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This chapter provides a description of Arrow's approach to contaminated land within the Project area. Potential contaminated land issues associated with the Project for this aspect generally relate to the historical, current and future use of hazardous materials in the environment, and any resultant contamination of land or groundwater.

A cross reference to the locations where each of the requirements of the ToR has been addressed is given in Appendix B which references both the study chapters (Sections 1 through 34) and/or the Appendices (A through EE).

11.1 Legislative Context

The following legislation, policy and guidelines are relevant to identifying values, mitigating and managing potential impacts associated with land contamination during construction, operations and decommissioning of the Project.

11.1.1 Environmental Protection Act, 1994 (Qld)

The *Environmental Protection Act 1994* (EP Act) is intended to protect the environment of Queensland, and sets out the relevant approval and regulation framework. Provision is made within the Act for the management of land that is contaminated, or that has previously been used for land uses that may have resulted in land contamination. A list of all 'Notifiable Activities' are available under Schedule 3 of the EP Act, which can include, but not limited to cattle dips, aerial spraying, landfills, chemical manufacturing or formulation, chemical storage, mineral processing, and petroleum product or oil storage. Land parcels (where Notifiable Activities are currently or historically have been undertaken) may be listed on the Environmental Management Register (EMR). Land parcels that are proven to be significantly contaminated are listed on the Contaminated Land Register (CLR). Both registers are managed by the Queensland EHP.

Relevant industry guidelines and codes of practice include:

Draft Guidelines for the Assessment and Management of Contaminated Land 1998 (Qld) (EHP, 1998)

These draft guidelines establish a process for the assessment and management of contaminated land in Queensland. They serve to facilitate compliance with the EP Act and outline a tiered process for the assessment and management of contaminated land.

National Environmental Protection (Assessment of Site Contamination) Measure 1999 (National Environmental Protection Council)

The purpose of the *National Environmental Protection (Assessment of Site Contamination) Measure 1999* (NEPM) is to establish a nationally consistent approach to the assessment of site contamination to ensure sound environmental management practices by the community including regulators, assessors, auditors, landowners, developers and industry. In addition, the NEPM looks to provide

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adequate protection of human health and the environment, where site contamination has occurred. An original NEPM was released in 1999, however, more recently a Draft NEPM was released to update the NEPM in line with improving scientific and technical capabilities.

11.2 Assessment Method

The assumptions and method relating to the contaminated land assessment are described below.

11.2.1 Desktop Study

A preliminary desktop review was conducted to identify the potential nature and likely frequency of contaminated sites within the Project area, as detailed within the Contaminated Land Technical Report (Appendix J) of this EIS. A full tiered management strategy as identified within the *Contaminated Land Draft Guidelines* (EHP, 1998) is not the adopted approach for this assessment given the location of wells, pipelines, facilities and associated infrastructure are yet to be confirmed during future development of the Project. This assessment established that a number of key constraints influence the amount of certainty that may be obtained about contaminated land in the Project area. Given these constraints, a management strategy (Section 11.6) has been developed to inform the assessment and management of contaminated land as the Project progresses under the hierarchy of avoidance, mitigation and management measures. The risks of disturbing or causing contaminated land were assessed with consideration of a number of constraints and key assumptions as outlined below.

- Due to the extensive and generally rural nature of the Project, there will be large tracts of land that are free of known contamination or have had no known exposure to historic or current Notifiable Activities and are not listed on the EMR or CLR.
- The EMR and CLR can only be searched on a land parcel basis (based on real property description). Therefore EMR / CLR searches have not been conducted in this assessment, as the defined location of Project activities are yet to be determined. Searches of the EMR and CLR will be conducted in accordance with the management strategy outlined in Section 11.6, following confirmation of the location of Project activities including construction, operations and decommissioning.
- Any of the Notifiable Activities and potentially contaminating land uses as identified within the EP Act may have been conducted within the Project area and therefore Project activities (including construction, operations and decommissioning) may affect this potentially contaminated land, however the frequency of these in the context of the overall Project is likely to be limited.
- Any of the land parcels on which Arrow may conduct Project activities could have been used previously for Notifiable Activities or potentially contaminating activities; however, the frequency of these is likely to be small.
- If a land parcel is listed on the EMR or CLR the contaminating activity may be confined to a small proportion of that land parcel and will not necessarily impact or provide potential for impact to the entire land parcel.
- There is the potential that during the completion of Project activities, land that has been historically contaminated but not listed on the EMR or CLR may be encountered or disturbed.

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- Appropriate management plans will be developed and implemented for identification, assessment and management of contaminated or potentially contaminated lands that may be encountered during Project activities. Potential contaminants of concern may be encountered which may adversely affect public and workforce human health, wildlife, stock, vegetation, infrastructure integrity, surface water, ground water and water users.
- Some Arrow Project activities are considered Notifiable Activities in their own right and land parcels may be required to be listed on the EMR, such activities may include:
 - Petroleum product or oil storage – Storing petroleum products or oil:
 - a) in underground tanks with more than 200 litre (L) capacity; or
 - b) in above ground tanks with
 1. for petroleum products or oil in class 3 in packaging groups 1 and 2 of the dangerous good code more than 2,500 L capacity or
 2. for petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code more than 3,000 L capacity; or
 3. for petroleum products that are combustible liquids in class C1 or C2 in AS 1940 – more than 25,000 L capacity.
 - Chemical Storage – (other than petroleum products or oil) – storing more than 10 t of chemicals (other than compressed or liquefied gases) that are dangerous goods under the dangerous goods code.
 - Regulated waste storage and/or treatment

Given the above key constraints and assumptions and in the absence of detailed information on the actual extent of contaminated land, the precautionary principle is applied, whereby the overarching assumption that land (including soil and/or groundwater) on which Arrow may propose to conduct development activities could potentially be contaminated, and as such will require a systematic approach to assessment during Project development.

Note that no physical environment site assessment for the presence of contaminants has been conducted at this stage of Project development. Where required, these will be conducted as part of the management strategy detailed (Section 11.6), once the location of Project activities has been defined.

11.3 Existing Environment and Environmental Values

Land can be contaminated through a range of historical and current land uses and activities. As such, a schedule of 38 Notifiable Activities is detailed within the EP Act. Potentially contaminating activities identified through the desktop review include activities mostly associated with agriculture and industrial land uses including homestead complexes, stockyard complexes, farming infrastructure, industrial areas, equipment laydown areas, landfill, mining and tailings activities.

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11.3.1 Notifiable Activities

It is noted that due to the large geographical extent of the Project area, many of the potential Notifiable Activities are likely to be encountered at some point within the Project area. However those that are not rural in nature are likely to be concentrated in more developed areas, and therefore are also considered unlikely to be impacted by the Project. Table 11–1 demonstrates an overview of the Notifiable activities likely to be encountered during the development of the Project area as identified in the Contaminated Land Technical Report (Appendix J of this EIS).

Table 11-1 Notifiable Activities Overview

| Potential and Likelihood | Notifiable Activities | Overview |
|--|--|--|
| May occur frequently in the Project area | Abrasive blasting | EMR listing identified for Lot 2 on SP161104. |
| | Aerial spraying | |
| | Asbestos manufacture or disposal | |
| | Battery manufacture or recycling | |
| | Chemical storage (other than petroleum products) | EMR listings identified for Lot 2 on SP161104 and Lot 4 on HT607. |
| | Defence establishment | One land parcel within Blackwater town identified as being used by Defence department. |
| | Electrical transformers | EMR listing identified for Lot 2 on SP161104 (previous Bow Energy tenement). Multiple land parcels from a review of land use have also been identified. |
| | Explosives production or storage | EMR listings identified for Lot 4 on HT607 and Lot 10 on HT584 (previous Bow Energy tenement). |
| | Gun, pistol or rifle range | EMR listings identified for Lot 3 on HT616 (previous Bow Energy tenement). |
| | Landfill | EMR listings identified for Lot 2 on SP161104, Lot 4 on HT607 and Lot 54 on HT407 (previous Bow Energy tenement). |
| | Livestock dip or spray race operations | EMR listings identified for Lot 10 on RP905042 and Lot 10 on RP619501 (previous Bow Energy tenement). Almost four hundred land parcels identified through land use assessment as related to cattle grazing, breeding or fattening or horses. |
| | Mine wastes | EMR listings identified for Lot 2 SP161104 and Lot 4 on HT607 (previous Bow Energy tenement). |
| | Mineral processing | Extractive industries identified for many land parcels from land use information. |
| | Petroleum or petrochemical industries | |
| | Petroleum product or oil storage | EMR listings identified for Lot 2 SP161104 and Lot 4 on HT607 (previous Bow Energy tenement). |
| Railway yards | Many land parcels identified as railway infrastructure through land use information. | |
| Scrap yards | | |

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| Potential and Likelihood | Notifiable Activities | Overview |
|--|--------------------------------------|--|
| | Service stations | Multiple service stations identified within Blackwater Township. |
| | Waste storage, treatment or disposal | Sewerage works identified near Blackwater through land use information |
| | Engine reconditioning works | EMR listings identified on Lot 2 on SP161104 and Lot 4 on HT607 (previous Bow Energy tenements). |
| Low potential to occur in the Project area | Asphalt or bitumen manufacture | |
| | Chemical manufacture or formulation | |
| | Coal fired power station | |
| | Coal gas works | |
| | Drum reconditioning or recycling | |
| | Dry cleaning | |
| | Fertiliser manufacture | |
| | Foundry operations | |
| | Herbicide or pesticide manufacture | |
| | Metal treatment or coating | |
| | Paint manufacture or formulation | |
| | Pest control | |
| | Printing | |
| | Smelting or refining | |
| Tannery, fellmongery or hide curing | | |
| Wood treatment and preservation | | |
| Unlikely to occur in the Project area | Lime burner | |
| | Pharmaceutical manufacture | |

11.3.2 Uncontrolled / Unidentified Activities

There is the possibility that unidentified or unrecorded Notifiable Activities or other activities with the potential to cause contamination may have previously occurred within the Project area. There is a requirement that *“if the owner or occupier of land becomes aware a Notifiable Activity is being carried out on the land, or if the land has been, or is being contaminated the owner or occupier must notify the administering authority”* (EHP, 1998). However in many rural locations, it is unlikely that activities have been notified. Activities that may contribute to land contamination include:

- Domestic landfills / waste areas / animal disposal areas / burn pits;
- Spillage / storage of chemicals / fuels / lubricants; and
- Agricultural use of pesticides / chemicals (e.g. cattle and sheep dips).

It is possible as the Project area is developed, that areas of unidentified contamination may be encountered. This is addressed in the management strategy detailed in Section 11.6.

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11.3.3 Existing Environmental Values

Existing environmental values have been identified that should be protected and will inform siting decisions on a local scale as the Project develops. In addition, they dictate the appropriate application of mitigation and management controls. These are presented in Table 11–2.

Table 11-2 Existing Contaminated Land Environmental Values

| Existing Environmental Value | Value | Sensitivity |
|---|---|-------------|
| Parks, reserves, conservation areas | Greenfield areas where there is a limitation to development | High |
| Areas with minimal areas of modification / development | Greenfield areas free from potentially contaminating activities | Moderate |
| Areas with moderate areas of modification / development | Land that has been developed and may have supported potentially contaminating activities | Moderate |
| Industrial areas or areas highly modified | Sites already recorded on the CLR / EMR or where known potentially contaminating activities have occurred | Low |

11.3.3.1 High Environmental Value Areas

Generally within the Project area, the vast majority of land will not have been subject to potentially contaminating activities and are accordingly greenfield sites. Greenfield areas have a higher relative environmental value, and as such, should be protected from:

- Disturbance of existing contaminated land; and
- Contamination through Project activities including petroleum / chemical storage.

11.3.3.2 Low and Moderate Environmental Value Areas

Due to the rural nature of the Project area, it is anticipated that the Project will encounter potentially contaminated sites that may or may not be listed on the EMR or CLR. In instances where the land parcel in question is in fact listed on the EMR / CLR, the actual development area may not be impacted. Alternatively, the land parcel may not be listed on the EMR or CLR; however uncontrolled / unregistered contamination may be encountered. The management strategy has been developed with these uncertainties in mind.

Due to the largely rural nature of the Project area several environmental values may extend across the one land parcel. Alternatively, a Notifiable Activity (e.g. livestock yard) may be recorded on the land parcel, yet only a small portion of the land may be affected. The proposed development of Project infrastructure is considered a predominantly industrial activity and therefore may proceed on land with low to moderate environmental values.

Site Selection

The nature of the development of the Project allows that potential land contamination can be considered during site selection. In general development of sites that have increased likelihood of

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contamination should be minimised / avoided where practicable. Without appropriate management, a potential exists for mobilisation of existing contamination that may impact human health or cause environmental harm.

11.4 Issues and Potential Impacts

Issues and potential impacts relating to contaminated land may stem from disturbance of existing contaminated land, and the potential to cause contaminated land through Project activities, including construction, operations and decommissioning.

The potential direct and indirect impacts of the Project on environmental values have been assessed using one of three impact assessment methods: significance assessment, risk assessment and compliance assessment; this study has used significance assessment. For further details see the Impact Assessment Method chapter (Section 6) of this EIS.

11.4.1 Disturbance of Existing Contaminated Land

The following Project activities could potentially contribute to the disturbance of existing contaminated land:

- Siting of Project infrastructure on contaminated land leading to exposure of human health or environmental receptors to contaminants;
- Disturbance of contaminated soil / groundwater through drilling of wells, installation of utilities, or construction works leading to exposure of human health or environmental receptors to contaminants; and
- Transport / movement of contaminated soil / groundwater following disturbance by Project activities leading to human health or environmental receptors to contaminants or contamination of previously unaffected soil or groundwater.

The type of activities being undertaken will determine the extent of land disturbance. For example, the footprint of land disturbance (and resultant potential contaminated soil) would be much less for a well installation compared to that associated with construction of a production facility. Risks of groundwater contamination associated with drilling activities are discussed in the Groundwater chapter (Section 14 of this EIS).

11.4.2 Potential for Project Activities to Cause Contaminated Land

There is presently no Notifiable Activity addressing CSG generally; however, aspects of the Project activities have the potential to result in land contamination. CSG extraction and CSG water collection and treatment are however, considered environmentally relevant activities under the EP Act. The level of impact depends on the proposed activity (construction, operations and decommissioning); and potential contamination during Project development may generally result from:

- Leaks or spills from fuel / chemical storage or handling leading to exposure of human health or environmental receptors to contaminants;

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- Leaks or spills from waste storage areas, leading to exposure of human health or environmental receptors to contaminants; and
- Overflow from brine dams leading to exposure of human health or environmental receptors to contaminants.

The potential release of untreated CSG water from wells, systems or dams and the potential release of brine from treatment facilities and dams may be considered to be an environmentally relevant activity if releases exceed a threshold volume.

11.4.3 Summary of Potential Impacts Prior to Mitigation

The potential impacts from disturbing existing contaminated land or generation of contaminated land through Project activities prior to implementing mitigation measures include adverse impacts to both human health and potential environmental receptors. The magnitude of this to environmental values will be moderate prior to mitigation.

Potential impacts may include exposure of site workers, the public, wildlife, stock, native and cultured vegetation, and areas of higher environmental value to contaminants that may have acute toxic or other chronic affects.

Management of potential impacts can be achieved through the implementation of avoidance, mitigation and management measures as outlined in the management strategy in Section 11.6.

11.5 Environmental Protection Objectives

The environmental protection objectives with respect to contaminated land include:

- To avoid or minimise the disturbance of contaminated land; and
- To avoid the contamination of land / water (including soil, ground or surface water) as a result of Project activities (including construction, operations and decommissioning).

11.6 Avoidance, Mitigation and Management Measures

Avoidance of potential contaminated land impacts is achieved through early identification of sensitive locations and suitable design and site selection.

11.6.1 Existing Contaminated Land

The avoidance, mitigation and management measures outlined below will be implemented for all activities that have the potential to cause / disturb land contamination. Arrow will seek to minimise impacts through implementation of the following strategy:

- If Project activities occur on land that is listed on the EMR / CLR, further assessment maybe required to determine if contamination exists [B085];

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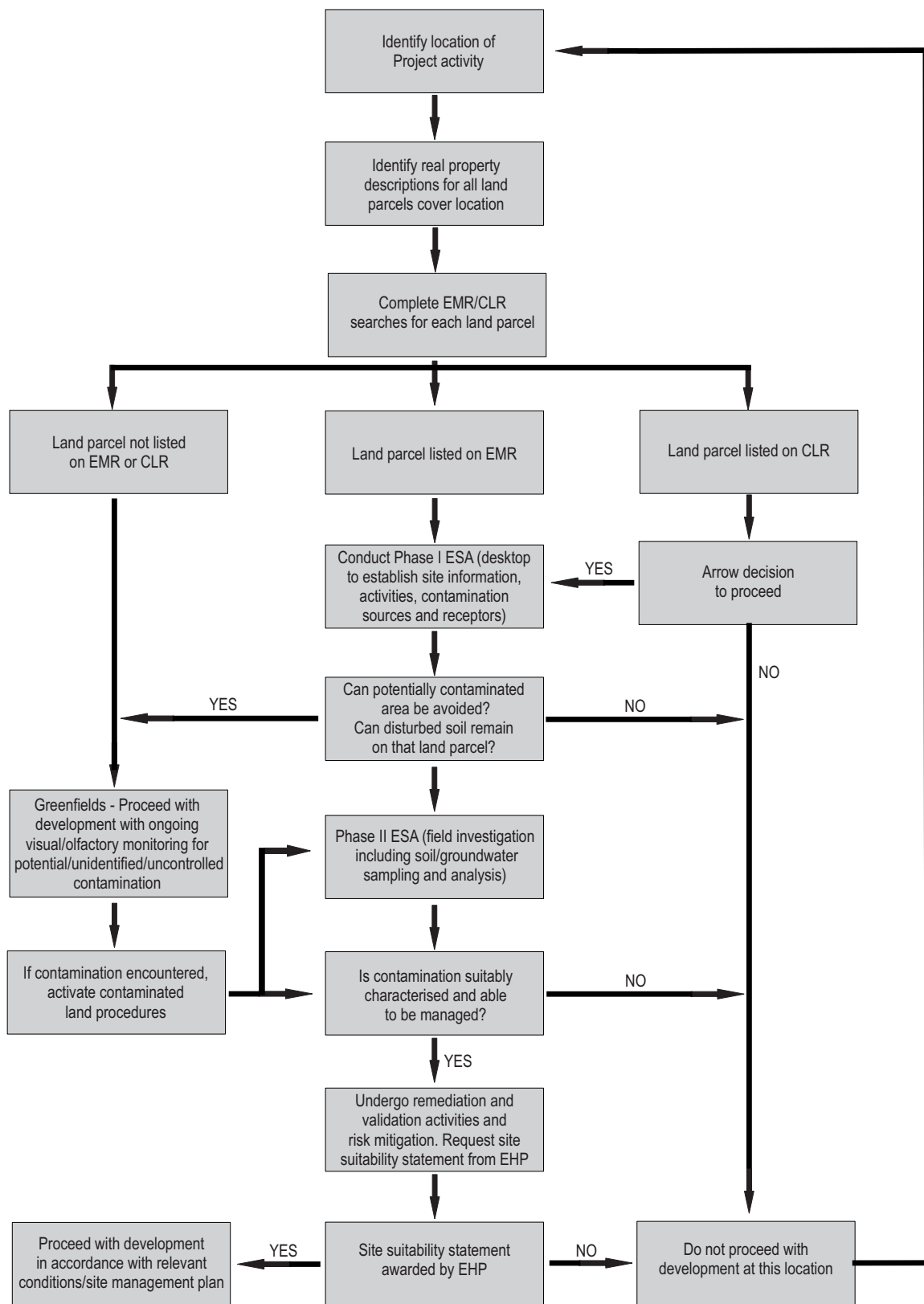
- Assess whether soil from land parcel on the EMR / CLR may be required to be removed from that land parcel – suitable soil transport and disposal approvals from EHP will be required [B086];
- Conduct site investigations on relevant land parcels to assess for presence of contamination to allow for appropriate siting decisions to be made [B087];
- Inspect and observe site locations for presence of contamination prior to commencement of intrusive activities [B277];
- Stop works and avoid unnecessary disturbance of contaminated soil / groundwater if encountered during Project activities [B090]; and
- Manage contaminated soil or groundwater that cannot be avoided through physical investigation; manage quantification of the type, severity and extent of contamination; and remediate or manage in accordance with the Queensland Government's *Draft Guidelines for the Assessment and Management of Contaminated Land 1998* [B088].

The extent of potential disturbance of contaminated soil will differ depending on the type of Project activity. The application of avoidance, mitigation and management actions for specified Project development activities is presented in Figure 11–1.

The above outlines the contaminated land management strategies to be followed once siting of infrastructure has been identified, or if unknown / uncontrolled contamination is encountered during Project activities. Contaminated land management strategies will be included in Arrow's standard operating procedures and EM Plan and will include but are not limited to:

- Stop intrusive works involving disturbance of previously unidentified soil / groundwater contamination [B091];
- Act immediately to protect human health and safety of site workers, public and environment [B092];
- Isolate areas containing contaminated soil / groundwater, where possible [B093];
- Undertake an assessment by a suitably qualified contaminated land specialist in accordance with the Queensland Government *Draft Guidelines for the Assessment & Management of Contaminated Land in Queensland* (Department of Environment, 1998) [B089].

Further detail of the standard operating procedures can be found in the EM Plan (Appendix Z) of this EIS.



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BOWEN GAS PROJECT EIS

PROJECT ACTIVITES



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11.6.2 Project Activities

Measures for avoidance, mitigation and management of potential contamination of soil / groundwater as a result of Project activities will include, but are not limited to:

- Apply appropriate international, Australian and industry standards and codes of practice for the handling and storage of hazardous materials, such as chemicals, fuels and lubricants [B078];
- Incorporate into an emergency response plan or water management plan procedures for the controlled discharge of CSG water [B345];
- Develop and implement emergency response and spill response procedures to minimise any impacts that could occur as a result of releases of hazardous materials or any loss of containment of storage equipment [B084];
- Ensure that appropriate spill response equipment including containment and recovery equipment is available onsite [B079];
- Assess and report contamination in accordance with documented operating procedures. This may include, but is not limited to [B080]:
 - Undertake an assessment by a suitably qualified contaminated land specialist;
 - Undertake environmental site assessment in response to identification of contamination;
 - Characterise, remediate and validate contamination; and
 - Carry out corrective actions as required;
- Records to be maintained of activities / incidents that have the potential to result in land contamination. Records will include information on storage location, personnel training, monitoring data and disposal procedures for appropriate chemicals, fuel and other potential contaminants [B081];
- Staff training as to identification of potential unexpected contamination [B082]; and
- Staff training as to appropriate handling, storage and containment practices for chemical, fuels and other potential chemicals as relevant [B083].