

Environmental Protection Act 1994
Level 1 Environmental Authority
Chapter 5A petroleum activity

Permit¹ Number: PEN100232408

Under the provisions of the *Environmental Protection Act 1994* this environmental authority is issued to:

Linc Energy Limited
32 Edward Street
BRISBANE QLD 4001

in respect of carrying out a Level 1 Petroleum Activity under Section 23 and under Schedule 5 of the *Environmental Protection Regulation 2008*:

Activity	Description
Schedule 5, No. 8	A petroleum activity, other than a petroleum activity mentioned in items 1 to 7, that includes a chapter 4 activity for which an aggregate environmental score is stated, including: ERA 8 1(a) (3) 1 - Chemical Storage – 50t or more of dangerous goods Class 1 or class 2, division 2.3 in containers of at least 10m³. ERA 10 (1) - Gas producing – Manufacturing, processing or reforming hydrocarbon gas: 200t/yr or more. ERA 60(1a) (i) (3) (1d) - Waste Disposal – operating a facility for disposing of, in a year, more than 200 000t of any, or any combination of regulated waste and general waste.

on or in relation to the relevant petroleum authorities identified below:

Relevant Petroleum Authority	Project Name	Project Location Description
Petroleum Facility Licence (PFL) 5	Gas to Liquid Plant	See Figures 1 and 2 in Appendix 3

This environmental authority (petroleum activities) is subject to the conditions that the holder carry out the above environmentally relevant activities in accordance with the conditions listed in the attached schedules.

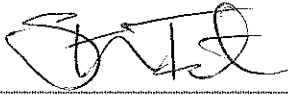
This environmental authority takes effect from the 20 July 2012.

This environmental authority remains in force unless it is cancelled, surrendered or suspended.

The anniversary date of this environmental authority is 18 September.

¹ Permit includes licences, approvals, permits, authorisations, certificates, sanctions or equivalent/similar as required by legislation administered by the Department of Environment and Heritage Protection.

51



20/7/2012

Date

Steven Tarte
Delegate of Administering Authority
Department of Environment and Heritage Protection

SCHEDULE OF CONDITIONS

This environmental authority incorporates the following schedules of conditions relevant to various issues:

- Schedule A - General Conditions
- Schedule B - Air Emissions
- Schedule C - Water Management
- Schedule D - Noise Management
- Schedule E - Waste Management
- Schedule F - Land Management
- Schedule G - Storage and Handling of Chemicals, Flammable and Combustible Substances
- Schedule H - Environmentally Sensitive Areas
- Schedule I - Petroleum Infrastructure
- Schedule J - Dams
- Schedule K - Community Issues
- Schedule L - Notification Procedures

- APPENDIX 1 - Definitions
- APPENDIX 2 - Environmentally Sensitive Areas
- APPENDIX 3 - Maps and Figures
- APPENDIX 4 - Determining Hazard Categories for Regulated Dams

ST

SCHEDULE A GENERAL CONDITIONS

PREVENT AND/OR MINIMISE LIKELIHOOD OF ENVIRONMENTAL HARM

- (A1) This authority does not authorise environmental harm unless a condition contained within this authority explicitly authorises that harm. Where there is no condition or the authority is silent on a matter, the lack of a condition or silence shall not be construed as authorising harm.
- (A2) In carrying out petroleum activities the holder of this authority must prevent and / or minimise the likelihood of environmental harm being caused.

MAINTENANCE OF MEASURES, PLANT AND EQUIPMENT

- (A3) The holder of this authority must ensure:
- a) that all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority are installed; and
 - b) that such measures, plant and equipment are maintained in a proper condition;
 - c) that such measures, plant and equipment are calibrated and operated in a proper manner; and
 - d) the operation and maintenance of all plant and equipment are carried out by a suitable qualified, competent and experienced person(s).
- (A4) All instruments, equipment and measuring devices used for measuring or monitoring in accordance with any condition of this authority must be calibrated, appropriately operated and maintained.
- (A5) The holder of this authority must ensure that operation and maintenance of all plant and equipment relating to the authorised petroleum activities are carried out by suitability qualified, competent and experienced person(s).
- (A6) No change, replacement or alteration of any plant or equipment is permitted if the change, replacement or alteration increases the risk of environmental harm from the petroleum activities.
- (A7) All analyses and tests required to be conducted under this authority must be carried out by a laboratory that has NATA certification for such analyses and tests, except as otherwise authorised by the administering authority.

FINANCIAL ASSURANCE

- (A8) The holder of this authority must provide a financial assurance in the amount and form required by the administering authority for the authorised petroleum activities.
- (A9) The financial assurance is to remain in force until the administering authority is satisfied that no claim is likely to be made on the assurance.



ENVIRONMENTAL MANAGEMENT SYSTEM

- (A10) The holder of this authority must:
- a) develop and implement an Environmental Management System (EMS) based on AS/NZS ISO 14001 to control and manage environmental risks and impacts related to the petroleum activities authorised on the relevant petroleum authority ; The EMS shall incorporate the following principles of ISO14001 as a minimum:
 - i. Environmental Policy;
 - ii. Environmental Aspects;
 - iii. Responsibility and Authority;
 - iv. Emergency Preparedness and Responses;
 - v. Incident Notification and Investigation;
 - vi. Legal Compliance;
 - vii. Monitoring and Measurement;
 - viii. Management Review.
 - b) submit a detailed description of the EMS mentioned in condition A10(a) within 60 days from the grant of this authority.

THIRD PARTY AUDITING

- (A11) Compliance with the conditions of this authority must be audited by an appropriately qualified third party auditor, nominated by the holder of this authority and accepted by the administering authority, within one year of the commencement of this authority, and then at regular intervals not exceeding two years.
- (A12) Upon receipt of the final third party audit report, the holder of this authority must submit a copy of the audit report to the administering authority within 28 days.
- (A13) The third party auditor must certify the findings of the audit in the report.
- (A14) The financial cost of the third party audit is to be borne by the holder of this authority.
- (A15) The holder of this authority must immediately act upon any recommendations arising from the audit report and:
- a) investigate any non-compliance issues identified; and
 - b) as soon as practicable, implement measures or take necessary action to ensure compliance with this authority.
- (A16) Subject to condition A15, and not more than three (3) months following the submission of the audit report, the holder of this authority must provide written advice to the administering authority addressing the:
- a) actions taken by the holder to ensure compliance with this authority; and
 - b) actions taken to prevent a recurrence of any non-compliance issues identified.

RECORDS

- (A17) The holder of this authority must record, compile and keep for a minimum of five (5) years all monitoring results required by this authority and make available for inspection all or any of these records upon request by the administering authority. Monitoring results relating to rehabilitation should be kept until the relevant petroleum tenure is surrendered.

ST

DEFINITIONS

- (A18) Certain words and phrases used in this authority are defined in Appendix 1 – Definitions. All terms used in this authority must be interpreted consistent with the definitions in the Environmental Protection Act 1994, its Regulation and Environmental Protection Policies.

SCHEDULE B AIR EMISSIONS

DUST AND PARTICULATE MANAGEMENT

- (B1) The release of any dust and particulate matter resulting from the petroleum activities must not cause an environmental nuisance at any sensitive or commercial place.
- (B2) In relation to a complaint received in Condition (B1), dust and particulate matter must not exceed the following levels at any sensitive or commercial place:
- a) Dust deposition of 120 milligrams per square metre per day, averaged over one month, when monitored in accordance with AS 3580.10.1 *Methods for sampling and analysis of ambient air - Determination of particulates - Deposited matter - Gravimetric method of 1991*; or
 - b) a concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM10) suspended in the atmosphere of 50 micrograms per cubic metre over a 24 hour averaging time, at a nuisance sensitive or commercial place downwind of the site, when monitored in accordance with AS3580.9.6 *'Ambient air – Particulate matter – Determination of suspended particulate PM10 high-volume sampler with size-selective inlet Gravimetric method'*; or AS 3580.9.8 *'Determination of suspended particulate matter – PM10 continuous direct mass method using a tapered element oscillating microbalance analyser'* or
 - c) a concentration of particulate matter with an aerodynamic diameter of less than 2.5 micrometre (µm) (PM2.5) suspended in the atmosphere of 25 micrograms per cubic metre over a 24 hour averaging time, at a nuisance sensitive or commercial place downwind of the site, when monitored in accordance with AS/NZS3580.9.10.2006.

ODOUR MANAGEMENT and VOLATILE ORGANIC COMPOUNDS (VOCs)

- (B3) The release of noxious and / or offensive odour(s) or any other noxious or offensive airborne contaminant(s) resulting from the petroleum activity must not cause an environmental nuisance at any sensitive or commercial place.
- (B4) When requested by the administering authority, odour monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any nuisance sensitive place. The results must be notified within 14 days to the administering authority following completion of monitoring.
- (B5) If monitoring indicates Condition (B3) is not being met then the environmental authority holder must:
- a) immediately implement odour abatement measures so that emissions of odour from the activity do not result in further environmental nuisance; and
 - b) address the complaint including the use of appropriate dispute resolution if required.

ALTERNATIVE ARRANGEMENTS AVAILABLE WHEN AIR EMISSIONS MAY CAUSE NUISANCE

- (B6) Where the holders of this authority has, at their cost, made alternative arrangements to the satisfaction of and with the written agreement of each person affected by nuisance air emissions at a sensitive or commercial place, then the requirements specified in Conditions (B1) - (B3) will not apply at that sensitive or commercial place for the period of the alternative arrangements.

ST

(B7) As a minimum each written agreement of an alternative arrangement must state:

- a) the location of the sensitive or commercial place;
- b) the names of the affected persons;
- c) the nature of the alternative arrangement(s) (e.g. provision of alternative accommodation); and
- d) the period of the alternative arrangement(s).

Flaring Gas

- (B8) Except where gas is being used beneficially, all gas produced by the coal gasification process must be flared following treatment through a gas /liquid separation plant, or be otherwise treated or contained, to ensure compliance with the conditions of this authority.
- (B9) The high pressure flare must be equipped with a continuously burning pilot or other automatic ignition system that assures gas ignition and provides immediate notification to appropriate personnel when the ignition system ceases to function.
- (B10) In the event of a malfunction or failure of the high pressure flare to operate, the environmental authority holder must notify the administering authority within 24 hours, detailing measures taken to repair and/or reignite the flare.
- (B11) Contaminants released from the high pressure flare must be directed vertically upwards, with no impedance.
- (B12) The high pressure flare must be constructed at a height, no less than six (6) metres above ground level, that is sufficient to ensure that the release of contaminants will comply with allowable ground level concentrations and other conditions provided in this authority.
- (B13) Contaminants must not be released to the atmosphere from the high pressure flare at a velocity less than 5 m/s during the first three months of operation, and thereafter not less than 8 m/s or greater than 32 m/s.
- (B14) The high pressure flare must be operated in such a way that the temperature for the combustion of gas by the flare is at least 980°C.

Low Pressure (LP) vent

- (B15) Contaminants released from the LP vent must be directed vertically upwards, with no impedance. The LP vent must be constructed at a height, no less than six (6) metres above ground level, that is sufficient to ensure that the release of contaminants during emergency purging of the gas-to-liquid plant will comply with allowable ground level concentrations and other conditions provided in this authority.

Modelling of Air Emissions and Dispersion

- (B16) After the commencement of this authority and prior to the first campaign of the demonstration gas to liquids plant being carried out, the holder of this authority must carry out air dispersion modelling using a recognised and appropriate model, to predict air quality at sensitive receptors within 3.5km the petroleum activities.
- (B17) The air dispersion modelling as required in condition B16 is to be carried out by a suitably qualified and experienced person.
- (B18) The air dispersion modelling as required in B16 shall be completed for the parameters identified below:
 - a) Odour
 - b) Total Volatile Organic Compounds (VOCs)
 - c) Benzo(a)pyrene

57

- d) Benzene
- e) Ethylbenzene
- f) Ethylene
- g) Toluene
- h) Xylenes (as a total of ortho meta and para isomers)
- i) Sulphur Dioxide (SO₂)
- j) Hydrogen Sulphide
- k) Carbon Monoxide (CO)
- l) Nitrogen Dioxide
- m) Phenol

(B19) The holder of the authority must submit to the administering authority a copy of the modelling report prior to the commencement of the next gas to liquids campaign following the granting of this authority.

Measurement of Plant Emissions

(B20) Within one month after commencing operations, the holder of this authority is to undertake a program of gas sampling and analysis of the HP Flare and LP vent when operating under normal conditions. The program must:

- a) Be performed with the aim of validating the emission dispersion model and characterising the air emissions from the HP Flare and LP Vent;
- b) Be performed on a post combustion basis;
- c) Include analysis of dust particles and total volatile organic compounds, dioxins and furans, as well as:
 - Gas velocity and volume flow rate;
 - Temperature;
 - Water vapour concentration.
 - Include sufficient sampling events to ensure representative analysis of the emissions.

Measurement of Ambient Air Quality

(B21) Within two months after commencing operations, the holder of this authority is to undertake a program of ambient air quality monitoring at not fewer than two sensitive receptors that were included in the modelling conducted as part of condition B16. The program must:

- a) Be performed with the aim of validating the emission dispersion model;
- b) Include analysis of the dust particles and total volatile organic compounds;
- c) Be conducted during conditions corresponding with the conditions included in the model.

Emissions and Air Quality Assessment Report

(B22) Within 28 days of the receipt of analysis of sampling conducted for both conditions B20 and B21, the holder of this authority must submit to DERM a report that addresses:

- a) Assessment of the efficiency of the high pressure flare and low pressure vent and the likely fate of all emissions found to be present within the gas sampled during the Air Emissions sampling program;
- b) Detail the sampling techniques used to carry out the sampling;
- c) Describe any variance between the sampling results received and those predicted by the model;
- d) Any re-run of the model due to calibration according to results received through the validation sampling;
- e) Provide a draft sampling regime and emissions criteria based on the results obtained.

ST

SCHEDULE C WATER MANAGEMENT

RELEASE TO WATERS

- (C1) The holder of this authority must ensure that the petroleum activities do not result in the release of contaminants to waters unless specifically authorised under this authority.

STORMWATER MANAGEMENT

- (C2) Except as otherwise provided by the conditions of this authority, petroleum activities must be carried out by such reasonable and practicable means necessary to prevent the contact of incident rainfall and stormwater runoff with waste or other contaminants arising from petroleum activities.
- (C3) All stormwater treatment devices must be maintained in proper and efficient working condition.
- (C4) A stormwater management system must be designed, implemented and maintained so that:
- a) in areas with the potential for significant erosion, contour banks and diversion drains are constructed to minimise the potential for overland flow to enter areas disturbed by petroleum activities;
 - b) erosion and sediment control structures are placed to minimise erosion of disturbed areas and prevent the contamination of any waters; and
 - c) contaminated stormwater runoff, incident rainfall and leachate is collected; and treated, reused, or released in accordance with the conditions of this authority.

GROUNDWATER MONITORING

- (C5) The holder must prepare and submit a shallow groundwater monitoring program to the administering authority within 3 (three) months after this authority is issued. If the administering authority gives to the holder of this authority any comment on the monitoring program within 21 days of receiving the document, the holder of this approval must have due regard to those comments when implementing the monitoring program.
- (C6) The Groundwater Monitoring Program must be developed by a person possessing appropriate qualifications and experience in the fields of hydrogeology and groundwater sampling design.
- (C7) The Groundwater Monitoring Program must be able to detect any significant changes to groundwater quality and groundwater levels due to activities authorised under this authority. The program must include:
- a) a groundwater monitoring network designed and installed for the authorised petroleum activities;
 - b) a sufficient number of monitoring sites to provide information on the following:
 - i. seepage from any regulated dam authorised under this authority and its effect on groundwater and soils;
 - ii. background monitoring sites (i.e. groundwater quality in representative bore(s) that have not been affected by any contaminants released to groundwater associated with activities authorised under this authority).
 - c) the location of monitoring points, parameters to be measured, frequency of monitoring, monitoring methodology used, trigger values;
 - d) the development of procedures to establish background ground water quality; and the installation and maintenance by a person possessing appropriate qualifications and experience in the fields of hydrogeology and groundwater monitoring program design.
- (C8) As a minimum, groundwater samples taken as part of the Groundwater Monitoring Program must be analysed for at least the following water quality parameters and at a frequency stipulated in

ST

Schedule C – Table 1 – Groundwater Quality Monitoring.

Schedule C Table 1 Groundwater Quality Monitoring

Quality Characteristic	Units	Limit Type	Contaminant Trigger Levels	Monitoring Frequency
Total Dissolved Solids	mg/L	Maximum	3230	Not exceeding three (3) Months
Conductivity	uS/cm	Maximum	4821*	"
pH	pH units	Range	6.5 – 8.5 ²	"
Total Alkalinity	mg/L	Maximum	816 [^]	"
Chloride	mg/L	Maximum	596 [^]	"
Sodium	mg/L	Maximum	670 [^]	"
Sulphate	mg/L	Maximum	1000 ¹	"
Fluoride	mg/L	Maximum	2 ¹	"
Cadmium	mg/L	Maximum	0.01 ¹	"
Arsenic	mg/L	Maximum	0.5 ¹	"
Lead	mg/L	Maximum	0.1 ¹	"
Zinc	mg/L	Maximum	20 ¹	"
Mercury	mg/L	Maximum	0.002 ¹	"
Phenol	mg/L	Maximum	0.05 ²	"
Total Petroleum Hydrocarbons	ug/L	Maximum	500 ²	"
Benzene	mg/L	Maximum	0.001 ²	"
Ethylbenzene	mg/L	Maximum	0.3 ²	"
Naphthalene	ug/L	Maximum	16 [#]	"
Toluene	mg/L	Maximum	0.8 ²	"
Xylene	mg/L	Maximum	0.3 ²	"
Total Polycyclic Aromatic Hydrocarbons (PAH)	ug/L	Maximum	3 [#]	"
Benzene (a) pyrene	ug/L	Maximum	0.1 [#]	"

1 – These limits derived from ANZECC 2000 water quality guidelines for livestock.

2 - These limits derived from ANZECC 2000 water quality guidelines for drinking water.

* - correlated from TDS

[^] - 90th percentile of all data collected from background monitoring wells numbers M1, M7, M10, M11 M12 and M15

[#] - Sourced from: Western Australia Department of Environment 2003. Draft Contaminated Sites Management Series Assessment Levels for Soils, Sediments and Water, Version 3, November 2003

- (C9) Prior to any groundwater sampling, groundwater levels must be measured to the nearest millimetre and reported in metres.
- (C10) All groundwater monitoring bores must be maintained in an operative condition and be reasonably accessible at all times to any authorised person.
- (C11) All determinations of groundwater quality and the evaluation/explanation must be performed by a person or body possessing appropriate experience and qualifications to perform the required determinations. This must include, but not be limited to an assessment as to whether there is any groundwater contamination.
- (C12) If groundwater contamination caused by the petroleum activities is encountered, the following must be considered to satisfy requirements under Condition (C11):
- a) the level of environmental harm caused as a result of such contamination; and
 - b) the conduction of a geodetic survey of all monitor bores to determine the relative water

ST

- surface elevations of each bore and reported in metres relative to the Australian Height Datum; and
- c) the determination of groundwater flow direction, groundwater flow rate and hydraulic conductivity.

(C13) Groundwater monitoring must continue in accordance with the Groundwater Monitoring Program until at least six months after decommissioning of all dams and after the Gas to Liquid Plant has shut down and only when monitoring results have demonstrated that there is no contamination of groundwater resulting from the petroleum activities.

GROUNDWATER MONITORING ANALYSIS REPORTING

(C14) The holder of this authority must ensure that groundwater monitoring data is gathered in accordance with this authority is analysed and interpreted to assess the nature and extent of any environmental impact of the environmentally relevant activity. The data, analysis and assessment must be submitted to the administering authority:

- a) every three (3) months; and
- b) with each Annual Return; and
- c) if the groundwater contaminant trigger levels defined in Schedule C – Table 1 are exceeded the holder of the authority must complete an investigation into the potential environmental harm and notify the administering authority within 14 days of receiving the analysis results.

(C15) If groundwater monitoring indicates that changes as described in Condition (C8) occur, then the information required must include any proposed actions to mitigate the changes in groundwater quality as well as means to prevent the event recurring.

DETERMINING WATER QUALITY CONTAMINANTS

(C16) All determinations of the quality of contaminants released to waters must be made in accordance with methods prescribed in the latest edition of the Department of Environment and Resource Management Water Quality Sampling Manual, and carried out on samples that are representative.

SCHEDULE D NOISE MANAGEMENT

- (D1) Noise from the carrying out of petroleum activities must not cause an environmental nuisance at any sensitive place or commercial place.
- (D2) The holder of this authority must investigate the potential noise impacts from the petroleum activities on surrounding sensitive and commercial places, following receipt of a complaint.
- (D3) If the investigation of noise emissions under Condition D2 indicates that noise emissions from the proposed petroleum activities are likely to cause environmental nuisance at surrounding sensitive or commercial places, then the holder of this authority must take appropriate measures to either relocate the petroleum activities or incorporate noise abatement and / or attenuation measures to mitigate those impacts as far as is practicable.
- (D4) For the purposes of investigating a complaint of unlawful environmental nuisance and determining compliance with condition (D1), noise emissions from the petroleum activities will not constitute unlawful environmental nuisance where the limits specified in Schedule D – Table 1 – Noise Limits are complied with.

57

Schedule D – Table 1 – Noise limits

Sensitive place						
Noise level dB(A) measured as:	Monday to Saturday			Sundays and public holidays		
	7am to 6pm	6pm to 10pm	10pm to 7am	9am to 6pm	6pm to 10pm	10pm to 9am
L_{A90}, adj, 15 mins	lesser of bg+3 or 48	lesser of bg+0 or 40	lesser of bg+0 or 40	lesser of bg+0 or 40	lesser of bg+0 or 40	lesser of bg+0 or 40
L_{A10}, adj, 15 mins	lesser of bg+5 or 50	lesser of bg+5 or 45	lesser of bg+0 or 40	lesser of bg+5 or 45	lesser of bg+5 or 40	lesser of bg+0 or 35
L_{A1}, adj, 15 mins	lesser of bg+10 or 55	lesser of bg+10 or 50	lesser of bg+5 or 45	lesser of bg+10 or 50	lesser of bg+10 or 45	lesser of bg+5 or 40
Commercial place						
Noise level dB(A) measured as:	Monday to Saturday			Sundays and public holidays		
	7am to 6pm	6pm to 10pm	10pm to 7am	9am to 6pm	6pm to 10pm	10pm to 9am
L_{A90}, adj, 15 mins	lesser of bg+5 or 50	lesser of bg+0 or 45	lesser of bg+0 or 40	lesser of bg+3 or 43	lesser of bg+0 or 40	lesser of bg+0 or 40
L_{A10}, adj, 15 mins	lesser of bg+10 or 55	lesser of bg+10 or 50	lesser of bg+5 or 45	lesser of bg+10 or 50	lesser of bg+10 or 45	lesser of bg+5 or 40
L_{A1}, adj, 15 mins	lesser of bg+15 or 60	lesser of bg+15 or 55	lesser of bg+10 or 50	lesser of bg+15 or 55	lesser of bg+15 or 50	lesser of bg+10 or 45

Note:

bg = **background noise level**. In the event that measured background is less than 25 dB(A), then 25 dB(A) can be substituted for the measured level

- (D5) Noise monitoring must be undertaken as directed by the administering authority to investigate any complaint of noise nuisance being caused by the petroleum and associated activities which the administering authority considers is neither frivolous, nor vexatious nor based on mistaken belief, and the results thereof notified to the administering authority within 14 days following the completion of noise monitoring.
- (D6) Noise monitoring must be undertaken in accordance with the latest edition of the Department of Environment and Resource Management's Noise Measurement Manual or the most recent version of *AS1055 Acoustics – Description and measurement of environmental noise and the EPA guideline, Assessment of Low Frequency Noise and Planning for Noise Control* and include:
- L_{Amax}, adj, 15 mins (L_{A10}, adj, 15 mins);
 - relevant background sound pressure level (L_{A90}, 15 mins);
 - L_{A1}, adj, 15 mins;
 - the level and frequency of occurrence of impulsive or tonal noise;
 - atmospheric conditions including wind speed and direction; and
 - location, date and time of measurements.

ALTERNATIVE ARRANGEMENTS AVAILABLE WHEN NOISE EMISSIONS MAY CAUSE ENVIRONMENTAL NUISANCE

- (D7) Where the holder of this authority has, at their cost, made alternative arrangements to the satisfaction of and with the written agreement of each person that may be affected by nuisance noise emissions at a sensitive or commercial place, then the requirements specified in Schedule D Table 1- Noise Limits will not apply at that sensitive or commercial place for the period of the alternative arrangements.

ST

(D8) As a minimum each written agreement of an alternative arrangement must state:

- a) the location of the sensitive or commercial place;
- b) the names of the affected persons;
- c) the nature of the alternative arrangement(s) (e.g. provision of alternative accommodation); and
- d) the period of the alternative arrangement(s).

SCHEDULE E WASTE MANAGEMENT

- (E1) The holder of the environmental authority must ensure that all activities do not result in the release or likely release of a contaminant to land or waters that results in material or serious environmental harm, unless the release is explicitly authorised under this environmental authority.
- (E2) Any spillage of hazardous contaminants or other contaminants that may cause environmental harm must be effectively contained and/or cleaned up as quickly as practicable. Such spillage must not be cleaned up by hosing, or otherwise thereby releasing such waste or contaminants to any land or waters.
- (E3) The holder of this authority must ensure that all general waste produced by the petroleum activities is removed from the relevant petroleum authority and disposed to a facility licensed to accept such waste.
- (E4) All regulated waste removed from the site must be removed by a person who holds a current authority to transport such waste under the provisions of the *Environmental Protection Act 1994* and sent to a facility licensed to accept such waste.
- (E5) When regulated waste is removed from within the boundary of the petroleum authority and transported by the holder of this authority, a record must be kept of the following:
- a) date of waste transport;
 - b) quantity of waste removed and transported;
 - c) type of waste removed and transported;
 - d) route selected for transport of waste;
 - e) quantity of waste delivered; and
 - f) any incidents (e.g. spillage) that may have occurred en route.
- (E6) The holder of this authority is authorised to release the maximum volume of treated effluent from the wastewater treatment plant to the irrigation area not exceeding 24,000 litres per day.
- (E7) The holder of this authority will undertake monitoring of treated effluent to meet the treated wastewater quality requirements prescribed in Schedule E - Table 1 of condition (E8) at the frequency prescribed in Schedule F - Table 2.
- (E8) The treated wastewater effluent that exceeds the wastewater quality prescribed in Schedule E - Table 1 must be discharged to the evaporation pond or recirculated into the process water system.

Schedule E - Table 1 Treated Wastewater Effluent Quality

Parameter	Maximum concentration
pH	6.0 – 8.5
EC ₂₅	1.6 dS/m
Ammonia	25 mg/L
NOx (N as nitrate and nitrite)	125 mg/L
Total P	12 mg/L



Parameter	Maximum concentration
BOD	20mg/L
TDS	1072 mg/L
BTEX	300ug/L
Phenol	50 ug/L
Sodium	460 mg/L
Chloride	750 mg/L
Cadmium	0.0001 mg/l
Arsenic	0.005 mg/L
Lead	0.001 mg/L
Zinc	0.03 mg/L
Mercury	0.006 mg/L
Fluoride	2 mg/L
Chromium	0.0001 mg/L
Copper	0.007 mg/L
Nickel	0.001 mg/L
Suspended Solids	10 mg/L

SCHEDULE F LAND MANAGEMENT

MINIMISING DISTURBANCE TO LAND AND SOIL MANAGEMENT

- (F1) The holder of this environmental authority must:
- a) minimise disturbance to land in order to prevent land degradation; and
 - b) ensure that for land that is to be significantly disturbed by petroleum activities, the top layer of the soil profile is removed; and
 - i. stockpiled in a manner that will preserve its biological and chemical properties, and
 - ii. used for rehabilitation purposes in accordance with Condition (F5); and
 - c) avoid the disturbance of sodic soils.

VEGETATION MANAGEMENT

- (F2) The holder of this authority must:
- a) prevent disturbance to vegetation; or minimise
 - b) manage the effects of clearing to prevent the loss of biodiversity, reduction of ecological processes and land degradation.

MANAGEMENT OF FAUNA

- (F3) The holder of this authority must develop, implement and maintain measures to prevent access by all livestock and access by fauna to any dam or water storage facility.

REHABILITATION REQUIREMENTS

- (F4) As soon as practicable and within three (3) months of cessation of petroleum activities, the holder of this authority must:
- a) if a notifiable activity has been carried out on the land or the land has been subject to contamination by a hazardous contaminant – investigate the contamination status of the land in accordance with the *Environmental Protection Act 1994* and with the *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland* (DEH, 1998) and, before the environmental authority is surrendered, obtain any necessary suitability statement that demonstrates that the land

ST

is suitable for its intended use, or

- b) if the petroleum activities have caused any land to be significantly disturbed for other reasons –take all reasonable and practicable measures to:
 - (i) re-establish surface drainage lines;
 - (ii) reinstate the top layer of the soil profile;
 - (iii) promote the re-establishment of vegetation; and
 - (iv) promote establishment of vegetation suitable for the post disturbance land use.
- c) Ensure that maintenance requirements for rehabilitated land is no greater than that required for the land prior to its disturbance by the petroleum activities.

(F5) All land significantly disturbed by petroleum activities must be rehabilitated to:

- a) a stable landform and with a self-sustaining vegetation cover and species that are similar to adjoining undisturbed areas;
- b) ensure that all land is reinstated to the pre-disturbed land use and suitability class;
- c) ensure that the maintenance requirements for rehabilitated land is no greater than that required for the land prior to its disturbance by petroleum activities; and
- d) ensure that the water quality of any residual void or water bodies constructed by petroleum activities meets criteria for subsequent uses and does not have potential to cause environmental harm.

(F6) Maintenance of rehabilitated areas must take place to ensure and demonstrate:

- a) stability of landforms;
- b) erosion control measures remain effective;
- c) stormwater runoff and seepage from rehabilitated areas does not negatively affect the environmental values of any waters;
- d) plants show healthy growth and recruitment is occurring; and
- e) rehabilitated areas are free of any declared pest plants.

(F7) Rehabilitation can be considered successful when the site can be managed for its designated land-use (either similar to that of surrounding undisturbed areas or as otherwise agreed in a written document with the landowner/holder and administering authority) without any greater management input than for other land in the area being used for a similar purpose and there is evidence that the rehabilitation has been successful for at least three (3) years.

Land Release Management Plan

(F8) The holder of this authority must:

- Develop and submit to the administering authority a Land Release Management Plan (LRMP) for the proposed petroleum activities. The LRMP must adequately address the following matters:
 - identification of environmental issue and potential impacts
 - control measures for routine operations to minimise likelihood of environmental harm;
 - contingency plans and emergency procedures for non-routine situations;
 - wastewater treatment system
 - irrigation system;
 - monitoring and reporting;
 - record keeping; and
 - periodic review of environmental performance and continual improvement.

(F9) The holder of this authority must submit a copy of the LRMP to the administering authority, within three (3) months of commencing the irrigation of treated wastewater effluent.

(F10) The LRMP must not be implemented or amended in any way that contravenes any condition of this authority.



Irrigation Area

- (F11) The holder of this approval must ensure that all treated wastewater effluent is contained within the area defined in Schedule F - Table 1.

Schedule F - Table 1 Irrigation Areas

Irrigation Area 2 (PFL2)		Irrigation Area 3 (PFL3)	
Easting (MGA 94 Zone 56)	Northing (MGA 94 Zone 56)	Easting (MGA 94 Zone 56)	Northing (MGA 94 Zone 56)
268.682.37	7019795.74	268.694.4	7.019.916.9
268.700.24	7019792.90	268.749.2	7.019.917.3
268.681.15	7019621.93	268.681.5	7.019.799.5
268.661.26	7019623.96	268.701.3	7.019.795.6
		268.742.1	7.019.851.7

- (F12) The holder of this authority must ensure that the species of vegetation planted in the irrigation area are salt tolerant species and include species such as Chinchilla white gum and suitable pasture grasses.
- (F13) The holder of this authority must ensure that irrigation is limited to drip irrigation and shall not exceed an application rate of 20 mm per week.
- (F14) The holder of this authority must ensure that irrigation system is installed using sub-surface drip irrigation.
- (F15) The holder of this authority must ensure that sub-surface drip irrigation system is installed to a depth between 200 mm to 400 mm beneath the surface.
- (F16) The holder of this authority must ensure that soil sodicity within the irrigation area, must be controlled by an initial application of granular gypsum to a rate of 3.2 tonnes per hectare.
- (F17) Subsequent soil sodicity control shall involve liquid dosing into the irrigation system.
- (F18) The rate and timing of the liquid based application must be determined following soil sodicity monitoring.
- (F19) Soil sodicity monitoring must be undertaken on a 12 monthly basis, following the initial application of granular gypsum.

Wet Weather Storage

- (F20) The holder of this authority must ensure that during wet weather events:
- irrigation shall cease, until a 24hour period has passed with 0 mm rainfall;
 - irrigation may only recommence once soil moisture levels are below 80% saturation;
 - irrigation must cease should soil moisture levels reach saturation; and
 - treated effluent is diverted to the 10 ML evaporation pond.

Evaporation Dam

- (F21) The holder of this authority must maintain, at all times, a minimum wet weather storage capacity of 1.2 ML, in the 10 ML evaporation dam identified in Figure 2.
- (F22) The holder of this authority must ensure that irrigation of treated effluent will cease upon completion of decommissioning of generator number 4.

ST

Monitoring

- (F23) Wastewater effluent testing shall be conducted every month by a NATA certified laboratory and at least weekly by a non-NATA certified laboratory.
- (F24) Wastewater effluent monitoring must be undertaken as shown in Table 2 below.

Schedule F - Table 2 - Wastewater Effluent Monitoring

Sampling Point	Wastewater Effluent Discharge Point	
Parameter	Units	Testing Frequency
pH	pH units	weekly
EC	uS/cm	weekly
NH ₃	mg/L	weekly
NOx (N as nitrate and nitrite)	mg/L	weekly
Total P	mg/L	weekly
BOD	mg/L	weekly
COD	mg/L	weekly
TDS	mg/L	weekly
BTEX	mg/L	Monthly
Phenol	mg/L	Monthly
PAH	µm/L	Monthly
Total TPH*	µm/L	Monthly
Sodium	mg/L	Monthly
Calcium	mg/L	Monthly
Magnesium	mg/L	Monthly
Chloride	mg/L	Monthly
Sulphate	mg/L	Monthly
Cadmium	mg/L	Monthly
Arsenic	mg/L	Monthly
Lead	mg/L	Monthly
Zinc	mg/L	Monthly
Mercury	mg/L	Monthly
Total Alkalinity	mg/L	Monthly
Fluoride	mg/L	Monthly

Note: * Total TPH includes, Naphtharlene and Benzene-(a)-pyrene.

- (F25) Soil monitoring shall be undertaken at frequencies shown in Table 3.
- (F26) Soil analysis must be undertaken by a NATA certified laboratory for the parameters listed in Table 3.
- (F27) Soil moisture must be tested at least twice per week or with in-situ monitoring probes.
- (F28) Soil condition monitoring will include the incidence of algal crusts.

ST

Schedule F - Table 3 – Soil Monitoring*

Parameter	Units	Testing Frequency#
pH	pH units	Monthly
EC	uS/cm	Monthly
NH ₃	mg/kg	Monthly
NOx (N as nitrate and nitrite)	mg/kg	Monthly
Total P	mg/kg	Monthly
Soil organic Matter	mg/kg	Monthly
BTEX	mg/kg	Monthly
Phenol	mg/kg	Monthly
PAH	µm/kg	Monthly
Total TPH*	µm/kg	Monthly
Sodium	mg/kg	Monthly
Calcium	mg/kg	Monthly
Magnesium	mg/kg	Monthly
Chloride	mg/kg	Monthly
Exchangeable sodium percentage	%	Monthly
Sulphate	mg/kg	Monthly
Cadmium	mg/kg	Monthly
Arsenic	mg/kg	Monthly
Lead	mg/kg	Monthly
Zinc	mg/kg	Monthly
Mercury	mg/kg	Monthly
Total Alkalinity	mg/kg	Monthly
Fluoride	mg/kg	Monthly

* sampling to be undertaken at 200 - 300mm, 500 - 600mm and 800 – 900mm and 1100 – 1200mm below ground level – at a rate of 1 site per 1250m² of irrigated land.

soil testing on a monthly basis for the first three months following commencement of irrigation. Then at six (6) month and annually there after.

Groundwater

- (F29) Shallow groundwater monitoring wells must be constructed as per requirements specified in the "Shallow Groundwater Monitoring Plan, Linc Energy, Chinchilla UCG-GTL Demonstration Facility" dated 25 November 2009.
- (F30) Two additional shallow groundwater bores must be installed adjacent to the irrigation sites (PFL2 and PFL3) to monitor seepage.
- (F31) Groundwater level monitoring of shallow bores must be undertaken on a monthly basis to determine whether seepage from irrigation causes recharge of the shallow 20m alluvial layer.

Reporting

- (F32) As soon as practicable and within three (3) months from the date of cessation of petroleum activities, the holder of this authority must provide to the administering authority with a report which assesses the performance of the implementation of the Land Release Management Plan, including consolidated soil and groundwater monitoring information.

51

SCHEDULE G STORAGE AND HANDLING OF CHEMICALS, FLAMMABLE AND COMBUSTIBLE SUBSTANCES

- (G1) All explosives, hazardous chemicals, corrosive substances, toxic substances, gases, dangerous goods, flammable and combustible liquids (including petroleum products and associated piping and infrastructure) must be stored and handled in accordance with the relevant Australian Standard where such is available.
- (G2) Notwithstanding the requirements of any Australian Standard, any liquids stored on site that have the potential to cause environmental harm must be stored in or serviced by an effective containment system that is impervious to the materials stored and managed to prevent the release of liquids to waters or land. Where no relevant Australian Standard is available, the following must be applied:
- a) storage tanks must be banded so that the capacity and construction of the band is sufficient to contain at least 110% of a single storage tank or 100% of the largest storage tank plus 10% of the second largest storage tank in multiple storage areas; and
 - b) drum storages must be banded so that the capacity and construction of the band is sufficient to contain at least 25% of the maximum design storage volume within the band.
- (G3) All containment systems must be designed to minimise rainfall collection within the system.

SCHEDULE H ENVIRONMENTALLY SENSITIVE AREAS

- (H1) Notwithstanding any other condition of this authority, the holder of this authority must ensure that petroleum activities:
- a) are not conducted within a category A or B Environmentally Sensitive Area (ESA); and
 - b) do not cause a significant disturbance within 1km of a category A ESA or within 500m of a category B ESA; and
 - c) are not conducted in a category C ESA unless there is a written agreement to enter the area for those activities from the relevant administering authority.

SCHEDULE I PETROLEUM INFRASTRUCTURE

GENERAL CONDITIONS

- (I1) Petroleum infrastructure must be located within the area defined by the relevant petroleum authority as shown in Figure 2 in Appendix 3.
- (I2) All petroleum infrastructure (including buildings, structures, petroleum equipment and plant erected and/or used for the petroleum activities) must be removed from the relevant petroleum authorities prior to surrender of this authority, except where agreed in writing by the administering authority and the current landowner.
- (I3) Prior to the commencement of decommissioning or abandonment activities, the scope of work for decommissioning or abandonment of project infrastructure shall be developed and agreed to with the administering authority.

PIPELINES

GENERAL CONDITIONS

- (I4) The holder of this authority must decommission each petroleum and gas pipeline to a situation where ongoing, or potential environmental harm is prevented or minimised. As a minimum, pipelines must be decommissioned such that:
- a) they no longer contain hazardous contaminants;

ST

- b) they are left in stable condition;
- c) all the above ground infrastructure is removed; and
- d) all areas disturbed by above ground infrastructure are rehabilitated in accordance with the requirements of this authority.

- (15) Prior to the commencement of decommissioning or abandonment activities, the scope of work for decommissioning or abandonment shall be developed and agreed to with the administering authority.

EMERGENCY RESPONSE PLANS FOR DEALING WITH INCIDENCES THAT MAY RESULT IN ENVIRONMENTAL HARM

- (16) The holder of this authority must provide the administering authority, within 3 (three) months from the date of this approval, with an Emergency Response Plan for operating the petroleum facility, to aid in the effective response to an emergency situation that may result in environmental harm. The plan shall include:

- a) means by which an emergency response is initiated;
- b) defined key roles and responsibilities required to respond to an emergency;
- c) facilities required to coordinate the emergency response;
- d) key contact list;
- e) criteria for escalation of an emergency;
- f) likely emergency scenarios and guidelines for responding to such scenarios;
- g) communication and documentation requirements; and
- h) evacuation protocols and muster points.

The Emergency Response Plans must be reviewed annually to validate the adequacy of the scope of emergency scenarios and adequacy of the content.

- (17) In accordance with Condition (16), the holder of this authority must ensure that relevant personnel must be trained and competent to effectively fulfill their roles required as detailed in the relevant Emergency Response Plans to deal with pipeline incidents that could potentially result in environmental harm. Training records are to be kept for five years.

- (18) Subject to Condition (16), the holder of this authority must undertake emergency exercises to:

- a) test the effectiveness of emergency response plan;
- b) validate the competency of key emergency response personnel;
- c) assess capability of to respond to an emergency;
- d) reinforce prior training; and
- e) identify opportunities for improvement.

Emergency response exercises may be in the form of simulated emergencies, practical drills, desktop exercises, resources and equipment checks, or other exercises designed to systematically include all personnel likely to be involved.

- (19) Subject to Condition (18), the holder of this authority must notify the administering authority in writing at least 10 (ten) business days prior to conducting emergency response exercise. The holder of this authority must also telephone the DERM's Pollution Hotline (1300 130 372) or local office the day during the emergency response exercise.

51

SCHEDULE J DAMS

ALL DAMS

- (J1) The hazard category of any dam must be assessed by a suitably qualified and experienced person:
- prior to its design and construction including modifications to an existing dam); or
 - upon any changes in its purpose or its stored contents and
 - at least once in each 12 month, period after its construction..
- (J2) The holder of this authority must not commence construction of any dam determined to be in the significant or high hazard category, unless the location, basic details, and hydraulic performance of that dam are specifically referenced in this authority.
- (J3) The holder of this authority must not abandon any dam but must decommission each dam so as to avoid any environmental harm.
- (J4) As a minimum, decommissioning must be conducted such that each dam is either:
- a) becomes a stable landform, that no longer contains flowable substances, or
 - b) is approved or authorised under relevant legislation for a beneficial use, or
 - c) is a void authorised by the administering authority to remain after decommissioning; and
 - d) is compliant with the decommissioning and rehabilitation requirements of this authority.

REGULATED DAMS – LOCATION

- (J5) The following regulated dams authorised under this environmental authority must be located within the control points defined in Schedule J - Table 1, below.

Schedule J — Table 1 (Location of Regulated Dams)

Name of Regulated Dam	Latitude (N) (GDA 94)	Longitude (E) (GDA 94)
Dam 1	NW corner 7019792	NW corner 268704
	NE corner 7019768	NE corner 268755
	SE corner 7019645	SE corner 268752
	SW corner 7019651	SW corner 268687

- (J6) The following regulated dams authorised under this environmental authority, must be in accord with the specifications in Schedule J - Table 2, below.

31

Schedule J— Table 2 (Specifications of Regulated Dams)

Name of Regulated dam	Hazard Category	Maximum surface area of dam (ha)	Maximum operational volume of dam (ML)	Maximum depth of dam (m)	Use of dam
Dam 1	Significant	0.736	8.97	2.27	Waste disposal

- (J7) The following regulated dams authorised under this environmental authority, must provide the hydraulic performance specified in Schedule J - Table 3, below.

Schedule J — Table 3 (Hydraulic Performance of Regulated Dams)

Name of Regulated dam	Spillway Capacity or Diversion Capacity (Levees) AEP	Design Storage Allowance (Dams other than levees) AEP (m ³)	Mandatory Reporting Level (Dams other than levees) AEP
Dam 1	1:1000	4.6ML	318.80 RL

NOTE: For each entry in the table for Design Storage Allowances, the method of calculation (either 'full hydrological analysis' or 'method of monthly deciles') must be specified in conjunction with the AEP level applicable to the hazard category and method of calculation - as indicated in the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams, maintained and published by the Department of Environment and Resource Management on its website.

REGULATED DAMS – CERTIFICATION AND OPERATION

- (J8) The holder of this environmental authority must not commence construction of a regulated dam (including modifications to an existing dam) unless:
- the holder has submitted to the administering authority two copies of a design plan, together with the certification of a suitably qualified and experienced person that the design of the regulated dam will deliver the performance stated in the design plan and that it will be compliant in all respects with this environmental authority, and
 - at least 20 business days has passed since the receipt of those documents, or the administering authority notifies the holder that a design plan and certification, has been received.
- (J9) Where construction has been conducted on a regulated dam (including modifications to an existing dam), operation of that regulated dam is prohibited unless the holder has submitted to the administering authority two hard copies and one electronic copy of the certified design plan and a set of 'as constructed' drawings and specifications, together with the certification by a suitably qualified and experienced person that the dam:
- has been constructed in accordance with the design plan;
 - with any minor changes, is still capable of delivering the performance stated in the design plan; and
 - is compliant with the conditions of this environmental authority
- (J10) All regulated dams under this authority, must be designed to have either a suitable synthetic or a compacted clay liner, such that the saline wetting front is not expected to progress through the liner during the lifetime of the dam.

51

- (J11) An operational plan must be kept current for each regulated dam, and cover all matters relevant to its operation and maintenance.
- (J12) Where an operational plan covers decommissioning and rehabilitation, those operations are to be consistent with the objectives in any design plan for the dam and the rehabilitation requirements of this environmental authority.
- (J13) The holder of this environmental authority must notify the administering authority immediately when the level in any regulated dam reaches the mandatory reporting level (MRL), and immediately act to prevent or minimize any actual or potential environmental harm.

REGULATED DAMS – ANNUAL INSPECTION AND REPORT

- (J14) Each regulated dam must be inspected annually by a suitably qualified and experienced person.
- (J15) At each annual inspection, the condition and adequacy of each regulated dam must be assessed for dam safety and against the necessary structural, geotechnical and hydraulic performance criteria.
- (J16) At each annual inspection, if a mandatory reporting level is required, it must be determined and marked on each regulated dam.
- (J17) A final assessment of adequacy of available storage in each regulated dam must be based on a dam level observed within the month of October and result in an estimate of the level in that dam as at 1 November
- (J18) For each annual inspection, two copies of a report on the condition and adequacy of each regulated dam, certified by the suitably qualified and experienced person and including any recommended actions to be taken to ensure the integrity of each regulated dam; must be provided to the administering authority by 1 December.
- (J19) The holder of this environmental authority must, upon receipt of the annual inspection report, consider the report and its recommendations, and take action to ensure that each regulated dam safely performs its intended functions.

DECOMMISSIONING REGULATED DAMS

- (J20) Prior to decommissioning any regulated dam authorised under this authority, the scope of work for decommissioning shall be developed and agreed to with the administering authority.
- (J21) Subject to condition (J20), the holder of this authority must:
 - a) Remove all remaining liquids in the dam.
 - b) Remove and dispose of synthetic liners and dispose at a facility licensed to accept such waste material;
 - c) Remove where possible all contaminated solids from the dam including contaminated subsoils and:
 - i. dispose of the contaminated solids at a facility licensed to accept such regulated waste; or
 - ii. encapsulate in a purpose built storage facility.
 - d) Design, install and maintain adequate diversion drains or similar structures to protect or minimise the erosion of any exposed surfaces by stormwater runoff.
 - e) Design, install and maintain adequate surface drainage to prevent water ponding and infiltration into any contaminated materials.
 - f) Address any contaminated site issues in accordance with Condition (F4).
 - g) Establish a monitoring program to determine the success of the decommissioning plan.
 - h) If required, remove the wall and rehabilitate the disturbed area in accordance with the rehabilitation conditions of this authority.
 - i) Rehabilitate the disturbed areas in accordance with the rehabilitation conditions of this authority.

ST

SCHEDULE K COMMUNITY ISSUES

- (K1) When the administering authority advises the holder of a complaint alleging nuisance, the holder must investigate the complaint and advise the administering authority in writing of the action proposed or undertaken in relation to the complaint.
- (K2) When requested by the administering authority, the holder of this authority must undertake monitoring specified by the administering authority, within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint of environmental harm at any sensitive or commercial place.
- (K3) The results of the investigation (including an analysis and interpretation of the monitoring results) and abatement measures implemented must be provided to the administering authority within fourteen (14) days of completion of the investigation, or receipt of monitoring results, whichever is the latter.
- (K4) If monitoring in accordance with Condition (K2), indicates that emissions exceed the limits set by this authority or are causing nuisance, then the holder of this authority must:
- a) address the complaint including the use of appropriate dispute resolution if required; and/or
 - b) as soon as practicable implement abatement or attenuation measures so that noise, dust, particulate or odour emissions from the authorised activities do not result in further environmental nuisance.
- (K5) The holder of this authority must maintain a record of complaints and incidents causing environmental harm, and actions taken in response to the complaint or incident; and
- (K6) The holder of this authority must record the following details for all complaints received and provide this information to the administering authority every 3 months:
- a) name, address and contact number for complainant;
 - b) time and date of complaint;
 - c) reasons for the complaint;
 - d) investigations undertaken;
 - e) conclusions formed;
 - f) actions taken to resolve complaint;
 - g) any abatement measures implemented; and
 - h) person responsible for resolving the complaint.
- (K7) The holder of this authority must retain the record of complaints required by this condition for five (5) years.

SCHEDULE L NOTIFICATION PROCEDURES

- (L1) The holder of this authority must telephone the DERM's Pollution Hotline (1300 130 372) or local office as soon as practicable after becoming aware of any release of contaminants not in accordance with the conditions of this authority or any event where environmental harm has been caused or may be threatened.
- (L2) Subject to Condition (L1), the holder of this authority is required to report in the case of uncontained spills (including hydrocarbon, associated water or mixtures of both) of the following volumes or kind:
- a) releases of any volume to water; and
 - b) releases of volume greater than 200L to land; and
 - c) releases of any volumes where potential serious or material environmental harm is considered to exist.

- (L3) The notification of emergencies or incidents as required by Conditions number (L1 and L2) must include but not be limited to the following:
- a) the authority number and name of holder;
 - b) the name and telephone number of the designated contact person;
 - c) the location of the emergency or incident;
 - d) the date and time of the release;
 - e) the time the holder of the authority became aware of the emergency or incident;
 - f) the estimated quantity and type of any substances involved in the incident;
 - g) the actual or potential suspected cause of the release;
 - h) a description of the effects of the incident including the environmental harm caused, threatened, or suspected to be caused by the release;
 - i) any sampling conducted or proposed, relevant to the emergency or incident; and
 - j) actions taken to prevent any further release and mitigate any environmental harm caused by the release.
- (L4) Within fourteen (14) days following the initial notification of an emergency or incident or receipt of monitoring results, whichever is the later, further written advice must be provided to the administering authority, including the following:
- a) results and interpretation of any samples taken and analysed;
 - b) outcomes of actions taken at the time to prevent or minimise environmental harm; and
 - c) proposed actions to prevent a recurrence of the emergency or incident.
- (L5) As soon as practicable, but not more than six (6) weeks following the conduct of any environmental monitoring performed in relation to the emergency or incident, which results in the release of contaminants not in accordance, or reasonably expected to be not in accordance with the conditions of this authority, written advice must be provided of the results of any such monitoring performed to the administering authority.

APPENDIX 1

DEFINITIONS

TERM	MEANING
Acceptance criteria	Means the measures by which actions implemented are deemed to be complete. The acceptance criteria indicate the success of the decommissioning and rehabilitation outcomes or remediation of areas which have been significantly disturbed by the environmentally relevant activities. Acceptance criteria may include information regarding: • stability of final land forms in terms of settlement, erosion, weathering, pondage and drainage; • control of geochemical and contaminant transport processes; • quality of runoff waters and potential impact on receiving environment; • vegetation establishment, survival and succession; • vegetation productivity, sustained growth and structure development; • fauna colonisation and habitat development; • ecosystem processes such as soil development and nutrient cycling, and the recolonisation of specific fauna groups such as collembola, mites and termites which are involved in these processes; • microbiological studies including recolonisation by mycorrhizal fungi, microbial biomass and respiration; • effects of various establishment treatments such as deep ripping, topsoil handling, seeding and fertiliser application on vegetation growth and development; • resilience of vegetation to disease, insect attack, drought and fire; vegetation water use and effects on ground water levels and catchment yields.
Accepted engineering standards	In relation to dams, means those standards of design, construction, operation and maintenance that are broadly accepted within the profession of engineering as being good practice for the purpose and application being considered. In the case of dams, the most relevant documents would be publications of the Australian National Committee on Large Dams (ANCOLD), guidelines published by Queensland government departments, and relevant Australian and New Zealand Standards.
Administering authority	Administering authority means - - for a matter, the administration and enforcement of which has been devolved to a local government under section 514 of the <i>Environmental Protection Act 1994</i> – the local government; or - for all other matters – the Chief Executive of the Department of Environment and Resource Management; or - another State Government Department, Authority, Storage Operator, Board or Trust, whose role is to administer provisions under other enacted legislation.
AEP	Means the Annual Exceedance Probability, which is the probability that at least one event in excess of a particular magnitude will occur in any given year.
Annulus	The space between the production casing and the inner injection tubing. It is filled with an inert fluid such that loss of the fluid to a water resource aquifer will not result in environmental harm or damage to the aquifer.
Aquitard	A formation that demonstrates a high degree structural integrity, low porosity, low hydraulic conductivity and a low level of geological anomalies that may allow fluid flow.
AR&R	means Australian Rainfall and Runoff, a well known hydrologic publication, available for purchase in hard copy and electronic versions, containing amongst other things data and techniques for estimating design rainfalls. At the present time these estimates are based on rainfall data to the mid 1980s from Bureau of Meteorology daily rainfall stations with some pluviograph data.
Assessable vegetation	Means vegetation in which clearing is assessable development under Schedule 3 and 24 of the Sustainable Planning Regulation 2009.

ST

TERM	MEANING
Assessment, assessed or assess	By a suitably qualified and experienced person in relation to a hazard assessment of a dam, means that a statutory declaration has been made by that person and, when taken together with any attached or appended documents referenced in that declaration, all of the following aspects are addressed and are sufficient to allow an independent audit at any time: (a) exactly what has been assessed and the precise nature of that assessment; (b) the relevant legislative, regulatory and technical criteria on which the assessment has been based; (c) the relevant data and facts on which the assessment has been based, the source of that material, and the efforts made to obtain all relevant data and facts; and (d) the reasoning on which the assessment has been based using the relevant data and facts, and the relevant criteria.
Associated water	Underground water taken from or interfered with from a petroleum well during the course of or resulting from carrying out petroleum activities. Associated water may be potable or suitable for stock purposes, or saline, high in fluoride, contain hydrocarbons, and/or is otherwise contaminated by a hazardous contaminant. It may be classified as a hazardous waste.
Associated works	In relation to a dam, means: (a) operations of any kind and all things constructed, erected or installed for that dam; and (b) any land used for those operations.
AS 2885	Australian Standard Pipelines – Gas and Liquid Petroleum (2007 or subsequent versions thereof)
Audit statement	States the extent to which activities carried out under the EA have been complied with its conditions, the accuracy of the final rehabilitation report, and the amount of financial assurance required.
Authority	Means an environmental authority granted in relation to an environmentally relevant activity under the <i>Environmental Protection Act 1994</i> .
Background noise level	Background noise level $L_{A90,15min}$ means the A-weighted sound pressure level of the residual noise exceeded for 90% of a representative time period of not less than 15 minutes, using time weighting, 'F'.
Beneficial use	in respect of dams means that the current or proposed owner of the land on which a dam stands, has found a use for that dam that is: (a) of benefit to that owner in that it adds real value to their business or to the general community, (b) in accordance with relevant provisions of the <i>Environmental Protection Act 1994</i>, (c) sustainable by virtue of written undertakings given by that owner to maintain that dam, and the transfer and use have been approved or authorised under any relevant legislation.
Casing inspection log	A log or combination of logs, fully interpreted on a joint-by-joint basis which determines the percent penetration of anomalies, distinguishes between internal and external corrosion and detects holes, pits, perforations, metal loss and metal thickness. The maximum burst resistance must be greater than 1.3 times the maximum allowable wellhead injection pressure.
Cement integrity log	Is a log using sonic or ultrasonic cement evaluation tools, using as a minimum dual receivers and a single transmitter and must provide a variable density or full wave train display, travel time curve, amplitude or attenuation curve, and gamma ray curve.

51

TERM	MEANING
Certification or certified	By a suitably qualified and experienced person in relation to a design plan or an annual report regarding dams, means that a statutory declaration has been made by that person and, when taken together with any attached or appended documents referenced in that declaration, all of the following aspects are addressed and are sufficient to allow an independent audit at any time: (a) exactly what is being certified and the precise nature of that certification. (b) the relevant legislative, regulatory and technical criteria on which the certification has been based; (c) the relevant data and facts on which the certification has been based, the source of that material, and the efforts made to obtain all relevant data and facts; and (d) the reasoning on which the certification has been based using the relevant data and facts, and the relevant criteria.
certified by a suitably qualified and experienced person" in relation to a hazard assessment of a dam	means that a statutory declaration has been made by that person and, when taken together with any attached or appended documents referenced in that declaration, all of the following aspects are addressed and are sufficient to allow an independent audit at any time: • exactly what has been assessed and the precise nature of that assessment; • the relevant legislative, regulatory and technical criteria on which the assessment has been based; • the relevant data and facts on which the assessment has been based, the source of that material, and the efforts made to obtain all relevant data and facts; and • the reasoning on which the assessment has been based using the relevant data and facts, and the relevant criteria.
Coefficient of runoff	means the ratio obtained by dividing the volume of surface runoff resulting from a contributing catchment due to a volume of rainfall that fell on that contributing catchment.
Competent person	A person with the demonstrated skill and knowledge required to carry out the task to a standard necessary for the reliance upon collected data or protection of the environment.
Commercial place	A work place used as an office or for business or commercial purposes, which is not part of the petroleum activity and does not include employees' accommodation or public roads.
Construction	Means a dam includes building a new dam and modifying or lifting an existing dam, but does not include investigations and testing necessary for purposes of preparing a design plan.
Contaminant	The <i>Environmental Protection Act 1994</i> defines, under Section 11, a contaminant as: (a) a gas, liquid or solid; or (b) an odour; or (c) an organism (whether alive or dead), including a virus; or (d) energy, including noise, heat, radioactivity and electromagnetic radiation; or a combination of contaminants.
CRCFORGE	is a method of producing estimates of design rainfalls by analysis and processing of data from Bureau of Meteorology daily rainfall stations up to the late 1990s. Output data and computer application are public domain and widely distributed in electronic form amongst the profession. This method produces estimates that extend to AEP 1 in 2,000
Critical duration	in relation to an hydrologic analysis is the duration of a design rainfall event that maximises the peak flow or volume that is the target of that particular analysis
Critical wet period	means the two, three or four month period, as determined by the application of Figure 1, that must be applied to the Method of Deciles as described in this Manual.

ST

TERM	MEANING
Dam	Means a land-based structure or a void that is designed to contain, divert or control flowable substances, and includes any substances that are thereby contained, diverted or controlled by that land-based structure or void and associated works. A dam does not mean a fabricated or manufactured tank or container, designed and constructed to an Australian Standard that deals with strength and structural integrity of that tank or container.
<i>Dam crest volume</i>	means the volume of material that could be within the walls of a dam at any time when the upper level of that material is at the crest level of that dam. That is, the instantaneous maximum volume within the walls, without regard to flows entering or leaving (eg via spillway).
<i>Design plan</i>	Is the documentation required to describe the physical dimensions of the dam, the materials and standards to be used for construction of the dam, and the criteria to be used for operating the dam. The documents must include all investigation and design reports, plans and specifications sufficient to hand to a contractor, and planned decommissioning and rehabilitation outcomes; so as to address all hazard scenarios that would be identified by a properly conducted hazard assessment for the structure. Documentation must be such that a 'suitable qualified and experience person' could conduct an independent review without seeking further information from the designer.
Design storage allowance or DSA	Means the minimum storage required in a dam at 1 November each year in order to meet the hydraulic performance requirements.
Development plan	Under the P & G Act, holders of petroleum authorities must submit a development plan for a petroleum lease or proposed petroleum lease. The plan gives detailed information about the nature and extent of activities to be carried out under the relevant lease.
Discharge area	Discharge area is: (a) that part of the land surface where groundwater discharge produces a net movement of water out of the groundwater; and (b) identified by an assessment process consistent with the document: Salinity Management Handbook, Queensland Department of Natural Resources, 1997; or (c) identified by an approved salinity hazard map held by the Department of Natural Resources, Mines and Water.
Dispersible soils	Soils in which clay material disintegrates into particles less than 2 microns across. This can be observed within 24 hours when soil crumbs are submerged in distilled water.
Dissects corridors	Dissects corridors of vegetation means clearing vegetation that results in a break more than 50 metres wide across a corridor.
Environmental Management Plan	The environmental management plan is an environmental management document to be submitted during the application process for a level 1 environmental authority (petroleum activities).
Environmental nuisance	Environmental nuisance is unreasonable interference or likely interference with an environmental value caused by: (a) noise, dust, odour, light; or (b) an unhealthy, offensive or unsightly condition because of contamination; or (c) another way prescribed by regulation.
Environmentally sensitive area	Environmentally sensitive area (as determined from the DERM GIS data base) means a location, however large or small, that has environmental values that contribute to maintaining biological diversity and integrity, have intrinsic or attributed scientific, historical or cultural heritage value, or are important in providing amenity, harmony or sense of community.
Evaporation pond	Evaporation pond means a dam or interceptor pond constructed outside a watercourse, wetland or waterway by excavating a pit and constructing a wall around the pit with the excavated material. Natural surface flow is excluded from the pond.
Financial assurance	A security deposit, either cash or a bank guarantee, held by the administering authority to cover the potential costs of rehabilitating areas significantly disturbed by the petroleum activities.

ST

TERM	MEANING
Flowable substance	Means matter or a mixture of materials which can flow under any conditions potentially affecting that substance. Constituents of a flowable substance can include water, other liquids fluids or solids, or a mixture that includes water and any other liquids fluids or solids either in solution or suspension.
Foreseeable future	Is the period used for assessing the total probability of an event occurring. Permanent structures and ecological sustainability should be expected to still exist at the end of a 150 year foreseeable future with an acceptable probability of failure before that time.
Formation	A named body of rock or minerals resources identified as distinct from other rocks on a geological map. It generally consists of a dominant rock type or combination of rock types.
Formation fracture pressure	The interpreted pressure reflecting that pressure rise when the formation starts to lose structural integrity. It can be estimated through such techniques as step rate injectivity tests.
Groundwater	Groundwater means subsurface water, generally saturating the soil or rock in which it occurs.
Hazard	In relation to a dam as defined in this authority, means the potential for environmental harm resulting from the collapse, or failure of the dam to perform its primary purpose of containing, diverting or controlling flowable substances.
Hazardous contaminant	A contaminant that, if improperly treated, stored, disposed of or otherwise managed, is likely to cause serious or material environmental harm because of: (a) its quantity, concentration, acute or chronic toxic effects, carcinogenicity, teratogenicity, mutagenicity, corrosiveness, explosiveness, radioactivity or flammability; or (b) its physical, chemical or infectious characteristics.
Hazard category	Means a category, either low significant or high, into which a dam is assessed as a result of the application of tables and other criteria in the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (Version 1.0, 2008) as contained in Appendix 4 of this authority.
Hydraulic performance	Means the capacity of a regulated dam to contain or safely pass flowable substances based on a probability (AEP) of performance failure specified for the relevant hazard category in the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (Version 1.0, 2008) as contained in Appendix 4 of this authority.
Inert fluid	The fluid contained in the annulus that is monitored to ascertain integrity of the injection string. If a loss of this fluid is detected indicating a loss of mechanical integrity, adjacent water resource aquifers are protected from harm due to the inert nature of this fluid.
Infrastructure	Means water storage dams, roads and tracks, buildings and other structures built for the purpose and duration of the conduct the petroleum activities, but does not include other facilities required for the long term management of the impact of those activities or the protection of potential resources. Such other facilities include dams other than water storage dams, waste dumps, voids, or stockpiles and assets, that have been decommissioned, rehabilitated, and lawfully recognised as being subject to subsequent transfer with ownership of the land.
Injection tubing	The inner casing that conveys the injection fluid and terminates at the injection zone. This tubing provides the primary containment of the injection fluid.
Injection zone	The zone of the injection formation where the injection tubing terminates.
leachate	means a liquid that has passed through or emerged from, or is likely to have passed through or emerged from, a material stored, processed or disposed of on site which contains soluble, suspended or miscible contaminants likely to have been derived from the said material.
Levee	Means an embankment that is designed only to provide for the containment and diversion of stormwater or flood flows from a contributing catchment, or containment and diversion of flowable materials resulting from releases from other works, during the progress of those stormwater or flood flows or those releases; and does not store any significant volume of water or flowable substances at any other times.

51

TERM	MEANING
L _A 90, adj 15	Is the background A-weighted sound pressure level obtained using time weighting 'F' exceeded for 90 percent of any 15 minute time period.
L _A 10, ad, 10 mins	Means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 10% of any 10 minute measurement period using Fast response.
L _A max, adj, T	L _A max, adj, T is the adjusted average maximum A-weighted sound pressure level measured over a time period T. The maxima must be measured on a sound level meter with a frequency-weighting that corresponds to perceived loudness ("A" weighting) and the meter must be set to the "fast" response time-weighting. The measured values are to be adjusted upwards by 2 dB(A) to 5 dB(A) if the noise source has tonal characteristics. The measuring period must be in excess of five minutes. The arithmetic average of the adjusted maxima, after eliminating any extraneous noise peaks, is the measure used to characterise the noise environment. (This measure will generally be similar to a percent exceedance of 10% or less. Refer to Australian Standard AS1055.)
Lake	A natural or artificial body of water, either permanent or intermittent.
Land degradation	Land degradation includes the following: (a) soil erosion; (b) rising water tables; (c) the expression of salinity; (d) mass movement by gravity of soil or rock; (e) stream bank instability; and (f) a process that results in declining water quality.
Land use	Term to describe the selected final use of the land, which is planned to occur after the cessation of petroleum operations.
Level 2 petroleum activity	A Level 2 petroleum activity is a petroleum activity that, under section 20(1) of the EP Act is prescribed as a level 2 environmentally relevant activity.
Level 1 petroleum activity	A Level 1 petroleum activity is a petroleum activity that, under section 20(1) of the EP Act is prescribed as a Level 1 environmentally relevant activity.
Licensed waste disposal facility	A facility approved under a development approval and operated by a holder of a registration certificate for environmentally relevant activity item number 75 under Schedule 1 of the <i>Environmental Protection Regulation 1998</i> .
mg/L	Means milligrams per litre
Mandatory reporting level or MRL	Means a warning and reporting level determined in accordance with the current version of the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams published by the Department of Environment and Resource Management.
NATA	National Association of Testing Authorities.
Noise	Noise means a sound or vibration of any frequency, whether transmitted through air or any other physical medium.
Odour	Means organoleptic attributes perceptible by the olfactory organ on sniffing certain volatile substances.
Odour Concentration	Mean the number of odour units
Odour Unit (OU)	One odour unit (OU) is that concentration of odorant(s) at standard conditions that elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.
Offensive	Means causing offence or displeasure; is disagreeable to the sense; disgusting, nauseous or repulsive.
Operational land	Means the land associated with the petroleum project for which this authority has been issued.
Operational Plan	Means a document that amongst other things sets out procedures and criteria to be used for operating a dam during a particular time period. The operational plan as defined herein may form part of a plan of operations or plan otherwise required in legislation.

ST

TERM	MEANING
Oxygen activation log	A log which employs pulsed neutron techniques to activate oxygen nuclei, creating a radio-active nitrogen isotope of a very short half life.
Packer	A device designed to prevent fluid flow between two elevations in a well.
Packer isolation test	A pressure test of the tubing/casing annulus designed to evaluate the integrity of the casing, tubing and packer. The pressure in the annulus should be the greater of 7,000 kPa or 1.3 times the wellhead injection pressure. The packer isolation test is considered successful when the required pressure is applied and maintained for 15 minutes with variations not exceeding 3 percent of the applied pressure.
Petroleum activities	Petroleum activities means activities authorised to take place on land subject to a petroleum authority, including rehabilitation and decommissioning activities.
Petroleum authority	A petroleum authority is— (a) a 1923 Act petroleum tenure granted under the <i>Petroleum Act 1923</i> ; or (b) a petroleum authority granted under the <i>Petroleum and Gas (Production and Safety) Act 2004</i> ; or a licence, permit, pipeline licence, primary licence, secondary licence or special prospecting authority granted under the <i>Petroleum (Submerged Lands) Act 1982</i> .
Petroleum project	A petroleum project is all activities carried out, or proposed to be carried out, under 1 or more of the following, in any combination, as a single integrated operation— (a) a 1923 Act petroleum tenure granted under the <i>Petroleum Act 1923</i> ; (b) a petroleum authority granted under the <i>Petroleum and Gas (Production and Safety) Act 2004</i> ; a licence, permit, pipeline licence, primary licence, secondary licence or special prospecting authority granted under the <i>Petroleum (Submerged Lands) Act 1982</i>
Petroleum works site	A separate location on the area subject to a petroleum authority where petroleum activities are undertaken (e.g. a well site, seismic survey line, camp site, compressor site, evaporation pond etc).
Potential discharge area	Low lying parts of the landscape (relative to adjacent terrain) where groundwater movements are within 2-5m of the land surface and the landscape may be subject to upward movement of groundwater in the future.
Production casing	The outer casing which extends into the injection zone. Within it is an inert fluid between the production casing and the inner tubing conveying the injection fluid. It provides the secondary containment protection of the injection fluid.
Protected area	Means: • a protected area under the <i>Nature Conservation Act 1992</i>; or • marine park under the <i>Marine Parks Act 1992</i>; or • a World Heritage Area.
Progressive rehabilitation	Rehabilitation (defined below) undertaken progressively or as a staged approach to rehabilitation as petroleum operations are ongoing.
Radioactive tracer survey	A logging survey which injects radioactive material with a down-hole injector at or near the maximum allowable injection pressure.
Reference site (or analogue site)	May reflect the original location, adjacent area or another area where rehabilitation success has been completed for a similar biodiversity. Details of the reference site may be as photographs, computer generated images and vegetation models etc.
Regulated dam	means any dam in the significant or high hazard category as assessed using the criteria in the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (Version 1.0. 2008) as contained in Appendix 4 of this authority.
Regulated waste	A non-domestic waste mentioned in Schedule 7 of the <i>Environmental Protection Regulation 1998</i> (whether or not it has been treated or immobilised), and includes — (a) for an element—any chemical compound containing the element; and (b) anything that has contained the waste.
Rehabilitation	The process of reshaping and revegetating land to restore it to a stable landform and in accordance with the acceptance criteria set out in this environmental authority and, where relevant, includes remediation of contaminated land.

ST

TERM	MEANING
Representative	A sample set which covers the variance in monitoring or other data either due to natural changes or operational phases of the petroleum activities.
Riverine area	Refers to the land confined to the flood flow channel of a watercourse.
Salinisation	Means the process of salts accumulating in soils or waters.
Sedimentation dam	A bunded or excavated structure used to contain and settle waterborne sediment running off disturbed areas.
Self sustaining	An area of land that has been rehabilitated and has maintained the required acceptance criteria without human intervention for a period nominated by the administering authority.
Sensitive place	Sensitive place means any of the following places – (a) a dwelling; (b) a library, childcare centre, kindergarten, school, college, university or other educational institution; (c) a hospital, surgery or other medical institution; (d) a protected area or an area identified under a conservation plan as a critical habitat or an area of major interest, under the <i>Nature Conservation Act 1992</i>; (e) a marine park under the <i>Marine Parks Act 1982</i>; and a park or garden that is open to the public (whether or not on payment of money) for use other than for sport or organised entertainment).
Sewage	Sewage is the effluent discharged from a sanitary appliance (i.e. sewage treatment works).
Significantly disturbed land	Significantly disturbed land and significant disturbance means land if: (a) it is contaminated land; or (b) it has been disturbed and human intervention is needed to rehabilitate it: i. to a state required under the relevant environmental authority; or ii. if the environmental authority does not require the land to be rehabilitated to a particular state – to its state immediately before the disturbance. Examples of a disturbance to land: (a) areas where soil has been compacted, removed, covered, exposed or stockpiled; (b) areas where vegetation has been removed or destroyed to an extent where the land has been made susceptible to erosion; (c) areas where land use suitability or capability has been diminished; (d) areas within a watercourse, waterway, wetland or lake where petroleum activities occur and human intervention is necessary to restore or stabilise the disturbed area; (e) areas submerged by hazardous waste storage and dam walls in all cases; (f) areas under temporary infrastructure. Temporary infrastructure includes any infrastructure (roads, tracks, bridges, culverts, dams, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads etc) which is to be removed after petroleum activities have ceased; or (g) areas where land has become contaminated land and a suitability statement has not been issued. However, the following areas are not significantly disturbed: (a) areas off the petroleum authority (e.g. roads or tracks which provide access to the petroleum authority); (b) areas previously significantly disturbed which have been rehabilitated to the administering authority's satisfaction; (c) areas under permanent infrastructure; (d) areas that were significantly disturbed prior to the grant of the environmental authority, unless those areas are re-disturbed by the holder of the environmental authority during the term of the authority; minor disturbances such as drill sumps and minor respreading of soil on GPS located seismic lines.

TERM	MEANING
Significant wetland	Means the area of land that supports plants or is associated with plants that are adapted to and dependent on living in wet conditions for at least part of their life cycle and that is— a) a regional ecosystem listed in Table 14 and the area on the ground represented as a swamp, lake, marsh, waterhole, wetland, billabong, pool, spring or like, on the most recent 1:250 000 Geoscience Australia topographic map of the area; or b) a Ramsar wetland.
Silo data drill	means the service (provided for a fee or charge) provided by the Department of Natural Resources and Water at the following web address: ' http://www.nrw.qld.gov.au/silo/ '.
Spillway	Means a weir, channel, conduit, tunnel, gate or other structure designed to permit discharges from the dam, normally under flood conditions or in anticipation of flood conditions.
Stable	Means land form dimensions are or will be stable within tolerable limits now and in the foreseeable future. Stability includes consideration of geotechnical stability, settlement and consolidation allowances, bearing capacity (trafficability), erosion resistance and geochemical stability with respect to seepage, leachate and related contaminant generation.
Step rate injectivity test	The well is closed and a stabilized pressure is measured. Pressure is then increased at set intervals while pumping fluid into the formation. A linear (straight line) increase of flow with pressure is expected if the formation holds integrity. If the flow rate increases substantially for minimal change in pressure, this is inferred as the formation fracture point.
Substantiated commentary	Interpretation of experimental evidence derived from samples obtained from the site to be used for injection. It is not inferred interpretation based on similar situations and the literature.
Suitably qualified and experienced person for dams	Means one who is a Registered Professional Engineer of Queensland (RPEQ) under the provisions of the Professional Engineers Act 1988, OR registered as a National Professional Engineer (NPER) with the Institution of Engineers Australia, OR holds equivalent professional qualifications to the satisfaction of the administering authority for the Act; AND the administering authority for the Act is satisfied that person has knowledge, suitable experience and demonstrated expertise in relevant fields, as set out below: (a) knowledge of engineering principles related to the structures, geomechanics, hydrology, hydraulics, chemistry and environmental impact of dams; and (b) a total of five years of suitable experience and demonstrated expertise in the geomechanics of dams with particular emphasis on stability, geology and geochemistry, and (c) a total of five years of suitable experience and demonstrated expertise each, in three of the following categories: • investigation and design of dams. • Construction, operation and maintenance of dams. • hydrology with particular reference to flooding, estimation of extreme storms, water management or meteorology. • hydraulics with particular reference to sediment transport and deposition, erosion control, beach processes. • hydrogeology with particular reference to seepage, groundwater. • solute transport processes and monitoring thereof. • dam safety.
Surface casing	The surface casing is the outer-most casing string designed to provide the tertiary protection for the production casing and injection tube.
Third party auditor	means a suitably qualified person who is either a certified third party auditor or an internal auditor employed by the holder of the environmental authority and the person is independent of the day to day management and operation of activities covered by this environmental authority
This authority	means this environmental authority.

SR

TERM	MEANING
This approval	means this environmental authority.
Tolerable limits	Means a range of parameters regarded as being sufficient to meet the objective of protecting relevant environmental values. For example, a range of settlement for a tailings capping, rather than a single value, could still meet the objective of draining the cap quickly, preventing pondage and limiting infiltration and percolation.
Top layer	The surface layer of a soil profile, which is usually more fertile, darker in colour, better structured and supports greater biological activity than underlying layers. The surface layer may vary in depth depending on soil forming factors, including parent material, location and slope, but generally is not greater than about 300mm in depth from natural surface.
TPH	Total petroleum hydrocarbons
Void	Means any man-made, open excavation in the ground.
Watercourse	Mean the area of land between the high banks of a natural channel—whether artificially improved or not—in which water flows permanently or intermittently, and that is represented as— (a) a creek, stream, river or watercourse on the most recent 1:100 000 Geoscience Australia topographic map; or (b) a creek, stream, river or watercourse on the most recent 1:250 000 Geoscience Australia topographic map in areas where there is no 1:100 000 Geoscience Australia topographic map available.
Waters	includes all or any part of a river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, unconfined water in natural or artificial watercourses, bed and banks of a watercourse, dams, non-tidal or tidal waters (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and groundwater.
Waterway	A naturally occurring feature where surface water runoff normally collects, such as a clearly defined swale or gully, but only flows in response to a local rainfall event.
Wetland	Means the area of land that supports plants or is associated with plants that are adapted to and dependent on living in wet conditions for at least part of their life cycle, and that is— (a) a regional ecosystem listed in Table 14; or (b) the area on the ground represented as a swamp, lake, marsh, waterhole, wetland, billabong, pool, spring or like, on the most recent — 1:100 000 Geoscience Australia topographic map of the area; or 1:250 000 Geoscience Australia topographic map, in areas where there is no 1:100 000 Geoscience Australia topographic map available; or (c) listed as an 'active' spring in the Queensland Springs Database, which can be accessed at the following internet address: http://www.epa.qld.gov.au/nature_conservation/habitats/wetlands/springs/
Wild river areas	Wild river areas are defined in the <i>Wild Rivers Act 2005</i> and may include the following— (a) high preservation areas; (b) preservation areas; (c) floodplain management areas; and (d) subartesian management areas.
Work Program	Under the P & G Act, holders of petroleum authorities are required to submit a work program for an authority to prospect. The program gives detailed information about the nature and extent of activities to be carried out under the authority.



APPENDIX 2

ENVIRONMENTALLY SENSITIVE AREAS

Category A and B environmentally sensitive areas

Category A and B environmentally sensitive areas are listed in Section 25 and 26 respectively of the *Environmental Protection Regulation 2008*.

Category C – Environmentally Sensitive Areas

LAND AREA CLASSIFICATION	ADMINISTERING LEGISLATION	ADMINISTERING AUTHORITY
Nature Refuges and Resource Reserves	<i>Nature Conservation Act 1992</i>	Department of Environment and Resource Management
Koala Habitat Area	<i>Nature Conservation (Koala) Conservation Plan 2006</i>	Department of Environment and Resource Management
An area identified as essential habitat by the EPA for a species of wildlife listed as endangered, vulnerable, near threatened or rare under the Nature Conservation Act 1992	<i>Nature Conservation Act 1992</i>	Department of Environment and Resource Management
Declared Catchment Areas	<i>Water Act 2000</i>	Department of Environment and Resource Management and/or Relevant Storage Operator or Board
River Improvement Areas	River Improvement Trust Act 1940	Department of Environment and Resource Management and the Relevant River Trust
Former Designated Landscape Area - Stanbroke Pastoral Holding	Aboriginal Cultural Heritage Act 2003	Department of Environment and Resource Management
Areas under Part 5 Division 2 of the Aboriginal Cultural Heritage Act 2003 and Torres Strait Islander Cultural Heritage Act 2003	Aboriginal Cultural Heritage Act 2003 Torres Strait Islander Cultural Heritage Act 2003	Department of Environment and Resource Management
State Forest or Timber Reserves	Forestry Act 1959	Department of Environment and Resource Management



DPI Research Sites	Nil	Department of Employment, Economic Development and Innovation
Areas of land occupied by the Bureau of Sugar Experiment Stations.	Sugar Industry Act 1999	Department of Employment, Economic Development and Innovation
Coastal Management Districts	Coastal Protection and Management Act 1995	Department of Environment and Resource Management
Declared Areas	Vegetation Management Act 1999	Department of Environment and Resource Management
An area shown as a wetland on a 'map of referable wetlands'	Environmental Protection Act 1994	Department of Environment and Resource Management
Reserves under the Land Act 1994	Land Act 1994	Department of Environment and Resource Management
An 'of concern' regional ecosystem identified in the database maintained by the EPA called 'Regional ecosystem description database' containing regional ecosystem numbers and descriptions.	Nil	Department of Environment and Resource Management

51

APPENDIX 4 - DETERMINING HAZARD CATEGORIES FOR REGULATED DAMS

Manual for Assessing Hazard Categories and Hydraulic Performance of Dams Version 1.0

Scope of Manual

This manual is designed to ensure that the standards used for the design, construction, operation, modification and decommissioning of dams are appropriate to the hazards associated with their potential failure.

This Manual replaces and supersedes the previously used information sheets 'Determining Dams Containing Hazardous Waste' and 'Managing Dams Containing Hazardous Waste'.

Background to Manual

Good practice requires that all dams be assessed for the hazards associated with 'dam break' and 'failure to contain', and the impacts of such potential failures estimated. Those dams that could have significant or high impacts need to be carefully designed and operated. Hazards are situations where:

- Something exists that could cause environmental harm, and
- An environmental value is present which could be harmed.

The early identification of the hazard potential of a dam is important as this determines the standard of reliability required for construction and operation of the dam.

Purpose and Mode of Operation of Manual

The purpose of this manual is to guide the assessment of the hazard category of all dams, and thereby determine those dams that require documentation of basic design performance and monitoring, and specify the basic design performance and monitoring required for those dams.

This manual does *not* utilise risk (level) or risk (cost) assessment. Dams include levees, bunds and voids, but *not* any bunds designed for spill containment to an Australian Standard, for example AS1940. Notes on hazard assessment based on failure event scenarios are in Appendix A of this document.

Dams may be assessed using this manual into one of three hazard categories: low, significant or high. A suitably qualified and experienced person should review all available information on a dam, including a site inspection if necessary; and determine the appropriate hazard category for each dam.

While all dams subject to this manual must be assessed by a suitably qualified and experienced person for "dam break" and "failure to contain" hazard potential, dams with man-made embankments more than a specified height or minimum volume and contaminant concentration, cannot be assessed as low hazard.

Site inspection of a dam is at the discretion of the suitably qualified and experienced person conducting the hazard assessment, provided that all relevant aspects have been researched and documented. Lodgement of documentation of hazard assessments with the EPA is *not* required unless specified.

Dams assessed as being in the low hazard category will generally be self-regulated by the owners, but will remain subject to an annual hazard assessment and general decommissioning conditions.

Dams that are assessed as being in the significant or high hazard category are referred to as 'regulated dams' because certification of design to performance standards by suitably qualified and experienced persons is normally required to be lodged, and certified annual inspections and reports must be provided.



Hazard Category Assessment Criteria for this Manual

All dams as defined must have their hazard category assessed based on the potential harm resulting from failure event scenarios as set out in Tables 1 and 2 and guided by this text. For dams with a volume in excess of 250 megalitres, guidance is provided on the following page regarding dam break hazard.

However, as set out in the subsequent sections 'Hazard Category based on Height' or 'Hazard Category based on Contaminant Concentration and Minimum Volume', dams that meet the criteria in those sections must be assessed as regulated dams – either in the significant or high hazard category.

Hazard Category - Based on Assessment of Hazard Potential (Failure Event Scenarios)

The two basic possible "failure" sets of scenarios to be applied in any assessment are:

1. **"Failure to contain"** – spills or releases from the dam due to any cause, and
2. **"Dam break"** - collapses of the dam structure due to any possible cause.

The assessment of hazard category of a dam based on possible failure event scenarios, is conducted by assuming that a failure event of each type specified has occurred ie 'failure to contain' and 'dam break'. In each case, the potential environmental harm (ie. the consequences) resulting from each such assumed failure event is then assessed using Tables 1 and 2. The hazard category for the dam overall, will be the highest hazard category produced in any category of harm, generated by any failure event scenario.

Environmental values may be on-site as well as off-site. An economic impact to the dam owner *only* and not related to environmental harm, would not require a rating under Tables 1 or 2. Failure to contain hazard assessments must consider long term potential adverse effects due to release of contaminants to groundwater systems and soil profiles, as well as potential consequent effects on surface water systems.

Table 1 Failure to Contain Scenarios

ENVIRONMENTAL HARM	FAILURE TO CONTAIN HAZARD CATEGORY		
	High	Significant	Low
Categories of Harm			
General environmental	Location such that harm to a significant environmental value is likely, or serious environmental harm is possible. Such a value might include the presence of protected or endangered flora or fauna.	The environmental value is of lesser significance and harm is possible but not likely, or material environmental harm is possible.	No environmental values of significance, or only trivial environmental harm is possible.
Loss or harm to humans	Consumption of contaminated waters by humans with consequent loss or harm is likely.	Consumption of contaminated waters by humans with consequent loss or harm is possible.	No contamination of waters used for human consumption expected.
Loss of stock	Consumption of contaminated waters by stock with consequent loss or harm is likely.	Consumption of contaminated waters by stock with consequent loss or harm is possible.	Contaminated water not available to stock or no harm expected from consumption.
General economic loss	Serious harm to communities, industrial, commercial or agricultural facilities, important utilities, or other water resources in the failure path.	Material harm to industry, secondary roads, minor railways, public utilities, or other water resources in the failure path.	Trivial harm to environmental values such as environmental nuisance arising from minor spills.

The hazard category of a dam can be changed by redesigning the proposal to change the situation eg. by repositioning the dam to isolate it from the environmental value. However, a hazard category cannot be changed by reliance on any structure, man-made or otherwise (including bunds) to control the risk of a failure of the dam, where that structure could also be subject to failure under a possible scenario. In the case of voids used as storages, potential contamination and overtopping must be considered.

In relation to a dam break scenario, consideration must always be given to downstream consequences including failure of other storages that may be affected by the flood wave. The consequences of such sequential failure of other storages must be considered as part of the harm caused.

Where the dam crest volume is greater than 250 megalitres, the hazard assessment must address by dam break analysis the hazard associated with consequent failure of other dams, containments or on-site infrastructure downstream of the dam being considered in the assessment.



Table 2 Dam Break Scenarios

ENVIRONMENTAL HARM	DAM BREAK HAZARD CATEGORY		
	High	Significant	Low
Categories of Harm			
General environmental	Location such that harm to a significant environmental value is likely, or serious environmental harm is possible. Such a value might include the presence of protected or endangered flora or fauna.	The environmental value is of lesser significance and harm is possible but not likely; or material environmental harm is possible.	No environmental values of significance, or only trivial environmental harm is possible.
Loss or harm to humans	Location such that people are routinely present in the failure path and if present loss or harm is likely. Consumption of contaminated waters by humans with consequent loss or harm is likely.	Location such that people are routinely present in the failure path and if present loss or harm is possible. Consumption of contaminated waters by humans with consequent loss or harm is possible.	Location such that people are not routinely present in the failure path. No contamination of waters used for human consumption expected.
Loss of stock	Location of stock such that loss of stock likely. Consumption of contaminated waters by stock with consequent loss or harm is likely.	Location of stock such that loss of stock possible. Consumption of contaminated waters by stock with consequent loss or harm is possible.	Stock not in path of dam break flood. Contaminated water not available to stock or no harm expected from consumption.
General economic loss	Serious harm to communities, industrial, commercial or agricultural facilities, important utilities, or other water resources in the failure path.	Material harm to industry, secondary roads, minor railways, public utilities, or other water resources in the failure path.	Trivial harm to environmental values such as environmental nuisance arising from minor spills.

For the purposes of assessing the aspect of potential environmental harm in Tables 1 or 2, the cost of potential environmental harm within the meaning of the *Environmental Protection Act 1994* may be taken to be the cost of rehabilitation or restoration of the environmental value harmed.

In the unusual situation where: a dam has contaminants such that the 'failure to contain' hazard is assessed as 'significant', but the 'dam break' hazard is assessed as 'high' and it is not proposed or not possible to use a 'full hydrologic analysis'; then for purposes of Table 5 only a hazard category of 'significant' may be applied. That is, the default performance AEP for DSA of that dam is 0.1 (1 in 10).

Hazard Category Based on Height of a Man-made Embankment

While all dams as defined are subject to assessment using Tables 1 and 2 of this document, a dam is a regulated dam if it incorporates a man-made embankment and the height of that embankment is greater than 8 metres as measured between the crest and the lowest point of the toe of that embankment.

Such a dam must be assessed as in the significant or high hazard category and not in the low hazard category, even though it could be argued that the dam is low hazard by merely applying Tables 1 and 2.

Hazard Category Based on Contaminant Concentrations and Minimum Volume

While all dams are subject to assessment using Tables 1 and 2 of this document, a dam is a regulated dam if that dam:

- (a) is likely to contain contaminants at a greater concentration than that indicated in Table 3, or outside the range of pH indicated in Table 3, at any time when the volume contained within the dam is greater than 50% of the dam crest volume, AND
- (b) has a dam crest volume that is greater than that indicated in Table 3.

Such a dam must be assessed as in the significant or high hazard category and not in the low hazard category, even

35

though it could be argued that the dam is low hazard by merely applying Tables 1 and 2.

Table 3 - Contaminant Concentrations and Minimum Volumes

Contaminant ¹	Liquor ²	Total Solids ³	Dam Crest Volume
Arsenic	1.0 mg/L	500 mg/kg	2.5 ML
Boron	5.0 mg/L	15,000 mg/kg	2.5 ML
Cadmium	10 µg/L	100 mg/kg	2.5 ML
Cobalt	1.0 mg/L	500 mg/kg	2.5 ML
Copper	1.0 mg/L	5,000 mg/kg	2.5 ML
Lead	0.5 mg/L	1,500 mg/kg	2.5 ML
Mercury	2 µg/L	75 mg/kg	2.5 ML
Nickel	1.0 mg/L	3,000 mg/kg	2.5 ML
Selenium	50 µg/L	150 mg/kg	2.5 ML
Zinc	20 mg/L	35,000 mg/kg	2.5 ML
Cyanide	10 mg/L	2,500 mg/kg	2.5 ML
pH	5 to 9 inclusive	Net acid generation pH < 4.5	2.5 ML
Chloride	2,500 mg/L	-	10 ML
Fluoride	2.0 mg/L	-	10 ML
Sulphate	1,000 mg/L	-	10 ML
Salinity (conductivity)	4,000 µs/cm	-	10 ML

¹ Metals should be analysed in accordance with recognised test methods by a NATA certified laboratory.

² These concentrations apply to contaminants in solution, and therefore all samples should be filtered using the techniques described in the Water Quality Sampling Manual (EPA 1994).

³ Applies to the solids in a dam. Total solids include suspended and colloidal solids.

Hydraulic Performance Criteria for Regulated Dams

Purpose and Application of Performance Criteria in Design

Hydraulic performance criteria mean the capacity of a regulated dam (as defined) to divert, contain or safely pass substances when operated alone, or in a project. There are really two types of objectives:

- In the case of spillways or levees, to have the dam survive or provide flood protection to a certain standard based on the assessed hazard category of the regulated dam; AND
- In the case of dams that are likely to contain contaminants, avoiding or minimising environmental harm by successful containment, or environmental use or release at acceptable concentrations.

Where contaminants will be stored in concentrations such that release would cause environmental harm, a default design method is to provide a minimum available storage capacity in that dam, or elsewhere on site with failure contingency, referred to as a Design Storage Allowance (DSA). A Mandatory Reporting Level (MRL) is also usually applied as a warning level or flag, for action by the owner and the EPA.

ST

An alternative to providing available storage capacity for all required dams, is to demonstrate to the satisfaction of the EPA that a positive environmental benefit is achieved by operating a water management system that provides for storage such that agreed release limits and receiving water limits are not exceeded. Design and conditions would ensure that contingency is provided for failure or absence of a pump during critical operations, with mandatory reporting of such absence or failure.

Performance criteria for estimating basic design quantities in terms of AEP are set out in Tables 4 and 5 of this manual. For spillways or levees, the interpretation and application are well understood. Where DSA (and MRL) would be required, basic design quantities may be estimated using default conservative methods, or using a 'Full Hydrologic Analysis' involving water balance modelling using real historical rainfalls (see later). Whatever hydrologic techniques are used for estimating basic design quantities for dams, the effect on hazard and performance arising from the adopted design must be addressed.

In order to estimate worst case concentrations in releases from dams containing contaminants, design rainfall up to the spillway AEP in Table 4, must be applied to dams or sequences of dams. Starting volumes and concentrations of contaminants may be drawn from water balance modelling or using conservative assumptions, based on analysis of actual monitoring data in statistically robust data sets.

Estimating Basic Design Quantities

Estimates of design quantities based on the AEP criteria set out in Tables 4 and 5 of this manual for regulated dams, must be determined as set out below, and documented accordingly:

1. Except as specified below in this manual, a runoff coefficient of 1.0 must be used for all watershed translation of rainfall into runoff and no deductions must be allowed for losses due to evaporation.
2. For each regulated dam that is not a levee, a spillway must be designed and maintained to pass the peak flow from a design storm of critical duration for the relevant contributing catchment, at the annual exceedance probability (AEP) specified in Table 4. In determining the spillway capacity, the assumption must be made that the dam commences full at the spillway crest level, and that diversion drains designed to restrict the contributing catchment, are not effective.
3. For each regulated dam that is not a levee, and at any time could contain contaminants whose release would cause material or serious environmental harm, a DSA and MRL must be provided.
4. When required, DSA volume and contingency must be provided on site, and be estimated from either:
 - (a) a 'full hydrologic analysis' as specified below and in table 5, OR
 - (b) the 'method of deciles' as specified below using the AEP value in Table 5.If a full hydrologic analysis is not conducted, then the 'method of deciles' must be used.
5. An MRL is the lowest level required to allow either of the following to be retained within the dam:
 - (a) the runoff from a 72 hour duration storm at the AEP specified in the Table 5; OR
 - (b) a wave allowance at that AEP as estimated using a recognised engineering method.
6. Each levee must be designed and maintained to isolate and divert the peak flow from either:
 - (a) a design storm of critical duration for the contributing catchment relevant to the zone to be protected by the levee, at an AEP specified in Table 4, OR
 - (b) the estimated level and flow rate of a release of flowable materials resulting from a failure of relevant other works or infrastructure; AND such that
 - (c) in at least one place in the levee crest, there is a restricted length of low crest, due to limiting the freeboard at that point or otherwise, such that a flood exceeding the design protection of the levee will be directed to a planned area or areas within the zone to be protected.

Full Hydrologic Analysis

Watershed Criteria

A 'full hydrologic analysis' must use models with appropriate timesteps not exceeding a daily timestep, that obey the law of conservation of matter (mass balanced), and use either:

- a calibrated watershed component based on soil moisture balance accounting, or



- a runoff coefficient of 1.0 for all watershed translation of rainfall into runoff.

A watershed component of a model must be calibrated using local rainfall data and consequent flows, volumes or levels recorded at intervals the same as, or less than, the intervals to be used in analysis.

Calibration of a watershed component for *water balance modelling* must meet the following criteria:

- at least three events must be included in the calibration data timeline, with each event resulting in 100% of the contributing catchment producing runoff *at some time* during the rainfall event;
- at least one event is estimated to be less frequent than ARI 5 when the real rainfall event is compared against design rainfall events of the same duration from AR&R or CRCFORGE;
- the simulated volumes or flows must agree with the recorded to within 10% for natural catchments and 20% for disturbed catchments; and
- calibrations must be reviewed annually based on any additional qualifying events that have been recorded during the interim.

Inputs and Outputs for DSA Modelling

All *water balance* analyses for DSAs must be based on historical rainfall sequences representative of the site and sourced from either the Bureau of Meteorology daily rainfall stations or the Silo Data Drill, using a continuous water balance simulation covering at least 100 years. Daily evaporative losses may be allowed in respect of lake evaporation based on accepted methods - such as Morton's method for shallow lakes. Daily data for Morton's method is available on the Silo Data Drill. No average monthly evaporative losses must be allowed in model time steps when rainfall is being applied.

A regulated dam, a system of dams or a project, shall be considered compliant with the DSA requirement in Table 5 if, for the dam and the system or project of which it forms a part, either:

- each dam spills at a frequency or during events consistent with the AEP in the table and such that releases will not exceed agreed limits, OR
- it is demonstrated to the satisfaction of the EPA using appropriate hydrology that releases will not exceed agreed limits *and* those releases are a positive environmental benefit.

Releases from either design must be checked using appropriate design storm hydrology (see earlier).

Where the contributing catchment is less than or equal to 50 square kilometres and for the purposes of this manual, the AEP of an event shall be estimated solely by rainfall analysis against a design rainfall event of the same duration and catchment area from AR&R or CRCFORGE. Otherwise, a frequency analysis of surface water flows shall be used, supported by rainfall analyses of contributing catchments.

Method of Deciles for DSA (default method)

The 'method of deciles' is the use of a bureau of meteorology daily rainfall station of sufficient length, recorded at a location sufficiently close to the site physically and with similar meteorology, to be acceptable for conservative estimation of rainfall reporting to a dam. If it is clearly demonstrated that no suitable daily rainfall stations are available to conduct the analysis, then Silo Data Drill may be used.

A critical wet period is determined from Figure 1 based on the physical location of the site relative to catchments in Queensland. The maximum rainfall for the critical wet period each year is then determined and a probability distribution applicable to rainfall analysis, or a 'best fit' curve fitted to those data points.

Rainfall depths for relevant AEPs are interpolated or extrapolated as necessary, and a runoff coefficient of 1.0 used for relevant contributing catchments to generate run-off volumes for combination with estimated other inputs to the dam over the critical wet period.

Estimating Volume for MRL (default method)

The default method for estimating the volume allowance for MRL is to apply a design rainfall event to the contributing catchment of the particular dam or sequence of dams, making conservative assumptions: ie. a runoff coefficient of 1.0, and pumps are not operable during the event.

ST

Table 4 Performance Criteria – Spillway and Levee Rating – Annual Exceedence Probability (AEP)

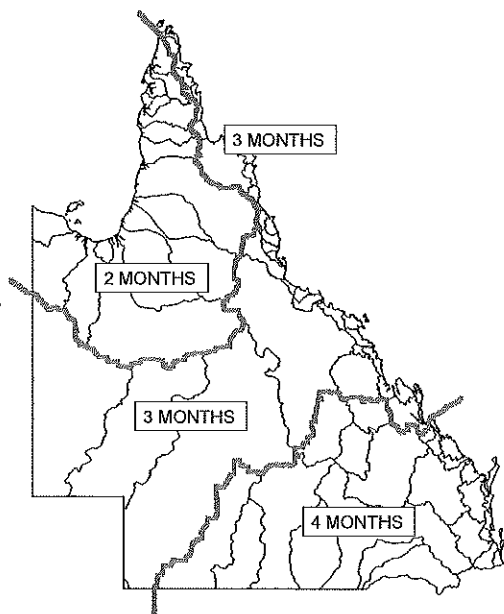
Life of Project involving Dam	Design Event Probability AEP by Hazard Category and Lifetime	
	High	Significant
Less than 10 years	0.0001 (1 in 10,000)	0.001 (1 in 1,000)
11 to 20 years	0.00005 (1 in 20,000)	0.0005 (1 in 2,000)
21 to 50 years	0.00002 (1 in 50,000)	0.0002 (1 in 5,000)
51 to 100 years	0.00001 (1 in 100,000)	0.0001 (1 in 10,000)

Table 5 Performance Criteria – Design Storage Allowance and Mandatory Reporting Levels – AEP

Hazard Category	Design Event Probability AEP		
	DSA Full Hydrologic Analysis	DSA Deciles Analysis	MRL (72 hour event)
High	0.01 (1 in 100)*	0.01(1 in 100)	0.01(1 in 100)
Significant	0.1 (1 in 10)*	0.1 (1 in 10)	0.01(1 in 100)

*NOTE: Full Hydrologic Analysis for multiple dams includes alternative compliance (see earlier).

Figure 1 – Critical Wet Periods for ‘Method of Deciles’



5

References

1. *Downstream Hazard Classification Guidelines*, ACER Technical Memorandum No. 11, U.S. Department of the Interior, Bureau of Reclamation 1988.
2. *Guidelines on Dam Safety Management*, Australian National Committee on Large Dams (ANCOLD) August 2003.
3. *Guidelines on Assessment of the Consequences of Dam Failure*. Australian National Committee on Large Dams (ANCOLD) 2000.
4. *Guidelines on Tailings Dam Design, Construction and Operation*. Australian National Committee on Large Dams (ANCOLD) August October 1999
5. *Queensland Dam Safety Management Guidelines*. Department of Natural Resources and Mines 2002
6. *Guideline for Failure Impact Assessment of Water Dams*. Queensland Government Department of Natural Resources and Mines April 2002.
7. *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland*. Queensland Department of Minerals and Energy January 1995
8. *Dam Safety Course Notes*. Queensland Government Dam Safety Group DPI Water Resources March 1994.

51

APPENDIX A

Notes on Hazard Assessment based on Failure Event Scenarios

Notes on Hazard Assessment based on Failure Event Scenarios

Failure to Contain Hazard

"Failure to contain" hazards are those potential dam failures that are non-flood producing, but the release of contaminants would endanger environmental values including human life. Examples of events include:

- Release of contaminated waters from a spillway during stormwater inflow events,
- Punctured membrane discharging contaminated process water or tailings,
- Releases due to pipe bursts in tailings or process water circuits associated with the dam,
- Piping (localised failure) of containment banks or bunds,
- Excessive foundation seepage,
- Overtopping of tailings dams by superelevation of tailings beaches or blockage of drainage,
- Erosion of containment structures around mining waste (decommissioned tailings dams, waste heaps etc.), and
- Dust and gas emissions.

Evaluation of the hazard potential on release requires information on the probable chemical nature of the stored material, including rates, volume and concentrations at the time of a possible release. Acidity and metal ions in solutions due to prolonged contact with ore bodies or stored material must be considered.

Contaminant concentrations in an unplanned release must be estimated based on the contaminant concentration in the dam, basic design parameters such as storage volume, and resulting dilution in the stormwater. Operational water balance models that may be used to assess the basic adequacy of on-site storage volumes; may also be used to estimate likely instances of volumes and concentrations.

In any case, 'time of concentration' design rainfall events must be applied with conservative assumptions to catchments contributing to individual relevant dams or groups of dams; to estimate the outcomes for worst case contaminant release or collapse, and the AEP levels at which such outcomes occur. The hazard assessment must consider the interaction of any failure of a dam with any other dams on site.

Dam Break Flood Hazard

The prerequisites for a dam break hazard are the existence, either permanently or temporarily, of a large body of water or other flowable substances (slimes, tailings etc); and environmental values, including stock, human life or property, that are susceptible to harm should a dam break occur.

The estimated extent of the flood at a particular probability level is called the 'flood footprint'. The potential for losses to humans and stock must be considered. A high hazard for humans on a flood plain or elsewhere is associated with water depths occurring in excess of 300 millimetres (0.3 metre).

If the 'flood footprint' is contaminated by the dam break flood, the environmental harm and potential for consequent harm from contaminants including access by stock or humans to the contaminants, must also be fully considered. Clean up in the general environment can involve substantial costs that would fall within the meaning of 'environmental harm' in the Act.

Basic Hazard Evaluation Data

Applications that involve the construction and operation of any containment structure, must include relevant information on which an initial hazard assessment by the applicant has been undertaken.

Dam owners are likely to have much of the information already available. The minimum information is:

- specification by map/s of the location of the proposed project in relation to surrounding land use and watercourses – including the general topography and contours at a suitable scale,
- details of environmentally sensitive areas, rare and endangered species and human habitation and infrastructure developments in the near vicinity or general area and particularly downstream,
- details of watercourses and groundwater aquifers that are or might be used as water resources,
- engineering sketch drawings, in accordance with good professional practice and sufficient to fully define the layout, structure, volume and proposed means of construction of all aspects of operations associated with the proposal,
- details of quantities and concentrations of all raw materials, products, by-products and waste products produced in operations associated with the proposal, and

31

- details of all studies conducted to assess requirements for storage and strength of all structures associated with the project – such as hydrological and geotechnical data.

Inspection of Site or Desktop Analysis

Whether or not a site inspection is required for a particular dam as part of a hazard assessment is a matter for consideration by the suitably qualified and experienced person concerned. Relevant factors to consider might be previous assessments, known changes, dams that are located remote from the main project site, and the likely outcomes. However, that person must be satisfied that all relevant aspects have been otherwise researched and documented to enable a reliable hazard assessment in each case.

Any assessment must include areas in the potential failure path or downstream of the dam that could be impacted by collapse or failure of the dam. Relevant matters include (but are not limited to):

- environmentally significant sites and species located in potential impact areas
- infrastructure including human habitation, worker accommodation and site offices, road crossings
- recreation facilities (parks and known local camping spots etc.) along watercourses
- raw (fresh water) storages on the same watercourse
- presence of stock, irrigation and domestic water supply pumps, and water holes
- downstream storage containments – such as tailings dams and process water dams
- mine adits (entrances to underground mining) and/or open cuts (voids) – current or proposed
- catchment modification works (diversion drains, bunds etc) – current or proposed

In the case of tailings dams and other waste disposal facilities, a site inspection should also note points of impact above the level of the dam. Typical impacts from such facilities include:

- dusting potential (eg. heavy metals, arsenic)
- gas emissions (eg. cyanide, hydrogen fluoride, hydrogen sulphide, sulphur dioxide)
- spray mist (acid evaporation ponds etc)
- offensive odours
- smoke and heat (including spontaneous combustion of stored material)
- visual amenity (in cases where such is critical to a significant environmental value)

Collation and Assessment of Data

A hazard category based on 'dam break' or 'failure to contain' scenarios, must be determined based on the most adverse environmental harm that can arise from the range of all possible scenarios. The hazard category is based on the consequences of failure, not on the perceived probability of the failure occurring.

The following aspects of possible adverse scenarios should be carefully considered:

- Depending on its severity and duration, a rainfall event may give rise to a spill from a dam that does not result in collapse of the dam structure but nevertheless causes some harm.
- Rainfall events may be of sufficient intensity and duration to lead to a collapse of the dam structure with consequent increase in harm.
- Where potential harm is by release of a contaminant, account should be taken of the potential dilution by clean runoff entering the dam prior to release and potential dilution in receiving waters.
- A suitable range of rainfall events will need to be considered in order to cover all potential harm scenarios and the range of performance contained in Tables 4 and 5.
- For an earth dam or bund wall, a 'sunny day' failure can also occur due to loss of structural integrity of the wall, such as piping failure or weakness in zones of the wall (various causes).

• Of course, the probability of piping and similar mechanisms occurring are reduced by good design and construction practices, and regular inspections by informed operators and qualified professionals. The purpose of a hazard assessment, is to identify dams that require more care and attention in that regard.

