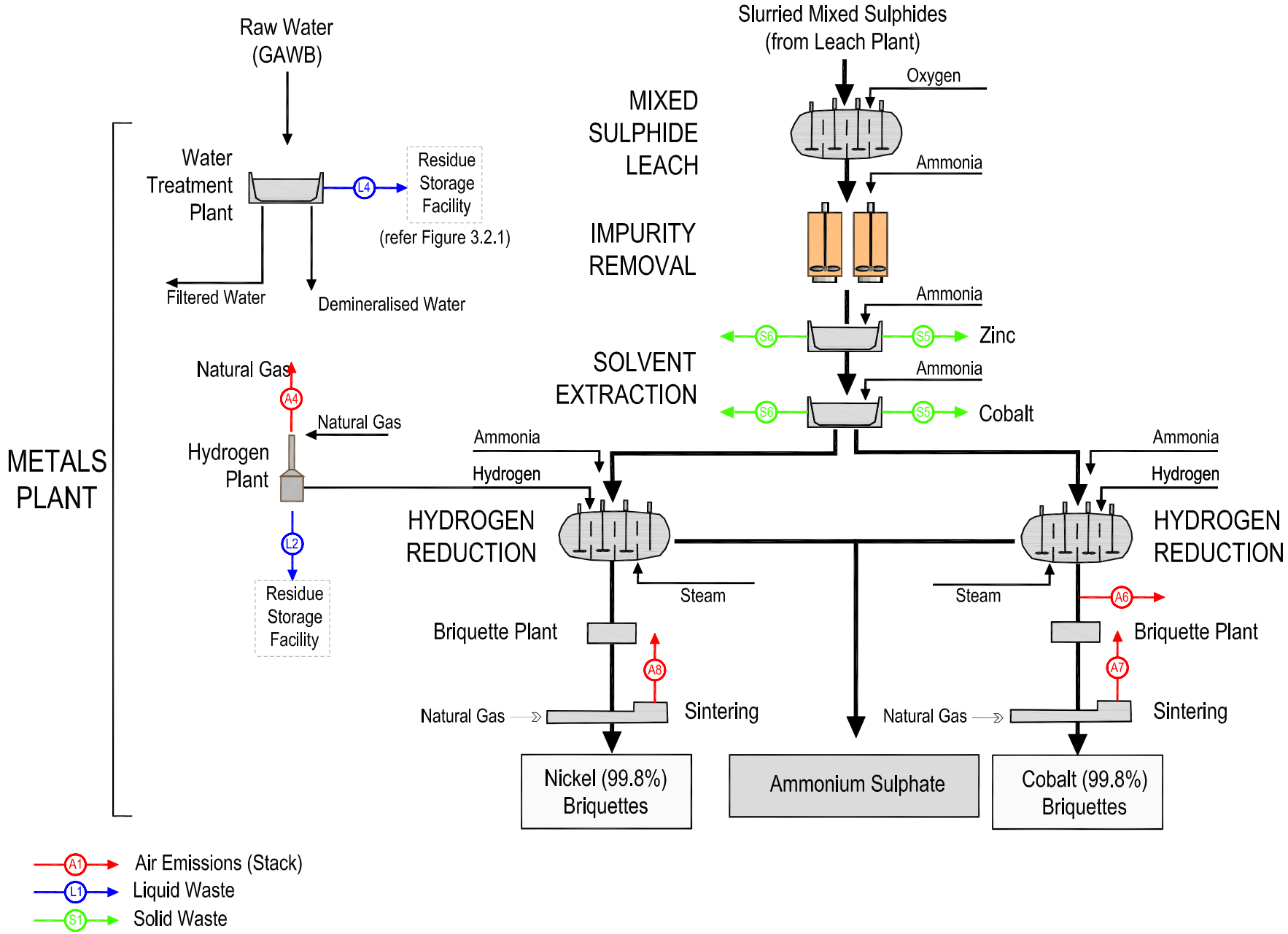
Figure: 4.1.2 | Rev. B | A4

Title: METALS PLANT - WASTE MANAGEMENT SCHEMATIC



- Where the hazardous contaminant exhibits hazardous characteristics because of its toxicity, carcinogenicity, mutagenicity, teratogenicity, flammability, corrosivity, reactivity, ignitability or infectiousness, through its physical, chemical or biological characteristics; or
- That may cause environmental harm if improperly transported, treated, stored, disposed or otherwise managed.

4.3 Waste Minimisation

As a generator of waste, GPNL will ensure that it meets its obligations under both the *EPP (Waste Management)* and *Environmental Protection (Waste Management) Regulation 2000* during the design, construction and operational stages of the project.

The key principles of cleaner production and application of the waste management hierarchy have been an integral part of the design philosophy of the GNP. According to the waste management hierarchy, the following is the preferred order of adoption of waste management practices:

- Waste avoidance
- Waste re-use
- Waste recycling
- Energy recovery from waste
- Waste disposal.

GPNL's commitment to implementing these principles is demonstrated through the following:

- Recovery of excess heat at each step of the process in waste-heat boilers, superheaters and economisers. Heat will be recovered in the form of superheated steam and low-pressure saturated steam to be used to meet process requirements and generate power.
- Recovery and re-use of off-spec products and high pressure acid leach (HPAL) and mixed sulphide precipitation (MSP) autoclave descale within the process.
- Storage of runoff from process areas for re-use as process water within the refinery where appropriate.
- Re-use of decant water from the RSF as process water within the refinery where appropriate.
- Collection of sulphur waste by a licensed contractor for recycling e.g. large scale composting facility which generates horticultural products.
- Recovery and re-use of multimedia filters from the waste treatment plant.
- Recycling of waste oil, scrap steel, filter belts and rubber where possible.

4.3.1 Waste Management Plan

GPNL is committed to continual improvement in waste management and will develop a waste management plan in accordance with the relevant legislation prior to commencement of operations. It is anticipated that this plan will include:

- The scope and objective of the plan.
- The environmental values to be protected.
- The inputs and outputs of the process, and their impact on the environmental values.
- The opportunities and actions to be taken to implement the waste management hierarchy.
- Life cycle assessment recommendations.

- Action plans.
- Emergency response procedures.
- Training and management.
- A monitoring and reporting program.

All site personnel and contractors will implement the waste management hierarchy when undertaking activities on site in the following order of priority:

1. The generation of waste will be prevented or reduced by substituting inputs for those that generate waste; increasing efficiency in the use of raw materials, energy, water or land; redesigning processes or products; and improving maintenance and operation of equipment.
2. Re-use of waste will be achieved by recovering solvents, metals or oil and re-using them for a secondary purpose.
3. Wastes will be segregated for recycling into new products. Wastes that can be recycled include glass, cardboard, paper, plastics, aluminium, batteries, oil, drums and rubber.
4. Energy generated from waste will be recovered and utilised where possible.
5. Where appropriate, licensed contractors will dispose of waste, or treat and dispose of waste, in ways that minimise harm to the environment. This will be achieved by employing bio-treatment to degrade material into a compound or mixture, blending or mixing waste to obtain a compound or mixture, storing or repackaging waste, and disposal to a landfill.

4.3.2 Waste Prevention

Waste prevention is the first step in minimising the amount of waste produced. Careful planning can also result in a substantial cost saving. For example, the amount of material brought on site for the project can be minimised by careful consideration of what is needed. Any excess materials and used chemical containers will, where practical, be returned to the supplier or other local users.

4.3.3 Waste Separation

Solid waste streams will be separated into various components at the point at which they are produced. Waste separation at source will be achieved by providing bins for re-usable or recyclable materials. An area will be allocated within the refinery for the collection of large quantities of waste.

The implementation of waste management strategies will ensure that the site does not become contaminated with fuel or process liquor spills during the construction and operational phases.

4.3.4 Contamination Avoidance

During both construction and operational phases, careful consideration will be given to the choice of materials used in the refinery as this can also have an impact on the ultimate volume of waste going to landfill.

4.4 Waste Tracking

All waste movement out of the refinery site will be tracked in accordance with the requirements of the *Environmental Protection (Waste Management) Regulation 2000* Schedule 2. “Prescribed information for waste tracking.” Specifically this will include recording the following information:

- Name, address, local government area and contact details of generator.
- Name, address, contact details and environmental authority number of receiver.
- Name, address, contact details and environmental authority number of transporter.
- The day and time the waste is given to the transporter.
- The load number.
- Registration number of the vehicle transporting the load.
- If the waste is a dangerous good:
  - The type and number of containers in which the waste is contained.
  - Its UN number.
  - Its packing group designator.
  - Its dangerous goods class and any subsidiary risk.
- The following details of the waste:
  - The type of waste.
  - Amount expressed in kilograms or litres.
  - Its physical nature (solid, liquid, paste or gas).
  - Its waste code.
- The waste origin code for the activity that generated the waste.

A waste tracking system using customised software and a computerised data entry system and recording process will be utilised.

4.5 Construction Wastes

4.5.1 Pipeline Construction

Construction of the pipelines is not expected to generate significant quantities of waste. The key waste streams will include:

- Regulated/hazardous waste (oils, greases, solvents etc).
- Trees and vegetation from site clearing.
- General waste.
- Recyclables such as scrap pipe, steel offcuts, plastics.
- Hydrostatic test water.

4.5.2 Refinery and Residue Storage Facility Construction

The major solid waste streams likely to be generated during construction of the refinery and the RSF are as follows:

- Trees and other vegetation from initial clearing.
- Timber from concrete formwork, boarding and associated waste.
- Scrap steel and offcuts, including weldmesh, conduit, pipework, nuts, bolts and concrete reinforcing rods.
- Concrete, plaster board and cement sheeting.

- Insulation materials.
- Plastics from conduit and pipe work.
- Miscellaneous wastes from a range of construction activities including:
  - General office refuse, paper, food scraps, food containers and wrappings.
  - Packaging materials from equipment, material, stores and spare parts.
  - Residues from painting, lubricating fluids and fuels for machinery.

4.5.3 Waste Generation

A summary of each waste type, estimated volumes and management options for construction wastes generated at the refinery, pipeline and RSF are outlined in Table 4.5.1.

Table 4.5.1 Waste Type, Volume and Management

Waste Type and Generation Point	Estimated Volume	Management
Non-recyclable general waste including: • Packaging; • Ropes; • Cardboard; • Construction workers' village wastes including; – Putrescibles, – Paper, – Timber; and – Plastic piping.	*Pipeline* - 5 m^3 per week; *Refinery* - 10 m^3 per week; and *RSF* - 5m^3 per week (approx).	Disposed of by licensed contractor to designated landfill.
Regulated wastes including: • Hazardous Wastes: – Gasket adhesives, – Fuels and oils, – Cutting lubricants, – Cleaning agents, – Water treatment chemicals, and – Non-destructive testing - spent pipeline x-ray film (chemicals) • Batteries • Tyres	*Pipeline, refinery and RSF* - Minor quantities	Removed by licensed contractor for recycling or treatment/disposal.
Recyclables including: • Scrap metal; • Welding rods; • Circumferential fibre/nylon rope spacers used in pipe transport; • Construction workers' village waste; • Building waste: – Timber from concrete frameworks – Scrap steel and off cuts – Some plastics – Some oils	*Pipeline* – Minor quantities; *Refinery* – 2 t per week (approx); and *RSF* – Minor quantities.	Wastes will be segregated for reuse/recycling where practical and an economical service exists. Removed by licensed contractor.

Table 4.5.1 Waste Type, Volume and Management

Waste Type and Generation Point	Estimated Volume	Management
Hydrostatic Test Water (pipeline only)	*Pipeline* - 70,000 kL (approx).	May be supplied for beneficial use in consultation with the relevant landholder; or Disposed to land via a stabilised area that prevents any runoff to sensitive environmental areas.
Sewage Sullage	*Refinery* - Maximum 40,000 L/d. *RSF and Pipeline* – Variable (up to 350 personnel for pipeline and 50 personnel for RSF).	Treated at Calliope Shire Council sewage treatment plant. RSF and pipeline treated on site by package sewage treatment system and disposed of by reticulating over adjacent grazing land.

4.5.4 Potential Impacts and Mitigation Measures

Potential impacts associated with the inappropriate management of construction waste streams may include:

- Visual impacts.
- Water or land contamination.
- Harm to flora and fauna.
- Introduction and/or spread of pests and weeds.
- Health and hygiene issues.

Opportunities for recycling materials, dependent upon the availability and capacity of local facilities, will be investigated and implemented where practicable. The general principle of 'Reduce, Reuse, Recycle' will be adopted.

Waste, where practicable and taking into account health and hygiene issues, will be segregated and collected on-site and stored in suitable containers for removal to approved facilities as agreed with the relevant local council prior to construction. It is expected that at least 10% of all construction materials can be recycled.

The following are examples of how materials, identified as construction wastes, have potential for reuse or recycling:

- Where possible, tree wastes from site clearing will be chipped and stockpiled for future use on site landscaping and rehabilitation areas.
- Soil from excavation work will be stripped in layers, stockpiled and reused for contouring, landscaping and rehabilitation.
- Recyclable building wastes will be collected separately and re-used or recycled, for example:
  - Timber from concrete formwork will be recovered and reused.
  - Scrap steel and off-cuts will be recycled.
  - Pallets for re-use or recycling.
  - Plastics will be recycled.
  - Oils will be collected and sent for recycling.

The impacts associated with waste will be successfully mitigated through the implementation of a waste management plan. Specific waste mitigation and minimisation techniques are contained in Section 14.

GPNL has also considered using a modular construction technique for the refinery (refer to Section 5.13) which will reduce the generation of construction wastes.

4.6 Operational Liquid Wastes

Where practicable, liquid wastes will be recovered and reused within the refinery. This will be achieved through the provision of bunded areas surrounding refinery processing areas. Sumps and permanently mounted sump pumps and discharge piping will be utilised to re-circulate liquid wastes into the process and enable maximum recovery of metals and reagents and minimisation of liquid wastes for disposal. Some examples of recovery and reuse of liquid wastes include:

- Spillages of liquid caustic in the caustic storage area recovered to the sulphide precipitation process.
- Liquids generated during clean-up of the sulphide precipitation filters and associated equipment and spillages in the sulphide precipitation flocculant area recovered to the sulphide precipitation process.
- Recovery and reuse of aqueous and organic liquids from crud generated in the solvent extraction area and from drainage of solvent extraction vessels, filter backwashes and spillages in the solvent extraction area.
- Solution from the scrubber in the nickel reduction area recovered to the ammonium sulphate plant.
- Spillages in the flocculant preparation areas recovered to the relevant process plant equipment.
- Sulphur blowdown from the hydrogen plant recovered to the sulphuric acid plant sulphur preparation area.
- Liquids generated in the sulphur preparation areas during clean-up recovered to the pressure acid leach process.

The major liquid waste streams generated by the GNP during operations, which are not reuseable due to process constraints, are:

- Return water from the RSF in excess of refinery needs (comprised of liquor recovered from the RSF residue thickener and decant liquor from the RSF).
- Seawater used for cooling purposes.
- Cooling water and boiler blowdowns.
- Sewage.
- Start-up and shutdown wastes.

The sources, quantities and fate of the liquid wastes generated by the refinery's operation for Stage 2 are presented in Table 4.6.1 and are described further in the following sections. Details of the environmental effects of the disposal of liquid wastes are provided in Section 8.

Table 4.6.1 Liquid Wastes

Source	Stream No.[1]	Quantity (ML/y)	Destination
RSF return water (barren liquor)	L1	27,000	Disposal to Port Curtis via diffuser
Boiler blowdown	L2	60[2]	Disposal to Port Curtis via diffuser
Cooling water blowdown	L3	30[2]	Disposal to Port Curtis via diffuser
Reject water from water treatment plant	L4	1,800[2]	Disposal to Port Curtis via diffuser
Power station cooling water	L5	231,000	Disposal to Port Curtis via diffuser

Table 4.6.1 Liquid Wastes

Source	Stream No.[1]	Quantity (ML/y)	Destination
Sewage from offices and ablutions	-	54,000 L/d	To sewerage treatment plant at Yarwun

[1] Refer Figures 4.1.1 and 4.1.2.

[2] Quantity included in quantity for RSF thickener overflow and RSF decant liquor. Liquid waste added in final neutralisation, pumped to RSF and returned to refinery for disposal with excess return liquor.

Blowdown from boilers, cooling water towers and reject water from the water treatment plant will be discharged to the RSF with process residue. These liquid wastes will then return to the refinery with decant liquor (L1) for re-use in the refinery. The cooling water and return liquor will be combined and discharged to Port Curtis via a diffuser system near the Clinton wharf at the RG Tanna Coal Terminal. A summary of the potential environmental impacts associated with the containment of liquid wastes within the RSF is provided in Table 4.6.2. Sewage will be sent to the Calliope Shire sewage treatment plant.

Table 4.6.2 RSF Sources of Potential Environmental Harm and Control Measures

Source of Potential Environmental Harm	Potential Environmental Impacts	Control Measures
Seepage / Loss of containment of residue liquor	Potential contamination of surface and groundwater	• Dry stacking and amphirol machining of residue to create a low permeability cover (refer Section 9.3). • Seepage collection trench designed to collect seepage (refer Section 9.3). • Strategic program of groundwater monitoring bores. • Design of RSF in accordance with best practice, including stabilised embankments, spillways and maximising dry residue areas (refer Section 2.5.3 and Section 9.3)

Details of the environmental effects of the disposal of liquid wastes on the marine environment and proposed control measures to reduce impacts are provided in Section 8.3.

4.6.1 RSF Thickener Overflow and Decant Liquor

Following removal of metals for recovery as nickel and cobalt products, the leach liquor will be combined with solid residues from the leach plant and neutralised before being pumped to the RSF for long term storage. The solid residue will be thickened in the RSF thickener before being discharged to the RSF. Liquor separated in the RSF thickener and liquor decanted from the RSF will be combined in return liquor tanks and pumped back to the refinery. Some of this liquor will be used in the refinery for re-pulping gypsum.

The surplus return liquor in excess of the refinery's re-use requirements will be combined with the cooling water return and pumped through a diffuser to Port Curtis. Eductors at the discharge ports will reduce the temperature of the liquor by diluting it with seawater. The environmental impacts of the discharge are discussed in Section 8.3

4.6.2 Power Station Cooling Water

Cooling water for the power station will be seawater drawn from Port Curtis. This water will be used in a "once through" system with the water passing through heat exchangers and then being discharged back into Port Curtis.

4.6.3 Sewage

The refinery sewerage system will comprise a system of underground gravity sewers, pumping stations and rising mains to allow sewage to be pumped to the adjacent Calliope Shire sewage treatment plant. Arrangements for the treatment of domestic sewage from the refinery's administration and ablution areas are discussed in Section 3.4.

4.6.4 Stormwater Runoff

Stormwater will be managed by bunding process areas. All stormwater runoff from process areas will be screened and contained in settlement ponds. Water from the settlement ponds will be used as process water makeup within the refinery or treated when required and discharged to Port Curtis. Details of stormwater management within the refinery site are provided in Section 8.2.

4.6.5 Start-up and Shutdown Wastes

Contaminated water may be generated from equipment cleaning in preparation for start-up and during shutdowns. These wastes will only be generated intermittently i.e. at start-up and during maintenance periods which are unlikely to occur more than once per year. This contaminated water will be reused in the process where possible, or treated to an acceptable standard and discharged.

4.7 Operational Solid Wastes

Where possible, solid wastes produced during operations will be recovered and reused in the process plant to maximise recovery of metals and minimise solid waste for disposal. Some examples of recovery and reuse of solid wastes include:

- Milled sulphide precipitation autoclave scale recovered to the sulphide precipitation process.
- Recycled nickel and cobalt powders, nickel and cobalt dusts from the baghouses and recycled green briquettes recovered for briquetting.
- Nickel and cobalt powder dryer fines recovered through the wash water system.
- Ammonium sulphate recovered as a by-product, some of which is used in nickel and cobalt reduction.

The main solid waste streams generated during the operation of the refinery, which will not be able to be reused due to process constraints, include:

- Process residue
- Scale (from cleaning autoclaves)
- Lime slaker grit
- Sulphur filter rejects
- General solid waste.

The sources and quantities of solid wastes predicted to be generated from the refinery during operations for Stage 2 are given in Table 4.7.1.

Table 4.7.1 Solid Wastes

Waste	Source	Stream No.[1]	Quantity	Fate
Process Residue	Final Neutralisation	S1	10,850 kt/y	Engineered residue storage facility
Autoclave Scale	HPAL Autoclaves	S2	200 t/y	Engineered residue storage facility
Lime Slaker Grit	Lime Plant	S3	NA (dependent on lime quality)	Engineered residue storage facility
Sulphur Filter Rejects	Sulphuric Acid Plant	S4	8 kt/y	Disposal by licenced contractor e.g. agricultural end use
Zinc Sulphide	Solvent Extraction	S5	80 t/y	Engineered residue storage facility but options for recovery and resale currently being investigated
Solvent Extraction Crud	Solvent Extraction	S6	6 t/y	Disposal by licenced contractor
Acid Plant Catalyst – spent vanadium oxide	Acid Plant	S7	90 m^3/y	Disposal by licenced contractor, may be possible to resale for vanadium recovery

[1] Refer Figures 4.1.1 and 4.1.2.

4.7.1 Process Residue

Process residue will be the main waste product to be generated from the refining process and will comprise the solids remaining after the nickel and cobalt have been extracted from the nickel laterite ore and the process liquors have been neutralised.

The residue will be stored in an engineered RSF designed specifically for the long term storage of refinery residue. Residue will be deposited as a high density slurry. Some of the liquor discharged in the slurry will separate from the solid phase. The surface liquor will be pumped back to the refinery and the solids will further settle and consolidate. At the end of its operating life, the RSF will be rehabilitated to form a self-sustaining land surface. Refer to Section 9 for further details.

4.7.2 Autoclave Scale

Scale will be generated from cleaning the HPAL and MSP autoclaves. Mixed sulphides generated from de-scaling will be recycled through the refinery. Scale that cannot be re-used within the refinery will be disposed of in an appropriate area of the RSF.

4.7.3 Lime Slaker Grit

Lime slaker grit waste will be generated within the lime slaker. This waste stream will be non-hazardous and it will be disposed of in a selected area of the RSF.

4.7.4 Sulphur Filter Rejects

Sulphur filter rejects will be mainly composed of gypsum formed when the minor quantity of acid within the sulphur prill is neutralised with lime during sulphur melting. Small amounts of inert solid contaminants may be present in the incoming sulphur. These will be filtered out and disposed of with the gypsum by a licenced contractor. The volumes of solid waste generated are expected to be small in comparison with the total volume of sulphur.

Waste contractors have indicated that one option for reuse is treatment in large scale composting facilities, which produce horticultural products.

4.7.5 Zinc Sulphide

Zinc will be selectively removed from the metal-containing liquor in the solvent extraction circuit in the metals plant. Zinc will be removed as zinc sulphate in solution and converted to solid zinc sulphide. Options for the sale of this by-product for subsequent zinc recovery are being considered. If it cannot be reused, it will be disposed of in the RSF.

4.7.6 Solvent Extraction Crud

Solvent extraction crud, formed when organic materials adsorbs on to any solids present in the feed solutions to the solvent extraction process, will be treated in batches, filtered, and packaged in drums for disposal by a licenced contractor.

4.7.7 Acid Plant Catalyst

The catalyst required for the conversion of sulphur dioxide to sulphur trioxide in the sulphuric acid plant, breaks down gradually with time and thermal cycling during plant start-up and shutdowns. During planned maintenance shutdowns, the catalyst will be screened, with the fine particles being removed. This spent catalyst will be disposed of by a licenced contractor.

4.7.8 General Refuse

The following general solids waste streams will be generated during the operational phase of the project:

- Plastic materials and packaging.
- Insulation materials.
- Used filter cloth.
- Operational maintenance waste such as cleaning rags and fabrication off-cuts.
- General timber and cardboard packaging materials.
- General office waste paper, cardboard, food containers and scraps.

These general wastes will be disposed of at a suitable local licensed landfill (refer Section 4.10). GPNL is considering potential waste synergies with other industrial operations in the area to reduce potential impacts from wastes.

4.8 Operational Air Emissions

The major air emissions released from the refinery will be particulate matter and gases, particularly from the sulphuric acid plant, power station and leach plant stacks. There are also likely to be dust emissions associated with the handling and storage of limestone and sulphur.

HPAL technology is acknowledged as emitting lower amounts of particulates and greenhouse gases than alternative process technologies. Features of the project designed to minimise air emissions include the measures listed below:

- Emergency venting protected against through the provision of pressure safety valves.
- Use of robust prill or pastille sulphur product to minimise fugitive emissions associated with sulphur handling and storage.
- Use of dust suppressants where relevant, such as during sulphur unloading.
- Watering of disturbed areas and dry ore handling areas.
- Double absorption sulphuric acid production technology to minimise sulphur dioxide emissions.
- High efficiency scrubbing of steam from the HPAL flash vessels.
- Capture and combustion of potential fugitive gases such as hydrogen sulphide.
- On-line stack gas monitoring where natural gas is combusted to maintain efficient combustion operation.

The sources of air emissions associated with the refinery (continuous operation of Stage 2) are presented in Table 4.8.1 for total emission rates from the site. A detailed assessment of the impacts of air emissions is provided in Section 8.7.

Table 4.8.1 Air (Stack) Emissions

Source Name	Stream No.[1]	Stream Emission Rates
Sulphuric Acid Plant	A1	152 g/s (Sulphur dioxide - SO_2) 8.7 g/s (Sulphur trioxide - SO_3)
Hydrogen Sulphide Incinerator	A2	1.6E-03 g/s (SO_2) 0.8 g/s (Oxides of nitrogen - NO_x)
Power Plant	A3	0.5 g/s (SO_2) 17.8 g/s (NO_x)
Hydrogen Plant	A4	6.5 g/s (NO_x)
Neutralisation Vent	A5	8.9E-04 g/s (Hydrogen sulphide - H_2S)
Cobalt Dryer Vent Gas	A6	3.7E-06 g/s (H_2S)
Cobalt Sinter Furnace Stack	A7	9.8E-06 g/s (Cobalt particulate) 5.9E-04 g/s (Cadmium) 5.9E-04 g/s (Mercury) 2.0E-03 g/s (Other particulate metals)
Nickel Sinter Furnace Stack	A8	1.8E-03 g/s (Nickel particulate) 5.5E-03 g/s (Cadmium) 5.5E-03 g/s (Mercury) 1.8E-02 g/s (Other particulate metals)

[1] Refer Figures 4.1.1 and 4.1.2.

4.9 Pipeline Operational Wastes

Wastes generated during operation of the pipeline are expected to be minimal. Very minor volumes may be generated during pipeline maintenance activities. Wastes generated during operation of the pipeline would be disposed of at the local authority waste disposal facilities described in Section 4.10.

4.10 Waste Disposal

Operational and construction solid wastes that cannot be recycled or re-used will be disposed of at various local authority waste disposal facilities. A summary of waste facilities located within the project area, including capacity and wastes accepted, is provided in Table 4.10.1.

Table 4.10.1 Local Authority Waste Disposal Facilities

Shire	Location	Capacity	Facilities
Calliope	Landfill: • Benaraby Transfer Stations: • Yarwun • Mt Larcom • Raglan	Supports Gladstone waste indirectly 40,000-50,000 people	• Domestic • Regulated • Recyclable • Green waste
Fitzroy	Landfills: • Gracemere • Alton Downs Transfer Stations: • Bouldercombe • More planned and under development	Gracemere -3 - 4 years Alton Downs -12 months	• Domestic • Light commercial • Some recyclable • Scrap metal • Green waste • Regulated
Gladstone	Gladstone WasteTransfer Station, Joe Joseph Drive	Supports approx 30,000 people Landfill to Benaraby	• Domestic • Regulated • Green Waste • Recyclable • Inert waste (soil, gravel)