4 Project description

4.1 Project need

As described in Section 3.1, the historical use of the Site has resulted in extensive contamination of both the soil and groundwater. A detailed description of the nature and extent of contamination can be found in Chapter 3 and in Appendix B.

The project involves the urgent treatment of groundwater hotspot contamination on the Site. These hotspots are shown in Figure 6 and further detailed in Appendix B. This is necessary to address DECCs concern regarding the 'significant risk of harm' and to minimise human health and environmental impacts currently affecting the Site and its surrounding areas, and to facilitate effective land use planning. In addition, due to the location of the groundwater remediation system, a disused timber gantry will need to be demolished. Whilst it is not listed on any heritage register, the gantry has been assessed as having local heritage significance and archival recording is accordingly recommended. As the timber of the gantry is highly contaminated, adaptive reuse is not possible.

The majority of groundwater contaminants are heavy metals including lead, zinc and arsenic (Soil & Groundwater Consulting, 2006). Of these, the major contaminants are lead and zinc. This is consistent with the historical use of the adjacent Pasminco land as a lead/zinc smelter and the historical distribution of slag wastes from the smelter on the Site. The Site's groundwater contamination is well in excess of the ANZECC (2000) criteria.

Furthermore, the proposed project will assist in the coordination of the proposed remediation strategy for the Site and remediation which has already commenced on the neighbouring Pasminco lands.

4.2 Project objectives

The principle objective of the hotspot remediation approach is to establish a targeted hotspot groundwater recovery system and water treatment facility to remediate localised areas of highly contaminated groundwater along the northwestern boundary.

4.3 Alternatives to the project

An options analysis has been conducted for alternatives for the proposed project. These are described below. A more detailed analysis of groundwater remediation options is contained in Appendix B. It focuses on the applicability of various treatment methodologies, outlined below, and how effective they are at treating groundwater contaminants.

Do nothing option

One option is to not treat the contaminated groundwater hotspots. However, the primary objective of this remediation proposal is to remediate localised areas, or hotspots, of highly metal impacted groundwater along the northwestern boundary.

Failure to treat these hotspots will result in heavily contaminated groundwater continuing to migrate off-site to Pasminco land. As such, this option will not result in the project objectives being met and is not considered feasible.

This option will also be contrary to DECC's recommendations of having 'significant risk of harm' addressed as soon as possible.

Treat and remove from site option

The second option is to treat and remove groundwater from the Site. The groundwater treatment system proposed is a 'closed-loop' system, where contaminated groundwater is extracted, treated and re-injected further up stream. This facilitates further extraction and treatment, as the reinjected water will flow downstream and return to the extraction trenches. Whilst treating and removing groundwater from the Site will achieve, in part, the project objective of the hotspot remediation, it will not allow for the impacted groundwater to be returned to the aquifer where it can be later recovered for further treatment. Furthermore, removing the groundwater from Site will result in a dewatering of the groundwater system, which will result in a negative impact (water loss) to the environment. As such, this is not considered a viable option.

Extract and re-inject

The third and preferred option is extraction and re-injection as it allows treatment of the contamination hotspots as well as ensuring the longer-term health of the groundwater system. This option will meet the project objective and result in fewer environmental impacts, as the treated water will not be required to be taken off the Site.

Treatment options

As previously mentioned, the assessment of groundwater remediation options has focused on the applicability of various treatment methodologies for the groundwater contaminants encountered at the Site. The options assessed were:

- Reagent injection.
- Capping.
- Ion exchange.
- Precipitation.
- Permeable reactive barrier.
- Acid neutralisation.

The range of options considered for the targeted remediation of groundwater hotspots impacted by metals were evaluated against the following criteria:

- The potential for removal of contaminant mass from the Site.
- The potential for reduction of metal concentrations in groundwater discharging from the Site.
- The practicability of the remediation option.
- The generation of waste requiring off-site disposal.
- Control of risks to human health and the environment.
- Cost.

A scoring system was used to rank the possible remediation options against the above criteria. On this basis, a pump and treat system employing precipitation combined with gravity clarification was considered the most appropriate technology to apply for targeted hotspot remediation.

4.4 Detailed description of project

Remediation action plan

The project will involve the targeted remediation of contamination hotspots at the northern area of the Site. This will reduce the contamination level of the groundwater system, prior to the installation of the containment cell in stages 2 to 4 of the remediation strategy. The target of these works will be in the southern and western portion of the northern area of the Site (Figure 6).

Figure 6 Contamination hotspots

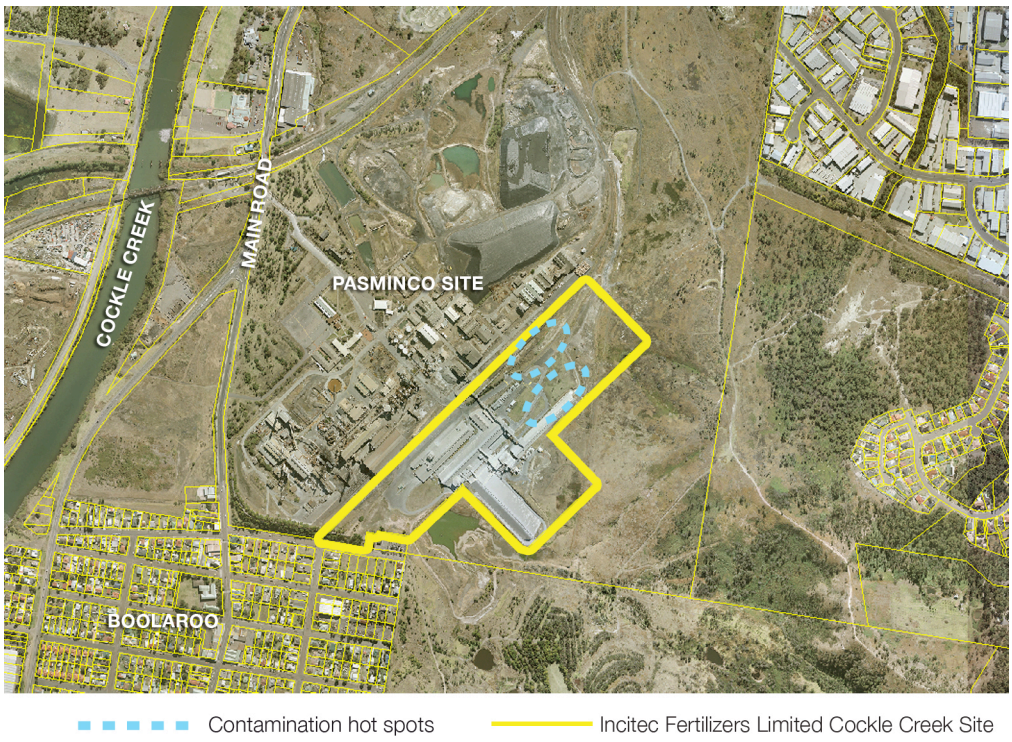


Figure 6 shows the hotspots containing concentrations of heavy metal contaminants that are well in excess of ANZECC (2000) guidelines.

Groundwater flow is naturally toward the west in the direction of Cockle Creek. Therefore, groundwater discharge from the Site will be predominantly in a westerly direction across the Site's western boundary.

The proposed groundwater interception scheme will develop a depression in the groundwater system in the vicinity of the hotspot areas such that the contaminated groundwater will be drawn toward the low point of the depression, ie the extraction system, and is thus prevented from crossing the site boundary. The longitudinal arrangement of the extraction system essentially perpendicular to the groundwater flow direction (parallel to the site boundary) will result in an elongated depression in the watertable with the long axis of the depression perpendicular to the groundwater flow. This will optimise the recovery of impacted groundwater which may otherwise have migrated across the site boundary.

The ongoing extraction of the groundwater will maintain this level of the watertable depression and restrict the movement of contaminated groundwater from the hotspot areas at the Site. It is expected that the groundwater extraction and treatment system will continue until such time as it can be demonstrated to the satisfaction of the Site auditor that the residual contamination does not pose an unacceptable risk to the environmental values of the groundwater system.

General features of the project will include:

- Groundwater extraction.
- Providing a treatment plant that will remove metals via precipitation with alkali, flocculation and gravity thickening of the precipitant and finally dewatering of the precipitant via Geotubes®.
- Providing electricity and water services to the treatment plant via underground conduit.
- Re-injection of groundwater into the aquifer.
- Removal of existing railway trestle structures.

The groundwater will be extracted by pumps on the surface and will then be directed via a pipeline to a specialised precipitation treatment plant where the metal contaminants will be removed from the water stream. The result of this process will be a waste product encapsulated by a Geotube® as described in Section 4.5. The filled Geotube® will either be disposed within the containment cell or disposed off-site in accordance with EPA requirements. A more detailed description of the treatment system is given below, and in Appendix B.

Groundwater extraction and treatment system

The options for groundwater system extraction are currently undergoing trials on-site. The result of these trials will determine the precise configuration of the groundwater extraction and treatment system. Both options have been assessed as part of this EA. These are:

- Trenching to remove shallow impacted groundwater. The trenches will be installed perpendicular to the groundwater flow direction (parallel to the western boundary) as indicated in Figure 7 and excavated to a depth of six metres and a width of 0.8 metres with an approximate length of 65 metres. The trench can be further extended if required. A broadly uniform drawdown will occur along the trench due to the high permeability of the backfill material. The level will be controlled by the rate of water removal from the sump. The sump associated with the extraction trench shall be fitted with a single submersible pump.
- Groundwater wells to be used in place of extraction trenches. Wells have the advantage of creating less site disturbance but a disadvantage is they are limited by the nature of the formation screened by the well. The greater surface area of the trench in contact with the aquifer has the potential to overcome localised variations in aquifer physical properties that may not occur with wells. To achieve a similar objective to the trench, a series of extraction wells will be placed at the required spacing perpendicular to the groundwater flow direction (parallel to the western boundary). This will result in a series of overlapping drawdown cones resulting from each well, which will give an overall depression in the watertable along the series of wells. As the objective of the wells is to remove shallow impacted groundwater, they will be seven metres deep and screened from seven to one metre below ground level. An extraction well diameter of 150 millimetres will allow for fitting with a submersible pump. All extraction pumps will be able to be controlled individually to allow optimisation of the extraction regime. It is anticipated that approximately six extraction wells will be required in place of a trench, although this will be refined following the on-site trial.

The groundwater will be returned to the shallow aquifer described in Section 7.1 and detailed in Appendix B via an infiltration trench as described in Section 4.5. This trench will either be located at a higher gradient than the aquifer or located between extraction locations to further facilitate the recovery of impacted groundwater. This will ensure the return of treated water to the aquifer occurs within the zone of influence of the extraction system, so that treated groundwater is eventually recovered again by the extraction system. It will also help mitigate any risks associated with the re-injection of water into the aquifer, such as mobilising contaminants. Treated water could also be disposed to sewer or stormwater locations, subject to licensing requirements.

The groundwater treatment system will be in operation until construction of the containment cell begins, provided that the contamination of the hotspots is reduced to an appropriate level.

The following diagrams illustrate how the extraction and treatment facility will work. Figure 7 illustrates the extraction system with trenches, while Figure 8 shows an extraction system with wells. Further detail regarding their installation can be found in Section 4.6 (construction methodology). Detail regarding the operation and potential operational impacts of this facility can be found in Chapter 7 and in Appendix B.

Figure 7 Extraction system with trenches

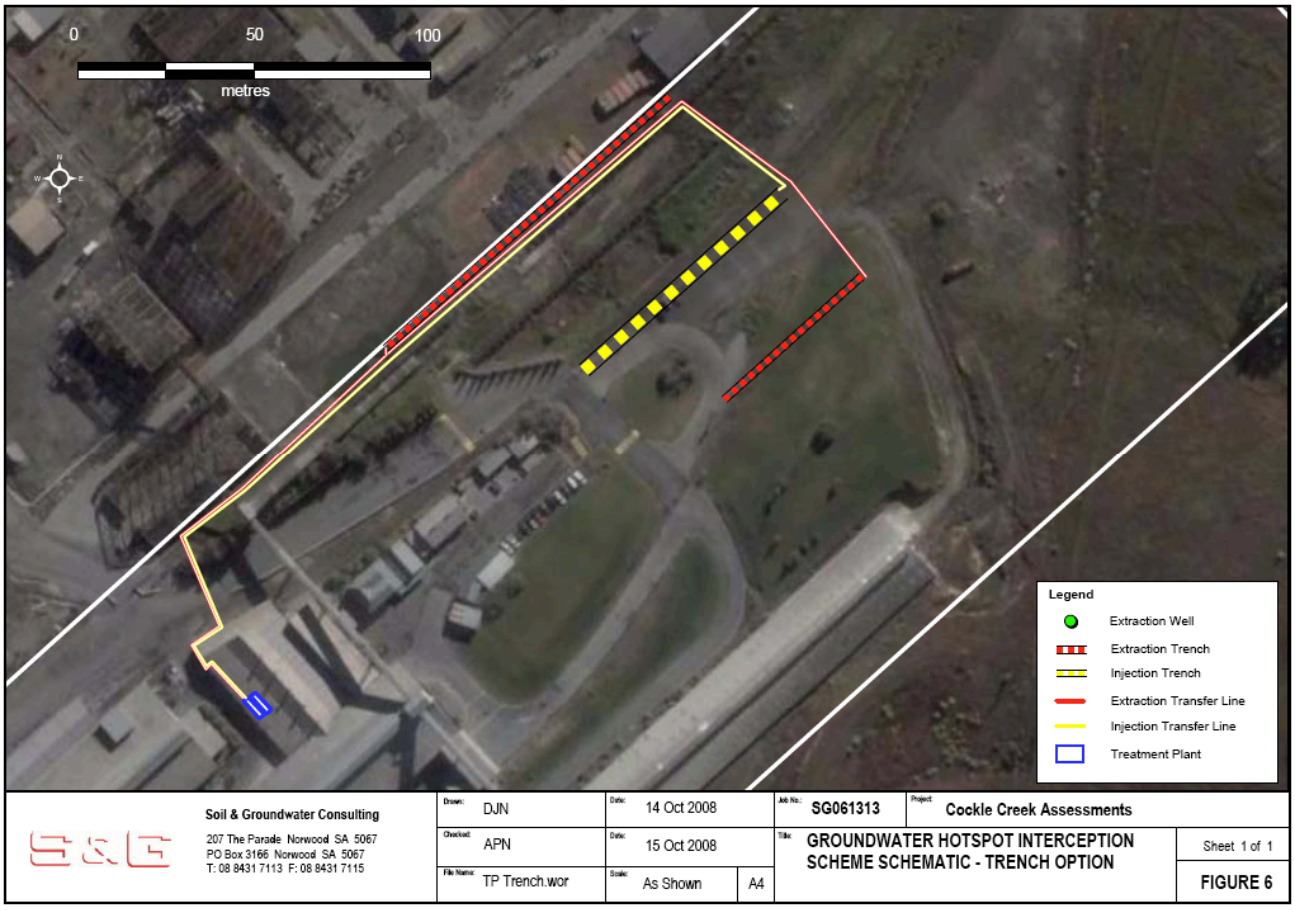


Figure 8 Extraction system with wells

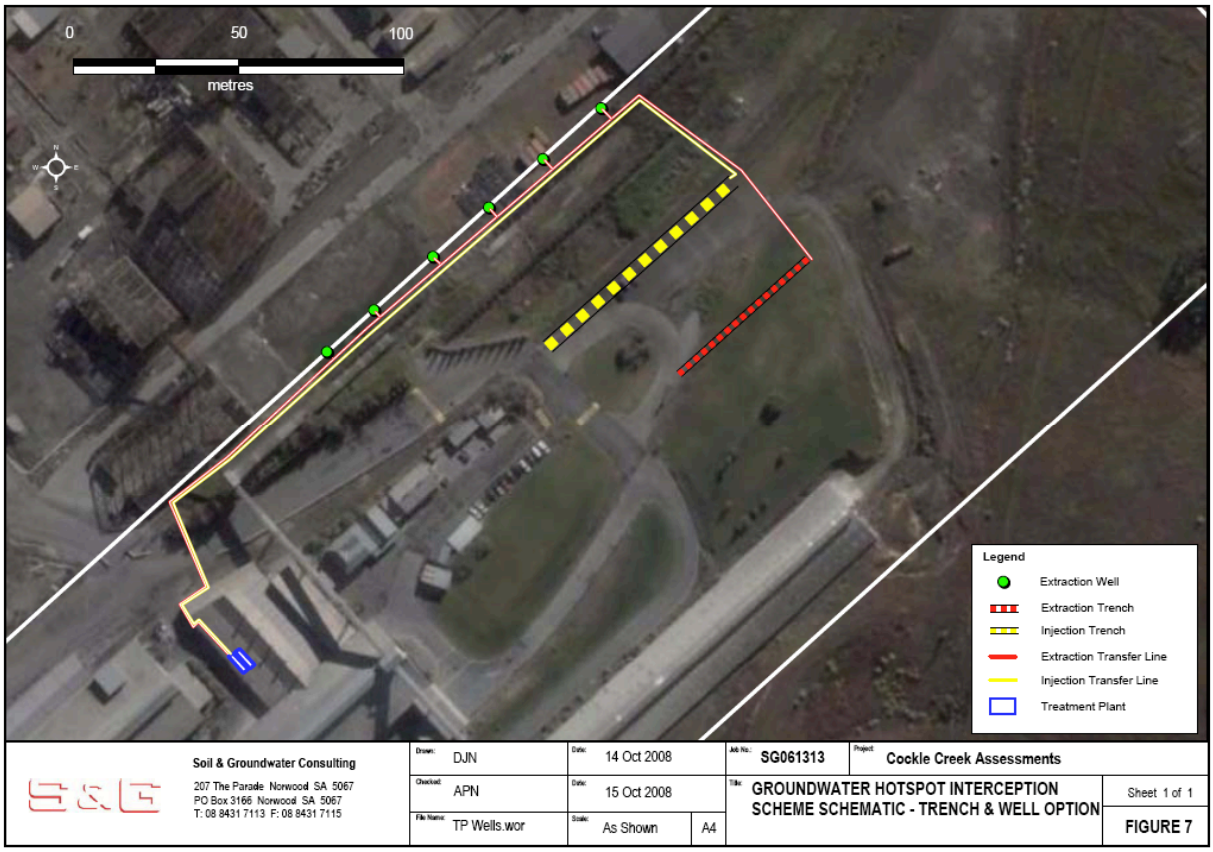
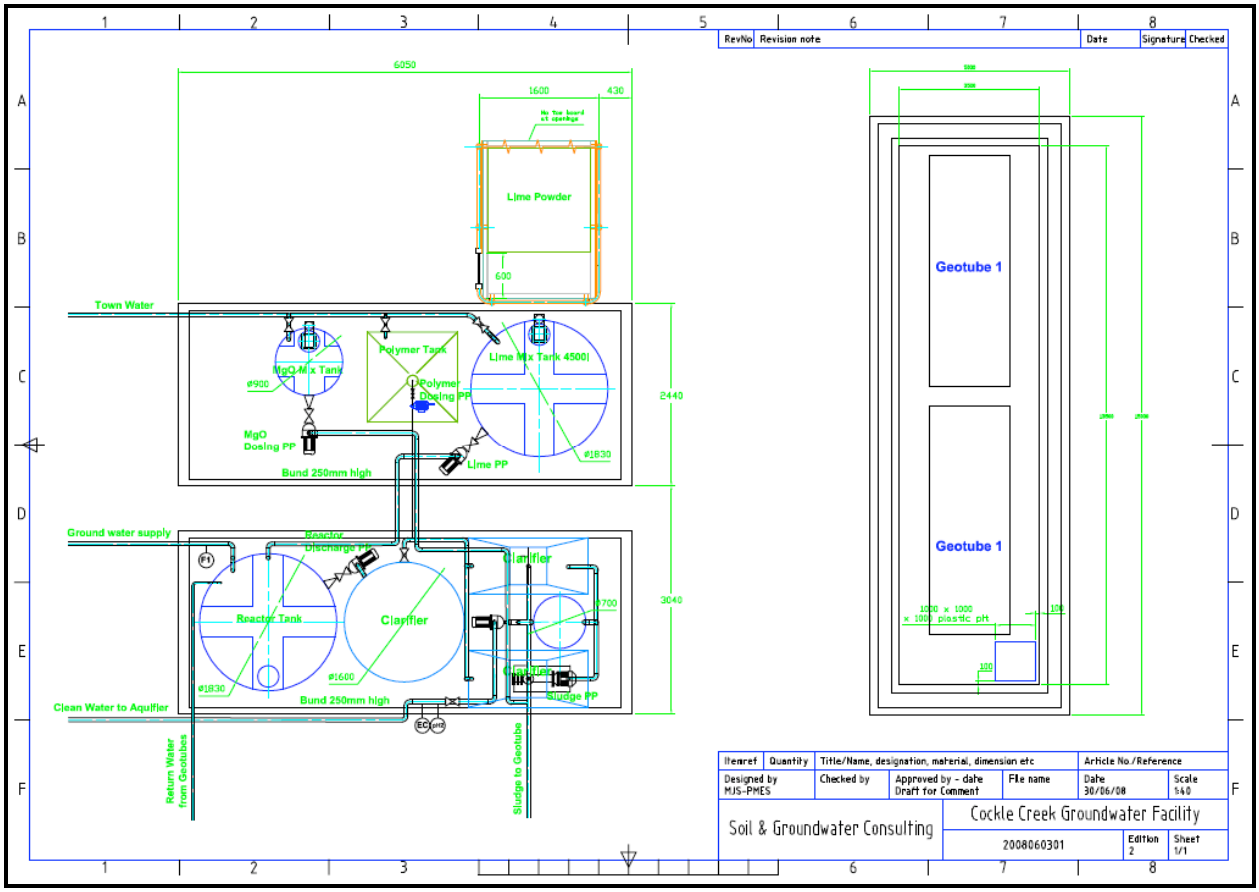


Figure 9 provides a plan of the proposed treatment system of the groundwater facility.

Figure 9 Treatment system



4.5 Proposed groundwater remediation process

The groundwater treatment plant (GTP) will be constructed off-site as a packaged plant and will be housed in two shipping containers, which will be transported to the Site and housed within an existing building. The plant operation will be fully automated and operated by a programmed logic control (PLC) unit. Each shipping container will be fitted with a 250 millimetres deep impermeable bund. The bunds will be fitted with level switches that will shut down the GTP in the event that water is detected in either bund. A modem will be fitted to the plant which will allow alarms to be sent from the plant via SMS. It will also be possible to request a status from the plant for example, instantaneous flow rate and pH remotely through the plant GSM modem.

Operator attendance of the plant will be required routinely to prepare lime slurry, magnesium oxide slurry and polymer solution. Calibration of the two pH meters will also be required as per schedule.

Groundwater extraction

Groundwater extraction will occur from either or both series of wells located along the Site's western boundary and from an extraction trench that will run parallel to the north-western boundary (refer to Figure 7 and Figure 8). Total flow is expected to be less than approximately one cubic metre per hour and will flow to a 4,500 litre polyethylene reaction tank. The wells will be fitted with small electric submersible extraction pumps and the extraction trench will each be fitted with extraction sumps. The actual pumping regime will be optimised based on extraction and system performance.

The extracted groundwater will be transferred to the reaction tank via an underground polyethylene pipeline. All inflow into the GTP will pass through a magnetic flow meter that will provide both instantaneous flow rate and totalised flow readings. The plant PLC will include controls to cease plant operation in the scenarios of a dry infiltration trench or wells and/or extracted groundwater discharge line failure. This control will include no flow detection i.e. if no flow is detected at the flow meter during extraction pump operation then a fault condition will be identified shutting down groundwater extraction. A remote monitoring system will allow Soil and Groundwater Consulting to observe flow rate and totalised flow and therefore, in conjunction with other parameters, enable logging and assessment of GTP performance.

Reaction tank

The treatment process is a continuous process. A pressure transducer fitted to the reaction tank will be used to balance the level of the reaction tank. If low level is reached in the reaction tank then discharge from the tank will cease until the tank level returns to the normal operating range. If high level is reached then filling of the tank is suspended until such time the tank level falls to within the normal operation range. A high level will be set. If this level is reached a plant fault condition will be identified and the plant will shut down. A high level overflow into the container bund will also be provided as a failsafe. The reaction tank is continuously stirred by recirculating of the liquid.

Lime slurry

Lime will be dosed to the reaction tank with a variable speed Bredel peristaltic pump from a 4,500 litre lime slurry tank. The slurry can be prepared at a concentration between ten and 20 per cent. Lime will be purchased in 20 kilogram bags and added manually to the slurry tank via an elevated platform. It is expected that slurry preparation will be carried out approximately weekly. The lime slurry tank will be filled using the Site's reticulated water. The filling operation will be carried out as a manual operation without requiring isolation from the GTP. The tank will be fitted with a mechanical float valve to control filling. A high level overflow into the container bund will be provided as a failsafe. The lime slurry tank will be continuously stirred with a mechanical stirrer.

pH control

The optimum pH range for precipitation of the metals of concern has been determined in laboratory trials and the set point for precipitation will be 7.5 units. A pH probe will be installed in the reaction tank. The lime dosing pump will be controlled via a pH control loop, and dosing will cease at a pH of 7.6 units. If the pH in the reaction tank falls below 7.4 units, the forward feed to the clarifier is suspended until such time that the set point is achieved. If the pH in the reaction tank falls below 7.0 units the GTP will shut down and an alarm will be sent to the operator via SMS.

Polymer dosing

Polymer is required to increase the settling rate of the precipitate. A 1,000 litre intermediate bulk container fitted with a stirrer will be used for polymer make up and storage. Dosing will be carried out with a small dosing pump. Polymer will be dosed in-line between the reaction tank and the clarifier. The polymer pump will be linked to the reaction tank discharge pump and will therefore start and stop in unison with this pump. The discharge line of the dosing pump will be fitted with a no flow switch. If there is no flow the plant will shut down and an alarm will be sent to the GTP operator via SMS.

Polymer selection and dosing rate will be determined by the polymer supplier using static cylinder tests. Fine tuning of dose rate will be undertaken during commissioning of the plant. Polymer preparation will be a fully manual operation. The stirrer will only operate during polymer preparation.

Clarifiers

The GTP will be fitted with a total of three clarifying devices. The primary clarifier will be a circular stainless steel hopper bottomed tank, which all flow will pass through. The flow will then be equally split between two rectangular polyethylene hopper bottomed tanks acting in parallel as secondary clarifiers, to efficiently capture settled solids. Solids are removed on a timed basis from the bottom of each hopper using a mono pump. Bench trials indicate that sludge volume will be approximately five per cent of throughput. It is therefore expected that approximately one cubic metre of sludge will be created daily. The sludge will be pumped to one of two Geotubes® located within a bunded area adjacent to the GTP. The primary clarifier will be fitted with a high level switch which stops inlet flow until such time that the level drops. This control 'times out' so that if the level in the clarifier does not return to the operating level within a set period of time the plant shuts down.

The secondary clarifiers discharge to a 500 litre polyethylene break tank which will be fitted with a pressure transducer. A pump fitted to this tank will pump treated water back to the infiltration trench while the break tank level is within the normal operating range, below the normal range the pump will stop. If the level in the tank is above the normal range then feed to the clarifier will stop. A high level overflow into the container bund will be provided as a failsafe.

Magnesium oxide slurry

When sludge is discharged from the clarifier hoppers magnesium oxide slurry will be added to the sludge as a further safeguard to stabilise the sludge in accordance with disposal requirements. The slurry will be dosed in line with a Bredel peristaltic fixed speed pump which will be linked to operate only during sludge discharge pump operation.

Magnesium oxide slurry will be prepared manually in a 1,000 litre tank, which will be filled using town water and continuously stirred with a mechanical stirrer. The tank will be fitted with a mechanical float valve to control filling. A high level overflow into the container bund will be provided as a failsafe.

Geotubes®

Geotubes® are constructed of high strength permeable geotextiles that are fabricated into bags that can be filled with a variety of materials that require dewatering. The weave of the Geotubes® creates small pores that confine sludges whilst allowing 'free' water to pass through the Geotube®. This results in effective dewatering and efficient volume reduction of the sludge which allows for staged filling of the bags.

After the final cycle of filling and dewatering the retained sludge will be further consolidated by natural drying through the escape from the sludge and Geotubes® of residual water vapour. Two Geotubes® will be located adjacent to the GTP in a bunded area. Excess water draining from the tubes will be collected in a sump and then pumped back in to the reaction tank. The bunded area will also have a high level cut off switch fitted which will stop the GTP if triggered.

Treated groundwater infiltration

Treated water will be infiltrated into the aquifer by gravity drainage via a clean rubble filled infiltration trench. A level sensor will be fitted to the trench to allow continuous monitoring. Should the trench level reach a preset high level, the GTP operation will cease until such time that the level returns to the operating range. This control will prevent surface inundation or trench overflow.

A summary of the initial findings can be found in Appendix B.

4.6 Construction methodology

General

Construction of the groundwater recovery and treatment facilities will last approximately four weeks. The two main components of construction are the civil works associated with the installation of the groundwater extraction and injection infrastructure and the installation of the pre-built groundwater treatment plant.

Prior to the civil works beginning the existing disused gantry will need to be demolished. This area consists of a series of large wooden trestles located on concrete footings. The contamination status of the gantry will be assessed to determine appropriate handling and disposal requirements. Where possible, waste materials will be separated and reused. Any contaminated waste materials will be disposed of in accordance with DECC requirements. The volume of the wood and concrete contained within the gantry area is not currently known with any level of accuracy.

The standard work hours will be Monday to Friday, 7 am to 5 pm. Work outside of these hours will be by special arrangement only. The main equipment required for the works will be two large excavators, a drill rig, a tip truck, a water cart and associated equipment. There will be three machine operators and a supervisor provided by the civil contractor.

Installation of the groundwater extraction system

The first stage of the civil works will be the excavation of an extraction trench running north parallel to the Site's western boundary with the installation of up to six extraction wells running along the western boundary. This trench will be approximately 65 metres in length, six metres deep and 0.8 metres wide. The project will require the excavation of a re-injection trench approximately 95 metres long, six metres deep, and two metres wide also running north parallel to the Site's western boundary as indicated in Figure 8.

The excavated soil will be transported to an on-site stockpile located within an existing site building. In the event that soil was required to be stored outside, this material will be managed in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2006).

If groundwater wells are found to be the best method for extraction, they will be drilled with a truck-mounted drill rig. A driller and an offsider will operate the equipment and the rig will be self-contained. Spoil from the drilling works will be stockpiled adjacent to the drilling location. Contaminated fill will be segregated from the natural soil and then managed along with other contaminated materials from the trenching operations. As drilling works will be mostly below the watertable, dust generation will be minimal.

Water tankers/sprayers will be used to control dust within the excavation or demolition areas as required. Dust will be managed under the direction of the Site supervisor. Appropriate dust control equipment will be available at all times during the works program.

Installation of the GTP

The treatment plant will be predominantly housed in two locked shipping containers that will be fitted-out off-site. The shipping containers are bunded internally and fitted with cut-off switches that stop all flow should the bund fill with water. Plumbing and electrical services for the treatment plant will be installed simultaneously with the civil works. A bunded area will be created immediately adjacent to the treatment plant. This area will contain the water released from the Geotubes®. This water is collected and returned to the infiltration trench.

The transfer of contaminated groundwater to the plant will occur via pipelines, which will be in shallow trenches and cut under existing internal site roadway. Electrical cables for pump operation (well and sump pumps) will be in same conduit and transfer power from the existing site building to the extraction locations. Pump control will be maintained from the treatment plant programmable logic controller.

In addition, a site supervisor will be present to ensure that the works are carried out to specification and in accordance with health and safety plans and environmental management plans. An exclusion zone will be created around the civil works with access restricted to personnel that are required to be within the working zone. All works, equipment storage, excavated materials, fill materials and amenities will be within the Site.

As defined by the DGRs, construction is considered a key issue for this environmental assessment. A detailed assessment of the impacts of this construction methodology and proposed mitigation measures can be found in Section 7.2.

4.7 Operation

The operation of the project is as described Chapter 3 of the conceptual RAP (Appendix B).

Other than reagent addition, which will occur weekly, the treatment plant requires minimal maintenance. Instruments will require calibration on a monthly basis and calibration records will be kept. The main reagents to be added are hydrated lime and magnesium oxide. These materials are not classed as dangerous substances and no licensing is required to store these materials, nevertheless the materials are inherently dusty and highly alkaline resulting in some potential hazards. The treatment plant has been designed such that exposure to dusts will be minimised. Work instructions will be created to detail the reagent addition procedure, including safety measures and personal protective equipment required to reduce the hazard risk.

A baseline groundwater monitoring program will be conducted in the study area. Periodic groundwater monitoring will be conducted throughout the remediation program to characterise the influence of the remediation program on groundwater contaminant concentrations. Monitoring of the treatment plant influent and effluent concentrations will be undertaken routinely to verify the performance of the treatment plant and ensure that injected water complies within the nominated target criteria.

The results will be assessed as they are collected, and the temporal and spatial influence of the remediation system on the groundwater quality will be determined. The residual groundwater concentrations will be assessed against the remediation objectives to determine the requirement for continuation of remediation. The results will be provided periodically to the site auditor for review and comment. When it is determined that the remediation objectives have been met, a report will be prepared for the site auditor for consideration and agreement.

The groundwater remediation system will be operated under an environmental management plan to identify and appropriately address environmental risks associated with the installation and operation of the plant.

The treatment plant and the extraction and injection infrastructure will be fitted with appropriate monitoring and control systems such that the plant can be operated remotely through a programmed PLC unit, although manual replacement of the reagents will be periodically required. The system will incorporate a number of failsafe and backup controls such that any breach of the system or operational parameters occurring outside an acceptable range will result in plant and pump shutdown. The treatment plant and all the control and management functions will be tested and verified during the

commissioning phase. In the case of shutdown, the system will only be reset following correction of the malfunction.

Furthermore, as defined by the DGRs, operation is considered a key issue for this environmental assessment. A detailed assessment of the impacts of the operation methodology and proposed mitigation measures can be found in Section 7.3. This section includes details regarding the classification of all potential sources of liquid and non-liquid wastes, quantities, storage, treatment and disposal or reuse of waste generated.

5 Stakeholder consultation

5.1 Introduction

This chapter provides an overview of the stakeholder consultation activities carried out during the preparation of the EA as well as the communications and consultation activities proposed during the public exhibition phase of the proposed project.

Consultation objectives

A communications and consultation strategy has been prepared for the proposed project to ensure that stakeholders are consulted and appropriately informed.

The primary objective of the consultation process for the proposed project is to meet the DGRs for stakeholder consultation. These requirements are to:

- Consult with the relevant local, State or Commonwealth government authorities, service providers, community groups or affected landowners:
  - DECC.
  - Department of Health (DoH).
  - Department of Water and Energy (DWE).
  - Mines Subsidence Board.
  - Lake Macquarie City Council.
  - The administrators of the Pasminco Cockle Creek Smelter site.
- The consultation process and the issues raised must be described in the environmental assessment.

In addition to the consultation requirements of the Director-General, the stakeholder consultation process was designed to meet the following objectives:

- Preserve, build and enhance the reputation of IFL.
- Gain stakeholder input and support for the project so that proposed demolition and remediation works at the Site can be carried out effectively.
- Ensure that relevant project information is shared with stakeholders, including customers, in an accessible format.
- Ensure that communications activities are undertaken in coordination with key project milestones.
- Ensure that IFL employees are kept up to date with latest information regarding the Site remediation project.

5.2 Preliminary consultation

Key stakeholders

Some early consultation with key stakeholders has been undertaken in relation to the proposed project. This included meetings with Lake Macquarie Council, DECC and the administrators of the Pasminco Cockle Creek smelter site. In addition, the project team has been in contact with the Mine Subsidence Board, and has submitted licence applications with DWE.

A letter was also sent to the following stakeholders during preparation of this EA:

- DECC.
- DoH.
- DWE.
- NSW Department of Primary Industries (DPI).
- Mine Subsidence Board.
- Lake Macquarie City Council.

The letter provided a brief outline of the project, and invited each agency to provide feedback to IFL with any issues or concerns they may have in relation to the proposal. The letter also offered a briefing from the project team to provide further information on the project and discuss key issues.

Issues discussed during preliminary consultation, including those raised in response to the letter, are presented in Table 2 below. A reference to where each issue is addressed within this environmental assessment is also included.

Table 2 Stakeholder areas of interest

Stakeholder	Area of interest	Where addressed within this EA
DECC	• Containment strategy overview • Preliminary cell design • Remediation update and hotspot remediation approach • Conceptual RAP • Draft VRA	Chapters 3 and 4 Appendix A and C
DWE	• Groundwater hotspot extraction and injection,	Chapters 3 and 4
Mine Subsidence Board	• Location of mine workings in and near the IFL Site, • Advised of subsidence parameters for future mining, and certification required for any future development.	Section 8.2
DPI	• Discussion with land holders regarding coal titles within the subject area, • Request for ongoing consultation with the Mine Subsidence Board and the NSW DPI Mineral Resources Division,	Section 5.3
Pasminco administrators	• Cross boundary and surface water issues,	Section 7.1

Local community

A community newsletter has been prepared and was distributed in October 2008 to over 3,000 neighbouring residents in Boolaroo, Macquarie Hills, Speers Point and Argenton. The newsletter will inform residents about the proposed remediation works and will let them know how they can provide their feedback on the proposal. The newsletter also includes the project contact details for community enquiries and/or complaints. A copy of the newsletter has been included in Appendix E.

5.3 Ongoing consultation

Although a number of preliminary consultation activities have been completed, the major activities described in the stakeholder consultation plan will be implemented during public exhibition of this EA. During public exhibition of this EA, the following activities will be undertaken:

- A further issue of a community newsletter will be distributed to the local Cockle Creek and Boolaroo community.
- Further meetings will be held with relevant government agencies, and community and environment groups as appropriate.
- Advertisements will be placed in local newspapers.
- A fact sheet will be published and distributed at community locations.
- Website information regarding the project will be prepared.
- Media releases will be prepared and issued as appropriate.

Consultation with all stakeholders and the community will be flexible and ongoing.

6 Environmental risk analysis

6.1 Environmental assessment requirements

The Site has been declared a remediation site and is to be assessed under Part 3A of the EP&A Act. The DoP has subsequently authorised a staged approval process. Project approval is being sought for Stage 1 of the overall remediation strategy described in Section 3.2 of this report.

As required by the DGRs, an environmental risk assessment was undertaken for the project. The risk assessment process identified a number of potential issues for consideration based on preliminary assessments of the Site and experience in similar remediation projects. The risk assessment process is described in more detail in Section 6.2.

6.2 Environmental risk assessment

Overview and environmental risk assessment methodology

The environmental risk assessment is an important step in the process of assessment of environmental impacts. It is used to guide the level of environmental investigations and assessments, project design, appropriate mitigation measures and management responses and to identify potentially significant residual impacts.

The environmental risk assessment has been performed in accordance with the principles of *AS/NZS4360:2004*. The risk of each potential impact has been ranked by identifying the consequences of the impact and the likelihood of it occurring. Measures are then proposed to mitigate the key risks associated with the proposed project.

The risk rating categories determined through the analysis are summarised in Table 3.

Table 3 Risk rating categories

Risk rating score	Risk category	General description
1, 2 or 3	High	Detailed assessment and planning necessary to develop appropriate measures to mitigate and manage the potential impacts.
4 or 5	Medium	Potential impacts can be mitigated through the application of relatively standard environmental management measures.
6	Low	Potential impacts either require no specific management measures or are mitigated adequately through other working controls (such as detailed design requirements, normal working practice, quality and safety controls).

The consequence definitions used in determining the risk rating are given in Table 4.

Table 4 Risk assessment consequence definitions

Consequence level	Definition
Catastrophic	• Will result in a major prosecution under relevant environmental legislation. • Will cause long-term and irreversible impacts.
Major	• Will result in a fine or equivalent under relevant environmental legislation. • Will cause medium-term, potentially irreversible impacts.
Moderate	• Will result in medium-term, reversible impacts.
Minor	• Will result in short-term, reversible impacts.
Insignificant	• Will not result in any impacts.

By considering the frequency of activities that may cause the impact and the probability of the impact occurring during that activity, the likelihood of each identified impact occurring is also used in determining the risk rating. Impact probabilities are classed as:

- Very likely – almost certain to occur in the course of normal or abnormal operating circumstances.
- Likely – event is likely to occur in the course of normal operations.
- Unlikely – event could occur in the course of normal or abnormal operating circumstances.
- Very unlikely – event may occur in exceptional circumstance.

The risk rating of each potential impact is then determined through combining the consequence and likelihood according to the matrix provided in Table 5.

Table 5 Risk matrix

		Likelihood			
		Very likely	**Likely**	**Unlikely**	**Very unlikely**
Consequences	**Catastrophic**	1	1	2	3
	Major	1	2	3	4
	Moderate	2	3	4	5
	Minor	3	4	5	6
	Insignificant	4	5	6	6

Environmental risk assessment analysis

The risk assessment was based on information from the preliminary environmental assessment and experience on similar remediation projects. A series of team meetings were carried out with key members of the project team and the environmental assessment consultants, to identify and review the potential risks associated with the project. The results of the environmental risk analysis are summarised in Table 6.

Table 6 Environmental risk analysis

Issue	Potential impacts	Overall risk category	EA section addressed
Air quality			
Dust generation during construction	• Dust may be disturbed/produced during digging and trenching for construction. • Dust produced may be contaminated. • Dust may be generated during removal of gantry.	Medium	Section 7.2 and 7.3
Emission generation	• Construction and monitoring vehicles produce emissions.	Medium	Section 7.2 and 7.3
Groundwater			
Construction activities causing contamination	• Construction may increase contamination of groundwater.	Medium	Section 7.1
Uncontrolled release of contaminated groundwater during operation	• Spillage of contaminated groundwater from piping or treatment facility. • Potential for equipment failure resulting in untreated groundwater being reinjected.	Medium	Section 7.1
Uncontrolled release of treated groundwater during operation	• Potential for treated groundwater to spill on re-injection.	Low	Section 7.1
Surface water			
Construction activities impact surface water regime	• Civil works may impact on surface water regime.	Low	Section 7.1
Surface water impacts on construction activities	• Surface water migration may disturb civil works. • Surface water erosion during construction.	Medium	Section 7.1
Soil			
Exposure to contaminated soil	• Soil excavated during construction may be contaminated. • Workers may be exposed to contaminated soil.	High	Section 7.1
Uncontrolled release of contaminated soil	• Spillage of contaminated soil during transportation. • Escape of soil from stockpile areas.	Medium	Section 7.1

Issue	Potential impacts	Overall risk category	EA section addressed
Mine subsidence			
Unexpected mine subsidence events	• Mine subsidence events occur during project.	Low	Section 8.2
Noise and vibration			
Noise and vibration impacts community during construction	• Noise levels during construction may exceed existing noise levels from the plant. • Noise from equipment used during construction may affect local businesses and residents. • Vibration during construction may cause damage to built structures.	Low	Section 7.2 and 7.3
Noise and vibration impacts during operation	• Noise treatment plant may exceed noise levels from existing site machinery.	Low	Section 7.2 and 7.3
Indigenous heritage			
Discovery of an indigenous heritage item	• Unknown indigenous heritage items may be uncovered during construction works.	Low	Section 7.4
Destruction of an indigenous heritage item	• Unknown indigenous heritage items may be inadvertently destroyed during construction works.	Low	Section 7.4
Non indigenous heritage			
Removal of heritage items	• Some heritage items will be removed during construction works.	Medium	Section 7.4
Contamination of heritage items	• Retained heritage items may be contaminated.	High	Section 7.4
Destruction of unknown heritage items	• Unknown heritage items may be discovered during construction works.	Low	Section 7.4
Flora and fauna			
Discovery of unknown flora/fauna species	• Significant flora and/or flora species may be unearthed during construction works.	Low	Not addressed in this EA
Impact on flora/fauna arising from construction works	• Accidental death of fauna • Potential for invasion of weeds	Low	Not addressed in this EA

Issue	Potential impacts	Overall risk category	EA section addressed
Hazards and risks			
Impact on personnel or property arising from construction works	• Physical hazards during construction works may cause injury to personnel or damage property.	Medium	Not addressed in this EA
Impact on environment arising from construction works	• Potential for grass fires as a result of 'hot works' during construction. • Failure of treatment plant. • Spillage of water treatment materials.	Low	Not addressed in this EA
Visual amenity			
Decrease in visual amenity during construction works	• Equipment and fencing present during construction may reduce visual amenity for surrounding users.	Low	Section 8.1
Decrease in visual amenity as a result of project	• Removal of vegetation may reduce visual amenity. • Removal of gantry.	Low	Section 8.1
Land use impacts			
Interruptions to the existing site operations	• Location of treatment facility impacts on site operations.	Low	Not addressed in this EA
Socio-economic impacts			
Construction works impact on local residents	• Disruption to the local community may occur during construction works.	Low	Not addressed in this EA
Traffic			
Disruptions in traffic	• Increased traffic to and from the Site may disrupt local road traffic during construction. • Increased internal traffic disrupts site operations.	Low	Section 7.2

Issue	Potential impacts	Overall risk category	EA section addressed
Waste and resource management			
Generation of construction waste	• Generation of waste may occur during construction of stage 1. • Increased demand on local resources. • Workers generate domestic waste.	Medium	Section 7.2
Generation of contaminated waste during construction	• Excavation of unknown contaminated materials.	Low	Section 7.2
Generation of waste from operation of project	• Generation of waste from treatment plant.	High	Section 7.3
Greenhouse gas emissions resulting from plant operation	• Operation of plant generates greenhouse gas emissions.	Medium	Section 7.3

6.3 Outcomes of environmental risk assessment

Environmental issues that were determined to be high risk were considered in this EA in more detail than those indicated to be medium or low risk. This approach is based on the fact that issues exhibiting medium to low risks can be mitigated through the application of standard environmental management measures.

Key issues

The environmental risk analysis identified three items of high risk for the proposed project. These are:

- Soil.
- Non-indigenous heritage.
- Waste and resource management.

The potential impacts of the proposed project on these key issues are explored in detail in Chapter 7.

Non-key issues

Twelve items were identified as presenting a low to medium level of risk. These are:

- Groundwater.
- Air quality.
- Surface water.
- Mine subsidence.
- Noise and vibration.
- Heritage – indigenous.
- Flora and fauna.
- Hazards and risks.
- Visual amenity.
- Land use impacts.
- Socio-economic impacts.
- Traffic.

Despite the medium to low risks associated with groundwater, surface water and indigenous heritage, these issues are discussed in conjunction with the key issue of non-indigenous heritage, in Chapter 7, because of their overall importance to the Site.

Further non-key issues associated with construction of the proposed project are addressed in relation to overall construction impacts in Section 7.2. These include:

- Noise and vibration.
- Air quality.
- Traffic.

There will be minimal socio-economic impacts associated with the proposed project. This issue has therefore not been further considered in this EA.

Impacts on flora and fauna, hazards and risks, and landuse will be addressed as part of a construction environment management plan (CEMP). This will be finalised prior to construction occurring. The non-key issues of visual amenity and mine subsidence are addressed in Chapter 8.

7 Assessment of key issues

This section provides details of key environmental issues associated with the proposed project that were identified as a result of the risk assessment including groundwater, soils, non-indigenous heritage, and waste and resource management. The following information is provided in relation to such issues:

- Existing environment.
- Potential impacts due to the proposed project.
- Measures to avoid, minimise, or mitigate the identified potential impacts.

Although surface water and indigenous heritage were not identified as key issues, these are included in this section with discussion on the closely related issues of groundwater and non-indigenous heritage respects.

This chapter also contains as assessment of impacts associated with the construction and operation of the proposed project as specified in the DGRs, and the measures that will be adopted to manage these. The key issue of waste and resource management that resulted from the environmental risk assessment is addressed in this context, along with other issues such as noise, air quality, and traffic management.

7.1 Soil and water

Existing environment

A detailed description of the existing soil and water characteristics of the Site is provided in the conceptual RAP at Appendix B. A summary of the findings contained in that report is provided below.

Surface water

The nearest naturally occurring surface water body to the Site is Cockle Creek, approximately one kilometre to the west of the Site. The creek drains directly to Lake Macquarie, approximately two kilometres to the south of the Site. There is also a fresh water dam adjacent to the south-eastern boundary of the Site. The dam wall is located within the site boundary, while the remainder of the dam located on the spill way and a spill way directs any discharge form the dam to Cockle Creek.

Storm water management at the Site differs by area, with current arrangements for our study area summarised as follows:

- Run off from the undeveloped northern part of the study area is generally captured by two open drainage channels that convey water to a point on the northern site boundary with Pasminco. From here, the surface water drains to large dams on the Pasminco lands, where it is treated as part of the Pasminco remediation project.
- A number of drainage easements exist on the Site in favour of Pasminco. These easements are intended to provide for drainage of water for Pasminco activities located on the eastern (uphill) side of the Site.

Groundwater

Regional hydrogeological assessments conducted for the neighbouring Pasminco site suggest that the regional groundwater system does not currently discharge to surface waters at Cockle Creek. These assessments assumed that this is due to dewatering activities at a nearby colliery. The potential for the discharge from the groundwater system to Cockle Creek was considered given the possibility that dewatering activities may cease and the groundwater flow may rebound. The future planned remediation works (stages 2 to 4) will remove the source of the groundwater contamination and, as such, prevent continued contamination of the groundwater being discharged from the Site. Therefore it is considered that the planned remediation works will have a long-term benefit, by ensuring that the source of groundwater contamination is removed from the system.

The natural groundwater levels (not those in fill material) at Cockle Creek are below sea level as a result of dewatering by the colliery, hence the natural groundwater cannot discharge to the natural discharge points as the induced levels are below these levels and the groundwater must flow to the colliery. Once this dewatering stops, groundwater levels will rebound to pre-mine levels in due course (maybe many years) as recharge and leakage from the creek cause the groundwater levels to recover. Groundwater will not continue to discharge to points lower than sea level as these points will no longer occur, and sea level will become the new benchmark. Creek levels in Cockle Creek are tidally influenced and are close to sea level. Given the presence of Munibung Hill and the hydrogeology of the area, the most probable discharge point for groundwater from the Site will be Cockle Creek once the natural balance is restored. Hence the removal of contaminants will minimise the environmental risk to the creek posed by the contamination in the long term.

Further to these assessments, targeted groundwater investigations were recently conducted on the northern section of the Site in preparation for assessment of the overall remediation strategy. The key features are summarised in Table 7:

Table 7 Groundwater contamination

Contaminant	Criteria	Contaminant concentration	Exceedance
Zinc	0.015 mg/L[1]	6,600 mg/L	Yes
Cadmium	0.0055 mg/L[1]	17 mg/L	Yes
Copper	0.0013 mg/L[1]	2.3 mg/L	Yes
Lead	0.0044 mg/L[1]	0.64 mg/L	Yes
Mercury	0.0004 mg/L[1]	0.049 mg/L	Yes
Nickel	0.07 mg/L[1]	0.62 mg/L	Yes
Ammonia (as N)	0.91 mg/L[1]	6.6 mg/L	Yes
Nitrate (as N)	0.16 mg/L[2]	12 mg/L	Yes
PAH	Not specified	Below laboratory reporting limits	No
Cyanide	0.004 mg/L [1]	Below laboratory reporting limits	No
Organochlorine pesticides	Not specified	Below laboratory reporting limits	No
Phenols	Not specified	Below laboratory reporting limits	No
Polychlorinated biphenyls	Not specified	Below laboratory reporting limits	No
Volatile halogenated compounds	Not specified	Below laboratory reporting limits	No

[1] *ANZECC 2000 95 per cent marine trigger*

[2] *ANZECC 2000 95 per cent marine (Low Reliability) trigger*

Further characteristics of the groundwater contamination at the Site are:

- Whilst the southern area of the Site (the infilled gully area) was the initial concern and the reason for the issue of the *Declaration of Remediation Site,* recent investigations have indicated that the groundwater in the northern area of the Site is more heavily impacted. This may be due to the increased potential for recharge and leaching in this area as a result of the lack of any hardstand surface cover.
- The distribution of groundwater contamination generally indicates that the highest groundwater concentrations are located in areas where relatively large volumes of slag material are present directly hydraulically up gradient. This also tends to correspond with the highest soil contamination concentrations and leachability results.
- The highest groundwater contaminant concentrations generally occur in the fill or shallow natural groundwaters at each location.
- Low pH groundwaters were encountered across the Site with results ranging from 2.9 to 7.2. Almost all results were found to be below pH 7. The average groundwater pH was approximately 5.1.
- During sampling events, there were no odours apparent or visually impacted groundwater indicative of gross organic contamination.

Soils

The following provides a summary of the key features of the recent extensive soil investigations at the Site, which are described in detail in the conceptual RAP in Appendix B.

Table 8 Soil contamination

Contaminant	Criteria	Contaminant concentration	Exceedance
Total phosphorus	2000 mg/kg [1]	102,000 mg/kg	Yes
Sulfate	667 mg/kg [1]	14,000 mg/kg	Yes
Calcium	No criteria	241,000 mg/kg	N/A
Ammonia (as N)	No criteria	71 mg/kg	N/A
Nitrate (as N)	No criteria	39 mg/kg	N/A
Arsenic	20 mg/kg [1]	6,800 mg/kg	Yes
Cadmium	3 mg/kg [1]	3,500 mg/kg	Yes
Chromium	400 mg/kg [1]	2,700 mg/kg	Yes
Copper	100 mg/kg [1]	8,900 mg/kg	Yes
Lead	600 mg/kg [1]	46,000 mg/kg	Yes
Mercury	1 mg/kg [1]	52.3 mg/kg	Yes
Nickel	60 mg/kg [1]	1,300 mg/kg	Yes
Zinc	200 mg/kg [1]	229,000 mg/kg	Yes
TPH (C6-C9)	65 mg/kg – C6–C9 [2]	Below laboratory reporting limits	No
TPH (C10-C36)	1,000 mg/kg – C10–C36 [2]	230 mg/kg	No
Benzene	1 mg/kg [2]	0.4 mg/kg	No
Toluene	1.4 mg/kg [2]	0.3 mg/kg	No

Contaminant	Criteria	Contaminant concentration	Exceedance
Ethyl benzene	3.1 mg/kg [2]	0.2 mg/kg	No
Xylenes	14 mg/kg [2]	0.7 mg/kg	No
PAHs	20 mg/kg [3]	3.2 mg/kg	No
OCP	No group criteria	Below laboratory reporting limits	NA
PCB	10 mg/kg [3]	Below laboratory reporting limits	No
VHC	No group criteria	Below laboratory reporting limits	NA

[1] *NEPM EIL*

[2] *NSW EPA sensitive use guideline*

[3] *NEPM HIL A (Low Density Residual) guideline*

US EPA TCLP and ASLP leach tests were undertaken on selected samples and indicated that the metals in fill materials at the Site were highly leachable. In particular, lead and zinc leachability showed that all fill materials are potentially moderately to highly leachable and therefore will be required to be managed as part of the overall remediation strategy.

For a detailed discussion of the contamination status of the soils at the Site, refer to the Appendix B.

Potential impacts

Surface water

The Site has existing surface water management systems that control drainage and runoff. Given the distances from the Site and existing water management systems to nearby water bodies, it is not considered that there is a high potential for surface runoff to transport contaminants or other water pollutants to nearby water bodies as a result of the proposed project.

Runoff from the undeveloped northern part of the Site is generally captured by two open drainage channels that convey water to a point on the northern Site boundary with Pasminco. This water is then diverted around the construction area by a drainage channel. As such, it will not require treatment as part of the proposed project. Once discharged onto the Pasminco lands this water is captured in large downstream dams and treated as part of the Pasminco remediation.

It is noted that during the construction of the project there is a low potential for surface water to be impacted by contaminated materials and runoff. During trenching works, there is potential for wet weather runoff to enter the excavations and come into contact with contaminated materials and groundwater. Appropriate dewatering procedures and disposal or treatment of the water will be required to ensure contaminants are not released to the environment as a result.

During the operation of the groundwater treatment plant, surface water runoff will again be controlled by the existing surface water management system. The risk of pollution of surface water from an uncontrolled release of untreated groundwater during operation is considered minimal given the existing infrastructure in place.

The potential risks to surface water quality during both construction and operation will be minimised through the implementation of standard/best practise management measures as described in *Managing Urban Stormwater: Soils and Construction*, published by Landcom (2006).

Groundwater

The project will target hotspots of groundwater contamination that occur in a shallow aquifer to the north-west portion of the Site. These works will precede the development of a containment cell at the Site. The groundwater treatment proposed is necessary at this point, as access to the groundwater will be constrained following the construction of the containment cell.

The groundwater treatment will improve overall groundwater quality and optimise the recovery of shallow contaminated groundwater. It will also provide interim hydraulic containment of the highly impacted groundwater in the northern area. This will be achieved by a closed-loop system whereby treated groundwater is re-injected upstream of an extraction point. This allows for continued extraction and treatment of the groundwater and a progressive lowering of contaminant concentrations.

This process is in line with DECC (2007) *Guidelines for the Assessment and Management of Groundwater Contamination* as it controls the short-term risks that the contamination hotspots present. It will also reduce the mass of contaminants present in the groundwater to the same level as the surrounding sites.

Potential impacts arise from the re-injection of treated groundwater into the aquifer as this may result in the mobilisation of contamination off-site. Also, appropriate procedures must be implemented should contaminated groundwater be encountered during excavation. These are considered in the table below.

Soil

The potential to further contaminate the soil at the Site due to construction activities are considered minimal. Earthworks will be required for the installation of the extraction and re-injection infrastructure associated with the treatment plant. These works will be temporary and occur over a period estimated to be about 4 weeks. All exposed earthwork areas will require adequate erosion and sedimentation controls to be implemented to prevent any migration of materials off-site.

All spoil generated from the construction process will require classification, appropriate management and, if necessary, disposal in accordance with DECC requirements. Any clean material will be used for backfilling, however it is estimated that a further 1500m^3 of clean fill will be required to be imported to the Site.

In addition, appropriate handling methods will be required to ensure any risk to human health is managed when dealing with contaminated materials during construction. These are considered in the table below.

There will be no impacts on soil once the construction activities are complete.

Cumulative impacts

The adjacent former Pasminco site will run a remediation program in parallel to the overall remediation strategy for the Site. The two processes will be largely independent, however there is some potential for cross-boundary interactions during the remediation processes. This will require a coordinated approach to be taken with regard to scheduling works and remediation activities.

The Pasminco site administrators and project managers will be consulted on all remediation activities with potential cross-boundary implications. The consultation will occur prior to any activities taking place to ensure appropriate and relevant issues management.

Achieving compatibility of this proposed project and remediation of the adjacent Pasminco site is an objective of this project. The primary cross-boundary issues are detailed in Section 3.3 of this EA.

Management and mitigation measures

Table 9 provides details of approaches to the management and mitigation of potential impacts on soil and water as a result of the proposed project.

Table 9 Proposed management and mitigation measures of soil and water impacts

Potential impact	Proposed management and mitigation measures
Construction	
Surface water	
Contamination of surface water resulting from infiltration into excavations	• Water will be diverted away from the excavation through standard sediment control measures as defined in the *Managing Urban Stormwater: Soils and Construction* manual published (Landcom, 2006). • Excavations will be covered and bunded to avoid infiltration of surface water. • A detailed dewatering procedure will be developed prior to work starting.
Groundwater	
Contaminated groundwater is encountered during excavation	• Soils excavated from below the water table will be temporarily stored in a disused shed on the Site for later inclusion within the containment cell.
Soil	
Escape of contaminated sediment	• Contaminated sediment will be stored in an existing site building • If the site building is unavailable, stockpiled material will be managed in accordance with the *Managing Urban Stormwater: Soils and Construction* (Landcom, 2006). This could include mitigation measures such as watering down the stockpile and covering prior to completing each days work, to prevent the escape of any contaminated dust or sediment.
Operation	
Surface water	
Contamination of surface water	• Current site drainage systems minimise the volume of surface water entering the Site. • All excavations will be backfilled. • Contaminated sediment will be stored in an existing site building to prevent the infiltration of any surface water. • If the site building is unavailable, stockpiled material will be managed in accordance with the *Managing Urban Stormwater: Soils and Construction* (Landcom, 2006). This could include mitigation measures such as watering down the stockpile and covering, to prevent the infiltration of any surface water.
Groundwater	
The re-injection of treated groundwater results in the mobilisation of existing contaminants off-site.	• The design of the groundwater treatment system is 'closed loop'. This will ensure that any groundwater re-injected will be within the extraction zone of the treatment system and, as such, will prevent any mobilisation of contaminants off-Site.

Potential impact	Proposed management and mitigation measures
Soil	
Ongoing maintenance of stockpiles	• Stockpiles will be stored in an existing site building. • If the site building is unavailable, stockpiled material will be managed in accordance with the *Managing Urban Stormwater: Soils and Construction* (Landcom, 2006) and may include mitigation measures such as watering down the stockpile and covering prior to completing each days work, to prevent the escape of any contaminated dust or sediment.

7.2 Construction impacts

A detailed description of the construction methodology and scheduling is provided in Chapter 4. An assessment of the potential environmental impacts of construction, and management measures that will be used to address these are described below.

Existing environment

Air quality

The simultaneous remediation of the adjacent IFL and Pasminco sites has the potential to have a cumulative adverse impact on air quality. Remediation activities on the Pasminco lands are expected to carry on throughout 2008, with completion in 2009. The existing effluent treatment plant on the site will be decommissioned and a new one installed in 2009, and all works will be completed by 2010. The proposed project is scheduled to begin in 2009, so the potential exists for a limited period of overlap in the Pasminco and IFL Site remediation works during 2009.

Table 10 indicates recorded existing background particulate concentrations for the Site.

Table 10 Background particulate concentrations*

Averaging period	Ambient TSP concentrations	Ambient PM_{10} concentrations	Ambient $PM_{2.5}$ concentration
Highest daily average	70-230 µg/m^3	45-55 µg/m^3	25-30 µg/m^3
Exceedances of daily limit	NA	0-2 days/year	0-2 days/year
Annual average	30-50 µg/m^3	19 µg/m^3	10 µg/m^3
Exceedances of annual limit	None	None	All years exceed

**Particulate matter is categorised into three different groups:*

- *TSP – total suspended particulate.*
- *$PM_{2.5}$ – particulate less than or equal to 2.5 microns in diameter.*
- *PM_{10} – particulate less that or equal to 10 microns in diameter.*

The existing background heavy metal concentrations were also assessed for the Site. The results can be found in Table 11:

Table 11 Background heavy metal concentrations

Substance	Maximum 24-hour concentrations (µg/m^3)	Range of average concentrations (µg/m^3)	Basis
Lead	1.42	0.015 – 0.128	Monitoring at Pasminco site HVAS stations for period 2005 - 2007
Zinc	1.52	0.024 – 0.176	
Cadmium	0.11	0.001 – 0.005	
Copper	2.31	0.014 – 0.439	
Arsenic	0.16	0.004 – 0.011	
Mercury	0.63	0.000 – 0.015	
Nickel	0.012	0.002 – 0.0026	Monitoring at Pasminco site HVAS stations for 2003
Chromium	0.015	0.0019 – 0.0025	

Source: Soil and Groundwater (2008)

Arsenic and cadmium were found to occasionally exceed non-carcinogenic effect screening thresholds at certain receptor sites. The inhalation-related cancer risk potential due to longer-term (1995-2007) concentrations of these metals was estimated to be greater than one in 100,000 (assuming exposure to concentrations occur).

Average annual baseline dust deposition rates were observed to be in the range of 0.8 g/m^2/month to 2.6 g/m^2/month across all IFL and Pasminco monitoring sites. Rates were in the range of 0.8 g/m^2/month to 1.8 g/m^2/month for all off-site monitors in proximity to or within residential areas.

These background concentrations and dust deposition rates are considered to represents a conservative estimate of the levels likely to occur at the time of the proposed Site remediation, due to these levels including emissions from initial Pasminco remediation activities and operational Site releases.

Construction impact assessment

Construction erosion and sedimentation

During the construction of the groundwater extraction and injection infrastructure there is potential for erosion and sedimentation to occur. The trenching activities required could expose contaminated materials comprising a mixture of natural and fill materials, which could be mobilised by surface runoff during wet weather. Given the temporary nature of the trenching works, this impact will be manageable through the implementation of appropriate control measures.

Erosion attributable to the construction activities has a low potential to transport contaminated materials from the Site to nearby water bodies. However, the transport of contaminants from the Site could pose a risk to human health and further contamination of the Pasminco lands, although this is unlikely.

Erosion and sedimentation control measures will therefore be required during construction to minimise the risk of sediment migrating off-site. These management measures will be implemented in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2006). Details of mitigation of erosion and sedimentation impacts are provided in Table 12.

Construction surface water and groundwater quality

A detailed description of the project in relation to surface water and groundwater impacts is provided in Section 7.1. Mitigation measures identified as being necessary to manage surface water and groundwater impacts during construction are also provided in Table 12.

Construction noise

Noise from the construction of the project works will result from bulldozers, excavators, and other equipment used for excavation works. Noise will also result from truck movements and potential bore drilling for groundwater treatment wells.

It is anticipated that the current operational noise produced by the Site and remediation activity noise levels will mask any noise produced by the construction works. It is therefore considered unlikely that the surrounding community will experience a notable increase in noise and vibration as a result of the construction, as these works will not exceed existing noise levels.

The closest residential and community noise receivers are located at the southern end of the Site. The proposed project works will be located at the northern arm of the Site, and blocked by large storage sheds, which are likely to act as a barrier to any noise travelling across the Site. Construction will last approximately two weeks and occur during standard working hours of 7 am to 5 pm, so any noise impact will be temporary.

Mitigation and management measures associated with noise and vibration are provided in Table 12.

Construction air quality

Potential atmospheric emission sources associated with construction of the proposed project include:

- Dust generation as a result of excavation of trenches.
- Front-end loader trucks loading to trucks of natural material fill.
- Vehicle entrainment from paved and unpaved on-site roads due to the transfer of natural material to piles and the fill to shed 4 for storage, and import of ballast to Site.
- Unloading and placement of ballast rock.
- Wind erosion from exposed areas.
- Vehicle tailpipe releases.

NSW DECC advisory thresholds for heavy metal concentration are not expected to be exceeded as a result of the project and are not expected to result in any additional health risk. The annual lead advisory threshold is not expected to be exceeded.

Given the short duration of the construction activities for the proposed project, and the low concentrations of air pollutants expected, it is anticipated that the impacts of the proposed project on local air quality will be minor. Dust generated from the proposed project will be controlled by measures described in Table 12.

Construction traffic

During peak times, the construction works will result in less than five vehicles per hour entering and exiting the Site. It is anticipated that the road network in the vicinity of the Site will continue to operate satisfactorily and no improvements are required on traffic capacity grounds.

The works are expected to generate a total of 170 external truck movements, including 20 trucks associated with the removal of gantry and foundations, and a further 150 trucks associated with the importation of 1500 m^3 of ballast fill material. The importation of fill material is expected to occur over a minimum two-week period, and will result in no more than 15 trucks per day (15 in, and 15 out). This is equivalent to less than three vehicle movements per hour.

The predicted additional traffic during the construction phase will be readily accommodated, and the performance of intersections in the locality of the project Site will not be adversely affected.

Up to five employees will be involved in construction of the proposed project. The worst case scenario will be an additional five vehicles per hour. Worker arrivals and departures are not expected to significantly overlap with truck arrival and departures.

The proposed access routes to the Site for heavy vehicles is the existing main access road through the Pasminco lands. The use of the existing site access onto Main Road south of the railway bridge will permit turns to be made in all directions, from traffic approaching in both directions along TC Frith Avenue and Main Road. There is also ample storage space available within the Site for vehicles, alleviating the need for on-street queuing or waiting.

The internal road network used by heavy vehicles will vary daily due to circumstances such as tipping location and weather. In addition, heavy vehicles will not be limited to the existing internal road system and will traverse unsealed areas.

The traffic generated by the project will relate to normal registered vehicles and no special permits will be required.

Despite the minimal impacts on traffic and access, standard mitigation measures will be adopted. These are outlined in Table 12.

Construction waste

Construction of the groundwater treatment system involves a number of activities, and each of these may lead to various waste sources. These could include:

- Contaminated soil, displaced as a result of trenching or drilling of wells for the groundwater treatment system.
- Demolition of railway gantry on the western boundary of the Site.
- Treated groundwater, as a result of being passed through the groundwater treatment system.
- Green waste from clearing of grass and shrubs on the Site.
- Waste fuels and oil from machinery and vehicles used during construction.
- General domestic waste produced by workers on-site.

Waste management in NSW is regulated by a number of acts including the *Protection of the Environment Operations Act 1997* and the *Waste Avoidance and Resource Recovery Act 2001*. The generation and management of waste during construction and operation of the project will be subject to the requirements of these acts, and other policy measures that encourage the efficient use of resources, avoid environmental harm, and provide for the continual reduction in waste generation.

Construction management and mitigation measures

Proposed management and mitigation measures for potential construction related impacts are shown in Table 12.

Table 12 Proposed management and mitigation measures for construction impacts

Potential impact	Mitigation and management measures
Erosion and sediment control	
Escape of contaminated sediment	• Store in an existing site building, or. • Store in accordance with *Managing Urban Stormwater: Soils and Construction* manual published by Landcom (2006). May include mitigation measures such as watering down the stockpile and covering prior to completing each day's work, to prevent the escape of any contaminated dust or sediment.
Surface water/groundwater	
The potential impacts and proposed mitigation measures for surface water and groundwater impacts are provided in Section 7.1.	
Noise and vibration	
Noise from excavation and/or drilling Noise produced by demolition of gantry structures	• Works will be undertaken in accordance with the NSW Industrial Noise Policy (EPA, 2000) and the Environmental Noise control Manual (EPA, 1994). • If receivers are affected by an increase in noise levels, temporary attenuation measures (such as erection of noise barriers) will be implemented. • Demolition, excavation, drilling, and construction activities will only be undertaken during standard working hours in order to minimise noise impacts. • If any residents are affected by an increase in noise levels, ongoing consultation with affected residents will occur in order to develop mitigation measures or make suitable arrangements.

Potential impact	Mitigation and management measures
Air quality	
Dust generation during excavation and/or drilling works, and transportation of material	• Fill will be stored in a shed pending future placement in the containment cell. • Unpaved roads will be controlled through watering or other means to ensure a minimum control efficiency of 60 per cent. This is readily achievable through the implementation of an effective wet suppression program. • Fill materials will be transferred directly to shed storage and be sufficiently moist to prevent blow-off of material during truck transit. Alternatively, trucks may be covered. • In the event that fill material is deposited, it will be cleaned up in a timely manner. • Natural stockpiles will be covered before the material dries out.
Exhaust emissions will be produced be vehicles and plant machinery	• Vehicle movements will be kept to a minimum. • All vehicles and plant will be properly maintained and kept in good working order. • Vehicles and machinery will be switched off when not in use.
Traffic and access	
Increase in heavy vehicle traffic and personnel on-site during construction of the stage 1 works	• Appropriate signposting will be clearly displayed throughout the Site. • A 15km/h speed limit will be implemented.

Increase in heavy vehicle traffic entering and exiting the Site	• Signage indicating possible heavy vehicle movements will be installed along Lake Road and Main Road in the vicinity of the main site access. These will include:
	  ◦ 'Trucks turning'.
	  ◦ '120m on right/left' located at 120 metres on both approaches.
	  ◦ Truck symbol sign at 60 metres on both approaches.

Internal traffic variations	• An internal traffic management plan will be prepared for each stage of remediation. • Contractors and subcontractors will be fully licensed and will attend a traffic safety site induction.
Waste	
Generation of contaminated soil waste/ contaminated fill	• Contaminated fill will be stored on site in shed 4, a secure storage area with sufficient capacity to accept the contaminated fill on a temporary basis. • Store in accordance with *Managing Urban Stormwater: Soils and Construction* manual (Landcom, 2006). May include mitigation measures such as watering down the stockpile and covering prior to completing each days work, to prevent the escape of any contaminated dust or sediment.

Potential impact	Mitigation and management measures
Generation of general waste	• Waste will be disposed of in accordance with the legislation as described above. • There will be 100% recovery for re-use of waste classified as virgin excavated natural material (VENM). • Where immediate re-use is not possible, spoil suitable for stockpiling will be stored, and the location, quality and quantity of spoil will be documented. Any additional environmental assessment or approval requirements for the stockpile will be undertaken as necessary. • Secondary waste materials will be re-used on-site where reasonable and feasible. • Where disposal is required, waste will be classified, handled, stored and disposed of in accordance with relevant guidelines.

7.3 Operation of the project

A detailed description of the operation of the project is provided in Chapter 4. The potential impacts of the project during operation are described below.

Operational impact assessment

Operation waste

Waste produced during operation of the proposed project will be minimal. The primary waste source during treatment plant operation will be the waste product resulting from the removal of contaminants from the groundwater, namely the Geotube® and reagent replacement. These materials will either be placed in the containment cell or disposed of in accordance with EPA requirements.

Dewatered precipitate will be the primary waste produced by the process. It is estimated that approximately one cubic metre of precipitate will be created on a daily basis. The Geotubes® have the capacity to accept 120 m^3 of wet precipitate. As the precipitate dewaters further precipitate can be added to the Geotubes®, therefore it is anticipated that the Geotubes® will take eight months to fill completely. It may be necessary to replace the Geotubes® once during the life of the project. The leachable fraction of the dewatered precipitate will be determined by laboratory analysis using the Australian Standard Leaching Protocol. It is anticipated that the leachable fraction of the dewatered precipitate will be considerably less than that of the fill materials, which will also be placed in the containment cell.

In addition to the dewatered precipitate, empty paper bags and 25 litre plastic pails resulting from the addition of reagents will be created. Empty bags will be suitable for disposal in the general waste bins at the Site. The plastic pails will be triple-rinsed and sent for recycling. Any waste oils generated from maintenance activities will be collected and sent for recycling.

Operational maintenance

The treatment plant and the extraction and injection infrastructure will be fitted with appropriate monitoring and control systems such that the plant can be operated remotely through a programmed PLC unit, although manual replacement of the reagents and Geotube® will be periodically required.

A baseline groundwater monitoring program will also be conducted in the area of interest. Periodic groundwater monitoring will be conducted throughout the remediation program to characterise the

influence of the remediation program on groundwater contaminant concentrations. Monitoring of the treatment plant influent and effluent concentrations will be undertaken routinely to verify the performance of the treatment plant and ensure that injected water complies within the nominated target criteria.

Operational noise

Noise may be created by the groundwater pumping system during operation of the groundwater treatment plant. The groundwater pumping station will be housed inside an existing shed on the Site, which will act as an acoustic barrier for the pumping station. In addition, the noise created by the pumping station is relatively low and is not expected to reach the noise levels currently produced by equipment on the Site. It is considered unlikely that nearby residential receivers or the wider community will notice an increase in noise or vibration as a result of the operation of the groundwater treatment plant. The operational impact of the plant is therefore considered to be negligible.

Operation air quality

Operational emissions were estimated for the proposed project with maximum daily dust emissions associated with operation were estimated to be approximately 10kg/day, 6kg/day, and 0.7kg/day, for TSP, PM_{10} and $PM_{2.5}$ respectively. Fugitive dust emissions during excavations and vehicle entrainment from unpaved road sections were estimated to comprise the main sources of emissions.

Baseline air quality data indicates that air quality goals in relation to particulates are already exceeded in the region on typically one or two days per year. This is generally due to events such as bushfires or dust storms. Therefore, limited potential exists for increments in ambient particulate concentrations.

The incremental maximum daily average PM_{10} and $PM_{2.5}$ concentrations across receptor sites due to the proposed project operations are predicted to be below 8µg/m^3 and 0.4µg/m^3 respectively. This increment is considered reasonable.

It is not expected that the proposed project operations will give rise to cumulative levels above annual air quality goals. Predicted dust deposition rates are predicted to occur well within the NSW DECC limits.

Operation management and mitigation measures

Management and mitigation measures designed to address operational impacts are detailed in Table 13.

Table 13 Potential operational impacts and their mitigation and management measures

Potential impact	Mitigation and management measures
Waste management	
Contaminated waste product resulting from treatment of groundwater	• The waste product encapsulated by a Geotube® will either be disposed within the containment cell or disposed off-site on accordance with DECC requirements.
Treated groundwater produced by treatment plant	• Treated water will be re-injected into the groundwater aquifer for further treatment, subject to DECC licensing requirements.
Maintenance	
Reagent handling	• Dusty and alkaline materials require dust management and personal protective equipment (PPE) to limit exposure.
Noise	
The groundwater treatment plant could produce noise during operation	• Noise levels produced will be very low, rendering them inaudible above the existing noise from the plant. In addition, the plant will be housed in an existing shed, providing an acoustic barrier to prevent noise travelling.
Air quality	
Dust emissions from trucks travelling along paved and unpaved roads	• Truck movements will be kept to a minimum. The potential for fill material being deposited on roadways and subsequently re-entrained by vehicles will be prevented through regulating the moisture content of material or the freeboard or covering of trucks.

7.4 Heritage

Existing environment

Overall historical background

The settlement and development of the Boolaroo area is closely tied with the development of the Pasminco lands and site. Historical land uses in the vicinity of the Site include farming and orchards, fishing, logging, and coal mining. Land was cleared for the first stage of the Cockle Creek works in 1895, and the first buildings were constructed between 1896 and 1897. As a result of the construction of the plant, a railway siding was established at what became known as ‘Sulphide Junction’, in 1897.

The IFL superphosphate plant was established in order to dispose of the by-product from other industrial processes. The original plant was established in 1913, with two main sheds, a sandstone office, and brick assay labs. The Site was expanded and refurbished a number of times during the 1930s and 1950s; these works included the addition of two more sheds.

Existing historical context

The Site is considered locally significant, as it is representative of early industry in the Hunter region. Much of the importance of the Site comes from its relationship and early connection with the Pasminco sulphide plant. The establishment of the plant was instrumental in the development of the local surrounding community; as such it is considered historically and culturally significant on a local level.

The Site itself is also a significant resource for the history of industrial manufacture. The manufacturing process of phosphate fertiliser is important, as this has largely remained unchanged since the plant first began functioning. The Site presents an ongoing industrial process of fertiliser manufacture starting in

the early twentieth century and continuing to this day. In addition, the layout and architecture of the Site presents an intact example of early twentieth century industrial landscape, and demonstrates the key characteristics of manufacturing procedures and industrial architecture. These heritage values manifest through the built heritage features of the study area and the current (and original) manufacturing process.

Items of significance

A desktop background study determined that no previously recorded historic heritage sites exist within the Site. A site inspection was carried out in order to undertake a heritage impact assessment for the Site. The complete heritage impact assessment can be found in Appendix D.

A number of site elements of local historical significance were identified. These are described in Table 14 below.

Table 14 Items of heritage significance

Item	Description
Sandstone and brick building	• Currently stands at the centre of the Site, functions as offices for Incitec Pivot staff. • Made of machine bricks with sandstone foundations and corners. • First item constructed on the Site, circa late 1890s. • External condition is fair, inside modified for office use.
Sheds 1–4	• Sheds 1 and 2 are made of galvanised iron and asbestos or fibro sheeting. Shed 1 has a railway line running parallel to the interior wall of the shed through the northern side. • Shed 3 is made of asbestos and steel, and is in poor condition with the roof appearing brittle and flaking at the top. • Shed 4 is a large rectangular shed with a sloping roof made from corrugated sheets of asbestos cement sheeting, and steel.
Railway line	• Runs north-east/south-west along the western boundary of the Site, abutting the Pasminco site. • Connects to Cockle Creek station and 'Sulphide Junction', runs partly into Shed 1. • Built entirely to service the Incitec Pivot fertiliser plant, and does not have further significance other than its direct connections to the study area.
Gantry	• Runs parallel to the railway line and are in a dilapidated state. • Consists of a wooden 'A' frame gantry, with steel pegs, support pegs, and a series of poles and beams. • Elevated to approximately 2.5–3 metres.

Indigenous heritage

While items of indigenous heritage significance were found in the vicinity of the Site, the study area itself was found to have no registered aboriginal sites within its boundary.

Potential impacts

Items of local heritage significance were identified on the Site. However, only the railway line and gantry are affected by the project.

The proposed project includes the demolition and removal of the railway line, and associated gantry, as described above. Due to the extensive contamination levels of the timber structures, adaptive re-use is

not an option for consideration. The structures will be demolished completely and disposed of in accordance with DECC requirements.

The contamination and location of the structures also present occupational health and safety risks. The contaminated timber could present a health risks to construction and demolition personnel. In addition, excavation required to dig the proposed trenches or wells is likely to compromise the integrity of the structures, potentially leading to their collapse.

The proposed project will not impact on the sandstone and brick building, or on the remaining sheds.

Management and mitigation measures

Table 15 describes the proposed management and mitigation measures for the potential heritage impacts of the project.

The contamination of the Site and subsequent removal of historical structures means that these mitigation measures should be carried out prior to demolition and remediation.

Table 15 Proposed heritage management and mitigation measures

Potential impact	Management and mitigation measures
Removal of railway line and gantries from the Site	• An archival photographic recording will be undertaken in accordance with the Department of Planning (Heritage Office) Guidelines 2001 (revised 2005) *Photographic recording of heritage items using film or digital capture*. • The recording will focus on the industrial process, capture modes and methods of manufacturing superphosphate, and record the standing structures associated with the Site. • Ongoing consultation with Council regarding site heritage.
Unidentified archaeological relics may be unearthed during construction	• Work will stop and the Heritage Council will be notified.

8 Assessment of non-key issues

Issues that do not pose a high risk as a result of the project and that are not addressed in Chapter 7, are assessed in this chapter.

8.1 Visual impact assessment

Existing environment

The major built form elements on the Site include:

- Four large industrial buildings in the centre of the Site – three running in a northeast-southwest direction and one perpendicular to these.
- Various roads accessing the buildings on the northeast and southwest ends of the Site, and associated vehicle layover areas.
- Two railway gantries, as described in Section 7.4 (Heritage).

The natural landform of the Site has been modified to allow construction of the industrial buildings. The ground immediately east of the Site rises steeply up to Munibung Hill.

The land on the Site is predominantly built-out or heavily disturbed. A large area of open space exists at the northern end of the Site, and is comprised of disturbed ground with some grass cover, and some tracks. A smaller area of open space exists at the southern end of the Site, and adjoins an electricity substation.

A freshwater dam lies immediately to the east of the southern open area, although it is generally not visible from the south. Some trees exist sporadically around the Site, but none are readily viewed from off-site at present.

The key viewpoints are:

- Oblique views from the easternmost residences on Firth to Fourth streets.
- Views form the south, east, and northeast in the open space that borders the eastern side of the Site on the western slopes of Munibung Hill.

Potential impacts

Several elements of the project may be visible during construction. These include:

- Remediation contractor's compound and contractor parking.
- Construction signage and fencing.
- Temporary earthworks, stock piling, and temporary erosion control.
- Major construction vehicles accessing and exiting the sites.
- Disturbance to ground for earthworks.

- Lighting of construction during dark hours for security.

None of these impacts is likely to be of a duration or magnitude to impact significantly on the visual amenity of the locality.

Construction of the project will require removal of the existing railway line and associated gantries. This will alter the views from within the Site, but this change will not be visible from outside of the Site. The removal of the structures is not expected to impact significantly on the visual amenity of the Site or its surrounds.

There will be no visible alterations to the Site once construction is completed.

Management and mitigation measures

Proposed mitigation and management of potential impacts to visual amenity are presented in Table 16.

Table 16 Visual impact management and mitigation measures

Potential impact	Mitigation and management measures
Construction elements of the project including parked cars, signage, fencing, and temporary earthworks may be visible during construction.	• Fencing to be in a dark colour such as grey or black. • Operational lighting to be fixed to avoid light spill towards residential areas. • Storage areas to be out of direct line of Site from residential dwellings; uphill land to be protected from earth disturbance. • Erosion control to be monitored. • Complete work as soon as possible.

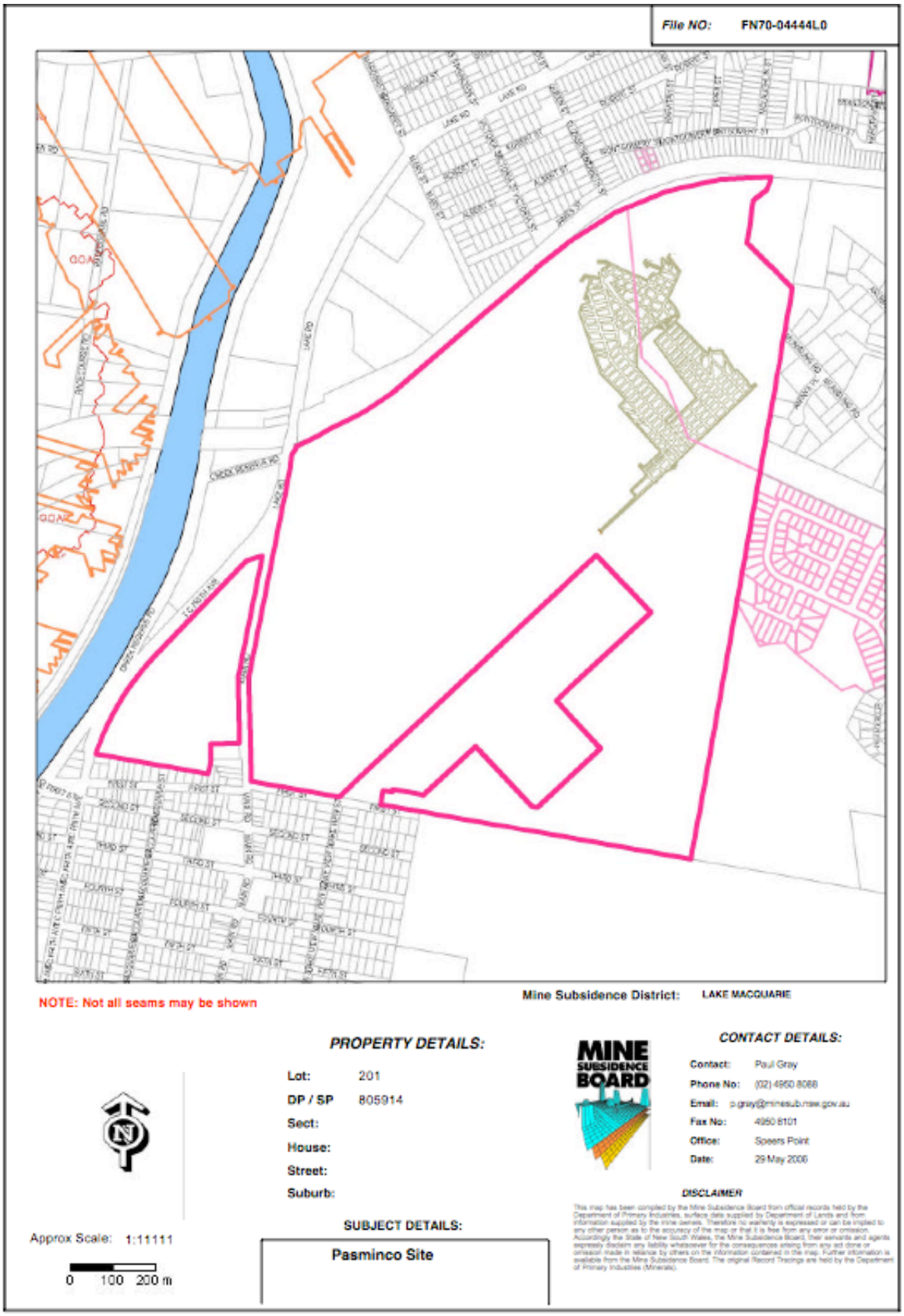
8.2 Mine subsidence

Existing environment

The entire region is a proclaimed Mines Subsidence District under the *Mine Subsidence Compensation Act 1961*.

No mining has occurred within the immediate vicinity of the Site or on the Site itself. The mine subsidence map provided in Figure 10 demonstrates that there are no areas of subsidence risk relating to the proposed project, or the Site as a whole.

Figure 10 Mine working areas in the vicinity of the Site



Potential impacts

The environmental risk assessment carried out as part of this EA determined that the risk of a mine subsidence event occurring will have major consequences but is very unlikely due to the large distance between the Site and the nearest mines.

Management and mitigation measures

Table 17 provides proposed measures to avoid impacts relating to mine subsidence due to the proposed project.

Table 17 Mine subsidence management and mitigation measures

Potential impact	Mitigation and management measures
Construction	
A mine subsidence event could occur during construction activities	• Identification of mine subsidence areas in the vicinity and ensure the Site is not likely to be affected. • Undertake excavation and drilling activities with caution.

9 Draft statement of commitments

The environmental assessment considers the project's potential environmental impacts and identifies the desired outcomes. Furthermore, the EA highlights the management measures required to avoid or reduce environmental impacts.

IFL is committed to implementing these management measures. The commitments listed in Table 18 are designed to avoid, manage, mitigate, offset and/or monitor the environmental impacts of the proposed project. Additionally, the proposed management measures provide surety during pre-construction, throughout construction and into the operational phase.

These measures form the basis of IFL's draft statement of Commitments (SoC), which is fully outlined in Table 18. The draft SoC specifically contains the following:

- The desired environmental outcomes.
- The actions that IFL is committed to undertaking to achieve the environmental outcomes.
- The timing of implementation of each commitment.

The commitments are based on the need to:

- Meet future planning approvals and associated environmental and planning investigations.
- Develop environmental management and mitigation measures during planning and design.
- Develop a strong systems culture during community consultation and engagement.
- Implement, monitor and review the management measures during construction and operation.

Table 18 Draft statement of commitments

Objective	Ref #	Commitment	Timing	Reference
Soil and water				
Minimise exposure of environment to excavated contaminated material.	S1	Excess soil will be managed on-site within managed stockpiles or located within an existing site shed. Any contaminated material will be stockpiled within the existing site shed. Any stockpiles will be managed to prevent erosion and dust.	Construction	Landcom (2006) *Managing Urban Stormwater: Soils and Construction*.
Minimise detrimental impacts from contamination or sediment in surface waters.	S2	Surface water will be managed during the construction stage to limit or prevent contact with contaminated materials. Sediment entrained in stormwater will be managed using sediment control measures adjacent to potential source areas. Additional measures will be implemented as required to provide adequate management.	Construction	Landcom (2006) *Managing Urban Stormwater: Soils and Construction*.
Manage treatment plant operation to minimise risks of environmental impacts.	S3	Provide adequate controls and failsafe mechanisms in the treatment plant and associated extraction and infiltration infrastructure to ensure plant operates within control parameters or shuts down with no adverse environmental impact.	Operation	To be included in CEMP to be prepared prior to work commencing.
Undertake monitoring to assess performance of the remediation system.	S4	Undertake routine monitoring of treatment plant to assess effectiveness of treatment plant and acceptability of discharge concentrations. Complete routine groundwater monitoring to assess changes in aquifer concentrations.	Operation	Monitoring plan to be written and agreed to by a DECC accredited site auditor.
Heritage				
Retain record of heritage items and structures on the Site.	H1	An archival photographic recording will be undertaken in accordance with the Department of Planning (Heritage Office) Guidelines 2001 (revised 2005) *Photographic recording of heritage items using film or digital capture*.	Pre-construction	NSW Department of Planning (Heritage Office) Guidelines 2001 (revised 2005) *Photographic Recording of Heritage Items Using Film or Digital Capture.*
	H2	Liaise with Council regarding site heritage.	Pre-construction and construction	Not applicable.
	H3	In the event that an unknown heritage item is discovered, work will cease temporarily to allow for archival recording of the item.	Construction	To be included in CEMP to be prepared prior to work commencing.

Objective	Ref #	Commitment	Timing	Reference
Air quality				
Minimise dust generation during construction and operation of proposed project.	A1	Appropriate dust control measures including covering or wetting of fill, will be undertaken to ensure dust generation is minimised.	Construction and operation	To be included in CEMP to be prepared prior to work commencing.
Minimise emissions from vehicles and plant equipment during construction and operation.	A2	Vehicles and equipment will be maintained and kept in good working order and switched off when not in use.	Construction and operation	To be included in CEMP to be prepared prior to work commencing.
Noise and vibration				
Minimise noise from excavation and drilling during construction of proposed project.	N1	Noise levels produced during construction of proposed project will not exceed existing noise levels within the Site or those of the Pasminco lands.	Construction	To be included in CEMP to be prepared prior to work commencing.
	N2	Works will be undertaken during standard working hours only in order to minimise disruptions to local residences. Working hours will be 7am to 5 pm.	Construction	To be included in CEMP to be prepared prior to work commencing.
Mitigate noise produced by operation of the groundwater treatment plant.	N3	The treatment plant will be housed in an existing IFL shed, providing an acoustic barrier that will prevent noise reaching local residential receivers. The noise levels of the treatment plant will not exceed those already existing within the Site.	Operation	Included as part of the treatment system design.
Visual amenity				
Reduce visual impact of construction elements of the proposed project.	V1	Measures including neutral coloured fencing, appropriate storage of plant and materials, and strategic lighting placement will be undertaken to minimise visual impacts of construction of the proposed project.	Construction	To be included in CEMP to be prepared prior to work commencing.
Mine subsidence				
Avoid a mine subsidence event during construction of the proposed project.	M1	Mine subsidence areas will be identified prior to construction. Construction will not proceed if a risk of subsidence is identified.	Pre-construction and construction	To be included in CEMP to be prepared prior to work commencing.

Objective	Ref #	Commitment	Timing	Reference
Traffic and access				
Minimise impact of increased construction traffic on local community.	T1	Appropriate signage will be installed along Main Road to warn local drivers of trucks turning and any other changed conditions.	Pre-construction	To be included in CEMP to be prepared prior to work commencing.
Waste management				
To minimise waste produced during construction of the propose project, and maximise re-use of materials.	W1	To minimise waste, the 'waste hierarchy' (avoid/resource recovery/disposal) will be maximised during construction. The way in which the waste hierarchy will be maximised will be documented and, where relevant to work activities, will be incorporated into work programs and site inductions.	Construction	*Waste Avoidance and Resource Recovery Strategy 2007* (DECC 2007).
Safely dispose of waste produced by operation of the treatment plant	W2	Waste produced during operation of the treatment plant will be disposed of inside the containment cell.	Construction and post-construction	In accordance with DECC requirements.

10 Project justification and conclusion

10.1 Project justification

Economic, social, and environmental justification

Project-level justification considers the project and its interaction with the immediate environment. It is concerned with the degree to which the project objectives are satisfied, and the performance of the project against a range of environmental, social and economic factors.

The key project objective is to establish a targeted hotspot groundwater recovery system and water treatment facility to remediate localised areas of highly metal impacted groundwater along the north-western site boundary, determined by DECC to present a 'significant risk of harm'. A disused timber gantry presently obstructs access to the hotspots and will be demolished as part of the project. As the timber is highly contaminated adaptive reuse is not possible and the timber will be disposed of.

A small number of primarily medium to low risk potential impacts are expected to occur as a result of the project. Mitigation measures have been proposed to address the impacts identified as part of this EA.

It is anticipated that the impacts of the project on the local community will be minor and temporary. Some of these impacts will include a minor increase in heavy vehicle traffic in the vicinity of the Site, minor visual impacts due to visible construction equipment and fencing on the Site, and a potential minor change in air quality within the Site. These will be mitigated by the measures outlined in Chapters 7 and 8. Importantly, the project will allow immediate reduction of contamination levels of the groundwater at the Site and prevent further spread of contaminated groundwater.

Overall it is considered that the minor impacts associated with the proposed project will be outweighed by the substantial benefits it will deliver.

Ecologically sustainable development

Ecologically sustainable development (ESD) is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD have been an integral consideration throughout the development of the project.

The EP&A Act recognises that ESD requires the effective integration of economic and environmental considerations in decision-making processes. There are four main principles supporting the achievement of ESD:

- Precautionary principle.
- Inter-generational equity.
- Conservation of biological diversity and ecological integrity.
- Improved valuation and pricing of environmental resources.

These are discussed below.

Precautionary principle

The precautionary principle deals with certainty in decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

The environmental risk analysis documented in Chapter 6 covers the potential impacts of the project. That analysis and the EA as a whole identify no threat of serious irreversible environmental damage.

Inter-generational equity

Social equity is concerned with the distribution of economic, social and environmental costs and benefits. Inter-generational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations.

While the project will have some impacts, they are not of a nature or extent that will result in disadvantage to any specific section of the community or to future generations. The project aims to provide benefits to present and future generations through the remediation of groundwater and improved environmental outcomes.

Conservation of biological diversity and ecological integrity

This project will occur in a highly modified and contaminated environment that contains little potential habitat for biodiversity. As a result, potential impacts on biodiversity are not anticipated. It is expected that the project will lead to an improvement in environment quality.

Improved valuation and pricing of environmental resources

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by a project, including air, water, land and living things. It is difficult to place a reliable monetary value on the residual environmental and social effects of the project. However, the value placed on environmental resources within and around the Site is evident nature of the project's resource-improving goals.

Consistency with objectives of the EP&A Act

The objects of the EP&A Act provide a framework within which the justification of the project can be considered. Table 19 presents these objectives and their relevance to the project.

Table 19 Objectives of the EP&A Act

EP&A Act objective	Comment
Encourages the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.	• The project will encourage proper management and improvement of the environment by reducing groundwater contamination present in a localised area, and by reducing the 'significant risk of harm' identified by DECC.
Encourages the promotion and co-ordination of the orderly and economic use and development of land.	• The project will reduce contamination at the Site, improving the quality of the land and increasing its potential for future redevelopment.
Encourages the protection, provision and co-ordination of communication and utility services.	• The project is designed to minimise impacts on communications and utility services.

EP&A Act objective	Comment
Encourages the provision of land for public purposes.	• Not relevant to the project.
Encourages the provision and co-ordination of community services and facilities.	• The project will improve the quality of the land on the Site, benefiting the local community.
Encourages the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.	• The project will improve the environmental values of the Site.
Ecologically sustainable development.	• See section *Ecologically sustainable development* above.
The provision and maintenance of affordable housing.	• Not relevant to the project.
Promotes the sharing of the responsibility for environmental planning between the different levels of government in the State.	• The environmental planning for this project has been completed in consultation with Lake Macquarie City Council as well as state government departments including DECC and DoP.
Provides increased opportunity for public involvement and participation in environmental planning and assessment.	• Consultation has been undertaken with the local community throughout the development of the proposed project, and will be ongoing. This is described in Chapter 5.

10.2 Conclusion

The proposed project will satisfy the objectives of establishing a targeted hot-spot groundwater recovery system and water treatment facility to remediate localised areas of highly metal impacted groundwater along the north-western site boundary.

Potential adverse impacts associated with the project have been fully assessed. Strategies to avoid, minimise and mitigate those impacts have been an integral part of the project development process. It is considered that the overall beneficial improvement of the groundwater quality will outweigh any potentially negative impacts on other environmental parameters which are only of a temporary nature. Furthermore, a number of commitments have also been made to ensure the best possible environmental outcomes are achieved during the construction and operation of the project.

11 References

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Appendix A

Voluntary remediation agreement

Appendix B

Conceptual remediation action plan

Appendix C

Director-General requirements

Appendix D Heritage assessment

Appendix E Community newsletter