QFCI

Date: 8/11/11 JM

Exhibit Number: 923

IN THE MATTER OF

THE QUEENSLAND FLOODS COMMISSION OF INQUIRY

A COMMISSION OF
INQUIRY UNDER THE COMMISSIONS OF INQUIRY ACT 1950

AND PURSUANT TO

COMMISSIONS OF INQUIRY ORDER (NO. 1) 2011

STATEMENT OF GRAHAM DAVID CORDINGLEY

I, Graham David Cordingley, of [redacted] Clayfield, Queensland, do solemnly, sincerely and truly affirm and declare:

1. I am employed by Arrow Energy Pty Ltd (**Arrow Energy**) as acting Environment Manager.

2. I make this statement (**Statement**) in response to the "Requirement to Provide Statement to Commission of Inquiry" from Justice Catherine E Holmes, Commissioner of Inquiry, Queensland Floods Commission of Inquiry (**Commission**) dated 13 September 2011 (**Inquiry Letter**).

Qualifications and Experience

3. I hold a Bachelor of Science (Australian Environmental Studies).

4. A copy of my current curriculum vitae is provided in **Annexure-GDC1**.

5. From December 2010 until present, my substantive role with Arrow Energy has been that of Compliance and Reporting Manager.

6. Since July 2011 I have acted in the role of Environmental Manager at Arrow Energy.

7. At the time of the wet weather events during late 2010 I was working with Lloyd Consulting as a Senior Environmental Scientist and had no involvement with work being undertaken by Arrow Energy at the Moranbah Gas Project (**MGP**).

8. I commenced employment with Arrow Energy on 20 December 2010, subsequent to which I have had ongoing involvement with the 2010/ 2011 flood event (**flood event**) at the MGP as a Compliance and Reporting Manager. The views expressed in this Statement regarding matters

occurring prior to commencement of my employment with Arrow Energy are based on a review of documentation made available to me and which I have identified in the period of time since receiving notice from the Commission.

9. Each matter identified below and shaded in a grey box (**Matter**) correlates with each numbered request in the Inquiry Letter. The information provided subsequent to each of the Matters responds to the proceeding matter.

Matter 1: A brief description of the main flood-related concerns at the Moranbah Coal Seam Gas project (**MGP**) (for example – hazardous waste and contaminants at the Project, effect of flood on the downstream environment, discharge requirements).

Safety to Personnel

10. The safety of site personnel was a key consideration during the flood event. On several occasions, for extended periods, field access was restricted due to safety concerns.

Structural Integrity of Coal Seam Water Dams

11. Maintaining the operational integrity of MGP dams was a key consideration during the 2010/ 2011 flood event.

Discharge of coal seam water to the Isaac River

12. The dam infrastructure on the MGP includes a pipeline from dam 5 to the release point into the Isaac River, as outlined by Condition BA1 of **EA PEN100015907 dated 14 September 2010** (found on page 8) and contained at **Annexure GDC-2**. Arrow Energy anticipated the need for additional discharges in the event of a flood event.

Beneficial Use of Coal Seam Water from the MGP

13. Arrow Energy entered into a commercial agreement with Millennium Mine in August 2006 to supply 500 ML/year of coal seam water for the purpose of coal washing. The supply of water to the Millennium Mine ceased when the mine entered into alternative commercial arrangements. This resulted in Arrow Energy being required to retain additional water that would have been

used for coal washings. This impacted on Arrow Energy's ability to accommodate additional water storage arising from the anticipated wet season. This placed increased pressure on the need for water storage and wet weather discharge at the MGP.

Access to Infrastructure

14. -Areas of the MGP tenure area were not accessible for extended periods due to the flood event. This severely affected the management of water balance between dams in addition to maintaining the operational integrity of the project.
15. Concerns were held relating to delays in scheduled upgrades of water management infrastructure (e.g. new dams) which were intended to increase storage capacity and address increased rain events associated with the wet season.

Matter 2 - An account of the flood preparedness activities undertaken by Arrow Energy in advance of the 2010/2011 wet season at the Project, including whether any particular activities were undertaken as a response to the forecast of an above-average rainfall wet season, or any government communications regarding that forecast.

Upgrade of Water Management Facilities

16. A combination of the following various management strategies were undertaken to manage water levels in Dams in response to excessive rainfall in the lead up to the flood event:
    a. A detailed risk assessment of the dam operations and storage capacities dated 18 November 2010 and identified at **Annexure-GDC3.**
    b. Production was reduced in several stages, details of which are provided in correspondence between Arrow Energy and the Department of Environment and Resource Management (DERM) and located at **Annexure-GDC4.**
    c. Installation of several kilometres of temporary 'lay flat' pipe-work between selected dams to enable 'water balance' activities; and
    d. Acceleration of the construction of additional storage infrastructure (i.e. Dam 11).

17. I have been advised by Arrow Energy representatives that Arrow Energy commenced a program of work to upgrade the water management facilities at the MGP in 2010. This project involved the construction of additional dam storage and a planned reverse osmosis (**RO**) water treatment plant. The upgrade of these water management facilities was required to ensure adequate capacity during the wet season and also to meet the Qld Government Coal Seam Water Management Policy dated June 2010 and as shown in **Annexure -GDC-5**.

18. Arrow Energy was, and is still, required to verify the water level in each dam prior to 1 November each year to determine whether there is a likelihood of exceeding Designed Storage Allowance (**DSA**) throughout the wet season.

19. If it is determined that there is potential for the DSA to be exceeded, Arrow Energy is required under the Environmental Authority (**EA**) to notify DERM and identify contingency plans. DERM was notified on 26 October 2010 that the DSA for Dam 1 would be exceeded. Correspondence from Arrow Energy to DERM advising of this fact is attached at **Annexure GDC-6.** I have been advised by Arrow Energy representatives that at the time of submission of this letter to DERM Arrow Energy envisaged that Dam 11 could be completed by December 2010 in order to alleviate potential storage issues associated with the wet season.

20. Upon Arrow Energy acknowledging delays to the Dam 11 completion date, it was decided that a release to the Isaac was the only means of mitigating the potential overtopping of the dams.

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22. Ross Stafford and Associates was commissioned to assess all regulated dams at the MGP. Results of this assessment are detailed in a report dated 16 February 2010. Dam 2 was identified in this report as requiring repairs to address structural integrity issues. Following confirmation that the completion of Dam 11 would be delayed and significant rainfall was occurring, Arrow Energy commissioned, URS to specifically evaluate Dam 2's structural integrity. This inspection was undertaken on 22 December 2010, resulting in a report being finalised on 24 December 2010 as

identified in **Annexure GDC-7**. As a result of this inspection, URS recommended lowering of the water level to 4 metres below its DSA.

23. To assist in meeting new EA conditions, namely condition C13 and C14 in EA PEN100015907, Arrow Energy prepared the MGP Water Management Project Execution Plan (Design Plan) dated 16 July 2010 **(Annexure GDC-8)** and in accordance with this plan Arrow Energy was in the process of upgrading infrastructure including Dam 11, a brine storage dam, a RO plant and planning an additional dam for the collection of treated water.

Matter 3 - With respect to the Environmental Authority in force at the Project for the 2010/2011 wet season, an account of: Any concerns Arrow Energy had arising from the drafting and negotiation of it and consultation between Arrow Energy; and The Department of Environment and Resource Management (DERM); Any inability on the part of Arrow Energy to comply with its terms; and Any risks to safety or the environment caused by its terms

24. MGP dams are regulated in accordance with the conditions of the relevant environmental authority. The environmental authority in force at the time of the 2010/ 2011 flood event (EA PEN100015907 dated 10 December 2010) is provided at **Annexure GDC-9**.
25. Infrastructure was designed in accordance with historical EA conditions which incorporated wet weather discharge facilities.
26. During the 2010/ 2011 wet season, the current **EA PEN100015907** did not satisfactorily provide for high flow emergency discharges to the Isaac River.
27. Discharge of coal seam water to a water course requires authorisation under the EA, or in the absence of this, a Transitional Environment Program (**TEP**). The authorisation of a wet weather conditional discharge to the Isaac River was originally granted under **EA number 170524** granted on 15 November 2004 **(Annexure GDC-10)** with an electrical conductivity (EC) limit of 1500 $\mu S.cm^{-1}$ measured at the designated downstream location. On 23 January 2006 a revised EA was

imposed **(PEN 170524)** altering discharge conditions and effectively prohibiting discharges to the Isaac River during high flow events.

28. In accordance with Condition C24 of EA **PEN100015907 (Annexure GDC-9)**, in correspondence to DERM dated 26 October 2010 Arrow Energy advised that the DSA for Dam 1 had been exceeded and that production had been curtailed to manage the volume of produced water and Arrow Energy was considering options to regain storage capacity in accordance with the condition C24 of the EA (**Annexure GDC-6**).

Matter 4 - With respect to any transitional environmental program (TEP) or emergency direction (ED) applied for, granted or refused relating to the Project during the period 1 October 2011 to 30 July 2011, an account of:

1. The reason the TEP or ED was required, and his opinion as to whether the TEP or ED was effective in resolving that issue
2. Any concerns arising from the terms of the TEP or ED
3. Any non-compliance with the TEP or ED, and, if so, any actions taken by DERM in response to that non-compliance
4. To the knowledge of Arrow Energy, any adverse effects to drinking water quality, an plant or animal species, any industry or agriculture, the environment or public health that occurred as a result of discharge of water under the TEP or ED

All documents lodged with DERM and all substantive correspondence with DERM, downstream environmental groups or landholders regarding the TEP or ED should be attached to the statement

29. A program notice (**Notice**) was submitted to DERM on 3 December 2010 under Section 333 of the *Environmental Protection Act 1994* (Qld) to control dam water levels at the Project **(Annexure GDC-11)**. A copy of the TEP and Decision dated 4 February 2011 to grant approval for draft TEP arising from this Notice is contained at **Annexure GDC-12.**

30. The intention of the TEP was to provide a short term solution for the management of infrastructure integrity through lowering dam levels, by assimilating the former wet weather discharge provisions as per the superseded **EA No 170524** dated 2004 **(Annexure GDC-10)**. In my view delays in DERM's issuance of the TEP limited its effectiveness and resulted in unnecessary risk to the structural integrity of water storage infrastructure and potential for over topping of the dams during a period of high flow in the Isaac River. I have been advised that the

opportunity to discharge water to the Isaac River on numerous occasions was lost due to these delays. Discharges during these high flow events would have allowed for additional dilution, which would have reduced potential environmental effects.

31. In general accordance with Draft TEP conditions, an emergency water release to the Isaac River occurred on 14 December 2011, during the TEP application period to address known structural integrity issues with Dam 2 and potential overtopping of this and other dams by infrastructure failure. The discharge was ceased after meeting with DERM later the same day following threatened enforcement action. Notice from DERM regarding this matter is contained in **Annexure GDC-13.**

32. The TEP, granted/approved on 4 February 2011 provided assistance in managing Dam levels for the duration of the limited release events during and following rainfall events, as permitted by the TEP. However, due to the limitations in the TEP and a reduced flow in the Isaac River, a combination of management strategies were undertaken to control the Dam Levels, including limiting production.

33. Concerns arising from the terms of the TEP included the release limits stated in Table 6 of the TEP were unable to be met for all listed parameters. I have been advised by an Arrow Energy representative that DERM were aware that the water quality limits detailed in the TEP would be breached, prior to the issue of the TEP. The results of all sampling and analysis programs were released to DERM as soon as possible following the release of the results from the analysing laboratory. All results were assessed against the release limits and reported to DERM.

34. Reporting timeframes did not allow for delays in transporting sample containers or samples during the flood event, or for circumstances where it was not safe to access sample points.

35. The release limits stated in Table 6 of the TEP were unable to be met for all listed parameters. In particular metal and metalloid concentrations exceeded limitations imposed by the TEP. Analytical results were periodically released to DERM for the duration of the TEP. The complete table of results is identified at **Annexure GDC-14.**

36. I am not aware of any adverse environmental effects resulting from Arrow Energy's releases to the Isaac River under the TEP.

37. Various documents and associated correspondence has been brought to my attention relating to substantive correspondence between Arrow Energy and DERM regarding the above TEP matter. Copies of these documents and associated correspondence are identified at **Annexure GDC-15**.

Matter 5 - A description of any concerns arising from the process of applying for and being granted or refused any TEP or ED, including:

- Arrow Energy's knowledge of the process in advance
- The transparency of the process
- The speed of the process
- The considerations taken into account or not taken into account
- The reasons given for any decision
- Consultation with relevant stakeholders

38. In my view the statutory process associated with the application and issuance of a TEP for water discharges was and remains ambiguous. During the application process, this resulted in time delays in the drafting and finalisation of the TEP detailed above.

39. To the best of my knowledge DERM did not provide Arrow Energy with reasons justifying the issuance of TEP conditions.

40. In my view the overly risk adverse attitude of the DERM towards issuing the TEP did not appropriately reflect the urgency of managing excess water and the safety and environmental risks associated with retaining the water.

Matter 6 - Details of any negotiation of environmental authority conditions or discussions with DERM since flooding experienced in the 2010/2011 wet season to resolve any issues raised above in 3, 4 or 5.

41. I have been advised by Arrow Energy representatives that Arrow Energy met with DERM on the 14 April 2011 to detail its current situation and requirements under the EA PEN100015907 regarding the long term water strategy for the Moranbah Gas Project.

42. I am aware that Arrow Energy representatives met with the Office of the Water Supply Regulator (**OWSR**) to discuss the permanent discharge of water from the MGP facility in accordance with Schedule B – Water, of EA PEN100015907.

43. I am aware of discussions have been held with OWSR regarding additional approval impositions arising under the *Water Supply (Safety and Reliability) Act 2008*.

44. I am aware of additional discussions between Arrow Energy and OWSR regarding:

    a. extensive sampling requirements that must be conducted post commissioning of water treatment equipment.

    b. The comprehensive nature of the draft analytical suite.

    c. The time consuming nature of approval processes administered by OWSR for any water discharges.

    d. Lack of provisions for emergency water discharges in exceptional circumstances.

Matter 7 - An explanation as to whether the new environmental authority conditions negotiated during 2011, if any, are advantageous or disadvantageous to Arrow Energy in the management of water, contaminants and hazardous waste at the Project, the downstream environment and safety issues.

45. I have been advised by Arrow Energy representatives that no new environmental authority conditions have been negotiated with DERM during 2011 in relation to the management of water, contaminants and hazardous waste associated at the project or the downstream environment and safety issues. An environmental impact assessment must be completed before changes to discharge conditions can be decided. Arrow has commenced this.

Matter 8 - A description of any concerns regarding the potential for pond overtopping at the site between 1 October 2010 and 30 July 2011

46. As previously stated in Items 22, 28, 29, 30, 31.

Matter 9 - An explanation of any current procedures or plans for future procedures by Arrow Energy to manage water at the Project other than by storing it in dams or ponds, including by using desalination plants, purification procedures or any other means.

47. The revised Bowen Basin Coal Seam Water Management Plan (**CSWMP**) at Annexure GDC-17 provides details regarding current water management processes and planning in progress for future water management processes. I have been advised by Arrow Energy Representatives that the CSWMP is a live document subject to ongoing revision.

48. Based on discussions with Arrow Energy representatives, I understand that the current water management process for the MGP involves the following:

    a. CSG water gathering via high density poly ethylene (**HDPE**) gathering network to aggregation dams; and

    b. Evaporation of CSG water via aggregation dams.

49. I am aware that Arrow Energy is currently installing a water treatment facility as part of a water management program, to facilitate water re-use options.

50. I have been advised by Arrow Energy representatives that the revised water management program will entail the following:

    a. CSG water gathering via HDPE gathering network to aggregation dams (unchanged).

    b. Treatment of all CSG water at a Water Treatment Facility (initially 2ML/d capacity) which employs micro-filtration and reverse osmosis to generate a concentrate water stream and a permeate water stream. This plant will operate at a recovery between 75 – 85% .

51. Based on comments made by Arrow Energy representatives I understand that both permeate and concentrate, will initially be stored in dams in line with EA requirements. Permeate water will undergo ionic amendment to lower the sodium absorption ratio (SAR) to make beneficial use possible. The amendment facility will utilise calcium chloride for SAR adjustment.

52. I am advised that the Water Treatment Facility is currently being constructed and that commissioning of the facility (including associated permeate and concentrate dams) is planned for December 2011.

53. While I understand that treated water will initially be stored in a purpose built Dam, this buffer storage is required to manage demand variations from planned and future water off-takes. I further understand that Arrow Energy is currently actively pursuing beneficial use options for this treated water which are further described in the CSWMP.

54. I have been advised by Arrow Energy representatives of a range of beneficial use options that are currently being actively pursued by Arrow Energy. These options include:

    a. Beneficial use by crop irrigation;

    b. Beneficial use by surrounding coal industry (e.g. coal washing); and

    c. Beneficial use by water service providers.

55. I am advised by Arrow Energy Representatives that Arrow Energy's current brine disposal strategy relies on evaporation and concentration in dams until crystallisation technologies have been further progressed and trialled.

Matter 10 - An explanation of that which is involved in managing water at the Project other than by storing it in dams or ponds, including using desalination plants, purification procedures or any other means.

56. There are currently no CSG water treatment facilities in operation at the MGP; however a reverse osmosis plant is currently being constructed to treat water for re-use/discharge. It is anticipated that this plant will be commissioned in December 2011.

57. Based on information provided by Arrow Energy representatives, I understand that Arrow Energy currently possesses a water supply licence (under renewal) for the use of untreated water for industrial beneficial use at Millenium Mine. The water is planned for use in coal washing activities in the approved quantity of 500 ML/yr. I understand that due to impacts arising from the 2010/ 2011 wet season, this agreement has not been utilised. I further

understand based on discussions with Arrow Energy officers that it is unlikely that the Millenium Mine will require beneficial use water in the near future.

58. The CSWMP (**Plan**) has been developed to be utilised in conjunction with Arrow Energy's CSG Water Management Strategy; and implemented to define and communicate Arrow Energy's strategy for the current and future management of CSG water in the Bowen Basin. Activities addressed by this plan include:

    a. Gas exploration;

    b. Appraisal; and

    c. Production interests for the domestic market.

59. In addition to fulfilling relevant legislative and policy requirements, the objectives of this Plan are to define the hierarchy of options for the disposal of CSG water from appraisal and production activities, by:

    a. Establishing a management framework for each CSG water disposal option;

    b. Identifying the environmental values potentially affected by activities addressed by the Planning as well as mechanisms for protection (e.g. established procedures);

    c. Ensuring action is taken, if any of the measurement criteria are not satisfied.

Signed and solemnly, sincerely and truly affirmed and declared by Graham David Cordingley, of 15 Hutton Street, Clayfield, Queensland at Brisbane, Queensland, this 26th day of September, 2011, before me.

[redacted]

Witness Signature / Signature

[redacted]

Print Name

Justice of the Peace (Qualified).

Our ref: Doc 1714863

13 September 2011

[redacted]
Vice President – Legal
Arrow Energy Pty Ltd
GPO Box 5262
BRISBANE QLD 4001

Dear [redacted]

Arrow Energy Pty Ltd – Moranbah Coal Seam Gas Project

Please find enclosed a Requirement to Provide Statement to the Commission addressed to Mr Graham Cordingley, Compliance and Reporting Manager - Environment for Arrow Energy, directed to the operation and regulation of Moranbah Coal Seam Gas Project.

The material is returnable to the Commission no later than 4 pm, Monday, 26 September 2011.

If you require further information or assistance, please contact [redacted] on telephone [redacted].

We thank you for your assistance.

Yours sincerely

[redacted]
Jane Moynihan
Executive Director

Encl.

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Our ref: Doc 1712632

13 September 2011

Graham Cordingley
Compliance and Reporting Manager - Environment
Arrow Energy Pty Ltd
PO Box 5262
BRISBANE QLD 4001

REQUIREMENT TO PROVIDE STATEMENT TO COMMISSION OF INQUIRY

I, Justice Catherine E Holmes, Commissioner of Inquiry, pursuant to section 5(1)(d) of the *Commissions of Inquiry Act 1950* (Qld), require Graham Cordingley to provide a written statement, under oath or affirmation, to the Queensland Floods Commission of Inquiry, in which the said Graham Cordingley provides:

1. a brief description of the main flood-related concerns at the Moranbah Coal Seam Gas Project ("the Project") (for example – hazardous waste and contaminants at the Project, effect of flood on the downstream environment, discharge requirements)

2. an account of the flood preparedness activities undertaken by Arrow Energy in advance of the 2010/2011 wet season at the Project, including whether any particular activities were undertaken as a response to the forecast of an above-average rainfall wet season, or any government communications regarding that forecast

   Any government communications regarding the above-average rainfall forecast for the 2010/2011 wet season should be attached to the statement.

3. with respect to the environmental authority in force at the Project for the 2010/2011 wet season, an account of:
   a. any concerns Arrow Energy had arising from
      i. the drafting and negotiation of it and consultation between Arrow Energy; and
      ii. the Department of Environment and Resource Management (DERM)
   b. any inability on the part of Arrow Energy to comply with its terms
   c. any risks to safety or the environment caused by its terms

4. with respect to any transitional environmental program (TEP) or emergency direction (ED) applied for, granted or refused relating to the Project during the period 1 October 2010 to 30 July 2011, an account of:
   a. the reason the TEP or ED was required, and his opinion as to whether the TEP or ED was effective in resolving that issue
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c. any non-compliance with the TEP or ED, and, if so, any actions taken by DERM in response to that non-compliance
d. to the knowledge of Arrow Energy, any adverse effects to drinking water quality, any plant or animal species, any industry or agriculture, the environment or public health that occurred as a result of discharge of water under the TEP or ED

All documents lodged with DERM and all substantive correspondence with DERM, downstream environmental groups or landholders regarding the TEP or ED should be attached to the statement.

5. a description of any concerns arising from the process of applying for and being granted or refused any TEP or ED, including:
   a. Arrow Energy's knowledge of the process in advance
   b. the transparency of the process
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6. details of any negotiation of environmental authority conditions or discussions with DERM since flooding experienced in the 2010/2011 wet season to resolve any issue raised above in 3, 4 or 5

7. an explanation as to whether the new environmental authority conditions negotiated during 2011, if any, are advantageous or disadvantageous to Arrow Energy in the management of water, contaminants and hazardous waste at the Project, the downstream environment and safety issues

8. a description of any concerns regarding the potential for pond overtopping at the site between 1 October 2010 and 30 July 2011

9. an explanation of any current procedures or plans for future procedures by Arrow Energy to manage water at the Project other than by storing it in dams or ponds, including by using desalination plants, purification procedures or any other means

10. an explanation of that which is involved in managing water at the Project other than by storing it in dams or ponds, including by using desalination plants, purification procedures or any other means

In addressing these matters, Mr Cordingley is to:

- provide all information in his possession and identify the source or sources of that information;
- make commentary and provide opinions he is qualified to give as to the appropriateness of particular actions or decisions and the basis of that commentary or opinion.

Mr Cordingley may also address other topics relevant to the Terms of Reference of the Commission in the statement, if he wishes.

The statement is to be provided to the Queensland Floods Commission of Inquiry by 4pm, Monday 26 September 2011.

The statement can be provided by post, email or by arranging delivery to the Commission by emailing info@floodcommission.qld.gov.au.

C. Holmes

Commissioner
Justice C E Holmes

IN THE MATTER OF

THE QUEENSLAND FLOODS COMMISSION OF INQUIRY

A COMMISSION OF
INQUIRY UNDER THE COMMISSIONS OF INQUIRY ACT 1950

AND PURSUANT TO

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identified in **Annexure GDC-7**. As a result of this inspection, URS recommended lowering of the water level to 4 metres below its DSA.

23. To assist in meeting new EA conditions, namely condition C13 and C14 in EA PEN100015907, Arrow Energy prepared the MGP Water Management Project Execution Plan (Design Plan) dated 16 July 2010 **(Annexure GDC-8)** and in accordance with this plan Arrow Energy was in the process of upgrading infrastructure including Dam 11, a brine storage dam, a RO plant and planning an additional dam for the collection of treated water.

Matter 3 - With respect to the Environmental Authority in force at the Project for the 2010/2011 wet season, an account of: Any concerns Arrow Energy had arising from the drafting and negotiation of it and consultation between Arrow Energy; and The Department of Environment and Resource Management (DERM); Any inability on the part of Arrow Energy to comply with its terms; and Any risks to safety or the environment caused by its terms

24. MGP dams are regulated in accordance with the conditions of the relevant environmental authority. The environmental authority in force at the time of the 2010/ 2011 flood event (EA PEN100015907 dated 10 December 2010) is provided at **Annexure GDC-9**.
25. Infrastructure was designed in accordance with historical EA conditions which incorporated wet weather discharge facilities.
26. During the 2010/ 2011 wet season, the current **EA PEN100015907** did not satisfactorily provide for high flow emergency discharges to the Isaac River.
27. Discharge of coal seam water to a water course requires authorisation under the EA, or in the absence of this, a Transitional Environment Program (**TEP**). The authorisation of a wet weather conditional discharge to the Isaac River was originally granted under **EA number 170524** granted on 15 November 2004 **(Annexure GDC-10)** with an electrical conductivity (EC) limit of 1500 $\mu S.cm^{-1}$ measured at the designated downstream location. On 23 January 2006 a revised EA was

imposed (**PEN 170524)** altering discharge conditions and effectively prohibiting discharges to the Isaac River during high flow events.

28. In accordance with Condition C24 of **EA PEN100015907 (Annexure GDC-9)**, in correspondence to DERM dated 26 October 2010 Arrow Energy advised that the DSA for Dam 1 had been exceeded and that production had been curtailed to manage the volume of produced water and Arrow Energy was considering options to regain storage capacity in accordance with the condition C24 of the EA (**Annexure GDC-6**).

Matter 4 - With respect to any transitional environmental program (TEP) or emergency direction (ED) applied for, granted or refused relating to the Project during the period 1 October 2011 to 30 July 2011, an account of:

1. The reason the TEP or ED was required, and his opinion as to whether the TEP or ED was effective in resolving that issue
2. Any concerns arising from the terms of the TEP or ED
3. Any non-compliance with the TEP or ED, and, if so, any actions taken by DERM in response to that non-compliance
4. To the knowledge of Arrow Energy, any adverse effects to drinking water quality, an plant or animal species, any industry or agriculture, the environment or public health that occurred as a result of discharge of water under the TEP or ED

All documents lodged with DERM and all substantive correspondence with DERM, downstream environmental groups or landholders regarding the TEP or ED should be attached to the statement

29. A program notice (**Notice**) was submitted to DERM on 3 December 2010 under Section 333 of the *Environmental Protection Act 1994* (Qld) to control dam water levels at the Project (**Annexure GDC-11**). A copy of the TEP and Decision dated 4 February 2011 to grant approval for draft TEP arising from this Notice is contained at **Annexure GDC-12.**

30. The intention of the TEP was to provide a short term solution for the management of infrastructure integrity through lowering dam levels, by assimilating the former wet weather discharge provisions as per the superseded **EA No 170524** dated 2004 (**Annexure GDC-10**). In my view delays in DERM's issuance of the TEP limited its effectiveness and resulted in unnecessary risk to the structural integrity of water storage infrastructure and potential for over topping of the dams during a period of high flow in the Isaac River. I have been advised that the

opportunity to discharge water to the Isaac River on numerous occasions was lost due to these delays. Discharges during these high flow events would have allowed for additional dilution, which would have reduced potential environmental effects.

31. In general accordance with Draft TEP conditions, an emergency water release to the Isaac River occurred on 14 December 2011, during the TEP application period to address known structural integrity issues with Dam 2 and potential overtopping of this and other dams by infrastructure failure. The discharge was ceased after meeting with DERM later the same day following threatened enforcement action. Notice from DERM regarding this matter is contained in **Annexure GDC-13.**

32. The TEP, granted/approved on 4 February 2011 provided assistance in managing Dam levels for the duration of the limited release events during and following rainfall events, as permitted by the TEP. However, due to the limitations in the TEP and a reduced flow in the Isaac River, a combination of management strategies were undertaken to control the Dam Levels, including limiting production.

33. Concerns arising from the terms of the TEP included the release limits stated in Table 6 of the TEP were unable to be met for all listed parameters. I have been advised by an Arrow Energy representative that DERM were aware that the water quality limits detailed in the TEP would be breached, prior to the issue of the TEP. The results of all sampling and analysis programs were released to DERM as soon as possible following the release of the results from the analysing laboratory. All results were assessed against the release limits and reported to DERM.

34. Reporting timeframes did not allow for delays in transporting sample containers or samples during the flood event, or for circumstances where it was not safe to access sample points.

35. The release limits stated in Table 6 of the TEP were unable to be met for all listed parameters. In particular metal and metalloid concentrations exceeded limitations imposed by the TEP. Analytical results were periodically released to DERM for the duration of the TEP. The complete table of results is identified at **Annexure GDC-14.**

36. I am not aware of any adverse environmental effects resulting from Arrow Energy's releases to the Isaac River under the TEP.

37. Various documents and associated correspondence has been brought to my attention relating to substantive correspondence between Arrow Energy and DERM regarding the above TEP matter. Copies of these documents and associated correspondence are identified at **Annexure GDC-15**.

Matter 5 - A description of any concerns arising from the process of applying for and being granted or refused any TEP or ED, including:

- Arrow Energy's knowledge of the process in advance
- The transparency of the process
- The speed of the process
- The considerations taken into account or not taken into account
- The reasons given for any decision
- Consultation with relevant stakeholders

38. In my view the statutory process associated with the application and issuance of a TEP for water discharges was and remains ambiguous. During the application process, this resulted in time delays in the drafting and finalisation of the TEP detailed above.

39. To the best of my knowledge DERM did not provide Arrow Energy with reasons justifying the issuance of TEP conditions.

40. In my view the overly risk adverse attitude of the DERM towards issuing the TEP did not appropriately reflect the urgency of managing excess water and the safety and environmental risks associated with retaining the water.

Matter 6 - Details of any negotiation of environmental authority conditions or discussions with DERM since flooding experienced in the 2010/2011 wet season to resolve any issues raised above in 3, 4 or 5.

41. I have been advised by Arrow Energy representatives that Arrow Energy met with DERM on the 14 April 2011 to detail its current situation and requirements under the EA PEN100015907 regarding the long term water strategy for the Moranbah Gas Project.

42. I am aware that Arrow Energy representatives met with the Office of the Water Supply Regulator (**OWSR**) to discuss the permanent discharge of water from the MGP facility in accordance with Schedule B – Water, of EA PEN100015907.

43. I am aware of discussions have been held with OWSR regarding additional approval impositions arising under the *Water Supply (Safety and Reliability) Act 2008*.

44. I am aware of additional discussions between Arrow Energy and OWSR regarding:

    a. extensive sampling requirements that must be conducted post commissioning of water treatment equipment.

    b. The comprehensive nature of the draft analytical suite.

    c. The time consuming nature of approval processes administered by OWSR for any water discharges.

    d. Lack of provisions for emergency water discharges in exceptional circumstances.

Matter 7 - An explanation as to whether the new environmental authority conditions negotiated during 2011, if any, are advantageous or disadvantageous to Arrow Energy in the management of water, contaminants and hazardous waste at the Project, the downstream environment and safety issues.

45. I have been advised by Arrow Energy representatives that no new environmental authority conditions have been negotiated with DERM during 2011 in relation to the management of water, contaminants and hazardous waste associated at the project or the downstream environment and safety issues. An environmental impact assessment must be completed before changes to discharge conditions can be decided. Arrow has commenced this.

Matter 8 - A description of any concerns regarding the potential for pond overtopping at the site between 1 October 2010 and 30 July 2011

46. As previously stated in Items 22, 28, 29, 30, 31.

Matter 9 - An explanation of any current procedures or plans for future procedures by Arrow Energy to manage water at the Project other than by storing it in dams or ponds, including by using desalination plants, purification procedures or any other means.

47. The revised Bowen Basin Coal Seam Water Management Plan (**CSWMP**) at **Annexure GDC-17** provides details regarding current water management processes and planning in progress for future water management processes. I have been advised by Arrow Energy Representatives that the CSWMP is a live document subject to ongoing revision.

48. Based on discussions with Arrow Energy representatives, I understand that the current water management process for the MGP involves the following:

    a. CSG water gathering via high density poly ethylene (**HDPE**) gathering network to aggregation dams; and

    b. Evaporation of CSG water via aggregation dams.

49. I am aware that Arrow Energy is currently installing a water treatment facility as part of a water management program, to facilitate water re-use options.

50. I have been advised by Arrow Energy representatives that the revised water management program will entail the following:

    a. CSG water gathering via HDPE gathering network to aggregation dams (unchanged).

    b. Treatment of all CSG water at a Water Treatment Facility (initially 2ML/d capacity) which employs micro-filtration and reverse osmosis to generate a concentrate water stream and a permeate water stream. This plant will operate at a recovery between 75 – 85% .

51. Based on comments made by Arrow Energy representatives I understand that both permeate and concentrate, will initially be stored in dams in line with EA requirements. Permeate water will undergo ionic amendment to lower the sodium absorption ratio (SAR) to make beneficial use possible. The amendment facility will utilise calcium chloride for SAR adjustment.

52. I am advised that the Water Treatment Facility is currently being constructed and that commissioning of the facility (including associated permeate and concentrate dams) is planned for December 2011.

53. While I understand that treated water will initially be stored in a purpose built Dam, this buffer storage is required to manage demand variations from planned and future water off-takes. I further understand that Arrow Energy is currently actively pursuing beneficial use options for this treated water which are further described in the CSWMP.

54. I have been advised by Arrow Energy representatives of a range of beneficial use options that are currently being actively pursued by Arrow Energy. These options include:

    a. Beneficial use by crop irrigation;

    b. Beneficial use by surrounding coal industry (e.g. coal washing); and

    c. Beneficial use by water service providers.

55. I am advised by Arrow Energy Representatives that Arrow Energy's current brine disposal strategy relies on evaporation and concentration in dams until crystallisation technologies have been further progressed and trialled.

Matter 10 - An explanation of that which is involved in managing water at the Project other than by storing it in dams or ponds, including using desalination plants, purification procedures or any other means.

56. There are currently no CSG water treatment facilities in operation at the MGP; however a reverse osmosis plant is currently being constructed to treat water for re-use/discharge. It is anticipated that this plant will be commissioned in December 2011.

57. Based on information provided by Arrow Energy representatives, I understand that Arrow Energy currently possesses a water supply licence (under renewal) for the use of untreated water for industrial beneficial use at Millenium Mine. The water is planned for use in coal washing activities in the approved quantity of 500 ML/yr. I understand that due to impacts arising from the 2010/ 2011 wet season, this agreement has not been utilised. I further

understand based on discussions with Arrow Energy officers that it is unlikely that the Millenium Mine will require beneficial use water in the near future.

58. The CSWMP (**Plan**) has been developed to be utilised in conjunction with Arrow Energy's CSG Water Management Strategy; and implemented to define and communicate Arrow Energy's strategy for the current and future management of CSG water in the Bowen Basin. Activities addressed by this plan include:

    a. Gas exploration;

    b. Appraisal; and

    c. Production interests for the domestic market.

59. In addition to fulfilling relevant legislative and policy requirements, the objectives of this Plan are to define the hierarchy of options for the disposal of CSG water from appraisal and production activities, by:

    a. Establishing a management framework for each CSG water disposal option;

    b. Identifying the environmental values potentially affected by activities addressed by the Planning as well as mechanisms for protection (e.g. established procedures);

    c. Ensuring action is taken, if any of the measurement criteria are not satisfied.

Signed and solemnly, sincerely and truly affirmed and declared by Graham David Cordingley, of [redacted] Clayfield, Queensland at Brisbane, Queensland, this 26th day of September, 2011, before me.

[redacted]

Witness Signature [redacted] Signature [redacted]

Print Name

Justice of the Peace (Qualified). QLD [redacted]

1 Annexure-GDC1

2 Annexure-GDC2

3 Annexure-GDC3

4 Annexure-GDC4

5 Annexure-GDC5

6 Annexure-GDC6

7 Annexure-GDC7

8 Annexure-GDC8

9 Annexure-GDC9

10 Annexure-GDC10

11 Annexure-GDC11

12 Annexure-GDC12

13 Annexure-GDC13

14 Annexure-GDC14

15 Annexure-GDC15

16 Annexure-GDC16

17 Annexure-GDC17

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Resume

PERSONAL

Name: **Graham David Cordingley**

[redacted]

Driver Licence: Open C Class

ACADEMIC

1996-1999 **Bachelor of Science (Environmental)**
Griffith University 1999
Majors:
- Environmental Planning
- Ecology and its Applications
- Land and Water Processes

FURTHER TRAINING

- Isotope Sampling (CSIRO/UQ)
- 4WD Training
- Arrow CSG - Safety Induction
- First Aid Training (May 2011)
- Soil Sampling
- Ground and surface water sampling
- Ambient Air Monitoring
- Environmental monitoring well construction
- Hazardous Waste Operations and Emergency Response (HAZWOPER) 24 hour
- Acid Sulfate Soil (ASS) Technical Workshop (3 days)
- Asbestos Awareness
- 'The Way of Influential and Sustainable Leadership'
- QSA Environmental Auditor Certification Workshop
- 28th Annual Groundwater School (University of WA)
- Fire and Emergency Response Training
- Industry Safety Inductions (30+)

EMPLOYMENT HISTORY

20 Dec 2010 - Current
Arrow Energy Pty Ltd - **(Compliance and Reporting Manager – Acting Environment Manager)**

Responsibilities
- Safety leadership
- Environment leadership
- Delivery of strategic environmental compliance
- Fast tracking general environment improvement areas
- Initiating a project based team environment
- Liaising with industry specific stakeholders, government sectors and proponents
- Engaging with internal project teams to assess and manage environmental support requirements
- Allocation of appropriate resources from a multidisciplinary team of environment specialists to support project delivery and overarching company direction
- Incident coordination and response
- Conducting field work to assist in the delivery of environmental awareness across the company
- Technical review of internal and external environment documents and reports
- Contract review and modification to ensure environmental compliance and best practice environmental management are the focus in the delivery of all projects
- Monitoring team performance
- Monitoring personal and individuals' tasks, targets
- Assistance with recruitment – professional staff

May 2010 – Dec 2010
Lloyd Consulting Pty Ltd - **(Contaminated Sites Specialist)**

Responsibilities
- Developing company capabilities to include intrusive contaminated site and acid sulfate soil investigations to complement existing auditing capabilities - Third Party Review Services
- Company OHSE Officer – safety leadership
- Safety management system development
- Project management
- Contaminated site assessment and management
- Third party audits - third party reviewer (TPR) assistance
- Contractor management
- Technical writing and review

2007 – 2010
AECOM Pty Ltd - **(Principal Scientist/Team Leader – Contaminated Sites)**

Responsibilities
- Team coordination and management
- Performance monitoring
- Project coordination and management
- Liaising with government and industry clients and proponents
- Third party audits - third party reviewer (TPR) assistance
- Contractor management

- Contaminated site assessment and management
- Site remediation and close out reporting
- Training – technical sampling methodology
- Environment reporting and technical/editorial reviewing

2005 –2007
RPS Pty Ltd **- (Managing Scientist)**

Responsibilities
- Company client representative and manager
- Project coordination and management
- Acid sulfate soil assessment and management
- Liaising with government, industry and community groups
- Contaminated site assessment and management
- Site remediation and close out reporting
- Environment incident response
- Hydrocarbon spill management
- Contaminant recovery dewatering management plans
- Environmental risk assessment
- Compliance - environmental management plans
- Asbestos assessment, training and management
- General environmental reporting and technical review

2004 – 2005
MPL Group Pty Ltd now Coffey Pty Ltd - **(A/Environment Team Leader)**
2003 – 2004
MPL Group (now Coffey Pty Ltd) - **(Team Leader - Property Hazard Services)**
2000 - 2004
MPL Group (now Coffey Pty Ltd) – **(Environmental Scientist to Senior Environmental Scientist)**

Responsibilities
- Team coordination/management and mentoring (13 professional staff)
- Administration of budgets and project controls
- Business development
- Project coordination/management and training
- Environmental auditing (due diligence, regulatory compliance and best practice)
- Consulting within environmental and OH&S legislation and regulations
- Liaising with Government, Industry and community groups
- Contaminated site management and remediation
- Environmental risk assessment
- Environmental reporting and peer review
- Development of soil and groundwater sampling and analysis programs
- Formulating and identifying strategies for operations in waste management, storage, transport and disposal facilities and general environmental management
- Environmental monitoring, including:
    - Soil, water and dust sampling training (NATA signatory)
    - Blast (vibration and over pressure monitoring and reporting)
    - Dust management planning and mitigation
    - Weather (wind and speed direction, humidity, pressure, temp)
    - Noise (baseline and compliance assessments)
    - Hazardous substances/materials identification, sampling and training

2000
Environmental Protection Agency (now DERM) - **(Environment Officer)**

Responsibilities

- Implementation of strategies for environmental management
- Liaising with government, industry and community groups
- Mine site compliance audits
- Incident response
- Reviewing applications for statutory approvals (various)
- Investigating environmental management and protection issues
- Implementing environmental management and protection legislation
- Formulating requirements, guidelines and identifying strategies for operations in waste management, storage, transport and disposal facilities and industry

1999
Department of Agriculture Fisheries and Forestry-Australia (AQIS) **(AQIS Inspections Officer)**

Responsibilities

- Identification of banned Australian weed seeds
- Identification of banned Australian pests
- Import and export ship inspections (Phyto-Sanitary Inspections)
- Compliance with international import and export legislation
- Adherence to Australian standards for exports
- Adherence to work place health and safety management

Department of Environment and Resource Management

Environmental Protection Act 1994
Level 1 Environmental Authority (chapter 5A activities)

DERM Permit[1] Number: PEN100015907

Under section 312M of the *Environmental Protection Act 1994* this permit is issued to:

Principal Holder
CH4 Pty Ltd
AM-60
Level 19
42 Albert Street
BRISBANE QLD 4000

Joint Holders
AGL Energy Limited
Level 22
101 Miller Street
NORTH SYDNEY NSW 2060

Shell CSG (ATP364) Pty Ltd
Level 2 LS
8 Redfern Road
HAWTHORN EAST VIC 3123

In respect to carrying out a Level 1 chapter 5A activity(ies) as per Section 23 of the *Environmental Protection Regulation 2008* on the relevant resource authorities listed below:

Project Name	Resource Authority Type(s) and Number(s)
Moranbah Gas Project	Petroleum Lease (PL) 191 Petroleum Lease (PL) PL196 Petroleum Pipeline Licence (PPL) 115 Petroleum Pipeline Licence (PPL)116

This environmental authority takes effect from 14 September 2010

The anniversary date of this environmental authority is 1 October.

This environmental authority is subject to the attached schedule of conditions.

[redacted]

14 September 2010
Date

[redacted]
Delegate of Administering Authority
Department of Environment and Resource Management

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

Additional advice about the approval

1. This approval is for the carrying out the following level 1 chapter 5A activity(ies):

Level 1 chapter 5A activity(ies):
6. A petroleum activity carried out on a site containing a high hazard dam or a significant hazard dam
8. A petroleum activity, other than a petroleum activity mentioned in items 1 to 7, that includes 1 or more chapter 4 activities for which an aggregate environmental score is stated, namely: ERA 8 (3)(a) – Chemical storage ERA 9(c) – Hydrocarbon gas refining ERA 15 – Fuel burning (500kg/hr or more) ERA 60 (1)(d)– Waste disposal ERA 63 (2)(b) – Sewage treatment

2. This approval pursuant to the *Environmental Protection Act 1994* does not remove the need to obtain any additional approval for this activity which might be required by other State and/or Commonwealth legislation. Other legislation administered by DERM for which a permit may be required includes but is not limited to the:

   - *Aboriginal Cultural Heritage Act 2003*;
   - The contaminated land provisions of the *Environmental Protection Act 1994*;
   - *Nature Conservation Act 1992*; and
   - *Water Act 2000*;
   - *Forestry Act 1959*;
   - *Water Supply (Safety and Reliability) Act 2008*.

   Applicants are advised to check with all relevant statutory authorities and comply with all relevant legislation.

3. This approval for the carrying out of a level 1 petroleum activity is not an acceptance of impacts on water levels or pressure heads in groundwater aquifers in or surrounding coal seams. The holder of this environmental authority may have obligations to minimise or mitigate these impacts under other state legislation.

4. This environmental authority consists of the following Schedules

Schedule A	General Conditions	Schedule G	Waste
Schedule B	Water	Schedule H	Rehabilitation
Schedule C	Regulated Dams	Schedule I	Monitoring Programs
Schedule D	Land	Schedule J	Community Issues
Schedule E	Environmental Nuisance	Schedule K	Notification Procedures
Schedule F	Air	Schedule L	Definitions

SCHEDULE A – GENERAL CONDITIONS

Authorised Petroleum Activities

(A1) In the carrying out of the petroleum activity(ies), the holder of this environmental authority must not exceed the numbers and maximum size(s) for each of the specified petroleum activities listed in Schedule A - Table 1 for each petroleum tenure.

Schedule A, Table 1 – Authorised Petroleum Activities

Tenure No.	Petroleum Activity	Number	Maximum size (where applicable)
PL191	Seismic (kms)	N/A	N/A
	Core Well(s)	N/A	N/A
	Exploration Wells	N/A	N/A
	Production Well(s)	210	N/A
	Compressor Station(s)	25	N/A
	Evaporation Dam(s)	0	N/A
	Regulated Dam(s) >401 megalitres	0	N/A
	Regulated Dam(s) <400 megalitres	14	<400 megalitres
	Reverse Osmosis Plants	1	2ML/day
	Brine Encapsulation Facilities	0	N/A
	Sewage Treatment Plant(s)	1	56KL/day/plant
PL196	Seismic (kms)	N/A	N/A
	Core Well(s)	N/A	N/A
	Exploration Wells	N/A	N/A
	Production Well(s)	20	N/A
	Compressor Station(s)	0	N/A
	Evaporation Dam(s)	0	N/A
	Regulated Dam(s) >400 megalitres	0	N/A
	Regulated Dam(s) <400 megalitres	1	<400 megalitres
	Reverse Osmosis Plants	0	N/A
	Sewage Treatment Plant(s)	0	N/A

Prevent or Minimise Likelihood of Environmental Harm

(A2) This environmental authority does not authorise environmental harm unless a condition contained in this environmental authority explicitly authorises that harm. Where there is no condition, the lack of a condition shall not be construed as authorising harm.

Maintenance of Measures, Plant and Equipment

(A3) The holder of this environmental authority must:

(a) install all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority;
(b) maintain such measures, plant and equipment in their proper and effective condition; and
(c) operate such measures, plant and equipment in a proper and effective manner.

(A4) No change, replacement or alteration of any plant or equipment is permitted if the change, replacement or alteration materially increases, or is likely to increase, the environmental harm caused by the petroleum activity.

Operational Plan

(A5) The holder of this environmental authority must develop an Operational Plan (the Plan) that provides detailed information about the activities to be carried out under this environmental authority.

(A6) The activities identified in the Plan must incorporate, but not be limited to, the petroleum activities set out in the approved Development Plan for the relevant petroleum authorities as required under the *Petroleum Act (1923)* or the *Petroleum and Gas (Production and Safety) Act 2004.*

(A7) The Plan must be consistent with the requirements of this environmental authority and include, but not be limited to:

(a) a stated period, not exceeding three (3) years, to which the Plan applies;
(b) a description of the existing infrastructure for conducting the petroleum activity(ies);
(c) a description of proposed infrastructure that will be developed during the term of the Plan
(d) a map or maps that:
    i. record the location of the infrastructure in place for conducting the petroleum activity(ies) that exists at the commencement of the period of the Plan, including but not limited to:
        - regulated dams;
        - wells;
        - transmission flow lines;
        - gas processing facilities; and
        - water treatment facilities;
    ii. record the location of approved additional infrastructure that will be developed for the conduct of the petroleum activities during the period of the Plan.
(e) for proposed disturbance or vegetation clearing in an Environmentally Sensitive Area (ESA) provide details on the scale and extent of the disturbance or clearing and if required a commitment to provide an environmental offset
(f) for each site to be disturbed, a description of the rehabilitation activities to be performed during the period of the Plan, including but not limited to:
    i. location (e.g. tenure, coordinates) and disturbance type (e.g. well lease, flow line, access track);
    ii. area to be rehabilitated;
    iii. use of reference sites;
    iv. species compositions; and
    v. post-disturbance land use;
(g) a description of progressive rehabilitation carried out including performance in relation to the requirements set out in the environmental authority and the proposed rehabilitation activities set out in the previous Plan; and
(h) the calculation of the financial assurance for the proposed maximum disturbance expected during the period of the Plan.

(A8) The initial Plan must be submitted to the administering authority within three months after the granting of this environmental authority.

(A9) Revised Plans must be submitted to the administering authority not less than three months prior to the expiry of the current Plan.

Financial Assurance

(A10) The holder of this environmental authority must:

(a) provide to the administering authority financial assurance in the amount and form required from time to time by the administering authority for the authorised petroleum activity(ies); and
(b) review and maintain the amount of financial assurance based on the activities and rehabilitation to be undertaken during the period of the Plan.

(A11) The calculation of financial assurance must be in accordance with the most recent version of the Department of Environment and Resource Management's Guideline "Financial assurance for petroleum activities".

(A12) 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.

Third Party Audit

(A13) Compliance with the conditions of this environmental authority must be audited by an appropriately qualified third party auditor, nominated by the holder of this environmental authority and accepted by the administering authority, for each period of the Operational Plan required under Conditions A5 – A9.

(A14) Notwithstanding Condition A13, the holder of this environmental authority may, prior to undertaking the third party audit, negotiate with the administering authority the scope and content of the third party audit

(A15) The report of the third party auditor for the relevant prior period must be submitted to the administering authority by the holder of this environmental authority with each revised Operational Plan submitted in accordance with Condition A8 and Condition A9.

(A16) The third party auditor must certify (including a statutory declaration) the findings of the audit in the report.

(A17) The financial cost of the third party audit is to be borne by the holder of this environmental authority.

(A18) The holder of this environmental authority must immediately act upon any recommendations arising from the audit report by:

(a) investigating any non-compliance issues identified; and
(b) as soon as practicable, implementing measures or taking necessary action to ensure compliance with the requirements of this environmental authority.

(A19) Subject to Condition A18, and not more than three (3) months following the submission of the audit report, the holder of this environmental authority must provide a written report to the administering authority addressing the:

(a) actions taken by the holder of this environmental authority to ensure compliance with this environmental authority; and
(b) actions taken to prevent a recurrence of any non-compliance issues identified.

Cultural Heritage

(A20) In the carrying out of the petroleum activity(ies) the holder of this environmental authority must not adversely impact on the cultural heritage values of any place registered on the Queensland Heritage Register.

SCHEDULE B – WATER

Contaminant Release

(B1) Contaminants must not be directly or indirectly released to any waters except as permitted under this environmental authority.

Erosion and Sediment Control

(B2) Erosion protection measures and sediment control measures must be implemented and maintained to minimise erosion and the release of sediment and contaminated stormwater to waters.

(B3) An Erosion and Sediment Control Plan must be developed and implemented for all stages of the petroleum activity(ies) and which has been certified by a professional with appropriate experience and/or qualifications accepted by the administering authority and must include but not be limited to:

(a) diverting uncontaminated stormwater run-off around areas disturbed by petroleum activity(ies) or where contaminants or wastes are stored or handled that may contribute to stormwater;
(b) contaminated stormwater runoff and incident rainfall is collected; and treated, reused, or released in accordance with the conditions of this environmental authority;
(c) roofing or minimising the size of areas where contaminants or wastes are stored or handled;
(d) revegetating the disturbed area as soon as practicable after the completion of works;
(e) using alternate materials and or processes (such as dry absorbents) to clean up spills that will minimise the generation of contaminated waters;
(f) erosion and sediment control structures are placed to minimise erosion of disturbed areas and prevent the contamination of any waters;
(g) an inspection and maintenance program for the erosion and sediment control features;
(h) provision for adequate access to maintain all erosion and sediment control measures especially during the wet season months from December to March;
(i) erosion and sediment control measures for construction of wells and pipelines on slopes >10%; and
(j) identification of remedial actions that would be required to ensure compliance with the conditions of this environmental authority.

(B4) A copy of the Erosion and Sediment Control Plan must be submitted to the administering authority upon request.

Maintenance and Cleaning

(B5) The maintenance and cleaning of vehicles and any other equipment or plant must be carried out in areas from where the resultant contaminants cannot be released into any waters, roadside gutter or stormwater drainage system.

Watercourses, Wetlands and Springs

(B6) In the carrying out of the petroleum activity(ies) the holder of this environmental authority must not clear vegetation, excavate or place fill, except for the construction of roads and pipelines, in or within:

(a) 200 metres from any natural significant wetland;
(b) 100 metres from any natural wetland, lakes or springs; or
(c) 100 metres of the high bank of any other watercourse.

(B7) The holder of this environmental authority must not excavate or place fill in a way that interferes with the flow of water in a watercourse, wetland, or spring, including works that divert the course of flow of the water or works that impound the water.

(B8) Despite Condition B7 pipeline and road construction works may be undertaken in watercourses, wetlands or springs where there is no practicable alternative such as the use of horizontal directional drilling methods, for a maximum period of ten (10) days, provided that the works are conducted in accordance with the following order of preference:

(a) conducting work in times of no flow; and
(b) using all reasonable and practical measures to reduce impacts in times of flow.

(B9) Activities or works resulting in significant disturbance to the bed or banks of a watercourse or wetland, or a spring must:

(a) only be undertaken where necessary for the construction and/or maintenance of roads, tracks and pipelines that are essential for carrying out the authorised petroleum activity(ies) and no reasonable alternative location is feasible;
(b) be no greater than the minimum area necessary for the purpose of the significant disturbance;
(c) be designed and undertaken by a suitably qualified and experienced person taking into account the matters listed in Section 5. Planning Activities and Section 6 Impact Management During Activities of DERM's *"Guideline – Activities in a watercourse, lake or spring associated with mining operations"* dated April 2008, or more recent editions as such become available; and
(d) upon cessation of the activities or works, commence rehabilitation immediately such that the final rehabilitation is to a condition that will ensure the ongoing physical integrity and the natural ecosystem values of the site.

(B10) Sediment control measures must be implemented to minimise any increase in water turbidity due to carrying out petroleum activity(ies) in the bed or banks of a watercourse or wetland, or a spring.

(B11) Routine, regular and frequent visual monitoring must be undertaken while carrying out construction work and/or any maintenance of completed works in a watercourse, wetland or spring. If, as a result of the petroleum activity(ies), water turbidity increases in the watercourse, wetland or spring outside contained areas, works must cease and the sediment control measures must be rectified to limit turbidity before activities recommence.

(B12) Petroleum activity(ies) must not be carried out in River Improvement Trust Asset Areas without the approval of the relevant River Improvement Trust.

Groundwater

(B13) The extraction of groundwater as part of the petroleum activity(ies) from underground aquifers must not directly or indirectly cause environmental harm to any spring, wetland or other surface waters.

Wild Rivers

(B14) In a declared Wild River Area, petroleum activity(ies) must be consistent with the conditions stated in the relevant Wild River declaration and in circumstances where there is any inconsistency or conflict the conditions of the Wild River declaration prevail.

Floodplains

(B15) The holder of this environmental authority must ensure that petroleum activity(ies), excluding limited petroleum activity(ies) do not significantly:
(a) concentrate flood flows;
(b) divert flood flows from natural drainage paths and alter flow distribution;
(c) increase the local duration of floods;
(d) increase the risk of detaining flood flows;
(e) increase the risk to the safety of persons from flooding; or
(f) increase the risk of damage to property from flooding.

Contaminant Release

(BA1) The release of contaminants to waters must only occur from the release points specified in Schedule BA, Table 1 – Contaminant Release Points, Sources and Receiving Waters and depicted in Figure 1 attached to this environmental authority.

Schedule BA, Table 1 - Contaminant Release Points, Sources and Receiving Waters

Release Point (RP)	Latitude or northing (GDA94)	Longitude or easting (GDA94)	Contaminant Source and Location	Monitoring Point	Receiving waters description
RP 1	-21° 57' 42"	148° 2' 35"	Treated CSG water from the reverse osmosis plant located on PL191 after 31 July 2011.	End of pipe for temperature and dissolved oxygen For all parameters in Schedule BA, Table 2, excluding temperature and dissolved oxygen; RO Facility Location -21° 58' 20" 148° 1' 0"	Isaac River – Dam 5 Discharge Point
RP2	-21° 57' 58"	148° 2' 45"			Isaac River (downstream) – Blair Athol Railway Bridge

(BA2) The release of contaminants to waters must not exceed the release limits stated in Schedule BA, Table 2 – Contaminant Release Limits for Release Point RP1 and RP2 when measured at the monitoring points specified in Schedule BA, Table 1 - Contaminant Release Points, Sources and Receiving Waters for each quality characteristic.

Schedule BA Table 2 – Contaminant Release Limits for Release Point RP1 and RP2

Physicochemical Parameters	Release Limits	Limit Type	Monitoring frequency
Electrical conductivity (µS/cm)	No limit	N/A	Daily during discharge events and for two days after cessation of discharge
pH (pH Unit)	6.5- 8.5	Range	
Dissolved oxygen (mg/L)	2	Minimum	
Turbidity (NTU)	25	Maximum	
Chloride (mg/L)	22 – 120	Range	
Sulphate (mg/L)	3 – 9	Range	
Calcium (mg/L)	>5	Minimum	
Magnesium (mg/L)	>1	Minimum	
Sodium (mg/L)	50	Maximum	
Chlorophyll-a (µg/L)	5	Maximum	

(BA3) The release of contaminants to waters from the release points must be monitored at the locations specified in Table 1 - Contaminant Release Points, Sources and Receiving Waters for

each quality characteristics and at the frequency specified in Table 2 – Contaminant Release Limits for Release Point RP1 and RP2.

Contaminant Release

(BA4) The holder must install, operate and maintain a stream flow gauging station(s) as specified in Schedule BA Table 3 – Contaminant Release during Flow Events to determine and record stream flows at the locations upstream of each Release Point(s) as shown in Schedule BA Table 1 - Contaminant Release Points, Sources and Receiving Waters, for any receiving water into which a release occurs.

(BA5) Notwithstanding any other condition of this environmental authority, the release of contaminants to waters must only take place during periods of natural flow events specified as minimum flow in Schedule BA Table 3 – Contaminant Release during Flow Events for the contaminant release point(s) specified in Schedule BA Table 1 - Contaminant Release Points, Sources and Receiving Waters.

Schedule BA, Table 3 – Contaminant Release during Flow Events

Receiving water description	Gauging station description	Latitude or northing (GDA94)	Longitude or easting (GDA94)	Minimum Flow in Receiving Water Required for a Release Event	Flow recording Frequency
Isaac River	Gauging station 1	-21° 57' 37"	148° 2' 17"	> or = 5 m^3/sec	Continuous (minimum daily)

(BA6) The total volume release through the release points must not exceed 0.023 m^3/s and 2 ML/day.

(BA7) The environmental authority holder must install and maintain a measuring device to measure/ meter the volume of treated CSG water released under this environmental authority.

(BA8) The measuring device/ meter must be installed prior to commencement of release of treated CSG water and its installation must comply with the most recent version of *'Draft standards and specifications for measuring /metering disposal of treated CSG water'*.

(BA9) Upon practical completion of the meter installation, the environmental authority holder must provide a completed 'Meter Installation Form" signed by the installer and the environmental authority holder confirming that the installation complies with the manufacturer's specifications and/or national standards and/or DERM's metering standards.

(BA10) The environmental authority holder must provide the administering authority with safe access to facilitate inspections, and comply with the manufacturer's instructions or best practice for the operation of the pump and meter installation.

(BA11) The releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build up of sediment in such waters.

Characterisation of Other Contaminants

(BA12) Prior to the release of water, the environmental authority holder must have prior written approval from the Office of the Water Supply Regulator (OWSR).

(BA13) If water has been released from authorised release points listed in Schedule BA, Table 1 – Contaminant Release Points, Sources and Receiving Waters authorised release points, the environmental authority holder must undertake an annual assessment of the contaminants of treated CSG water to determine the risk of environmental harm from release of treated CSG water to surface waters. This should consider the contaminants mentioned in the ANZECC & ARMCANZ 2000 guidelines. This annual assessment must be included in the Annual Return.

Notification of Release Event Exceedance

(BA14) If the release limits defined in Schedule BA, Table 2 – Contaminant Release Limits for Release Point RP1 and RP2 are exceeded, the holder of the environmental authority must notify the administering authority within twenty-four (24) hours of receiving the results.

(BA15) The environmental authority holder must, within twenty-eight (28) days of a release that exceeds the conditions of this environmental authority, provide a report to the administering authority detailing:

(a) the reason for the release;
(b) the location of the release;
(c) all water quality monitoring results;
(d) any general observations;
(e) all calculations;
(f) measures taken to prevent a repeat of the exceedance taking place; and
(g) any other matters pertinent to the water release event.

Event Based Surface Water Monitoring

(B16) Each monitoring and release point as specified in Schedule BA, Table 1 and Schedule BA, Table 3 must be marked and readily identifiable from the banks of the Isaac River.

(B17) The water quality of the Isaac River must be monitored for the physiochemical parameters and at the frequency specified in Schedule BA, Table 2 Contaminant Release Limits for Release Point RP1 and RP2 at a monitoring point 50 - 100 metres upstream; in addition to 200 metres and 1000 metres downstream of release point R2.

(B28) The holder of this environmental authority must keep written records of all discharge events to the Isaac River. The records must include, but not be limited to:

(a) The volume of water released through the release point(s);
(b) The release rate;
(c) date and time of discharge;
(d) flow rate at Gauging Station 1 during the discharge event;
(e) water quality characteristics monitoring results; and
(f) details of any observed impacts.

Water General

(BA19) The release of contaminants directly or indirectly to waters:
(a) must not produce any visible discolouration of receiving waters; nor
(b) must not produce any slick or other visible or odorous evidence of oil, grease or petrochemicals nor contain visible floating oil, grease, scum, litter or other objectionable matter.

Sewage Treatment Works

Release of Treated Sewage Effluent Contaminants to Land

(BC1) The peak design capacity of the sewage treatment plant must not exceed 216 equivalent persons based on a waste water generation rate of 250L/person/day.

(BC2) Sewage pump stations must be fitted with a stand-by pump and a visible or audible high level alarm.

(BC3) Treated effluent may only be released to land at the designated, fenced and delineated contaminant release area/s.

(BC4) Treated effluent must be not released to land within 100 metres of any residential area, watercourse, wetland, spring or protection area.

(BC5) The contaminant release area/s must be maintained in a proper and efficient condition so as to provide adequate assimilation, percolation, evaporation and transpiration of the released contaminants.

(BC6) Treated effluent must not be applied by spray irrigation and must be applied in a manner that does not cause damming or runoff of effluent beyond the contaminant release area/s.

(BC7) When weather conditions or soil conditions preclude the release of contaminants, for example, during and immediately after rainfall, the contaminants must be directed to on-site storage or lawfully disposed of off-site.

Quality of Contaminants Released from the Sewage Treatment Works

(BC8) Treated effluent must comply, at the sampling and in-situ measurement point(s), with each of the release limits specified in Schedule BC, Table 1 - Treated Sewage Effluent Standards for each quality characteristic.

(BC9) The release of contaminants to land must be monitored at the frequency and at the sampling and in-situ measurement point specified in Schedule BC, Table 1 - Treated Sewage Effluent Standards and records of the monitoring results kept for at least five years and made available to the administering authority on request.

Schedule BC, Table 1 - Treated Sewage Effluent Standards

Quality Characteristic	Sampling and in-situ measurement Point Location	Limit Type	Release Limit	Frequency
5-day Biochemical Oxygen Demand (inhibited)	Release pipe from sewage treatment plant after disinfection	maximum	20 mg/L	Monthly
Suspended Solids		maximum	30 mg/L	
pH		range	6.0 to 9.0	
E-Coli		80 percentile	1000 cfu per 100 mL	
		maximum	10000 cfu per 100 ml	

SCHEDULE C – REGULATED DAMS

(C1) The name of each regulated dam must be clearly signed at the dam location at all times.

(C2) Construction of any dam or modifications to an existing dam determined to be in the high hazard or significant hazard category in accordance with the most recent version of *"Manual for Assessing Hazard Categories and Hydraulic Performance of Dams"* is prohibited unless the required design plan details have been entered into the Regulated Dam Register and approved by the chief executive officer for the holder of the environmental authority, or their delegate, as being accurate and correct.

Regulated Dam Register

(C3) The holder of this environmental authority must maintain a Register of Regulated Dams that must include, as a minimum, the following information for each Regulated Dam:

(a) dam name, the coordinates for its location and date of entry in the register;
(b) dam purpose and its proposed/actual contents;
(c) hazard category assessed using the most recent version of *"Manual for Assessing Hazard Categories and Hydraulic Performance of Dams"* ;
(d) details of the composition and construction of any liner;
(e) dimensions (metres) and surface area (hectares) measured at the footprint of the dam;
(f) maximum operational volume (megalitres);
(g) design storage allowance at 1 November each year (megalitres);
(h) mandatory reporting level (metres);
(i) date construction was certified as compliant with the design plan;
(j) name and qualifications of certifier;
(k) dates on which the dam was inspected for structural and operational adequacy;
(l) date on which the report of the annual structural and operational adequacy inspection was provided to the administering authority;
(m) dates on which the dam was inspected for the detection of leakage through any liner; and
(n) dates on which the dam was inspected for the purpose of annually ascertaining the available storage capacity on the 1 November each year.

(C4) The holder of this environmental authority must provisionally enter the required information in the Register of Regulated Dams when a design plan for a Regulated Dam is submitted to the administering authority.

(C5) The holder of this environmental authority must make a final entry of the required information in the Register of Regulated Dams once compliance with Condition C16 has been achieved.

(C6) The holder of this environmental authority must ensure that the information contained in the Register of Regulated Dams is complete and current on any given day.

(C7) The holder of this environmental authority must submit the Register of Regulated Dams or information contained in the Register available to the administering authority at each annual return and when requested to do so in the form requested by the administering authority.

Construction and Operational Requirements for New Dams

(C8) All aggregation dams must:

(a) be designed with a floor and sides of material that will contain the wetting front and any entrained contaminants within the bounds of the containment system during its operational life including any period of decommissioning and rehabilitation; and
(b) have a system that will detect any passage of the wetting front or entrained contaminants through the floor or sides of the dam and enable the repair of the containment system or its decommissioning and rehabilitation.

(C9) All new aggregation dams must be designed and operated so that during any period of thirty (30) days, following the first ninety (90) days of operation of the dam, the total volume of water leaving the dam other than by evaporation must not be less than 85% of the volume of water that has entered the dam.

(C10) By 1 October 2011, all brine dams must:

(a) be designed with a floor and sides of material that will contain the wetting front and any entrained contaminants within the bounds of the containment system during its operational life including any period of decommissioning and rehabilitation;
(b) have a system that will detect any passage of the wetting front or entrained contaminants through the floor or sides of the dam, enable the repair of the containment system or its decommissioning and rehabilitation; and
(c) the collection and proper disposal of any contaminants that move beyond the bounds of the containment system.

(C11) All Regulated Dams must be designed in accordance with the requirements of the most recent version of *"Manual for Assessing Hazard Categories and Hydraulic Performance of Dams"* by and constructed under the supervision of a suitably qualified and experienced person.

(C12) The hazard category of any dam must be determined by a suitably qualified and experienced person, prior to its design and construction, upon any change in its purpose or its stored contents, and at least once in each two (2) year period after its construction.

(C13) The construction and operation of all new Regulated Dams, is prohibited unless the holder of this environmental authority has submitted to the administering authority a copy of the design plan, together with the certification of a suitably qualified and experienced person that the regulated dam:

(a) will deliver the performance stated in the design plan;
(b) has had its hazard category assessed and been designed in accordance with the requirements of the most recent version of *"Manual for Assessing Hazard Categories and Hydraulic Performance of Dams"*; and
(c) when constructed and operated, will be compliant in all respects with the relevant conditions of this environmental authority subject to specific exemptions provided in C29.

(C14) The design plan must include, but not be limited to:

(a) a statement of the relevant legislation, regulatory documents and engineering practice relied upon in the design plan;
(b) a statement of the facts and data being used in the design plan and the limitations to the application and interpretation of that material;
(c) an assessment of the hazard category of the proposed dam based on the indentification of potential impacts on any sensitive receptors for any applicable dam failure scenarios, including the cumulative impact should all dams fail at once;
(d) detailed specifications for the design, operation, maintenance and decommissioning of the dam(s);
(e) an operational plan that includes contingency / emergency response procedures designed to avoid / minimise discharges resulting from any overtopping or loss of structural integrity of the dam;
(f) design, specification and operational rules for any related structures and systems used to prevent the overtopping of the proposed dam;
(g) a detailed plan for the decommissioning and rehabilitation of the dam at the end of its operational life;
(h) any other matter required by the certifying suitably qualified and experienced person; and
(i) evidence supporting the claims of the certifier that they are a suitably qualified and experienced person.

(C15) If, within the 20 business days following the lodgement of a certified design plan the administering authority notifies the holder of this environmental authority, in writing, that the design plan is not compliant with either:

(a) the conditions of this environmental authority; or
(b) the requirements set out in the most recent version of "*Manual for Assessing Hazard Categories and Hydraulic Performance of Dams*"

then the construction and operation of the Regulated Dam is prohibited until the administering authority provides written advice that its construction may proceed.

(C16) When construction of any Regulated Dam is complete, the holder of this environmental authority must submit to the administering authority one hard copy and one electronic copy of a set of 'as constructed' drawings, together with the certification of a suitably qualified and experienced person that the dam 'as constructed' will deliver the performance stated in the design plan and at the time of certification it is compliant in all respects with the conditions of this environmental authority.

(C17) Each Regulated Dam must be maintained and operated in a manner that is consistent with the design plan and the certified 'as constructed' drawings for the duration of its operational life and until decommissioned and rehabilitated.

Livestock and Wildlife

(C18) The holder of this environmental authority must ensure reasonable and practicable control measures are in place to ensure that harm is not caused to livestock or wildlife through the construction and operation of a Regulated Dam.

Mandatory Reporting Level

(C19) The Mandatory Reporting Level must be marked on each Regulated Dam in such a way that it is clearly observable during routine inspections of each dam.

(C20) The holder of this environmental authority must notify the administering authority immediately when the level of the contents of any Regulated Dam reaches the Mandatory Reporting Level, and immediately act to prevent or, if unable to prevent, to minimise any actual or potential environmental harm.

Annual Inspection and Report

(C21) Each Regulated Dam must be inspected annually by a suitably qualified and experienced person.

(C22) 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 contained in the certified design plan.

(C23) An assessment of the adequacy of the available storage in each Regulated Dam is to be made, based on an actual dam level observed in the month of October in each year, and the resultant estimate of the level in that dam as at 1 November in each year must be equal or less than the design storage allowance for the dam.

(C24) Where the assessment of the adequacy of the available storage in any Regulated Dam indicates that the design storage allowance will be exceeded, or at any other time the holder of this environmental authority becomes aware that the design storage allowance has been or will be exceeded, the holder of this environmental authority must notify the administering authority within 24 hours, and immediately act to prevent or, if unable to prevent, to minimise any actual or potential environmental harm.

(C25) For each annual inspection, a copy 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 upon request.

(C26) The holder of this environmental authority must, upon receipt of the annual inspection report, consider the report and its recommendations, take action to ensure that each Regulated Dam will safely perform its intended function, and within one month of receiving the report, notify the administering authority in writing of the recommendations of the inspection report and the actions taken to ensure the integrity of each Regulated Dam.

Requirements for Existing Dams

(C27) By 1 October 2011, all existing aggregation dams must:

(a) Have a floor and sides constructed with material that will contain the wetting front and any entrained contaminants within the bounds of the containment system during its operational life including any period of decommissioning and rehabilitation; and
(b) have a system that will detect any passage of the wetting front or entrained contaminants through the floor or sides of the dam; and
(c) either be capable of repair to rectify any passage of the wetting front through the floor or sides of the dam or be decommissioned and rehabilitated.

(C28) By 1 October 2011, all existing CSG aggregation dams must be operated so that during any period of thirty (30) days, the total volume of water leaving the dam other than by evaporation must not be less than 85%of the volume of water that has entered the dam.

Specific authorisation for Dam 11

(C29) Despite Condition D8, Dam 11 may be constructed within Category B and C ESA buffer zones provided that the dam is located within the control points (CP) listed in Schedule C, Table 1.

Schedule C, Table 1 – Control Points for Dam 11

Control Point	Easting (MGA Zone 55)	Northing (MGA Zone 55)
1	603957	7572921
2	604344	7572921
3	604342	7572533
4	603957	7572534

SCHEDULE D — Land

General

(D1) Contaminants must not be directly or indirectly released to land except as permitted under this environmental authority.

Disturbance to Land – General

(D2) Prior to conducting petroleum activity(ies) that involve significant disturbance to land, an assessment must be undertaken of the condition, type and ecological value of any vegetation in such areas where the activity is proposed to take place.

(D3) The assessment required by Condition D2 must be undertaken by a suitably qualified person and include the carrying out of field validation surveys, observations and mapping of any category A, B or C Environmentally Sensitive Areas (ESA's) and the presence of species classed as endangered, vulnerable, rare or near threatened under the *Nature Conservation Act 1992*.

(D4) The holder of this environmental authority, when carrying out (a) petroleum activity(ies) must:

(a) avoid, minimise or mitigate (in order of preference) any impacts on areas of vegetation or other areas of ecological value;
(b) minimise the risk of injury, harm, or entrapment to wildlife and stock;
(c) minimise disturbance to land that may otherwise result in land degradation;
(d) ensure that for land that is to be significantly disturbed by (a) petroleum activity(ies):
    i. the top layer of the soil profile is removed;
    ii. stockpiled in a manner that will preserve its biological and chemical properties; and
    iii. used for rehabilitation purposes (in accordance with Condition H6) and
(e) prior to carrying out field based activities, make all relevant staff, contractors or agents carrying out those activities, aware of the location of any category A, B or C ESA's and the requirements of this environmental authority.

(D5) In accordance with Condition (D4) above, if significant disturbance to land is unavoidable, the holder of this environmental authority must not clear vegetation, excavate or place fill:

(a) in a way which significantly isolates, fragments or dissects tracts of vegetation resulting in a reduction in the current level of ecosystem functioning, ecological connectivity (i.e. stepping stone or contiguous bioregional/local corridor networks) and/or results in an increase in threatening processes (e.g. potential impacts associated with edge effects or introduced species);
(b) on slopes greater than 10% for activities other than pipelines and wells; or
(c) in discharge areas.

(D6) Clearing of remnant vegetation shall not exceed ten (10) metres in width for the purpose of establishing tracks and 20 metres in width for dual carriageway roads unless otherwise approved by the administering authority in writing.

(D7) Cleared vegetation must be stockpiled in a manner that facilitates respreading or salvaging and does not impede vehicle, stock or wildlife movements.

Disturbance to Land – Environmentally Sensitive Areas

(D8) Notwithstanding Conditions D2 to D7 inclusive, the holder of this environmental authority must ensure that the petroleum activity(ies):

(a) are not conducted in or within 200 metres of any listed category A, B or C ESA's; and
(b) do not involve activities other than (a) limited petroleum activity(ies) within 1km of a listed category A ESA, or within 500m of a listed category B or C ESA.

(D9) (A) limited petroleum activity(ies) carried out in accordance with Condition D8(b) must be preferentially located in pre-existing areas of clearing or significant disturbance to the greatest practicable extent.

Disturbance to Land – Endangered and Of Concern Regional Ecosystems

(D10) Despite Condition D8, where it can be demonstrated that no reasonable or feasible alternative exists, (a) limited petroleum activity(ies) may be undertaken within an endangered/of concern regional ecosystem (RE) and its associated buffer zone, provided that the area is not part of another listed category A, B or C ESA (e.g. a National Park) or associated buffer zone, subject to the following:

(a) the limited petroleum activity(ies) is/are located and carried out in areas according to the following order of preference:
   i. pre-existing cleared areas or significantly disturbed areas less than 200m from an Endangered/Of Concern RE;
   ii. undisturbed areas less than 200m from an Endangered/Of Concern RE;
   iii. pre-existing areas of significant disturbance within an endangered/of concern regional ecosystem (e.g. areas where significant clearing or thinning has been undertaken within a regional ecosystem, and/or areas containing high densities of weed or pest species which has inhibited re-colonisation of native regrowth);
   iv. areas where clearing of an endangered or of concern regional ecosystem is unavoidable;

(b) any vegetation clearing in an Endangered/Of Concern RE or associated buffer zone must not exceed any of the following areas:
   i. 10% of the remnant unit of Endangered/Of Concern regional ecosystem as ground truthed and mapped before any activity commences as per condition D2 and D3 of this environmental authority for the life of the project; or
   ii. more than $30m^2$ for the construction of a sump; or
   iii. six (6) metres in width for tracks; or
   iv. twelve (12) metres in width for pipeline construction purposes; and

(c) all reasonable and practical measures are taken to minimise the area cleared and to avoid the clearing of mature trees, which must include but not be limited to, for each well site, a risk assessment to determine the minimum amount of disturbance possible.

(D11) Details of any significant disturbance to land in or within 200m of Endangered or Of Concern regional ecosystems, along with a record of the assessment required by Conditions D2 and D3 must be kept and submitted to the administering authority upon request.

(D12) If the assessment required by Conditions D2 and D3 indicates that an ecosystem mapped as Endangered or Of Concern regional ecosystem by the Queensland Herbarium should be in a lower conservation value classification and the holder of this environmental authority wishes to undertake activities as if the ecosystem is of the lower conservation value they must notify the administering authority in writing before any significant disturbance to land takes place.

(D13) If, within the 20 business days following the lodgement of the notification under Condition D12 the administering authority notifies the holder of this environmental authority, in writing, that the regional ecosystem mapping requires further validation, then significant disturbance to land in the mapped regional ecosystem is prohibited until the administering authority provides written advice that significant disturbance to land may proceed.

(D14) When requested by the administering authority, the holder of this environmental authority must enter into an agreement with the administering authority to provide an environmental offset to counterbalance the impacts of the activity on Endangered or Of Concern regional ecosystem.

(D15) The holder of this environmental authority must comply with any environmental offset agreement made in accordance with the conditions of this environmental authority.

Disturbance to Land – State Forests and Timber Reserves

(D16) Despite Condition D8, activities may be undertaken within State Forests or Timber Reserves provided the holder of the environmental authority has written approval from the authority responsible for the administration of the *Forestry Act 1959*.

(D17) Where activities are to be undertaken in a State Forest or Timber Reserve that are also Endangered or Of Concern Regional Ecosystems, such activities may be undertaken in accordance with Condition D10 of this environmental authority, provided the holder of this environmental authority has written approval from the authority responsible for the administration of the *Forestry Act 1959*.

Soil Management

(D18) The holder of this environmental authority must develop and implement soil management procedures for areas to be disturbed by (a) petroleum activity(ies) prior to commencement of (a) petroleum activity(ies) in these areas to prevent or minimise the impacts of soil disturbance. These procedures must include but not be limited to:

(a) establishment of baseline soil information for areas to be disturbed including soil depth, pH, electrical conductivity (EC), chloride, cations (calcium, magnesium and sodium), exchangeable sodium percentage (ESP), particle size and soil fertility (including nitrogen, phosphorous, potassium, sulphur and micronutrients);
(b) a soils monitoring program outlining parameters to be monitored, frequency of monitoring and maximum limits for each parameter;
(c) identification of soil units within areas to be disturbed by petroleum activities at a scale of 1:100000, in accordance with the *"Guidelines for Surveying Soil and Land Resources, 2nd Edition"* (McKenzie *et al.* 2008), *"Australian Soil and Land Survey Handbook, 3rd Edition"* (National Committee on Soil and Terrain 2009) and *"The Australian Soil Classification"* (Isbell 2002);
(d) development of soil descriptions that are relevant to assessment for agricultural suitability, topsoil assessment, erodibility and rehabilitation, for example:
    i. shallow cracking clay soils;
    ii. deep cracking clay soils;
    iii. deep saline and/or sodic cracking clay soils with melonholes;
    iv. thin surface, sodic duplex soils;
    v. medium to thick surface (say >15 cm), sodic duplex soils; and
    vi. non-sodic duplex soils;
(e) detailed mitigation measures and procedures to manage the risk of adverse soil disturbance in the carrying out of the petroleum activity; and
(f) for areas of good quality agricultural land, detailed methods to be undertaken to minimise potential impacts.

(D19) A copy of the soil management procedures must be made available to the administering authority upon request.

Acid Sulfate Soils

(D20) The holder of this environmental authority must, when clearing in areas with acid sulfate soils or potential acid sulphate soils, develop and implement an acid sulfate soil environmental management plan prepared in accordance with Appendix 4 of the *"State Planning Policy 2/02 Guideline Acid Sulfate Soils"* and the Department of Environment and Resource Management's *"Queensland Acid Sulphate Soil Technical Manual" (Version 2.2 September 2004)* or more recent editions or supplements to these documents as such become available.

Fauna Management

(D21) The holder of this environmental authority must develop and implement fauna management procedures for the carrying out of the petroleum activity(ies), in particular pipeline construction,

construction and use of dams, to prevent or minimise harm or the potential risk of causing harm to fauna.

(D22) The fauna management procedures must include training and awareness of staff and contractors and ensure that any planned fauna handling is undertaken by a suitably qualified person.

(D23) A copy of the fauna management procedures must be made available to the administering authority upon request.

Pest management

(D24) In carrying out the petroleum activity(ies) the holder of this environmental authority must develop and implement an effective pest management program that includes but is not limited to the following:

(a) identification of pest species and infestation areas;
(b) prevents and/or minimises the introduction and/or spread of pests; and
(c) control and management of pest outbreaks as a result of petroleum activities.

(D25) A copy of the pest management program must be made available to the administering authority upon request.

Chemical and Fuel Storage

(D26) 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.

(D27) 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 bunded so that the capacity and construction of the bund 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 bunded so that the capacity and construction of the bund is sufficient to contain at least 25% of the maximum design storage volume within the bund.

(D28) All containment systems must be designed to minimise rainfall collection within the system.

Well Drilling, Completion and Stimulation

(D29) Hydraulic fracturing fluids must not contain benzene, ethylbenzene, toluene, xylene, naphthalene, phenanthrene or diesel.

(D30) A hydraulic fracturing chemical risk assessment is required to be carried out and submitted to the administering authority prior to hydraulic fracturing on PL191 and PL196.

(D31) The hydraulic fracturing chemical risk assessment required by Condition D30 must be reviewed:

a) when new or additional toxicological information becomes available for the chemicals used; and

b) when new chemicals, chemical concentrations or mixtures are used in hydraulic fracturing fluids.

(D32) The updated risk assessment required by Condition D31(a) must be submitted to the administering authority upon request .

(D33) The updated risk assessment required by Condition D31(b) must be submitted to the administering authority prior to the use of the new chemicals, chemical concentrations or mixtures for hydraulic fracturing on PL191 and PL196.

(D34) The holder of this environmental authority must monitor for the chemicals used in hydraulic fracturing fluids used on PL191 and PL196 and keep a record of the groundwater quality in any landholder's bore, subject to access being permitted by the landholder, that is located within a one (1) kilometre radius of a well subject to hydraulic fracturing.

(D35) The monitoring required under Condition D34 must be undertaken at least:

(a) within 2 months of hydraulic fracturing being undertaken;
(b) weekly for the first month subsequent to hydraulic fracturing being undertaken;
(c) monthly for the first six (6) months subsequent to hydraulic fracturing being undertaken; and
(d) annually for the first five (5) years subsequent to hydraulic fracturing.

(D36) The results of the monitoring required by Conditions D34 and D35 must be made available upon request to:
(a) the administering authority; and
(b) the landholder.

(D37) If the results of the monitoring required by Conditions D34 and D35 indicate that there has been a material impact caused by petroleum activities on groundwater quality, the holder of this environmental authority must notify:
(a) the administering authority within 24 hours; and
(b) any affected landholders within 24 hours or as per written agreement between the holder of this environmental authority and the landholder.

(D38) The holder of this environmental authority must ensure that the hydraulic fracturing process is carried out in such a manner that hydraulic fractures are only contained within the target coal seam.

SCHEDULE E – ENVIRONMENTAL NUISANCE

Odour, Dust and other Airborne Contaminants

(E1) The release of odour, dust or any other airborne contaminant(s), or light from the petroleum activity(ies) must not cause an environmental nuisance at any sensitive place or commercial place.

Noise

(E2) In the event of a complaint about noise from the carrying out of the petroleum activity(ies) being made to the administering authority and that the administering authority considers is not frivolous nor vexatious nor based on mistaken belief, then the emission of noise from the licensed place must not result in total noise levels at any sensitive or commercial place greater than those specified in Schedule E, Table 1 – Noise limits or Schedule E, Table 2 - Noise Limits for Main NQGP Compressor Station.

Schedule E, Table 1 – Noise limits

Time period	Noise level at a sensitive place measured as the Adjusted Maximum Sound Pressure Level $L_{A,max,adj,T}$
7am– 6 pm	Background noise level plus 5 dB(A)
6pm–10pm	Background noise level plus 5 dB(A)
10pm–7am	Background noise level plus 3 dB(A)
Time period	Noise level at a commercial place measured as the Adjusted Maximum Sound Pressure Level $L_{A, max, adj, T}$
7am –6 pm	Background noise level plus 10 dB(A)
6pm–10pm	Background noise level plus 10 dB(A)
10pm–7am	Background noise level plus 8 dB(A)

General note: In no case is the background noise level, $L_{A90, 15\ mins}$ to be less than 25 dB(A). In the event that measured background noise level is less than 25 dB(A), then 25 dB(A) is to be used.

Schedule E, Table 2 - Noise Limits for Main NQGP Compressor Station

Noise level dB(A) measured as	Monday to Saturday			Sundays and Public Holidays		
	7am - 6pm	6pm - 10pm	10pm - 7am	9am - 6pm	6pm - 10pm	10pm - 9am
	Noise Measured at a Noise Sensitive Place in Zones 1, 2, 4, 5, 9, 12, 13*					
$L_{A10, adj, 10\ mins}$	40	35	28	40	35	28
$L_{A1, adj, 10\ mins}$	45	40	33	45	40	33
	Noise measured at a Commercial place in Zones 1, 2, 4, 5, 9, 12, 13*					
$L_{A10, adj, 10\ mins}$	45	40	33	45	40	33
$L_{A1, adj, 10\ mins}$	50	45	38	50	45	38
	Noise Measured at a Noise Sensitive Place in Zones 3, 6, 7, 8, 10, 11, 14*					
$L_{A10, adj, 10\ mins}$	45			45		

$L_{A1, adj, 10 mins}$	50	50
$L_{Aeq, 10 mins}$ in sleeping areas (interior)	35	

* Refers to the Planning Scheme of the Shire of Belyando (Moranbah and environs) approved 23 February 1995

General note: In no case is the background noise level, $L_{A90, 15 mins}$ to be less than 25 dB(A). In the event that measured background noise level is less than 25 dB(A), then 25 dB(A) is to be used.

(E3) In the event of a complaint about noise from the carrying out of temporary petroleum activity(ies) being made to the administering authority and that the administering authority considers is not frivolous nor vexatious nor based on mistaken belief, then total noise emitted from the temporary petroleum activities must not exceed the noise acoustic quality objective of 55 dB(A)at any sensitive or commercial place between 7.00 am and 6.00 pm and background plus 3 dB(A) at other times.

(E4) In the event of a complaint about noise nuisance that the administering authority considers is not frivolous or vexatious then the holder of the environmental authority must prepare and submit a noise management plan to the administering authority within the reasonable and practicable timeframe specified in writing by the administering authority.

(E5) The noise management plan must address, but not be limited to, the following matters:

(a) identification of component noise sources and activities at the place(s) which impact on noise sensitive areas;
(b) the measured and/or predicted component and total level from Condition E5(a) at noise sensitive places;
(c) the reasonable and practicable control or abatement measures (including hours of operation) that can be undertaken to reduce identified intrusive noise sources;
(d) the level of noise at noise sensitive places that would be achieved from implementing these measures.
(e) the handling of future noise complaints;
(f) community liaison and consultation; and
(g) training of staff and contractors in noise management practices.

(E6 The holder of this environmental authority must commence implementation of the noise abatement measures recommended in the noise management plan not more that 30 days following its submission to the administering authority, accounting for any comments made by the administering authority within that time.

SCHEDULE F – AIR

(F1) Fuel burning or combustion equipment that is capable of burning at least 500kg of fuel in an hour must only release contaminants to the atmosphere as provided for in Schedule F – Table 1.

(F2) Contaminants must be directed vertically upwards.

Schedule F – Table 1 (release of contaminants)

Release point number		Minimum release height (meters)	Minimum velocity (m/sec)	Contaminant released	Maximum release limit (g/sec)
A1	Node 1 compressor stack	8	25	NOx	0.25
A2	Node 1 compressor stack	8	25	NOx	0.25
A3	Node 1 compressor stack	8	25	NOx	0.25
A4*	Node 2 compressor stack	TBA	TBA	NOx	TBA
A5*	Node 3 compressor stack	TBA	TBA	NOx	TBA
A6*	Node 3 compressor stack	TBA	TBA	NOx	TBA
A7*	Node 3 compressor stack	TBA	TBA	NOx	TBA
A8*	Node 4 compressor stack	TBA	TBA	NOx	TBA
A9*	Node 4 compressor stack	TBA	TBA	NOx	TBA
A10	MGPF compressor stack	8	25	NOx	0.8
A11	MGPF compressor stack	8	25	NOx	0.8
A12	MGPF compressor stack	8	25	NOx	0.8
A13	MGPF compressor stack	8	25	NOx	0.8

* Planned at the date of authority issue

1 The NOx limits are applicable at all times except start-up, shut down and calibration of emission monitoring devices. The maximium start-up period allowed is 30 minutes

TBA Contaminant release parameters to be finalised and advised in the Annual return due October 2010.

(F3) The holder of this environmental authority must maintain a Register of Fuel Burning or Combustion Equipment that is capable of burning at least 500kg of fuel in an hour and must include, as a minimum, the following information for each item of equipment:

(a) fuel burning or combustion equipment name and location;
(b) stack emission height (metres);
(c) minimum efflux velocity (metres /sec); and
(d) mass emission rates (g/s) / contaminant concentrations (mg/Nm^3 @ 5% O_2).

(F4) The holder of this environmental authority must ensure that the information contained in the Register of Fuel Burning or Combustion Equipment is complete and current on any given day.

(F5) The holder of this environmental authority must make the Register of Fuel Burning or Combustion Equipment or information contained in the Register available to the administering authority on request.

SCHEDULE G – WASTE

General

(G1) All general waste must be removed from the site and sent to a recycling facility or disposal facility licensed to accept the waste.

(G2) All regulated waste must be removed from the site 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 recycling facility or disposal facility licensed to accept the waste.

(G3) Waste must not be burned or allowed to be burned on the licensed site.

(G4) All waste fluids and muds resulting from drilling and exploration activities must be contained in a dam or containment structure for disposal, remediation or reuse where applicable.

(G5) Oil based drilling muds must not be used in the carrying out of the petroleum activity.

(G6) Synthetic based drilling muds must not be used in the carrying out of the petroleum activity other than with the written approval of the administering authority.

(G7) The holder of this environmental authority must ensure that coal seam gas water is contained, is not released to land or waters unless used for purposes specifically authorised:

(a) under this environmental authority; or
(b) under Section 186 of the *Petroleum and Gas (Production and Safety) Act 2004*; or
(c) under Section 86 of the *Petroleum Act 1923*; or
(d) under an approval of resource for beneficial use as provided for under the *Environmental Protection Act 1994*.

Coal seam gas water use for dust suppression

(G8) CSG water produced from the authorised petroleum activities may be used for dust suppression within tenures covered by this environmental authority, provided the water quality meets the limits specified in Schedule G, Table 1 – Road dust suppression water contaminant release limits for each of the water quality characteristics.

Schedule G, Table 1 – Road dust suppression water contaminant release limits.

Water Quality Characteristics	Unit	Limit	Limit Type
pH	pH Units	6.0 to 9.0	range
Total Suspended Solids	mg/L	30	maximum
Total Dissolved Salts	mg/L	2000	maximum
Total Petroleum Hydrocarbons	mg/L	10	maximum

(G9) Use of CSG water for dust suppression activities must be carried out in a manner that:

(a) vegetation is not damaged;
(b) soil erosion and soil structure damage is avoided;
(c) there is no surface damming of the CSG water;
(d) minimises deep drainage below the root zone of any vegetation;
(e) quality of shallow aquifers is not adversely affected; and
(f) there are no releases of CSG waters to any surface waters.

[redacted]

(G10) The holder of this environmental authority must ensure that the coal seam gas water to be used for domestic or stock purposes meets the ANZECC 2000 Water Quality Guidelines, or subsequent versions thereof, for stock and domestic purposes.

(G11) Coal seam gas water released to the environment in accordance with Condition G7 must not have any properties that could cause, nor contain any contaminants in concentrations that are capable of causing environmental harm.

Third Party Use

(G12) Wastewater generated from the authorised activities may be piped to Millennium Coal Mine ML70313 and ML7012 for use in coal washing and dust suppression.

(G13) The authority holder when discharging to Millennium Coal Mine must record daily the following details:

a) time and date of the discharge;

b) TDS and pH levels of the discharge; and

c) total volume discharged.

Water Release Reduction Strategy

(G14) As part of the Coal Seam Gas Water Management Plan ((CSGWMP) contained within the Environmental Management Plan)), the holder of the environmental authority must develop and implement an on-going Release Reduction Strategy to maximise CSG water use and minimise any release to waters . The strategy must address the following matters:

(a) implementation of schemes to achieve maximum use of the water;
(b) specific targets for achieving increased use of CSG water both treated and untreated;
(c) a market analysis at least every three (3) years to identify existing and future opportunities for water use;
(d) on-going review of emerging technologies and/or re-use options that could achieve significant reductions in mass loads of contaminants released to the environment;
(e) investigation of the feasibility of alternative options, practices and procedures to further minimise the volume and concentration of contaminants released to waters; and
(f) programs to implement feasible options to achieve increased water use and reduction in contaminant loads, including actions and timeframes for completion.

(G15) A progress report on the strategy required by Condition G14 is to be included in the Annual Return and address at least the following matters:

(a) details of the specific options, practices and procedures investigated;
(b) details of new practices, procedures and programs implemented since the last reporting period and targets met;
(c) where alternative options, practices and procedures are not considered feasible, the provision of justification to support that determination; and
(d) details of the option(s) yet to be implemented, including the timeframes for implementation, and justification for the chosen option(s).

(G16) Where any inconsistency exists between the conditions of this environmental authority and the Coal Seam Gas Water Management Plan, the conditions of this environmental authority prevail.

Salt Management

Brine Salt Reuse, Recycle or Off Site Disposal

(G17) Following cessation of petroleum activities, any residual brine or solid salt present in a CSG water dam must be removed and transported to a facility that can lawfully reuse, recycle or dispose of such waste.

SCHEDULE H – REHABILITATION

(H1) The holder of this environmental authority must not abandon any dam but must decommission each dam so as to prevent and/or minimise any environmental harm.

(H2) As a minimum, decommissioning must be conducted such that each dam either:

(a) becomes a stable landform similar to that of surrounding undisturbed areas, that no longer contains substances that will migrate into the environment, or
(b) is approved or authorised by the administering authority for use by the landholder following cessation of the petroleum activities.

(H3) Progressive rehabilitation of disturbed areas must commence as soon as practicable following the completion of any construction or operational works associated with the petroleum activity(ies).

(H4) As soon as practicable, but no later than twelve (12) months (or a longer period agreed in writing by the administering authority) after the end of petroleum activity(ies) causing significant disturbance to land, the holder of this environmental authority must:

(a) remediate contaminated land (e.g. dams containing salt);
(b) reshape all significantly disturbed land to a stable landform similar to that of surrounding undisturbed areas;
(c) on all significantly disturbed land, take all reasonable and practicable measures to:
i. re-establish surface drainage lines;
ii. reinstate the top layer of the soil profile; and
iii. promote establishment of vegetation.
(d) undertake rehabilitation in a manner such that any actual and potential acid sulfate soils in or on the site are either not disturbed, or submerged, or treated so as to not be likely to cause environmental harm; and
(e) decommission all inactive buried pipelines in accordance with the requirements of AS2885 and ensuring that there will not be any subsequent subsidence of land along the pipeline route.

(H5) All significantly disturbed land caused by the carrying out of the petroleum activity(ies) 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.

(H6) 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.

(H7) Rehabilitation can be considered successful when:

(a) the site can be managed for its designated land-use (e.g. similar to that of surrounding undisturbed areas);

(b) no greater management input than for other land in the area being used for a similar purpose is required and there is evidence that the rehabilitation has been successful for at least three (3) years;
(c) the rehabilitation is carried out in accordance with the goals, objectives indicators and completion criteria as specified in Schedule H, Table 1 – Planned rehabilitation specifications; or
(d) written agreement is obtained from the landowner/holder and administering authority.

[redacted]

Schedule H, Table 1 – Planned rehabilitation specifications

Petroleum activity feature	Relevant Resource Authority	Rehabilitation Goal	Rehabilitation objectives	Indicators	Completion criteria
All petroleum activity features	PL191 and PL196	1. Safe	Site safe for humans and animals	(a) Landform re-established	(a) No subsidence or major erosion gullies
		2. Non-polluting	Sediment and erosion control structures in place	(a) Sediment traps and design of erosion control measures	(a) Certification from suitably qualified and experience person and performance of control structures
			Storm water runoff does not pollute nearby watercourses	(b) Surface water monitoring	(b) Monitoring meeting release limits
			Encapsulated salt does not seep outside the monocell	(c) Groundwater monitoring	(c) Monitoring shows no adverse impacts on groundwater quality
		3. Stable	Minimise erosion	(a) Re-establish surface drainage lines	(a) no subsidence or areas of major erosion for at least 3 years
				(b) Vegetation cover	(b)(I) 50% cover (flat to sloping) and (b)(II) 75% cover (moderate to steep slopes) consisting of vegetation similar to immediate surrounding area. (b)(iii) vegetation cover is equivalent to immediate surrounding area where land use is cultivation.

Petroleum activity feature	Relevant Resource Authority	Rehabilitation Goal	Rehabilitation objectives	Indicators	Completion criteria
		4. Self-sustaining	Describe post activity land use or land suitability or land capability	(a) Floral Species diversity	(a)(I) Evidence that 80% of the immediate surrounding species diversity is achieved and maintained for 3 years. (a)(ii) If soil can be demonstrated as being substantially different after operations, objective is to establish other vegetation which fulfils the function of the vegetation immediately surrounding the area.
				(b) Presence of key floral species	(b)(i) Evidence that 80% of key species in the immediate surrounding area are present and maintained for 3 years. (b)(ii) Where agriculture is the planned final land use, the species should be those commonly used for pasture or crops known to be successful in soils of similar texture, drainage, pH and fertility.

SCHEDULE I – MONITORING PROGRAMS

General

(I1) The holder of this environmental authority must develop and implement a monitoring program, the result of which will demonstrate compliance with the conditions of this environmental authority.

(I2) All monitoring under this environmental authority must be conducted by a suitably qualified person.

(I3) All instruments, equipment and measuring devices used for measuring or monitoring in accordance with any condition of this environmental authority must be calibrated, and operated and maintained effectively.

(I4) The method of water sampling required by this environmental authority must comply with the most recent edition of the Department of Environment and Resource Management – Water Quality Sampling Manual.

(I5) All determinations of water quality must be:

(a) performed by a person or body possessing appropriate experience and qualifications to perform the required measurements; and
(b) made in accordance with methods prescribed in the latest edition of the Department of Environment and Resource Management - Water Quality Sampling Manual; and
(c) carried out on representative samples.

(I6) All analyses and tests required to be conducted under this environmental 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.

(I7) If monitoring conducted in accordance with this environmental authority indicated a condition or contaminant level that has caused, or has potential to cause, environmental harm, the environmental authority holder must:

(d) as soon as is practicable, take the necessary actions to rectify the condition or contaminant level so as to avoid or minimise environmental harm; and
(e) notify the administering authority of the condition or contaminant level and the actions taken to rectify it.

(I8) Any management or monitoring plans, systems or programs required to be developed and implemented by a condition of this environmental authority must be reviewed for performance and amended if required on an annual basis.

(I9) The holder of this environmental authority must record, compile and keep for a minimum of five years all monitoring results required by this environmental authority and make available for inspection all or any of these records upon request by the administering authority.

(I10) An annual monitoring report must be prepared each year and presented to the administering authority when requested. This report shall include but not be limited to:

(a) a summary of the previous twelve (12) months monitoring results obtained under any monitoring programs required under this environmental authority and, a comparison of the previous twelve (12) months monitoring results to both the limits set in this environmental authority and to relevant prior results; and
(b) an evaluation/explanation of the data derived from any monitoring programs; and
(c) a summary of any record of quantities of releases required to be kept under this environmental authority; and

(d) an outline of actions taken or proposed to minimise the risk of environmental harm from any condition or elevated contaminant level identified by the monitoring or recording programs.

Groundwater Monitoring

(I11) The holder of this environmental authority must prepare and implement a groundwater monitoring program within 40 business days of this environmental authority taking effect.

(I12) The groundwater monitoring program must be developed and implemented by a person possessing appropriate qualifications and experience in the fields of hydrogeology and groundwater sampling design.

(I13) The groundwater monitoring program must be able to detect any significant risks and changes to groundwater quality caused by petroleum activity(ies) authorised under this environmental authority. As a minimum the program must include:

(a) a groundwater monitoring network designed and installed for the petroleum activities; and
(b) a sufficient number of monitoring sites to provide information on the following:
  (i) seepage to groundwater and surrounding soils from any regulated dam authorised under this environmental 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 the activities authorised under this environmental authority).
(c) the location of monitoring points, parameters to be measured, frequency of monitoring, monitoring methodology used, trigger values; and
(d) the development of procedures to establish background ground water quality.

(I14) The groundwater monitoring program must provide for monitoring of groundwater quality as often as necessary to detect impacts of the petroleum activities authorised under this environmental authority, but not less frequently than biannually (every six months) for the first year of carrying out the petroleum activities and annually thereafter.

(I15) If groundwater contamination caused by the petroleum activities is encountered, the following must be considered to satisfy requirements under Condition I17.

(a) the level of environmental harm caused as a result of such contamination to soils and groundwater;
(b) the conduct of a geodetic survey of all monitoring bores to determine the relative water 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.

(I16) The holder of this environmental authority must ensure that the groundwater monitoring data gathered in accordance with this environmental 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 with each Annual Return.

(I17) If groundwater monitoring indicates that any significant changes in groundwater quality caused by petroleum activities are detected, then information must be submitted to the administering authority within ten (10) business days of receipt of the analysis indicating these changes, including any proposed actions to mitigate the changes in groundwater quality.

Air Monitoring (Point Source)

(I18) The holder of this environmental authority must conduct a monitoring program of contaminants released to the atmosphere at each release point recorded in the Register of Fuel Burning or Combustion Equipment (Condition F3) for the contaminants and at the frequency listed in Schedule I – Table 1 – Monitoring Frequency for Contaminants.

Schedule I, Table 1 – Monitoring Frequency for contaminants

Contaminant	Monitoring frequency
NOx as Nitrogen Dioxide	Within 3 months after commissioning of the fuel burning equipment; and Twice a year for the first two (2) years of operation; and Thereafter, annually
Carbon monoxide	

(I19) The monitoring program must comply with the following:

(a) Monitoring provisions for the release points must comply with the most recent edition of AS4323.1 Stationary source emissions method 1: Selection of sampling provisions.
(b) The following tests must be performed for each sample taken at each release point specified in the Register of Fuel Burning or Combustion Equipment (Condition F3):
  I. Gas velocity, volume and mass flow rate.
  II. Temperature.
  III. Water vapour concentration (for non-continuous sampling).
(c) Samples taken must be representative of the contaminants discharged when operating under maximum operating conditions.
(d) During the sampling period the following additional information must be gathered:
  i. Production rate.
  ii. Plant status.
(e) Monitoring of contaminant release must be carried out in accordance with the latest edition of the administering authority's Air Quality Sampling Manual.

Noise Monitoring

(I20) The holder of this environmental authority must undertake noise monitoring when requested by the administering authority to investigate a complaint of environmental nuisance at a sensitive or commercial place within the reasonable and practicable timeframe nominated by the administering authority, and report the results to the administering authority within three (3) business days of completion of the monitoring.

(I21) Noise monitoring and recording must include the following descriptor, characteristics and matters:

(a) $L_{AN,T}$ (where N equals the statistical levels of 1, 10 and 90 and T = 15 mins);
(b) background noise $L_{A90,T}$;
(c) the level and frequency of occurrence of impulsive or tonal noise and any adjustment and penalties to statistical levels;
(d) atmospheric conditions including temperature, relative humidity and wind speed and directions;
(e) effects due to any extraneous factors such as traffic noise;
(f) location, date and time of monitoring;
(g) if the complaint concerns low frequency noise, Max $L_{PZ,15\ min}$; and
(h) if the complaint concerns low frequency noise, one third octave band measurements in dB(LIN) for centre frequencies in the 10 – 200 Hz range for both the noise source and the background noise in the absence of the noise source.

(I22) The method of measurement and reporting of noise levels and background sound pressure levels must comply with the latest edition of the administering authority's *Noise Measurement Manual* or the most recent version of AS1055 Acoustics – description and measurement of environmental noise.

Nuisance Monitoring (other than Noise)

(I23) When the administering authority advises the holder of this environmental authority of a complaint alleging nuisance other than noise, the holder must investigate the complaint and advise the administering authority in writing of the action proposed or undertaken to resolve the complaint.

(I24) When requested by the administering authority, the holder of this environmental authority must undertake monitoring as specified by the administering authority, within a reasonable and practical timeframe nominated by the administering authority to investigate any complaint of environmental harm at any sensitive or commercial place.

(I25) 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 ten (10) business days of completion of the investigation, or receipt of the monitoring results, whichever is the latter.

(I26) If monitoring in accordance with Condition I24 and I25 indicates that emissions exceed the limits set in this environmental authority or are causing environmental nuisance, then the holder of this environmental authority must:

(a) address the complaint including the use of alternative dispute resolution services if required; and/or
(b) as soon as practicable implement abatement or attenuation measures so that light, dust, particulate or odour emissions from the authorised activities do not result in further environmental nuisance.

Annual Water Monitoring Reporting

(I27) The following information must be recorded in relation to all water monitoring required under the conditions of this environmental authority and submitted to the administering authority in the specified format with each annual return:

(a) the date on which the sample was taken;
(b) the time at which the sample was taken;
(c) the monitoring point at which the sample was taken;
(d) the measured or estimated daily quantity of the contaminants released from all release points;
(e) the release flow rate at the time of sampling for each release point;
(f) the results of all monitoring and details of any exceedances with the conditions of this environmental authority; and
(g) water quality monitoring data must be provided to the administering authority in the specified electronic format upon request.

SCHEDULE J – COMMUNITY ISSUES

(J1) The holder of this environmental authority must maintain a record of complaints and incidents causing environmental harm, and actions taken in response to the complaint or incident.

(J2) The holder of this environmental authority must record the following details for all complaints received and provide this information to the administering authority on request:

(a) name, address and contact number for complainant;
(b) time and date of complaint;
(c) reasons for the complaint as stated by the complainant;
(d) investigations undertaken in response to the complaint;
(e) conclusions formed;
(f) actions taken to resolve complaint;
(g) any abatement measures implemented to mitigate the cause of the complaint; and
(h) name and contact details of the person responsible for resolving the complaint.

(J3) The holder of this environmental authority must retain the record of complaints required by this condition for five (5) years.

SCHEDULE K - NOTIFICATION PROCEDURES

(K1) The holder of this environmental authority must telephone the administering authority's Pollution Hotline (1300 130 372) or local office and the landholder or their nominated representative within 24 hours of becoming aware of any release of contaminants not in accordance with the conditions of this environmental authority or any event where environmental harm has been caused or may be caused.

(K2) Subject to condition K1, the holder of this environmental authority is required to report in the case of uncontained spills of contaminants (including but not limited to hydrocarbon, CSG water or mixtures of both) of the following volumes or kind:

(a) releases of any volume of contaminants to water; and
(b) releases of volumes of contaminants greater than 200 litres of hydrocarbon, 2000 litres of brine or 10 000 litres of coal seam gas water to land; and
(c) releases of any volumes of contaminants where potential serious or material environmental harm has occurred or may occur.

(K3) The notification of emergencies or incidents as required by Conditions K1 and K2 must include but not be limited to the following information:

(a) the environmental authority number and name of the holder of this environmental authority;
(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 this environmental 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 any environmental harm that has occurred or may occur as a result of 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.

(K4) Within ten (10) business days following the initial notification of an emergency or incident or receipt of monitoring results, whichever is the later, a written report must be provided to the administering authority, including the following:

(a) results and interpretation of any samples taken at the time of the incident and analysed;
(b) the outcomes of actions taken at the time of the incident to prevent or minimise environmental harm; and
(c) proposed actions to prevent a recurrence of the emergency or incident.

(K5) 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 environmental authority, a written report on the results of any such monitoring must be provided to the administering authority.

SCHEDULE L - DEFINITIONS

Note: Where a term is not defined in this environmental authority the definition in the Environmental Protection Act 1994, *its regulations and Environmental Protection Policies or the* Petroleum and Gas (Production and Safety) Act 2004 *and its regulations must be used in that order.*

"acid sulfate soils" means soil or sediment containing highly acidic soil horizons or layers affected by the oxidation of iron sulfides (*actual acid sulfate soils*) and/or soil or sediment containing iron sulfides or other sulfidic material that has not been exposed to air and oxidised (*potential acid sulfate soils*).

"associated works" in relation to a dam, means:

- operations of any kind and all things constructed, erected or installed for that dam; and
- any land used for those operations.

"background noise level" means the sound pressure level, measured in the absence of the noise under investigation, as the L A90,T being the A-weighted sound pressure level exceeded for 90 percent of the measurement time period T of not less than 15 minutes, using Fast response.

"bed and banks" for a watercourse or wetland means land over which the water of the watercourse or wetland normally flows or that is normally covered by the water, whether permanently or intermittently; but does not include land adjoining or adjacent to the bed or banks that is from time to time covered by floodwater.

"beneficial use" means

- with respect to dams, that the current or proposed owner of the land on which a dam stands, has found a use for that dam that is:
  - of benefit to that owner in that it adds real value to their business or to the general community,
  - in accordance with relevant provisions of the *Environmental Protection Act 1994*,
  - 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. Or
- with respect to coal seam gas water, refer the DERM's Operational Policy *Management of water produced in association with petroleum activities (CSG water)* and *Notice of decision to approve a resource for beneficial use – CSG water* which can be accessed on DERM's website at www.derm.qld.gov.au.

"brine" means either saline water with a total dissolved solid concentration greater than 40 000mg/l or CSG water after it has been concentrated through water treatment processes and/or evaporation.

"bund or bunded" in relation to spill containment systems for fabricated or manufactured tanks or containers designed to a recognised standard means an embankment or wall of brick, stone, concrete or other impervious material which may form part or all of the perimeter of a compound and provides a barrier to retain liquid. Since the bund is the main part of a spill containment system, the whole system (or bunded area) is sometimes colloquially referred to within industry as the bund. The bund is designed to contain spillages and leaks from liquids used, stored or processed above ground and to facilitate clean-up operations. As well as being used to prevent pollution of the receiving environment, bunds are also used for fire protection, product recovery and process isolation.

"category A ESA" means any area listed in Section 25 of the *Environmental Protection Regulation 2008*.

"category B ESA" means any area listed in Section 26 of the *Environmental Protection Regulation 2008*.

"category C ESA" means any of the following areas:

- Nature Refuges as defined under the *Nature Conservation Act 1992*;
- Koala Habitat Areas as defined under the *Nature Conservation Act 1992*;
- State Forests or Timber Reserves as defined under the *Forestry Act 1959*;
- Declared catchment areas under the *Water Act 2000*;
- Resources reserves under the *Nature Conservation Act 1992*
- An area identified as "Essential Habitat" for a species of wildlife listed as endangered, vulnerable, rare or near threatened under the *Nature Conservation Act 1992*;
- Any wetland shown on the Map of Referable Wetlands available from DERM's website; or
- "Of concern" regional ecosystems identified in the database maintained by DERM called 'Regional ecosystem description database' containing regional ecosystem numbers and descriptions.

"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:

- exactly what is being certified and the precise nature of that certification.
- the relevant legislative, regulatory and technical criteria on which the certification has been based;
- 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
- 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.

"clearing" means:

- in relation to grass, scrub or bush—the removal of vegetation by disturbing root systems and exposing underlying soil (including burning), but does not include—
  - the flattening or compaction of vegetation by vehicles if the vegetation remains living; or
  - the slashing or mowing of vegetation to facilitate access tracks; or
  - the clearing of noxious or introduced plant species; and
- in relation to trees—cutting down, ringbarking, pushing over, poisoning or destroying in any way.

"commercial place" means a work place used as an office or for business or commercial purposes, which is not part of the petroleum activities and does not include employees accommodation or public roads.

"construction" in relation to a dam includes building a new dam and modifying or lifting an existing dam.

"CSG water" means groundwater that is necessarily or unavoidably brought to the surface in the process of coal seam gas exploration or production. CSG water typically contains significant concentrations of salts, has a high sodium adsorption ratio (SAR) and may contain other contaminants that have the potential to cause environmental harm if released to land or waters through inappropriate management. CSG water is a waste, as defined under s13 of the EP Act.

"CSG water concentrate" is the concentration of saline water waste stream from a water treatment process that does not exceed a total dissolved solid concentration of 40 000mg/L.

"CSG evaporation dams" is defined as an impoundment, enclosure or structure that is designed to be used to hold CSG water for evaporation.

"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.

"design plan" means 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 design and investigation reports, specifications and certifications, together with the planned decommissioning and rehabilitation works and outcomes. A design plan may include 'as constructed' drawings.

"discharge area" means:

(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 Environment and Resource Management.

"ecosystem functioning" means the interactions between and within living and nonliving components of an ecosystem and generally correlates with the size, shape and location of an area of vegetation.

"end" means the stopping of the particular activity that has caused a significant disturbance in a particular area. It refers to, among other things, the end of a seismic survey or the end of a drilling operation. It does not refer to the end of all related activities such as rehabilitation. In other words, it does not refer to the 'completion' of the petroleum activity, the time at which the petroleum authority ends or the time that the land in question ceases to be part of an authority.

"equivalent person or EP" means an equivalent person under volume 1, section 2 of the *Guidelines for Planning and Design of Sewerage Schemes*, October 1991, published by the Water Resources Commission, Department of Primary Industries, Fisheries and Forestry.

"existing CSG dams" means Dam 1, Dam 2, Dam 3, Dam 4, Dam 5, Dam 6, Dam 7, Dam 9, Dam 10, Dam 11 and Dam 13.

"fill" means any kind of material in solid form (whether or not naturally occurring) capable of being deposited at a place but does not include material that forms a part of, or is associated with, a structure constructed in a watercourse, wetland or spring including a bridge, road, causeway, pipeline, rock revetment, drain outlet works, erosion prevention structure or fence.

"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' means 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 acceptably low probability of failure before that time.

"hazard" in relation to a dam as defined, 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.

"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 *DERM's Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (Version 1.0, 2008)* or any updated version of the Manual that becomes available from time to time

"heritage place" means any place that may be of cultural heritage significance, or any place with potential to contain archaeological artefacts that are an important source of information about Queensland's history.

"high bank" means the defining terrace or bank or, if no bank is present, the point on the active floodplain, which confines the average annual peak flows in a watercourse.

"highly erodible soils" means very unstable soils that are generally described as Sodosols with hard – setting, fine sandy loam to silty clay loam surfaces (solodics, solodised solonetz and solonetz) or soils with a dispersible layer located less than 25cm deep or soils less than 25cm deep.

"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)* published by DERM on its website.

"impulsive sound" means sound characterised by brief excursions of sound pressure (acoustic impulses) that significantly exceed the background sound pressure. The duration of a single impulsive sound is usually less than one second.

"infrastructure" means water storage dams, roads and tracks, equipment, buildings and other structures built for the purpose and duration of the conduct of 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 (e.g. evaporation dams), pipelines and assets, that have been decommissioned, rehabilitated, and lawfully recognised as being subject to subsequent transfer with ownership of the land.

"itinerant activities" means activities that are carried out at various locations using transportable plant or equipment and carried out at one location and for less than 14 consecutive days and on more than two occasions in each calendar year.

"lake" means:

[redacted]

(a) a lagoon, swamp or other natural collection of water, whether permanent or intermittent; and
(b) the bed and banks and any other element confining or containing the water.

"landfill monocell" means a specialised, isolated landfill facility where a single specific waste type is exclusively disposed (i.e. salt).

"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 a dyke or bund 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 unplanned releases from other works of infrastructure, during the progress of those stormwater or flood flows or those unplanned releases; and does not store any significant volume of water or flowable substances at any other times.

"limited petroleum activities mean activities including geophysical surveys (including seismic activities), well sites, well pads, sumps, flare pits, flow lines and supporting access tracks. Limited petroleum activities do not include the construction of production infrastructure for processing or storing petroleum or by-products, dams, compressor stations, campsites/workforce accommodation, power supplies, waste disposal or other supporting infrastructure for the project.

"material impact" for the purposes of Condition D37 means an increase in concentration of a chemical used in fracturing fluids on PL191 and PL196 of >10% above background, detection of a chemical that was not present in the background sample or a chemical present at a concentration in excess of drinking water quality guidelines.

"max $L_{PZ,15\ min}$" means the maximum value of the Z-weighted sound pressure level measured over 15 minutes.

"mg/L" means milligrams per litre.

"Oil based drilling muds"- Oil-based mud where the base fluid is a petroleum product such as diesel fuel.

"overland flow water" means water, including floodwater, flowing over land, otherwise than in a watercourse or lake:

- after having fallen as rain or in any other way; or
- after rising to the surface naturally from underground.

"permanent infrastructure" includes any infrastructure (roads, tracks, bridges, culverts, dams, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads, pipelines etc), which is to be left by agreement with the landowner.

"pest" means species:

(a) declared under the *Land Protection (Pest and Stock route Management) Act 2002*;
(b) declared under Local Government model local laws; and
(c) which may become invasive in the future.

"regulated dam" means any dam in the significant or high hazard category as assessed using the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (Version 1.0, 2008)* or any updated version of the Manual that becomes available from time to time

"rehabilitation" means 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

"remnant unit" means a continuous area of remnant vegetation representative of a single Regional Ecosystem type or a single heterogeneous unit (multiple Regional Ecosystem types that cannot be distinguished individually due to the scale of mapping).

"River Improvement Trust Asset Area" means an area within a River Improvement Area declared under the *River Improvement Trust Act 1940* that is or has been subject to restoration or flood mitigation works. The locations and details of these areas can be obtained from the relevant River Improvement Trust.

"sensitive place" means

- a dwelling (including residential allotment, mobile home or caravan park, residential marina or other residential premises, motel, hotel or hostel; or
- a library, childcare centre, kindergarten, school, university or other educational institution;
- a medical centre, surgery or hospital; or
- a protected area; or
- a public 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.

"significantly disturbed land or significant disturbance to land" means disturbance to land as defined in section 28 of the *Environmental Protection Regulation 2008*.

"site" means the petroleum authority(ies) to which the environmental authority relates.
"spring" means the land to which water rises naturally from below the ground and the land over which the water then flows.
"stable" in relation to land, means landform 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.
"state heritage place" means a place entered in the Queensland heritage register under Part 4 of the *Queensland Heritage Act 1992.*
"suitably qualified person" means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis to performance relative to the subject matter using the relevant protocols, standards, methods or literature.
"suitably qualified and experienced person" in relation to 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:

- knowledge of engineering principles related to the structures, geomechanics, hydrology, hydraulics, chemistry and environmental impacts of dams; and
- 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
- 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.

"Synthetic based drilling muds"- Synthetic-based fluid is a mud where the base fluid is a synthetic oil.
"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
"threatening processes" means processes, features and actions that can have a detrimental effect upon the health and viability of an area of vegetation. For example altered hydrology, land use practices, invasion by pest and weed species, land degradation, edge effects and fragmentation.
"Temporary petroleum activities" means a petroleum activity that does not involve permanent fixture of equipment or infrastructure and includes (but not limited to) drilling, fracing, construction and decommissioning of infrastructure.

"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 damage and limiting infiltration and percolation.
"topsoil" means the surface (top) layer of a soil profile, which is 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 the natural surface.
"void" means any man-made, open excavation in the ground (includes borrow pits, drill sumps, frac pits, flare pits, cavitation pits and trenches).
"waters" includes all or any part of a creek, river, stream, lake, lagoon, dam, swamp, wetland, spring, unconfined surface water, unconfined water in natural or artificial watercourses, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and underground water.
"watercourse" means a river, creek or stream in which water flows permanently or intermittently:

(a) In a natural channel, whether artificially improved or not; or
(b) In an artificial channel that has changed the course of the watercourse;
but, in any case, only:
(c) unless a regulation under paragraph (d), (e) or (f) declares otherwise-at every place upstream of the point (point A) to which the high spring tide ordinarily flows and reflows, whether due to a natural cause or to an artificial barrier; or
(d) if a regulation has declared an upstream limit for the watercourse-the part of the river, creek or stream between the upstream limit and point A; or
(e) if a regulation has declared a downstream limit for the watercourse-the part of the river, creek or stream upstream of the limit; or
(f) if a regulation has declared an upstream and a downstream limit for the watercourse-the part of the river, creek or stream between the upstream and the downstream limits.

Watercourse includes the bed and banks and any other element of a river, creek or stream confining or containing water.

"wetland" means an area shown as a wetland on a 'Map of referable wetlands', a document approved by the chief executive (environment). A map of referable wetlands can be viewed at www.derm.qld.gov.au .

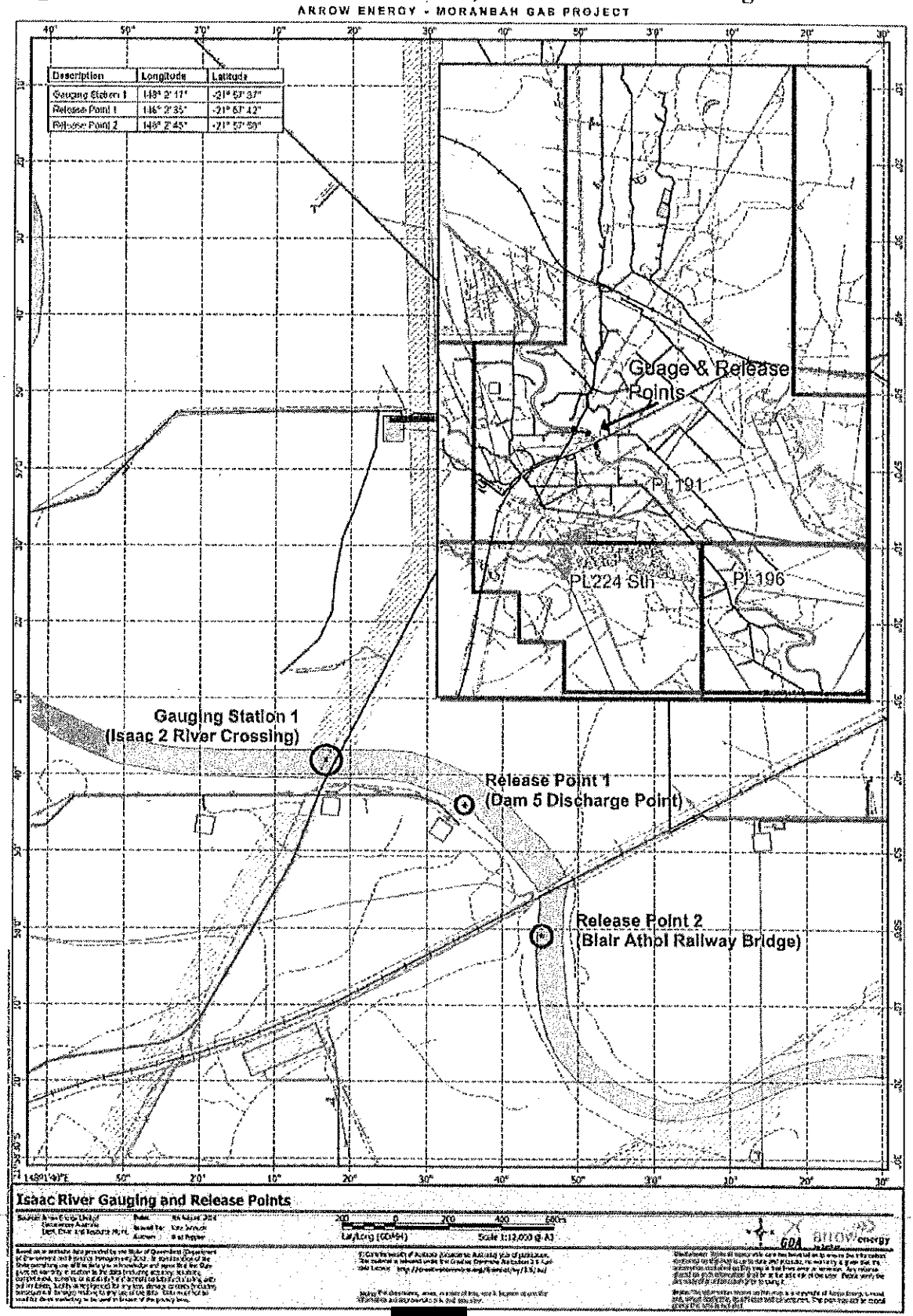
"wild river declaration" means a statutory instrument under the *Wild Rivers Act 2005*. A declaration lists the relevant natural values to be preserved and delineates certain parts of the wild river area and the different constraints that may apply in these areas. With reference to environmental authorities for petroleum, each declaration also specifies conditions to be included in a new authority if the activity is to be located within the wild river area.

"80th percentile release limits" means that not more than one (1) of the measured values is to exceed the stated release limit for any five (5) consecutive samples where:

(1) the consecutive samples are taken over a 5 month period; and
(2) the consecutive samples are taken at approximately equal periods.

End of Conditions

Figure 1 - Contaminant Release Points, Sources and Receiving Waters



INSTRUCTIONS: This form should record the agreed outputs from a Formal Risk Assessment as per the Risk Management Procedure 99-H-PR-0017

Department/Workgroup:	Moranbah Wellfield / Brisbane Environment Team	Risk Assessment Number:			
Topic / Activity:	Dam Level Management	Date:	18/11/2010	Time:	15:00
Location:	Moranbah Gas Project	Venue:	MGPF Meeting Room		

Risk Assessment Team

Name	Job Title	Company (if external)	Signature
[redacted] *(Team Leader)*	Production Manager	Arrow Energy	Refer Original
	Wellfield Superintendent	Arrow Energy	Refer Original
	HSE Superintendent	Arrow Energy	Refer Original
	Manager Environment – Compliance & Reporting	Arrow Energy	Refer Original
	Environment - Senior Water & Salt Infrastructure Coordinator	Arrow Energy	Refer Original
	Lead Production Engineer	Arrow Energy	Refer Original
	Operations Advisor	Arrow Energy	Refer Original

Background Information (include reference material)

MGP ponds have been approach Design Storage Allowance (DSA) levels for several months (at these levels Arrow is required to notify the Department of Environment and Resource Management). The primary reason is due to delays in the delivery of water infrastructure particularly dam 11 and the reverse osmosis plant.The water production forecast has been used to make decisions about corrective actions including progressively shutting down 45 of 165 high water to gas ratio wells since May. The goal of these controls was to maintain water levels at or below DSA until Pond 11 was completed as scheduled in early Novemeber. While this was achieved, unfortunately the delivery of Pond 11 has slipped back and the wet season has started early which has caused further delays to construction of dam 11.

Up to November the total water stored in dams has been decreasing gradually as the evaporation rate was greater than the water produced by the field. Relatively high rainfall during October and November has significantly reduced net evaporation rates, as well as contributing water in the dams in the form of rainfall. As a result, the total water stored across the dams has increased. Dam 1 was the DSA level in the last week of October.

This risk assesment addresses the risk associated with water storage with the MGP. Arrow is entering the wet season with high dam levels, additional rainfall will continue to contribute to existing storage levels and cause the schedule for pond 11 will slip further.

Produced water is no longer a key driver in water storage. Water production has reduced from over 1.5Ml/day to around 0.6Ml/day. Further shutdown of wells would not have a material impact on water production (estimated at 0.6ML/day) but a significant impact on gas production. This is because the high water to gas ratio wells have already been shut-in.

Pond 2 has further impacted storage capacity. Earlier this year it was noted that water was seeping through the dam wall. The water level was reduced below the leak level and maintained at the agreed level. An inspection last week found the seepage area to be damp again and so requires further reduction in operating level, hence impacting total storage on-site,

Continued poor evaporation and high rainfall present a real risk to overtopping of dams. Up to Novemeber the water strategy has been to distribute water between all dams to maximise evaporation and storage. This has kept levels near the DSA as required by DERM. This risk assessment recommends a change in strategy to reduce risk of overtopping by reducing levels in remote dams that will be hard to access and manage during a high rainfall event ie ponds 6,7,8 and 9 become inaccessible when there is flow in the Isacc river. The proposed strategy is to transfer water to ponds 1 and 10 which are easier to access, maintain and monitor. Pond 10 also has a spillway which significantly reduces the likelihood of dam failure should it overflow.

As the levels in the dams are quite high and more rain is forecast, it is also recommended that DERM be approached to allow the discharge of pond water into the Isaac River. This would reduce the liklihood of Pond 10 overflowing via the spillway.

Hazards and Consequences	Initial Risk	Control Measures	Tick if Current	Residual Risk
Dam 2 Leak leading to wall failure and environmental discharge to surrounding land & river	19	Reduce level by 500mm by transfer to Dam 10 which will rise by 125mm		15
		Disperse Bentonite inside dam wall at leak location to plug the leak	X	19
		Monitoring by daily inspection	X	19
		Investigate reinforcing dam corner		15
		Review Ross Stafford 2010 Dam Survey Report	X	19
		Investigate level telemetry		19
		Upgrade pump transfer capacity		15
Dam 8 Overtopping leading to environmental discharge to surrounding land	13	Pond 8 auto level control already installed & operating (no level feedback or indication of pump running) Spillway	X	9
Ponds 6, 7, & 9 Overtopping & Unable to access due to flooded river leading to wall erosion / wall failure and environmental discharge to surrounding land	19	Adjust level control settings on Pond 6 & 7 and place auto level control back into service (required equipment ordered)	X	15
		Shut down Pond 9 inflows and pump down to 500mm below DSA (includes related gas production)	X	15

Hazards and Consequences	Initial Risk	Control Measures	Tick if Current	Residual Risk
		Investigate dam level telemetry		19
		Carry out a maintenance inspection & test of transfer pumps & float switches		15
Pond 3, 4 & 5 Overtopping leading to wall erosion / wall failure and environmental discharge to surrounding land	19	Maintain at DSA by pumping to Pond 1 & 10	X	15
		Weekly inspection	X	19
		Shut off inflow (does not include related gas production)	X	15
		Investigate level telemetry		19
Dam 1 Overtopping leading to wall erosion / wall failure and environmental discharge to surrounding land	19	Maintain Dam 1 below MRL by transfer to Dam 10	X	15
Dam 10 Overtopping spillway leading to environmental discharge to surrounding land	13	Discharge undiluted dam water to river with a trigger point at Dam 10 MRL & carry out MRL reporting to DERM		8
		Investigate relocating RO plant from Arrow Surat to the MGP		13 (4 if implemented this wet season)
		Investigate Turbo Mister for enhanced evaporation located at Dam 1 / 10 including liaison with DERM of this option		13 (4 if implemented in this wet season)
		Investigate level telemetry		13

Hazards and Consequences	Initial Risk	Control Measures	Tick if Current	Residual Risk
		Investigate source of fresh water for dilution of discharge to river		13
DERM demanding cessation of all field water production (0.5 ML/Day)	22	Demonstration of ongoing water management plan (Dam 11, 12, 14 & RO plant) and implementation of risk controls determined by this risk assessment	X	19
Maximum Initial Risk Level (all scenarios):	**22**	**Maximum Residual Risk Level (all scenarios):**		**19**

Transfer control measures that require implementation based on residual risk of each identified hazard to assist the decision making process used to determine which risk will be treated first and what resource effort is required to achieve an acceptable level of risk.

Hazard Control Implementation Plan			
Priority	**Actions**	**Responsibility**	**Due Date**
1	Reduce Dam 2 level by 500mm by transfer to Dam 10	[redacted]	15/01/11 Currently transferring from Pond 2 to Pond 1
2	Disperse Bentonite inside dam wall at leak location to plug the leak		Complete Results not evident immediately
3	Investigate reinforcing the leaking corner of Dam 2		23/12/10
4	Conduct daily inspection of Dam 2 leak		19/11/10 In place and ongoing
5	Review Ross Stafford October 2010 Dam Survey Report for Dam 2 update		07/12/10
6	Investigate dam level telemetry		23/12/10

7	Adjust level control settings on Pond 6 & 7 and place auto level control back into service	[redacted]	Complete
8	Shut down Pond 9 inflows and pump down to 500mm below DSA		Complete
9	Carry out a maintenance inspection & test of transfer pumps, float switches & level indicators		03/12/10 Delayed due to lack of access ETA 10/12
10	Maintain Ponds 3, 4 & 5 below DSA by pumping to Pond 1 & 10		Complete
11	Conduct weekly inspection of all Dams & Ponds		Ongoing
12	Shut off inflow to Ponds 3, 4 & 5		Complete
13	Maintain Dam 1 below MRL by transfer to Dam 10		Ongoing
14	Produce an SOP for discharge of undiluted dam water to river with a trigger point at Dam 10 MRL (subject to approval of this Risk Control Action)		26/11/10 Delayed due to unexpected complexity ETA 8/12
15	Report MRL & submit Program Notice to DERM for imminent discharge to the river		When required
16	Investigate relocating RO plant from Arrow Surat to the MGP		Complete – Technically feasible however will take 12 weeks from approval to complete. This will not be in time to reduce the overtopping risk.
17	Investigate Turbo Mister for enhanced evaporation located at Dam 1 / 10		Complete - Technically feasible but not able to

		[redacted]	materially assist water disposal during expected wet season
18	Liaison with Arrow Management & DERM on all aspects of Water Management actions from this risk assessment outcomes		26/11/10 Ongoing
19	Investigate source of fresh water for dilution of discharge to river		Complete – Trucking dilution water is not feasible. Refer summary by Brad Wilson.
20	Install a direct discharge from Dam 10 to the river		03/12/10 Seeking approval for alternate discharge point through Ben M.

APPROVAL			
Risk Assessment Leader Sign-off			
Name:	[redacted]		
Job Title:	Production Manager	Date:	7/12/10
Signature:	[redacted]	Review Date:	14/12/10
Management Acceptance Sign-off (Required where residual risk is greater than Low Risk)			
Name:	[redacted]		
Job Title:	Assett General Manager - North	Date:	
Signature:		Review Date:	

Send copy of completed Risk Assessment to relevant site-based OHS section for inclusion in Corrective Actions Register.

CLOSE OUT			
Closed out:	☐ YES ☐ NO	Date:	
Name:		Job Title:	
Signature:			

Arrow Energy Risk Matrix

Consequence						Likelihood				
						Rare or practically impossible 0-5%	Not likely, uncommon 6-20%	Has occurred in the past but not common 21-50%	Likely, has occurred in recent history 51-80%	Common or almost certain >80%
Financial impact	**OH&S impact**	**Environmental impact**	**Schedule impact**	**Reputation/ Legal impact**		**Practically impossible**	**Not likely**	**Could Happen**	**Has Happened**	**Common**
>$50M	1 or more fatalities	Serious LT effect	> 3 Months	Widespread serious	**Catastrophic**	15	19	22	24	25
$10M to $50M	Permanent disability	Serious Med to LT	2 - 12 Weeks	Wider spread moderate	**Major**	10	14	18	21	23
$1M - $10M	Medical treatment	Moderate ST to Med	8 - 14 Days	Localised and moderate	**Serious**	6	9	13	17	20
$100k - $1M	Minor injury	Minor Short term	4 - 7 Days	Localised and minimal	**Minor**	3	5	8	12	16

<$100k	No injury	Low level No lasting	< 3 Days	No impact	Insignificant	1	2	3	4	5	11

Risk Ranking and reporting requirements	Very High (18-25)	Risks reported to the Board (through the (project) management structure and Risk Committee) on a monthly basis
	High (18-22)	Risks reported to the Board (through the (project) management structure and Risk Committee) on a monthly basis
	Medium (9-17)	Risks report to the Risk Committee (through the (project) management structure)
	Low (4-8)	Risk handled by normal (project) management structure
	Very low (1-3)	Risk handled by normal (project) management structure

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26 October 2010

Ref: ENV10-245

[redacted]
Manager, Petroleum and Gas Unit
Department of Environment & Resource Management
(sent via email 26 October 2010)

RE: Incident Notification - Threatened or Potential Environmental Harm

Dear [redacted]

On the behalf of Arrow Energy Limited (Arrow) I am providing notification of threatened or potential environmental harm on PL191/196 (under PEN100015907) - Moranbah Gas Project (MGP).

Date:
26 October 2010

Location:
Moranbah Gas Project PL191/196

Description:
The Design Storage Allowance (DSA) in Dam 1 has been exceeded. Production of gas and water from wells at the MGP has been curtailed to the point where net evaporation currently exceeds net coal seam water input. Arrow lacks sufficient storage in other dams to transfer sufficient water from Dam 1 to comply with the DSA prior to commissioning of Dam 11. Currently the forecast completion of Dam 11 is estimated to be early December.

Potential Impact:
Arrow will enter the early part of the wet season exceeding the DSA for Dam 1. At present other dams are below DSA levels.

Immediate Actions:
Production of gas and water from wells at the MGP has been curtailed to the point where net evaporation currently exceeds net coal seam water input. Arrow is currently considering a number of options to regain storage capacity. Any plans would be subject to detailed evaluation of safety implications and would comply with the requirements of the relevant Environmental Authority.

Regards,

[redacted]
Manager Compliance & Reporting

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Annexure–GDC5

Department of Environment
and Resource Management

Coal Seam Gas Water Management Policy

June 2010

Tomorrow's Queensland:
strong, green, smart, healthy and fair

Toward Tomorrow's Queensland

Queensland Government

Purpose

The purpose of this policy is to ensure that salt produced through coal seam gas (CSG) activities does not contaminate the environment and to encourage the beneficial use of treated CSG water.

The policy finalises the discussion paper published by the Department of Infrastructure and Planning titled Management of Water Produced from Coal Seam Gas Production Discussion Paper, May 2009. This policy relates to amendments to the *Environmental Protection Act 1994* (EP Act) enacted in 2010.

What is coal seam gas water?

CSG water is water extracted from coal seams in order to release coal seam gas. CSG is a natural gas consisting primarily of methane, which is adsorbed into coal. Once produced, it can be used for the same purposes and applications as conventional natural gas.

CSG water typically contains significant concentrations of salts. The salinity of CSG water is variable and is measured as the concentration of total dissolved solids. The total dissolved solids values may vary from 200 to more than 10,000 milligrams per litre.

For comparison, good quality drinking water has total dissolved solids values of up to 500 milligrams per litre. The total dissolved solids value of sea water is between 36,000 and 38,000 milligrams per litre.

What is saline effluent?

Treatment of CSG water through desalination technologies produces concentrated saline waste water.

This saline effluent contains concentrations of salts in excess of the source CSG water. The concentration of the saline effluent depends on the treatment process used and the salinity of the source CSG water.

Why has this policy been developed?

CSG production is an expanding industry supplying the domestic market for gas in Queensland. It will expand further with the establishment of export production facilities for LNG in Gladstone.

Significant quantities of water are generated in CSG production. The salty nature and commonly poor quality of CSG water means that it has the potential to cause environmental harm if released to land or waters through inappropriate management. The government wishes to see this water only stored and used in a manner that protects the environment from harm and maximises the opportunity to beneficially use the resource.

Relevant legislation

CSG water extraction is authorised under the *Petroleum and Gas (Production and Safety) Act 2004* or the *Petroleum Act 1923*.

Production of CSG and the associated CSG water must be authorised by an environmental authority issued under the EP Act. CSG water is a waste that must be either disposed of in accordance with the conditions of an environmental authority or used beneficially in accordance with a beneficial use approval.

The disposal of brine that may be created in the treatment of CSG water or the disposal of solid salt is also regulated under the EP Act. Brine and solid salt may also be used under a beneficial use approval.

References in this policy to the 'administering authority' are to Department of Environment and Resource Management's (DERM) exercise of formal powers under the EP Act.

Background

In October 2008, the government released the Queensland Coal Seam Gas Water Management Policy. That policy outlined the following principles for management of CSG water:

- Discontinue the use of evaporation dams as a primary means to dispose of CSG water; remediation of existing evaporation dams is to occur within three years with transitional arrangements to be developed in

consultation with industry.

- Dams necessary for water aggregation and the storage of brine from treatment facilities are to be fully lined to a standard determined by DERM.
- CSG producers are responsible for treating and disposing of CSG water.
- CSG water must be treated to a standard defined by DERM before disposal or supply to other water users.
- A CSG water management plan (CWMP) is to be incorporated into the environmental management plan (EMP) required for a large scale coal seam gas environmental authority application.
- CSG water in excess to that which can be directly injected or beneficially used, is to be aggregated for disposal.

In May 2009, the government released the Management of Water Produced from Coal Seam Gas Production Discussion Paper. This discussion paper acknowledged the increasing risks, both ecological and agricultural, associated with the significant quantities of salt being brought to the surface and requiring disposal as a result of the expansion of CSG production. It also acknowledged the undesirability of an increasing area of evaporation dams if these were to continue to be used as the primary means to dispose of untreated CSG water.

The discussion paper introduced three new issues:

- circumstances under which industry would be required to cooperate on developing and funding a CSG water aggregation and disposal system (or systems)
- reasonable and appropriate remediation action for existing evaporation dams
- appropriate disposal options for the saline effluent resulting from CSG water treatment.

Issues related to the CSG industry working cooperatively on developing a water aggregation and disposal system are not specifically addressed in this policy. They are to be dealt with through other government initiatives.

Policy framework for coal seam gas water management

1. Unless producers use direct injection of CSG water, or have arrangements for environmentally acceptable direct use of untreated CSG water, they must treat CSG water to a standard defined by DERM before disposal or supplying to other users.

The guideline: Preparing an Environmental Management Plan for Coal Seam Gas Activities sets out preferred and non-preferred management options for CSG water. These are:

- Category 1 – preferred management options include:
  - injection where detrimental impact unlikely
  - untreated use where detrimental impact unlikely
  - treatment to an agreed standard for agricultural, industrial and potable uses
- Category 2 – non-preferred management options include:
  - disposal via evaporation dams
  - disposal via injection where a detrimental impact is likely
  - disposal to surface waters
  - disposal to land.

The water management options in each category are not in any preferred order.

For CSG water management options involving beneficial use of the water, a project proponent must comply with a general approval of a resource for beneficial use, or apply for a specific approval of a resource for beneficial use.

A beneficial use approval changes the status of the material from a waste to a resource that can be used for a beneficial purpose. The holder of a beneficial use approval is obliged, through approval conditions, to manage that resource in a way that minimises the risk of environmental harm.

A general beneficial use approval is an approval of a resource, from which anyone can benefit. A specific beneficial use approval is an approval of a resource, of which only a stated person has the benefit.

The guideline: Approval of Coal Seam Gas Water for Beneficial Use describes the minimum standards for different types of beneficial use. DERM will issue a notice of decision to approve a resource for beneficial use (a general beneficial use approval) for CSG water for the following uses:

- aquaculture and human consumption of aquatic foods
- coal washing
- dust suppression
- industrial use
- irrigation
- livestock watering.

2. Evaporation dams are to be discontinued as a primary means for disposing of CSG water

Recent (2010) amendments to the EP Act prohibit construction of CSG evaporation dams approved under existing CSG authorities (apart from those where the construction of the dam has substantially commenced before the changes to the EP Act take effect on the 5 July 2010).

A CSG evaporation dam is defined as an impoundment, enclosure or structure that is designed to be used to hold CSG water for evaporation.

The prohibition exists until the holder of a CSG environmental authority gives the administering authority a revised CSG environmental management plan (EMP) demonstrating that there is no feasible alternative other than to build the dam, and the holder receives a notice in writing from the administering authority approving the construction of the dam.

An EMP must not include using a CSG evaporation dam in connection with carrying out a relevant CSG activity, unless the plan includes an evaluation of best practice environmental management for CSG water and alternative ways for managing the water. The evaluation must demonstrate that there is no feasible alternative for managing the water, other than a CSG evaporation dam.

All CSG environmental authority holders must submit a revised EMP within 12 months of the changes to the EP Act, which take effect on the 5 July 2010. This will ensure that existing holders and new holders are subject to the same requirements, and existing holders are meeting best practice environmental management. If a holder of a CSG environmental authority fails to comply with this section, the administering authority has the ability to amend the conditions of the environmental authority by reason of a contravention of the EP Act.

It is expected that only in very rare circumstances will justification exist for using an evaporation dam. The government considers that there will be no suitable justification for proposing disposal of CSG water in an evaporation dam during the production phase of a project.

Evaporation dams may be the only feasible option for CSG water disposal associated with exploration and appraisal wells. Evaporation dams may be considered when:

- water quality and quantity is uncertain
- infrastructure at, and access to, the well site is limited
- the well site is remote to the rest of the project activities.

If authorisation of an evaporation dam is to occur, it will be limited to the activity of exploring for petroleum or gas.

Exploring for petroleum or gas is carrying out an activity for the purpose of finding petroleum or gas. For example:

- conducting a geochemical, geological or geophysical survey
- drilling a well
- carrying out testing in relation to a well
- taking a sample for chemical or other analysis.

When DERM is assessing an evaluation, which has concluded that there is no feasible alternative for managing CSG water other than an evaporation dam, the following criteria will be considered:

(a) is exploring for petroleum or gas being carried out?

(b) has sufficient information been provided to demonstrate that legislative, environmental, technological, economic or social requirements have all been evaluated and taken into consideration when deciding that this is the most feasible option?

(c) is the proposed quantity of water to be produced from the well or group of wells less than 400 megalitres?

(d) is the proposed evaporation dam less than 20 hectares in size?

(e) is there a physical barrier, tenure constraint or factor of remoteness involved (>50 kilometres) that prevents an exploration well or group of wells from being connected to other water treatment or disposal facilities?

Under a CSG EMP, a re-evaluation of the use of any evaporation dam must be undertaken on an annual basis to determine if water management practices can be improved and whether any preferred management options in the CSG water management hierarchy can be employed.

Any approved evaporation dam must be designed and operated so that, if it is not intended to be connected to a project's water treatment system during the production phase, it can be decommissioned and rehabilitated as soon as possible and no longer than 10 years from when the dam was first commissioned.

Use of evaporation dams for the disposal of brine resulting from CSG water treatment processes is recognised as an acceptable management method for that particular waste stream. For the purposes of this policy, brine is defined as saline water with a total dissolved solid concentration greater than 40,000 milligrams per litre. A brine dam means a dam designed to receive, contain or evaporate brine.

The government's policy does not preclude dams for aggregation of CSG water or CSG water concentrate. Where options for injection and reuse are not immediately available, CSG water or CSG water concentrate may be contained in dams designed to aggregate water (such as deep dams with a small footprint), rather than dams designed to evaporate water (such as shallow dams with a large footprint).

To encourage preferred solutions for the treatment, use or disposal of CSG water and CSG water concentrate, the administering authority requires that during any period of 30 days, following the first 90 days after commissioning the operation of an aggregation dam, the total volume of water leaving that dam, other than by evaporation, must be not be less than 85 per cent of the volume of water that has entered the dam.

3. Dams necessary for water aggregation and the storage of brine from treatment facilities are to be fully lined to a standard determined by DERM.

DERM has developed performance-based standards, rather than prescriptive standards, for dams receiving CSG water, CSG water concentrate or brine. These standards will form part of the guideline: Dams in Environmentally Relevant Activities and the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams.

The objective is that any dam containing CSG water, CSG water concentrate or brine, must be designed to effectively avoid environmental harm through contamination of surrounding or underlying land and groundwater.

The following design standards will be applied to achieve this objective.

Aggregation dams and CSG water evaporation dams must:

- be designed with a floor and sides made of material to contain the wetting front and any entrained contaminants within the bounds of the containment system during its operational life, including any period of decommissioning and rehabilitation
- have a system to detect any passage of the wetting front or entrained contaminants through either the floor or sides of the dam
- either, be capable of repair to rectify any passage of the wetting front through the floor or sides of the dam, or be decommissioned and rehabilitated.

Brine dams must:

- be designed with a floor and sides made of material that will contain the wetting front and any entrained contaminants within the bounds of the containment system during its operational life, including any period of

decommissioning and rehabilitation

- have a system for the collection and proper disposal of any contaminants that move beyond the bounds of the containment system
- have a system that will detect any passage of the wetting front or entrained contaminants through either the floor or sides of the dam
- either, be capable of repair to rectify any passage of the wetting front through the floor or sides of the dam, or be decommissioned and rehabilitated.

The system implemented to detect the passage of the wetting front through either the floor or sides of the dam must consist of more than just monitoring groundwater aquifers.

The design, construction, operation, modification and decommissioning of any regulated dam that is part of a CSG project must be undertaken in accordance with the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams and the accompanying guideline: Dams in Environmentally Relevant Activities.

4. A CSG water management plan is to be incorporated into the environmental management plan required for an application for a level 1 environmental authority.

Recent amendments to the EP Act provide that where an application is for a CSG environmental authority, the accompanying EMP must state the following:

(a) the quantity of CSG water the applicant reasonably expects will be generated in connection with carrying out each relevant CSG activity

(b) the flow rate at which the applicant reasonably expects the water will be generated

(c) the quality of water, including changes in water quality, which the applicant reasonably expects will happen while each relevant CSG activity is carried out

(d) the proposed management of water, including the use, treatment, storage or disposal of the water

(e) the measurable criteria (management criteria) against which the applicant will monitor and assess the effectiveness of the management of water, including criteria for each of the following—

  (i) the quantity and quality of water used, treated, stored or disposed of

  (ii) protection of environmental values affected by each relevant CSG activity

  (iii) the disposal of waste, including, for example, salt generated from the management of water

(f) the proposed action to be taken if any of the management criteria are not satisfied, to ensure the criteria will be able to be satisfied in the future.

The EMP must not provide for using a CSG evaporation dam in connection with carrying out a relevant CSG activity, unless the plan includes an evaluation of best-practice environmental management for CSG water and alterative ways for managing the water. The evaluation must show that there is no feasible alternative for managing the water than a CSG evaporation dam.

The content requirements for a CSG water management plan (CWMP) are specified in the guideline: Preparing an Environmental Management Plan (EM plan) for Coal Seam Gas (CSG) Activities.

Once the revised EMP has been submitted, the annual returns thereafter must include an evaluation of the effectiveness of the management of CSG water under the management criteria specified in the EMP. The evaluation is required to state whether or not the CSG water has been effectively managed under the criteria; and if the water has not been effectively managed, the action that will be taken to ensure that water will be effectively managed under the criteria in the future. This process implements an adaptive environmental management regime for CSG water, whereby management criteria are established and evaluated on an annual basis.

5. What remediation action for existing evaporation dams is reasonable and appropriate?

The policy outlined in the Queensland Coal Seam Gas Water Management Policy, September 2008, requires remediation of existing evaporation dams to occur within three years. This three-year period expires on 1 October 2011.

For existing evaporation dams, the remediation action considered necessary by 1 October 2011 includes:

- all existing dams containing CSG water, CSG water concentrate or brine must meet the standards for either aggregation dams and CSG water evaporation dams, or brine dams, as set out in section 3
- all existing evaporation dams must be converted to operate as aggregation dams, be decommissioned; or a revised CSG EMP that includes an evaluation demonstrating no feasible alternative for managing the water, other than a CSG evaporation dam at a particular location, must have been submitted and the administering authority must have approved the use of the dam in writing.

6. Transitional arrangements will be developed by government in consultation with industry to address issues with existing evaporation dams. Remediation of existing evaporation dams is to occur within three years.

The government is aware that most CSG environmental authority holders will require more than 18 months to transition existing operations and infrastructure to meet the above remediation standards. For that reason, an appropriate transitional arrangement could include the voluntary submission of a draft transitional environmental program (section 330 EP Act) for the approval of the administering authority, by which existing dams will be able to be transitioned to these standards. The government considers that transitional environmental programs (TEPs) should not need to extend for longer than a three-year period. However, a longer period is available subject to public notification requirements, as described under the EP Act. The TEP may include either:

- a program to ensure all existing dams containing CSG water, CSG water concentrate or brine meet the standards as outlined in section 3
- a program to convert CSG evaporation dams into aggregation dams or brine dams
- a program to decommission and commence rehabilitation of any CSG evaporation dam that does not meet the standards, or that can not be converted to an aggregation dam or brine dam.

7. What management or disposal options are appropriate for the saline effluent and solid salt wastes resulting from water treatment?

The treatment of CSG water results in both high quality water but also a saline effluent that needs to be carefully managed. This saline effluent, if subject to evaporation, can produce a dry solid salt after the water evaporates. The decommissioning and rehabilitation of dams will also produce dam lining material contaminated with salt that will require proper disposal.

The government's goal is to prevent salt produced through CSG activities from contaminating the environment.

The government's policy follows the requirement of the EP Act that decisions about the disposal of waste be made on the basis of a waste management hierarchy from the most acceptable solution to the least acceptable solution.

For the management, treatment and disposal of brine and solid salt, the hierarchy is in order of decreasing preference:

1. waste reuse or recycling by chemically processing or treating brine or salt residues to create useable or saleable products (e.g. soda ash)
2. injection of brine into a natural underground structure that is geologically isolated and does not contain groundwater, which does or could supply water for potable or agricultural purposes
3. waste disposal of:
   - 3.1 brine solution by piped ocean outfall
   - 3.2 solid salt into a suitable existing licensed regulated waste disposal facility
   - 3.3 salt into a purpose-built licensed and regulated waste disposal facility on freehold land owned by the CSG

operator.

Any proposal for using a method of managing brine or solid salts that is lower than the highest method indicated in the hierarchy, must demonstrate why each of the more desirable approaches (higher up the hierarchy) could not be used. The administering authority will then consider approving and setting conditions for the proposal under the EP Act.

Disposal of brine solution to marine waters will only be allowed if it is from a suitably designed piped ocean outfall. As concentrated brine can be toxic to aquatic organisms, the administering authority will not authorise such discharges unless expert scientific analysis shows that the environmental values in the receiving marine waters will not be adversely affected by the discharge.

Solid salt wastes will only be able to be disposed of in a licenced regulated waste disposal facility.

The CSG operator must locate purpose-built facilities on land that is owned by the operator. If salt is to be disposed of in this way the CSG operator must ensure that the footprint and the number of any purpose-built facilities is minimised.

Such facilities will be listed on the contaminated land register and will require ongoing management action by the CSG operator, in accordance with a site management plan, before the gas production tenure underlying any site used for salt disposal can be surrendered.

Any facility must be designed and constructed by a suitably qualified and experienced person to provide the performance required for ensuring that the solid salt residue is contained within the facility for the foreseeable future.

The design and construction of any facility must:

- ensure that the salt is contained within the facility and does not contaminate the environment
- not occur above the natural surface level of the surrounding land
- minimise the risk of any adverse impact on sensitive environments, land with high ecological value, agricultural lands and useful surface water and groundwaters
- be located so that it is protected from regional or local flooding.

Definitions

Adaptive environmental management regime is a structured, iterative process of optimal decision making in the face of uncertainty, with an aim to reduce uncertainty over time via system monitoring and instigating change where required.

Aggregation dam is a dam that receives and contains CSG water or CSG water concentrate. An aggregation dam must be designed and operated so that during any period of 30 days, following the first 90 days of operation of the dam, the total volume of water leaving the dam, other than by evaporation, must not be less than 85 per cent of the volume of water that has entered the dam.

Brine is defined as saline water with a total dissolved solid concentration greater than 40,000 milligrams per litre.

Brine dam means a dam designed to receive, contain or evaporate brine.

CSG water is defined as underground water brought to the surface of the earth or moved underground in connection with exploring for, or producing, coal seam gas.

CSG water concentrate is the concentrated saline water waste stream from a water treatment process that does not exceed a total dissolved solid concentration of 40,000 milligrams per litre.

CSG evaporation dam is defined as an impoundment, enclosure or structure that is designed to be used to hold CSG water for evaporation.

Saline effluent includes both CSG water concentrate and brine.

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26 October 2010

Ref: ENV10-245

[redacted]

Manager, Petroleum and Gas Unit

Department of Environment & Resource Management

(sent via email 26 October 2010)

RE: Incident Notification - Threatened or Potential Environmental Harm

Dear [redacted]

On the behalf of Arrow Energy Limited (Arrow) I am providing notification of threatened or potential environmental harm on PL191/196 (under PEN100015907) - Moranbah Gas Project (MGP).

Date:
26 October 2010

Location:
Moranbah Gas Project PL191/196

Description:
The Design Storage Allowance (DSA) in Dam 1 has been exceeded. Production of gas and water from wells at the MGP has been curtailed to the point where net evaporation currently exceeds net coal seam water input. Arrow lacks sufficient storage in other dams to transfer sufficient water from Dam 1 to comply with the DSA prior to commissioning of Dam 11. Currently the forecast completion of Dam 11 is estimated to be early December.

Potential Impact:
Arrow will enter the early part of the wet season exceeding the DSA for Dam 1. At present other dams are below DSA levels.

Immediate Actions:
Production of gas and water from wells at the MGP has been curtailed to the point where net evaporation currently exceeds net coal seam water input. Arrow is currently considering a number of options to regain storage capacity. Any plans would be subject to detailed evaluation of safety implications and would comply with the requirements of the relevant Environmental Authority.

Regards,

[redacted]

Manager Compliance & Reporting

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URS

24 December 2010
Project No. TBD

Arrow Energy Limited
Level 19, AM60
42 - 60 Albert Street
Brisbane Queensland 4000

Attention: [redacted]
Water and Salt Coordinator

Dear [redacted]

Subject: Moranbah Gas Facility Pond 2 Site Visit by URS

URS Australia Pty Ltd (URS) is pleased to submit this letter of findings for Pond 2 located at the Moranbah Gas Facility. This letter provides a description of the project, scope of work completed by URS, identification of risks associated with the current condition of Pond 2 and recommendations to mitigate these risks in short-term and long-term.

1 Introduction

1.1 Background

The Moranbah Gas Facility (MGF) is located in the Bowen Basin, approximately 170km west of Mackay and approximately 10 kilometres north of Moranbah, Queensland. Pond 2 is one of several ponds used for storing saline water produced from coal seam gas (CSG) extraction and is believed to have been in operation for approximately five years. Arrow Energy Limited (AEL) retained URS to inspect Pond 2 for seepage and stability concerns. Based on the information provided by AEL[1] it is our understanding that Pond 2, along with all other AEL dams nearby, are running close to capacity due to recent heavy rainfall. Due to dam safety concerns, a decision was made to pump water from the dam into the Isaac River. Arrow Energy does not hold a licence to discharge and was subsequently instructed by DERM (Department of Environment Resource Management) to cease discharge. It is also understood that Pond 2 does not have a spillway and no outlet works.

1.2 Site Visit

A site visit was performed by a URS Geotechnical Engineer (Shaun Vemuri) on 22 December, 2010 to evaluate the current condition of Pond 2. Upon reaching the site, the URS Geotechnical Engineer met with AEL employees [redacted] to discuss the scope of work and subsequently underwent a visitor's induction. The URS Engineer was onsite from 8:45AM to 2:45PM on 22 December, 2010.

[1] Memo from [redacted] (URS) dated 17 December, 2010

URS Australia Pty Ltd (ABN 46 000 691 690)
Level 16, 240 Queen Street
Brisbane, QLD 4000
GPO Box 302, QLD 4001
Australia
T: 61 7 3243 2111
F: 61 7 3243 2199

2 Scope of Work

The objective of the site visit was to evaluate various components of the dam including (i) the upstream slopes, (ii) the crest and shoulders, and (iii) the downstream slopes to identify potential deficiencies. The focus was on noting deficiencies related to seepage, cracking, instability, depressions and maintenance concerns. In addition, the objective of the site visit was to characterise the foundation materials underlying the dam using test pits. However, due to insufficient time for clearance of underground utilities and not having access to an excavator, it was decided by AEL personnel to withhold excavation of the test pits. Hence, the URS Engineer was unable to evaluate the foundation materials underlying Pond 2.

3 Observations

3.1 Dam Orientation

Pond 2 is oriented in a northeast to southwest direction (see Figure 1). The pond is bordered by a railway track on the north and open land on the other sides. The pond crest can be accessed using a ramp located at the northeast corner.

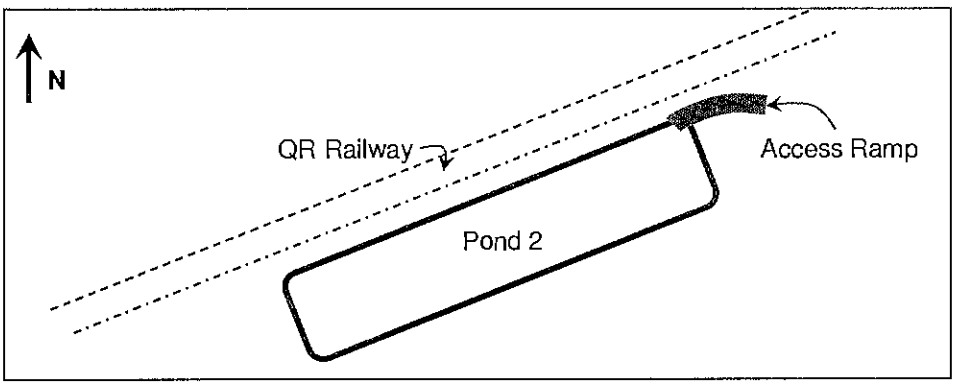
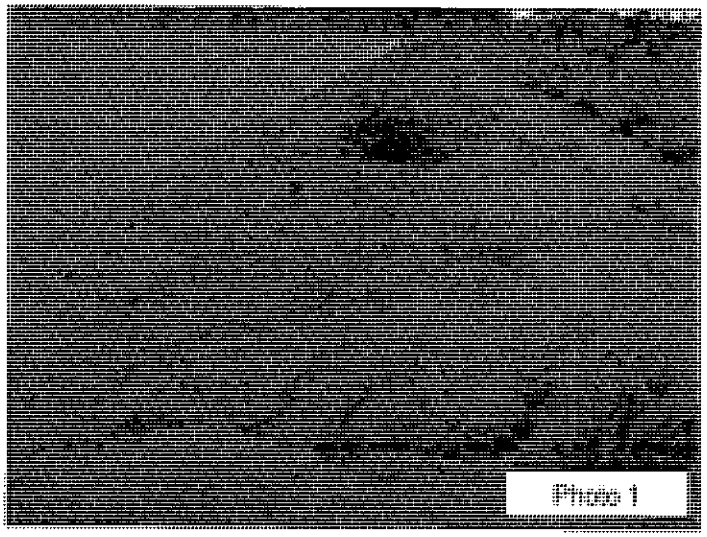
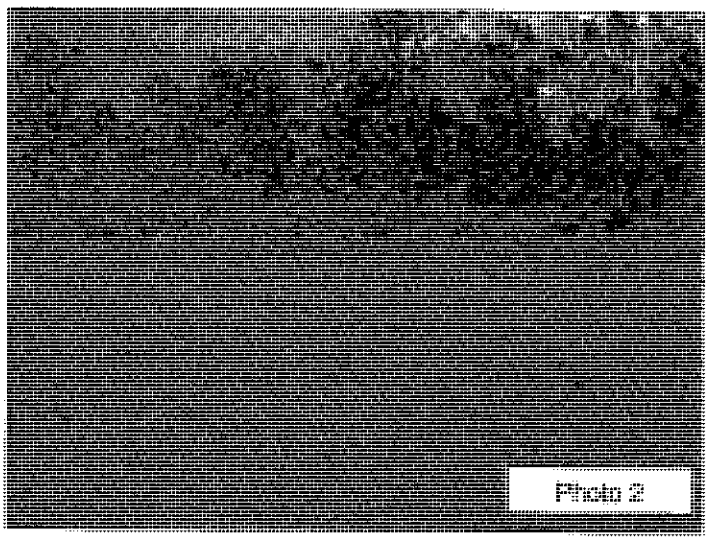


Figure 1: Sketch of Pond 2 in relation to surroundings

3.2 Upstream Slopes

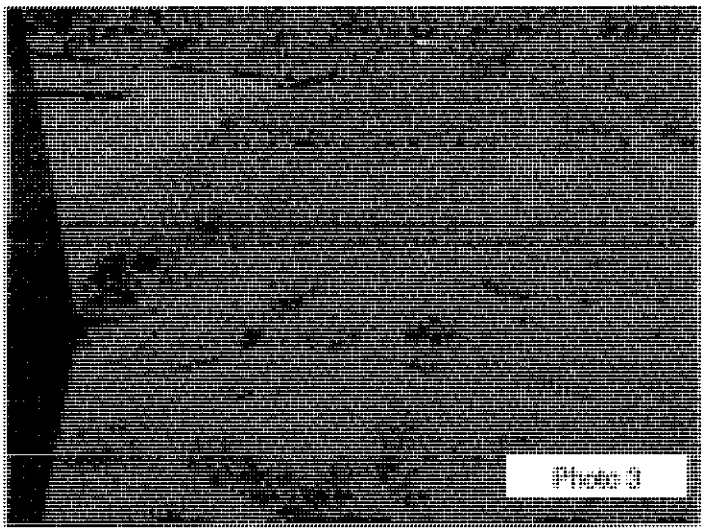
3.2.1. **Wave Action Erosion**: The action of waves on the upstream slope has resulted in wave action erosion (beaching) and degradation of the slopes (see Photos 1 and 2). The wave action has eroded the embankment material significantly in several locations. Portions of the upstream slopes have been eroded due to wave action reducing the overall width of the crest.





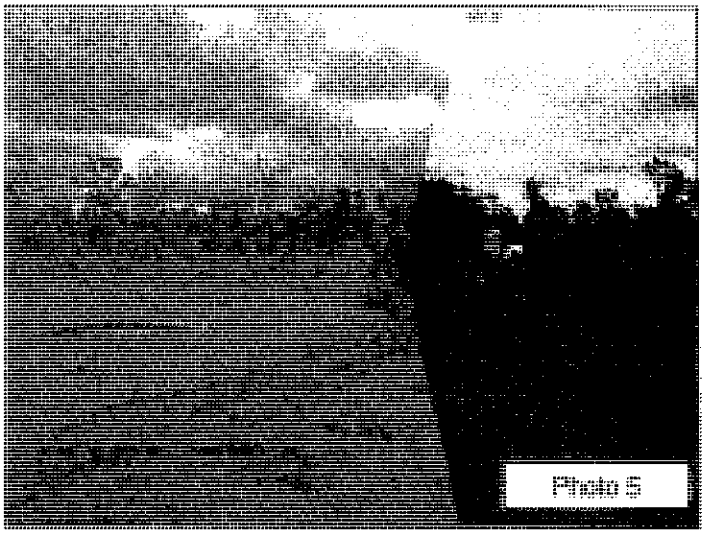
3.2.2. **Degradation**: Degradation of the upstream slopes appears to have been accelerated due to recent heavy rainfalls. Increased wave action from strong winds may also have caused the upstream slopes to erode into the crest, especially along the east side crest.

3.2.3. **Gullies:** Surface run-off has caused formation of gullies in several areas effectively reducing the cross-sectional area of the dam (see Photo 3). It is possible that the recent heavy rainfall has exacerbated the formation of gullies.



3.3 Crest and Shoulders

3.3.1. **Vegetative Growth:** Excessive vegetative growth was noted along the crest with deep-rooted vegetation (trees) in two locations (See Photos 4 and 5). Two trees approximately 200 millimetres in diameter were noted along the crest.



3.3.2. **Desiccation Cracking**: Honeycomb pattern (desiccation) cracking was noted at several locations along the crest. Surface runoff is collecting in desiccation cracks reducing the strength of the underlying embankment material.

3.3.3. **Transverse Cracking:** No clearly visible signs of transverse cracking (cracking perpendicular to the dam axis) were noted with Pond 2 crest. However, three (3) areas were noted along the crest where the crest surface was lower than surrounding areas (localised depressions) (See Figure 2). Specifically, one area was located north of the access ramp, one immediately south of the access ramp and one along the north side crest. The widest depression was approximately 10 meters in width and located approximately 1/3rd of the distance along the north side crest from north east corner (See Photo 6).

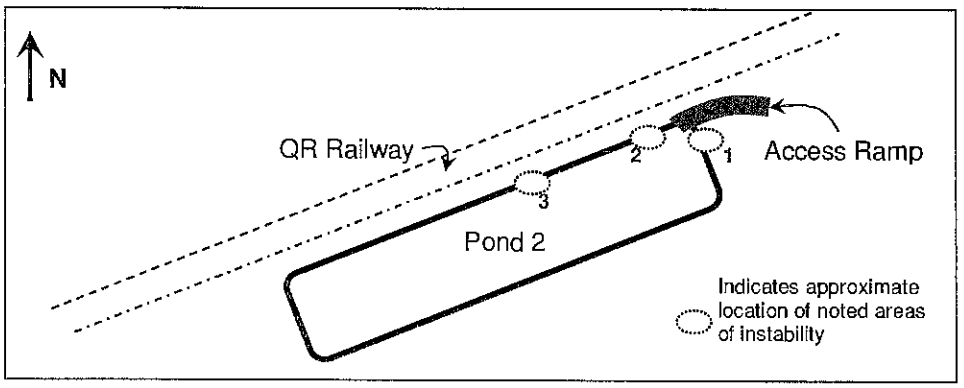
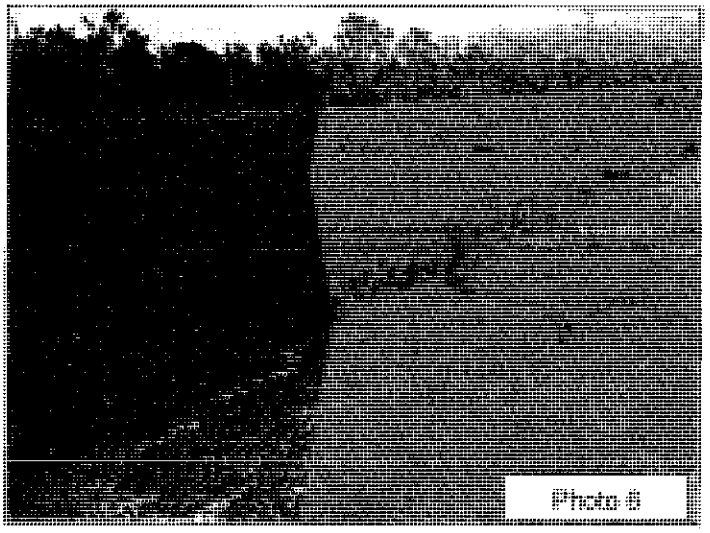
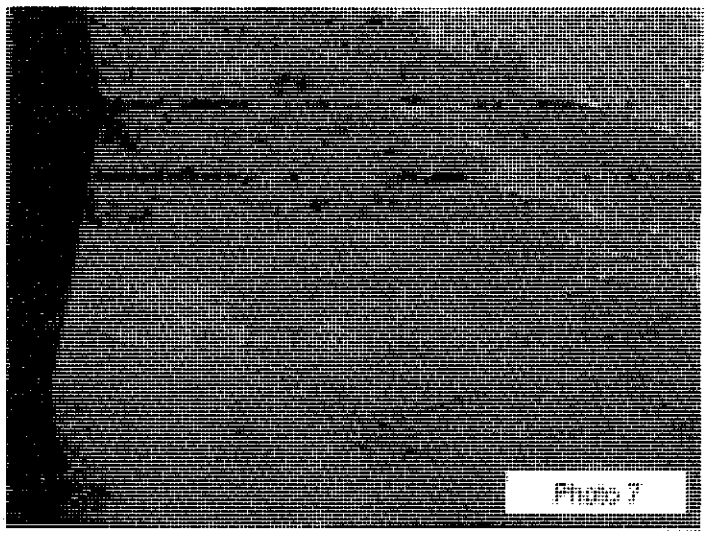


Figure 2: Noted areas of instability

3.3.4. **Longitudinal Cracking:** Signs of longitudinal cracking (parallel to the dam axis) were noted in the same three areas as mentioned in article 3.2.3. Longitudinal cracking in these areas appear to be the beginning scarps of unstable slopes downstream (See Photo 6).

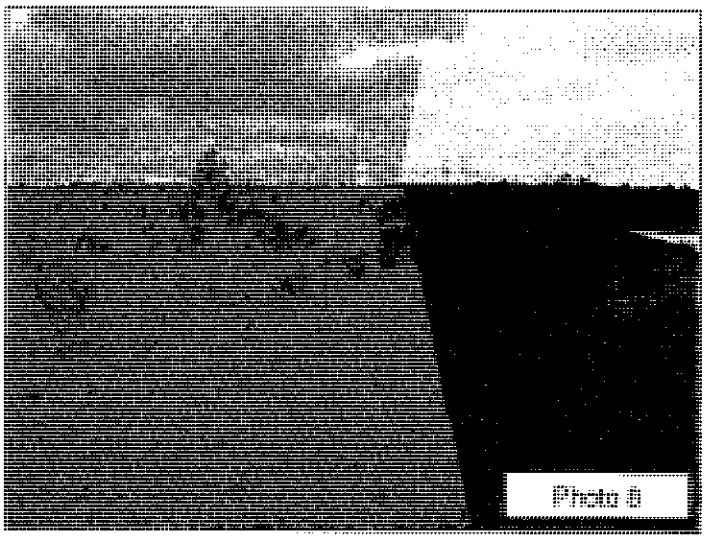


3.3.5. **Depressions:** Localised settlement in the crest surface was noted at several areas along the crest and this may be due to poor compaction and/or surface erosion. (See Photo 7).

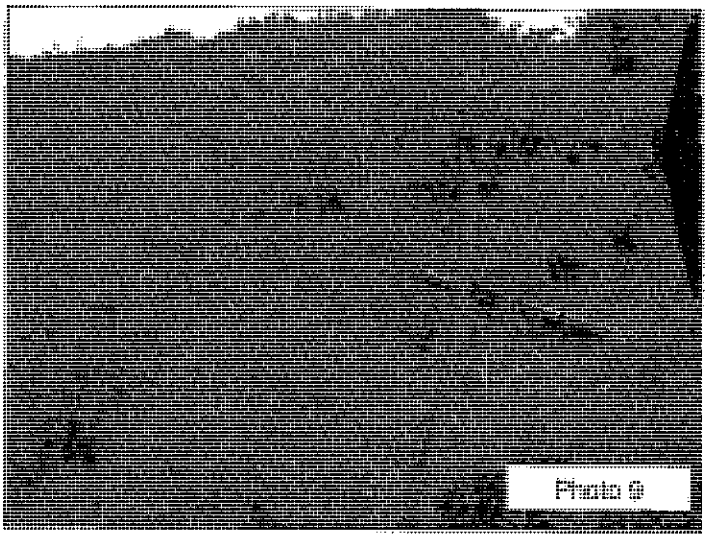


3.4 Downstream Slopes

3.4.1. **Thick Vegetation**: Thick vegetation significantly hindered the visual inspection of the downstream slopes (see Photo 8). It is possible that several signs of instability such as bulges, cracks and slides were obscured by vegetation and thus limiting the scope of inspection.



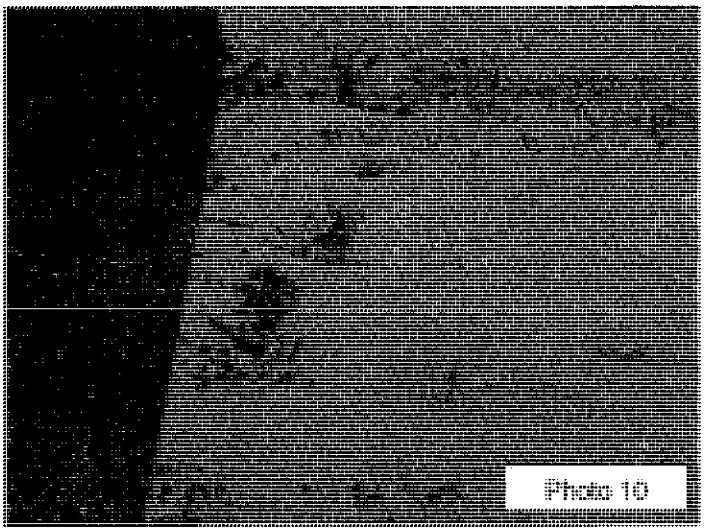
3.4.2. **Slope instability:** Slope instability was noted in three (3) areas shown in Figure 2. The scarps in these areas have extended to the downstream crest reducing the effective width of the crest. The slides near Area 1 and Area 2 appear to be fairly deep seated and significantly deep cracks (see Photo 9).



3.4.3. **Poor Compaction:** Downstream slopes appear to have significantly higher number of erosion rills, gullies and uneven surface than normally expected for such dams. Due to thick vegetation, the underlying surface was mostly obscured. However, the unevenness noted while walking the slopes, indicates that the slopes are rarely uniform. It is possible that inadequate compaction of embankment material has resulted in erosion and surficial sloughing. No records of construction were available for URS review at the time of this writing.

3.4.4. **Internal Erosion**: Internal erosion can occur when seepage flows along established pathways such as poorly compacted layer interfaces and cracks. Given that the dam is showing

signs of poorly compacted material, it is possible that internal erosion is occurring to some level along the downstream slopes. However, internal erosion cannot be confirmed until the slopes are cleared of vegetation. A visible sign of internal erosion was noted at the southwest corner of the dam (see Photo 10).



3.4.5. **Piping**: Piping is a significant risk to Pond 2. Piping occurs when the reservoir water moves through the pores of the dam with enough tractive force to remove soil particles at the exit point. Good indicators of piping are sand boils. While no sand boils were noted during the visual inspection, it is highly possible that the signs of seepage were obscured by thick vegetation.

3.4.6. **Sampling:** URS obtained soil samples from Area 2 for laboratory tests including soil classification and particle size analysis. Information from laboratory tests will be used for designing emergency response measures such as a reverse graded filter.

4 Conclusions and Recommendations

The following preliminary conclusions and recommendations are provided based on the observations made during the site visit. These conclusions and recommendations will need to be reviewed as further information is obtained regarding the nature of the embankment and based on further discussions with AEL.

4.1. **Dam Safety**: Given that there are three areas of potential instability on the downstream face of the embankment and the observed reduction in the effective crest width due to erosion, Pond 2 is considered to have an unacceptably high risk of embankment failure. Measures need to be implemented as a matter of priority to mitigate the risk of embankment failure.

4.2. **Short Term**: It is recommended that the water in Pond 2 be lowered to below the level of the observed instability on the downstream slopes. While no survey has been undertaken across the embankments, it is estimated that the water level will need to be lowered a minimum of four (4) meters below the Design Storage Allowance (DSA). Lowering the water level will reduce the short

term seepage risk until further action is taken regarding the future use of the dam. It is important that the water level be lowered immediately in preparation for the ongoing wet season.

4.3. **Daily Surveillance**: URS recommends daily surveillance of the embankment in the short term. AEL personnel inspecting the embankment must take photos on a daily basis for comparison and complete a record of each inspection noting the condition of the embankment and any observed changes.

4.3 **Slope instability:** URS has observed three (3) marginally stable areas that need further evaluation. It is recommended that vegetation be removed in these areas immediately to facilitate a second site visit during which the initially planned geotechnical investigations could be undertaken. If Pond 2 is completely dewatered in the short-term, further evaluation of these areas can be postponed until future use of the dam is determined.

4.4. **Spillway**: It is to be noted that Pond 2 does not have a spillway. This increases the risk of overtopping in the event of heavy rainfall. It is recommended that AEL maintain the water elevation in Pond 2 at least four (4) meters below the DSA (Design Storage Allowance) in short term. At the time of URS site visit, the pond water level was 405 mm below MRL (Mandatory Reporting Level).

4.5. **Downstream Slopes**: The URS Engineer could not fully inspect the downstream slopes of the embankment due to thick vegetation. It is recommended that AEL personnel mow the downstream slopes and shoulders as soon as possible to facilitate further inspection. If AEL decides to completely dewater the pond in short-term, mowing is not necessary until the future use of the dam is determined.

4.6. **Long Term Options**: Based on the information presented here, the following long term options need to be discussed with AEL to improve the safety of Pond 2.

- Option 1 would be to decommission the pond.
- Option 2 would be to lower the water level in the dam and maintain it at least four (4) meters below DSA until remedial measures are under taken. Remedial measures could include a range of measures to stabilise the embankments. However the scope of these works must also consider other key design issues such as provision of a spillway and the environmental impacts related to seepage from the dam.
- Option 3 would be to rebuild the dam completely.

5 Limitations

URS Australia Pty Ltd (URS) has prepared this memo in accordance with the usual care and thoroughness of the consulting profession for the use of Arrow Energy Limited and only those third parties who have been authorised in writing by URS to rely on the memo. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this memo.

The methodology adopted and sources of information used by URS are outlined in this memo. URS has made no independent verification of this information beyond the agreed scope of work and URS assumes no responsibility for any inaccuracies or omissions. No indications were found that information contained in this memo as provided to URS was false.

This memo was prepared based on the information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time. This memo should be read in full. No responsibility is accepted for use of any part of this memo in any other context or for any other purpose or by third parties. This memo does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this memo, URS must be notified of any such findings and be provided with an opportunity to review the recommendations of this memo. The contractor must recognise that the memo or drawings do not purport to show completely the existing conditions, nor does URS warrant the correctness of the designations given in the memos, or the correctness of any interpretation, deduction or conclusion shown in the memos or on the drawings.

Whilst to the best of our knowledge information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time. Therefore this document and the information contained herein should only be regarded as valid at the time of the evaluation unless otherwise explicitly stated in this report.

Yours faithfully
URS Australia Pty Ltd

[redacted]
Senior Geotechnical Engineer

[redacted]
Senior Principal

arrow energy
go further

MGP Water Management
Project Execution Plan

REV	DATE	DESCRIPTION	PREP'D	CHECK'D	APP'D
3	16/07/10	Update to incorporate latest strategy for Dam 12/14 & RO Plant	[redacted]		
2	06/05/10	Revision 2, incorporating latest strategy for Dam 11 and Stage 2			
1	30/03/10	Revision 1			
0	01/07/09	Issued for information			
Doc No.		03-G-PL-2012			

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CONTENTS

1. PURPOSE OF THIS DOCUMENT

The purpose of this document is to communicate to key stakeholders the need and proposed strategy to address the water management constraints at the MGP. This document provides:

1. a background to the current MGP water management status,
2. identifies the constraints,
3. communicates the Stage 1 and Stage 2 solution to expand water management capability at the MGP, and
4. facilitates collective agreement to move forward in unison.

2. DEFINITIONS

Brine - Under DERM's definition, a salt solution over 40,000 mg/L. Typically used to refer to the concentrate stream from an RO Plant, whether under or over 40,000 mg/L.

DSA - Design Storage Allowance (of a dam)

FEED - Front End Engineering Design

HP - High Pressure

Irrigation Water - Permeate from the RO plant, adjusted to correct the SAR, and sent to Dam 14.

LP - Low Pressure

MGP - Moranbah Gas Project

MGP JV - Wells and production facilities at Moranbah are owned and operated by a joint venture between AGL and Shell as CH4 Operations Pty Ltd.

MGPX - Moranbah Gas Project Expansion

MRL – Mandatory Reporting Level (of a dam)

OHS – Occupational Health & Safety

Permeate – The treated water from the Reverse Osmosis process, prior to SAR adjustment. This water is not considered potable water

PFW – Produced Field Water, water that is produced from the wells as a part of the extract of gas from coal seams

PLC - Programmable Logic Controller

RO – Reverse Osmosis, process to reduce salt content from water

WTF - Water Treatment Facility, ie the RO plant, its pre-treatment and post-treatment systems, and all associated plant that forms part of the facility. The terms WTF and RO Plant are often used interchangeably.

3. BACKGROUND

In late May 2008, Arrow, as Operator of the MGP JV, commissioned a Water Management Study to investigate the water management requirements at the MGP to cater for the 2008 & 2009 expansion of the Moranbah Gas Project (MGP). The report, issued 25 August 2008, recommended a 50 hectare Produced Field Water (PFW) evaporation Dam. The available capacity for PFW evaporation (in Dams 1 to 9) was 8.7 hectares. The methods of PFW disposal were: evaporation; dust suppression; supply to Millennium Coal Mine; and discharge to the Isaac River during a flow event, under the stipulated environmental licence conditions.

In mid 2008, the licence for wet weather discharge of PFW to the Isaac River was constrained by the Queensland Government reducing the effective conductivity levels to not more than 2,500 µS/cm (Site Licence). Construction and dust suppression limits were also constrained to conductivity levels of not more than 5,000 µS/cm (Site Licence). Current PFW conductivity levels at the MGP are approximately 8,000 – 13,000 µS/cm (ALS Lab Report). This left the only remaining discharge option for the PFW as the Millennium Coal Mine and evaporation.

Immediately following the August 2008 Water Management Study, Arrow undertook activities to scope the construction of a 50 hectare PFW evaporation Dam and piping network. This work included landowner approvals, environmental clearances and geotechnical investigations.

Late 2008, Arrow's environment department advised that government policy changed and evaporation Dams were no longer an accepted method of water management.

In December 2008, Arrow commissioned another Water Management Concept Study in support of the policy to define the timing and volume of the expected water flow rates and identify options to meet the policy. A draft report was received, 20 February 2009, and there was some concern regarding actual water production rates against drilling completion dates. These items were clarified via various drafts and finalised, 19 March 2009, indicating that the PFW would ramp up to 3.5MLD by September 09. (This figure has subsequently been revised downwards following further studies – see below). The recommendation was to install a Reverse Osmosis (RO) plant and brine Dam. The report estimated the duration to install a purpose built RO was 11 months.

In February, during the Water Management Concept Study, it became evident that the purpose built solution was not going to meet the timing requirements. The DERM was opposed to the construction of additional Dams without the use of an RO facility. As such, a leased RO plant and fast tracked brine Dam was identified as the preferred option. Arrow informally consulted the market place and received final proposals late March 2009. Simultaneously, Arrow requested a proposal to undertake a scoping study to prepare to execute a short term solution. This was also received late March 2009, and subsequently Arrow executed a contract, mid April 2009.

In late Feb 2009, the MGP operations advised that the Millennium Coal Mine had ceased accepting any water from the MGP, which closed off the only PFW discharge option at the MGP. This compounded the urgency to install a short term solution.

Following advice about Millennium, Arrow updated its assessment of current storage capacity, PFW flow rates and timing to reach maximum capacity. The assessments indicated that without any corrective action, there would be less than one month's water management capacity at the MGP.

The MGP operations began to shut-in a number of high water producing wells to delay the onset of reaching 'tank tops'. This assisted in providing additional time to allow any short term solution to be implemented.

In May 2009, Arrow's assessment around the difficulty of obtaining approvals to construct Dams without an RO in place changed. It was thought that Dam approvals, as part of the longer term beneficial use strategy, would be relatively straight-forward and could meet the required schedule. It was thus determined that the most cost effective option was not to lease an RO plant, but to construct the long term brine storage Dams. The Dams (Stage 1) could be used for storage, until a permanent solution could be identified. Conceptually this comprised an additional brine storage Dam and permanent RO facility (Stage 2, subject to a study).

In June 2009, Arrow conducted an option study to investigate the different PFW management options available. It was concluded that the best option was to build two PFW storage Dams in the short term and install a permanent RO plant and another Dam in the longer term. A second options study was conducted to determine how the treated water was to be disposed of. It was concluded that operations use would form a part of the base case for managing the treated water and as a risk-mitigating measure there was the discharge into the Isaac River. The value-added option being investigated was to supply to a third party for a fee, which has commercial risks.

In the scoping study performed by WDS the cost of the long term water management FEED was requested in order to use that figure for the AFE. The costs were higher than what was budgeted for and was difficult to interpret due to there being no allowance for project management. It was therefore decided that the FEED would go out to tender with reduction in scope, mainly in relation to negotiations with the RO vendor now falling under Arrow's scope. The expression of interest went out to three consultants, CH2M HILL, URS Asia-Pacific and WDS Oil & Gas.

In July 2009, there were delays in commencing geotechnical investigations, and delays in commencing the Dam Design Report, because these requirements were not clearly understood. These delays in critical activities, and the required duration for earthworks activities, pushed the best possible completion date of Dam 10 to late October 2009.

The three S2WM FEED proposals were evaluated and based on the most important criteria it was determined that URS had the best proposal to move forward with. The costs for URS's proposal were used for the STWM FEED AFE and the AFE was submitted for Arrow and JV approval.

In August 2009 the Dam drawings were received from the Dam designer. The bulk earthworks tender documentation was immediately sent out for a rapid response. All tenders were evaluated, and the company that provided the best offer was Lindley Mining Maintenance. Due to the increase of the Dam sizing to conform to DERM spillway / DSA / MRL requirements, as-bid earthworks cost increased 20% over what was originally budgeted.

The AFEs for both Stage 1 and Stage 2 Water Management were approved in mid August. With confirmation of funding approval URS was informed they were the preferred consultant to conduct the FEED engineering services for Stage 2 Water Management.

The Dam Design Report from the Dam designer was also completed in late August and was included in the submission of the environmental authority amendment to DERM. Also in late August the HDPE lining tender documents were issued to the contractors.

In early September 2009, DERM advised that a few items in the Dam Design Report required revising, and Dam 11 was removed from EA Amendment application. An additional requirement of financial assurance to obtain DERM approval wasn't highlighted before and resulted in delays in signing earthworks contract and DERM approval. Also in early September, due to Anglo's long wall mining plan, Dam 11 had to be moved to just south of Nodal Station 1. As a result of this decision, the pipeline length required to connect the dam doubled, and the pipeline cost increased by 120%.

Approval of the amended EA was granted by DERM in mid September and civil works commenced soon afterwards.

Additional information was requested by the HDPE lining tenderers. It was determined that Fabtech was the only company who could meet the timing requirements for the project. In October 2009 there was a significant period of contract negotiation with Fabtech, which ultimately resulted in a delayed mobilisation. By late October the majority of the civil works were completed.

In November 2009 the lining of Dam 10 commenced. However it was delayed due to rain, resulting in the need for additional site preparation to be performed.

In late November Dam 11 was moved again after consultation with Anglo due to their surface infrastructure being planned to be constructed on the proposed dam site. This resulted in additional costs due to a repeated geotechnical survey and further increases in costs for pipelines and roads. It also resulted in a delay in preparation of the EA for Dam 11 resulting in the dam not being built in time before Dam 10 would be full.

In early December 2009, Dam 10 fencing was completed and the valves were opened on the water line to allow water into Dam 10.

In mid December, initial RO tenders were issued, and by the end of December bids were received from all the vendors. A meeting was held with URS in early January 2010 to conduct a first pass review of the RO tenders and it was concluded that additional information was required from the vendors. One main piece of information that came out of the meeting was that the vendors were unlikely to achieved the requested 85% recovery – it was more likely to be closer to 77%. With this number in mind the size of Dam 12 was increased to 280ML in order to have sufficient overall brine storage capacity. An email was sent to the vendors requesting additional information and later in the month it was received.

The Asset team determined that a permeate dam (Dam 14) be constructed to mitigate against the risk of no disposal option being available when the RO plant is commissioned. The location of Dam 14 was determined in consultation with Anglo in order to avoid what happened previously with Dams 11 and 12.

In early February 2010, the locations of Dams 11, 12 and 14 were finalised in consultation with Anglo. Also in early February, a draft of the dam inspection report for the existing MGP dams was issued, stating that most of the dams require some remediation, while Dams 2 and 6 contain significant structural issues that need to be addressed. The project team is currently working on coordinating remedial works with the MGP Water Management project activities..

The Asset team and project team worked together to develop an option study into permeate disposal.

Meanwhile, URS completed the RO tender evaluation, concluding that the three shortlisted contenders were: Aquatec-Maxcon, Pall and Veolia. The evaluation was to be reviewed by Arrow before any further action would be taken with the bidders.

In late February it was determined that Dam 11 would need to be increased in capacity to offset the loss of capacity as a result of the Dam 2 leak and remediation works. This delayed Dam 11 engineering activities, increased the construction period, and increased construction costs for the bulk earthworks and HDPE lining.

In late March 2010, a restructuring of the MGPX project organisation commenced, with a focus of bringing all the development activities under one banner to allow better control of the project as a whole. Also in late March the amended AFE for stage 1 works was updated and issued internally. The land access form was submitted to the lands team in late March which included all the dams, pipelines and roads for the water management works in addition to the first set of wells for the MGPX.

In early April 2010 it was confirmed that the Dam 10 & 11 bulk earthworks contractor, Lindley, had gone into administration. This resulted in the works needing to be retendered. This had minimal impact on the schedule as the critical path ran through the environmental approval.

In May, the permeate disposal option study report identified the preferred option to be beneficial reuse, through both dust suppression and irrigation (share farming of fodder). The location for the irrigation site was eventually optimised and agreed as just west of the irrigation water dam (Dam 14). Formalising the irrigation agreement is a key project activity.

In early May 2010 the Environmental department informed the project team that brine storage dams will need to be double lined to conform to DERM guidelines. This has had a major cost and schedule impact on the construction of Dams 11 & 12.

Following review of URS's bid evaluation, it was decided that:

- the quality of URS's work was not up to Arrow's standards
- there was no guarantee that pricing had been kept confidential
- the procurement process had not necessarily followed the JV procedures
- the need for 2 x 1.0 ML/day plants was shown to be too costly for the possible future benefit it may deliver
- SAR adjustment, and transfer tanks/pumps, and other process definition, would be added to the RO vendor's scope, to cater for the above-noted developments in the project

Hence, it was decided the RO Plant would be re-specified by Arrow, and re-issued to the market place in conformance with all project procedures.

4. SCOPE

4.1 BUSINESS DRIVERS

(1) Provide a solution that allows the MGP to continue with its operations;

(2) Select the lowest cost option that meets the requirement;

(3) Ensure the option meets Arrow's safety standards;

(4) Meet the required time commitments.

4.2 OBJECTIVES AND TARGETS

The primary objective of this project is to allow the MGP to continue its operation, in an environmentally responsible way, unabated by the management of its produced field water. The main constraints to this objective is to conform to the MGP's EA licences and to deliver the project safely, on time and within budget.

The project will also conform to the requirements as stipulated within the Bowen Basin Coal Seam Water Management Plan (03-V-PL-0008) and Coal Seam Water Management Strategy (00-V-PL-007).

4.3 FACILITIES

The scope of work is divided into two phases, Stage 1 and Stage 2. Stage 1 is relatively straight-forward as it needs to happen to address immediate requirements. Stage 2 is less straight-forward, with the outcome subject to a Select & FEED phase. In order to align the Stage 1 facilities to Stage 2, some assumptions about Stage 2 were made. The facilities assumed to be required in Stage 2 are listed below. If Stage 2 scope changes, and Stage 1 scope is not ideally tailored to Stage 2, then that is a risk that must be considered in weighing up existing options prior to proceeding with Stage 1.

Stage 1 involves the installation of additional storage, Dam 10 and Dam 11.

(1) Dam 10 – is a fenced and lined Dam approximately 130ML, 32,400m2 x 4.5m operating depth.

(2) Dam 11 – is a fenced and double-lined Dam approximately 370ML, 149,800m2 x 4.5m operating depth.

(3) Short piping connection to Dam 10 as shown in Figure 2.

Stage 1 Additional Piping involves the installation of two pipelines from Dam 1 to Dam 11 & 12.

(1) Installation of two 125DN PE pipelines between Dam 1 and Dam 11 & 12 approximately 3.4km in length.

(2) Construction of a gravel road to wells P031/GM031 and Dam 11/12 approximately 800m in length.

Stage 2 involves the installation of additional storage, Dam 12, Dam 14 an RO Plant and associated pipework and balance of plant (subject to a Select Study and FEED study). In the interim, Stage 2 comprises:

(1) Dam 12 – is a fenced and double-lined Dam approximately 280ML, 98,100m2 x 4.5m operating depth.

(2) Dam 14 – is a fenced and lined Dam approximately 300ML, 127,500m2 x 4.5m operating depth.

(3) RO Plant, treating up to 2 ML/D PFW at approximately 77% recovery. The sizing of the RO Plant is based on the water forecast within the MGP as shown in figure 4.

(4) The pipeline balance of plant is shown in figure 3 for the stage 2 works.

(5) A pump is required at both Dam 1/10 and Dam 14. The Dam 1/10 pump will be the feed pump to the RO plant which will require VSD, MCC and control systems, while the Dam 14 pump will only require simpler control systems.

(6) The balance of plant in the vicinity of the RO Plant will include the follow; underground tanks, underground tanks, pumps, electrical works, site preparation, chemical binds shed / shelters, stand pipe, fencing.

(7) Power lines to deliver power to the Feed Pump at Dam 1/10, the RO Plant and Irrigation Water Pump (This may also supply the centre pivot irrigator).

(8) There will be gravel roads to the RO Plant and Dam 14 which total 1650m in length, note that for the road for Dam 14 involved the upgrading of an existing track for 70% of the length.

(9) The irrigation works will require a 500m radius centre pivot irrigator, a PE pipeline from Dam 14 to the centre pivot, and a fence around the crop.

A Select Study and FEED was completed to define the Stage 2 scope of Work.

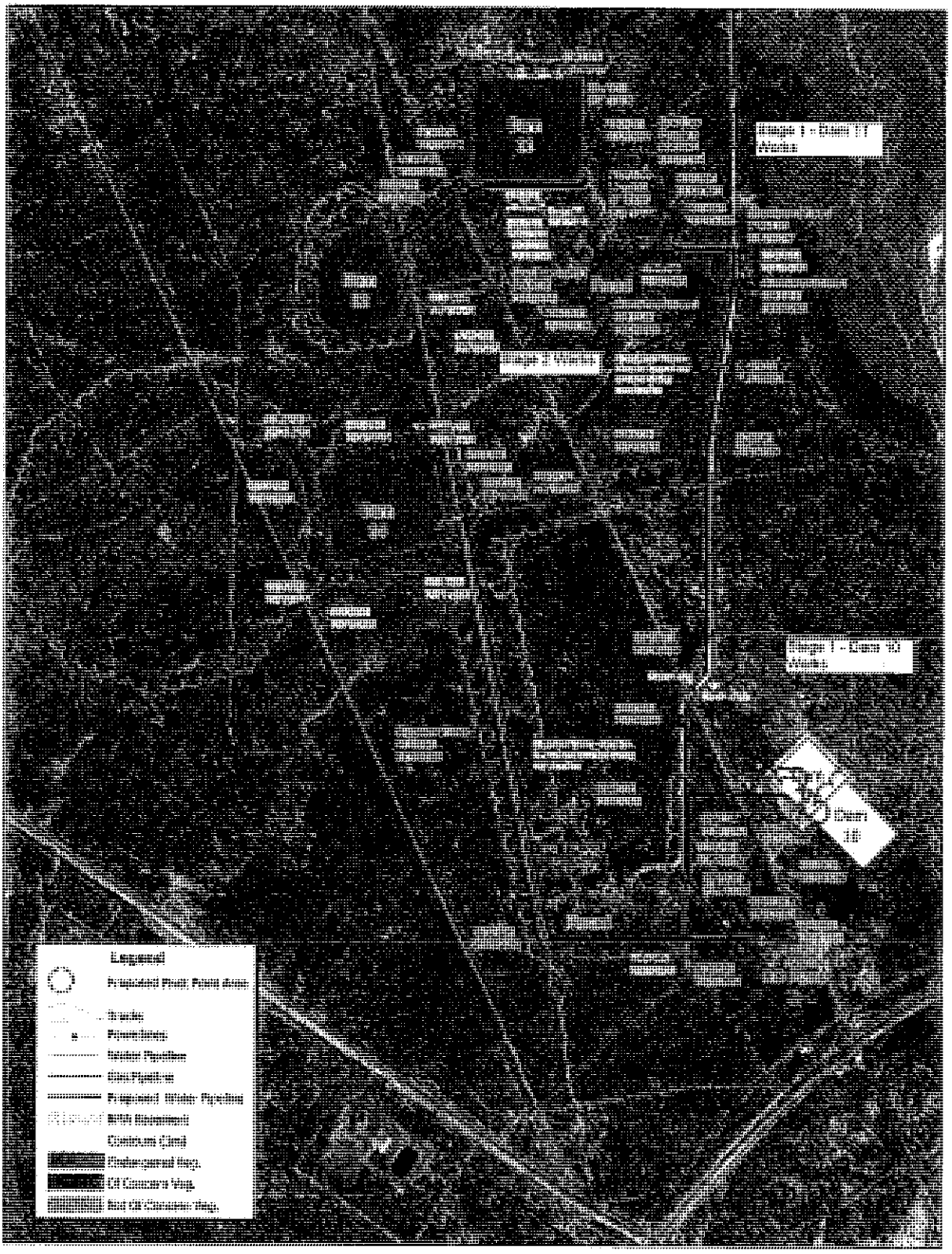


Figure 1 – Map of staged Water Management Facilities

Notes:

(1) Stage 1 Dam 10 facilities are clouded in pink

(2) Stage 1 Dam 11 facilities is clouded in green

(3) Stage 2 facilities are clouded in cyan

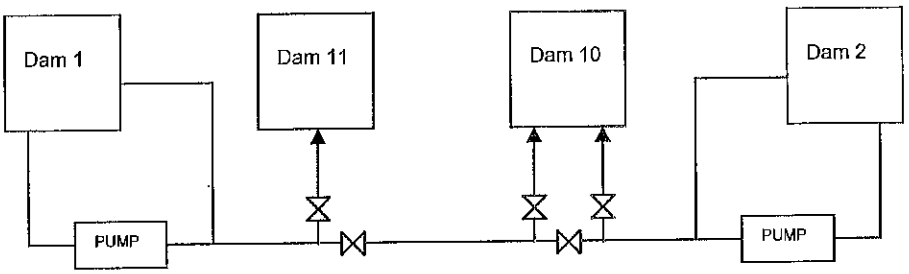


Figure 2 – PFD of Stage 1 (Red) and Stage 1 Additional Piping (Blue) Water Management, coloured lines are new infrastructure and set up negates need for additional pumps in short term.

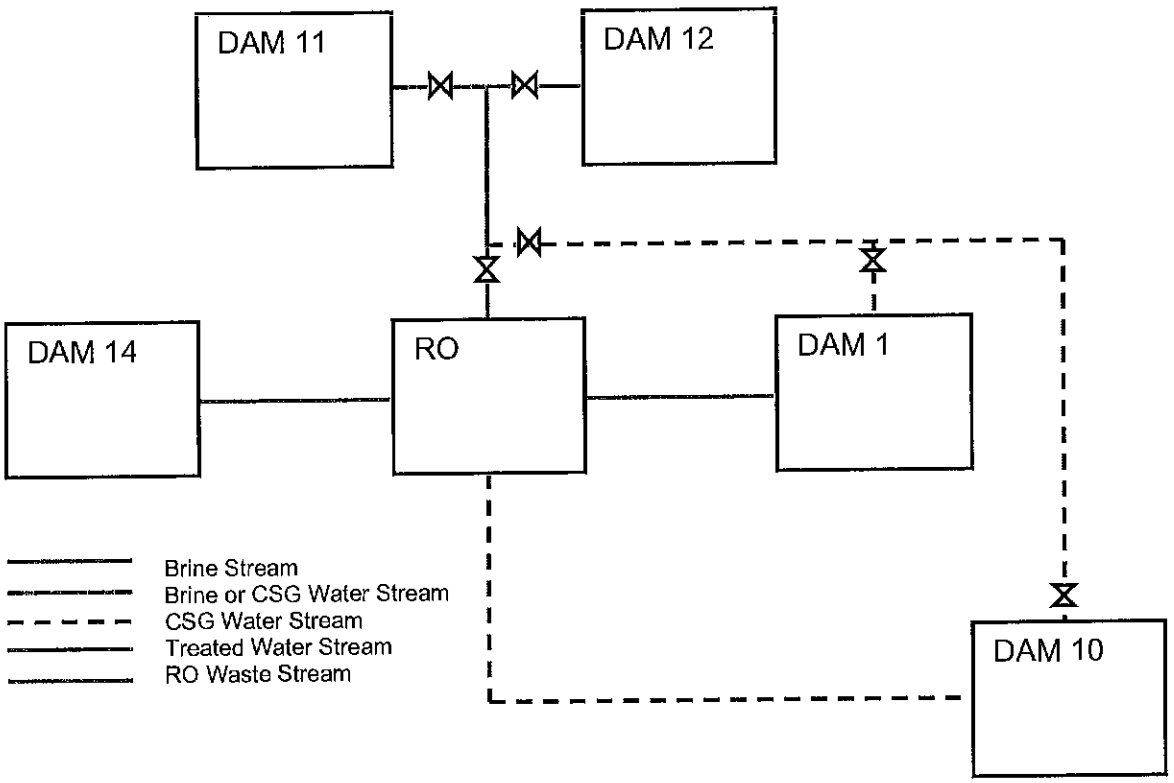


Figure 3 – PFD for Stage 2 Works. Note that the pipeline connecting Dam 11 to Dam 1/10 will no longer need to be used after Dam 11 is emptied of CSG water.

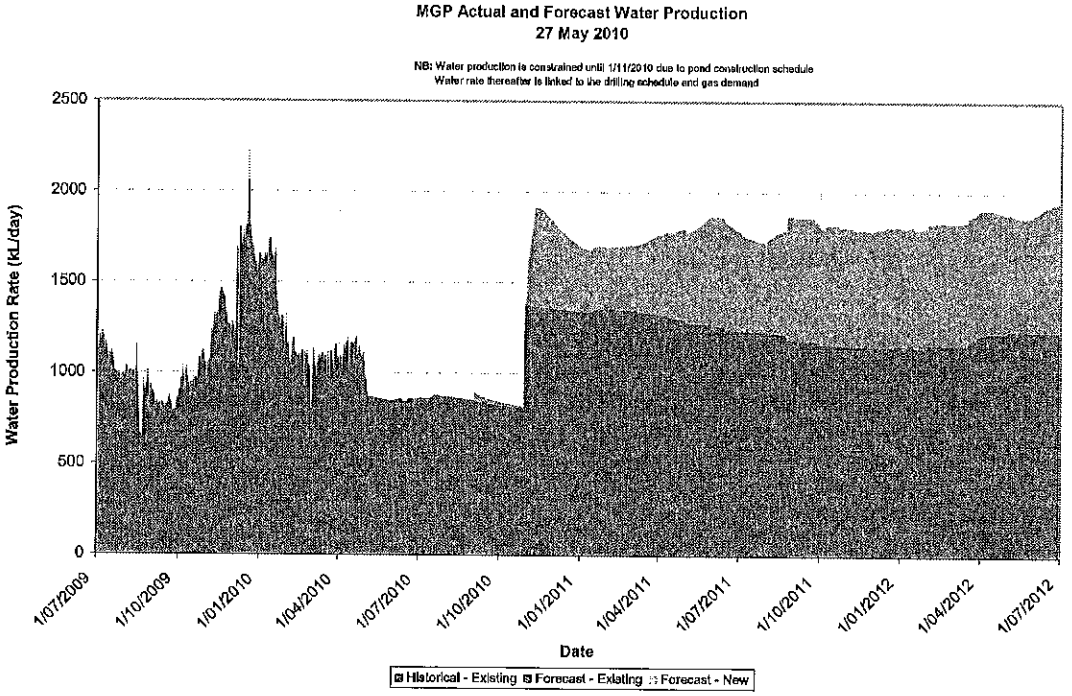


Figure 4 – MGP Water Forecast

4.3.1 OPTIONS

The option study before the commencement of Stage 2 FEED focused on two main areas, this includes:

(1) PFW treatment options

a. Arrow to build and operate a reverse osmosis plant;

b. Other entity to build and operate a reverse osmosis plant.

(2) Treated water disposal options

a. Discharge into Isaac river while it isn't flowing;

b. Sell to SunWater;

c. Sell to local coal mines;

d. Discharge into farmer's dam;

e. Operations use for construction and dust suppression.

4.4 BATTERY LIMITS

The Consultant shall develop and specify appropriate battery limits are to be developed and specified as part of the Services. Nominally, the following shall apply:

4.4.1 STAGE 1 WATER MANAGEMENT

(1) The upstream battery limit will be the connections to the Dam 1 and 2 transfer line. These connections are shown in figure 2.

(2) The downstream battery limit is Dams 10 and Dam 11, no additional infrastructure will constructed to move the water from the new Dams.

4.4.2 STAGE 1 WATER MANAGEMENT DAM 11 WORKS

(1) The upstream battery limit will be the pipeline connecting the pump from Dam 1.

(2) The downstream battery limits will be the end of the pipes at Dam 11 and when stage 2 works are completed Dam 12.

4.4.3 STAGE 2 WATER MANAGEMENT

(1) The upstream battery limit will be the pipeline connecting the feed pump from Dam 1/10.

(2) The downstream battery limits is to be determined during the options study.

4.5 SERVICES

4.5.1 STAGE 1 EXECUTION

(1) Undertake a survey of all existing Dams at the MGP.

(2) Prepare a scope of work.

(3) Prepare request for funding.

(4) Prepare detailed design drawings:

a. Layouts / GA's.

b. Maps of the Dam locations (Ariel map including the tenure boundary, Dam and any other site disturbance because of the project).

c. Engineered plans of the Dams including spillway, water level indicator displaying the spill way mark (mandatory requirement) and fence.

(i) Dam 10 drawings.

(ii) Dam 11 drawings, to contain an operating volume of 370ML.

d. Dam construction and liner specification (refer Dam 8 Specification).

(5) Prepare Water Management Plan.

(6) Prepare Execution, EPC or EPCM scope of work and Cost Estimate.

(7) Prepare Tenders and Evaluate.

(8) Supervise Site works.

4.5.2 STAGE 2 OPTIONS STUDY

The options study (ref OPS10-70) for water off-take for this project was conducted by the asset team. It had concluded that the best options to proceed with are a share farming arrangement with [redacted] and use for operation activities. It is critical that the contract and associated approvals for this shared farming agreement are created and ratified as soon as possible.

4.5.3 STAGE 2 FEED

(1) URS completed the FEED study (03-PM-REP-2033) on schedule on 30 June 2010. The following was the original Scope of Services required to be provided:

a. Water Balance (understanding the time remaining before "tank tops"). Water balance to consider longer term water flows, with consideration to use of the introduction of a reverse osmosis plant. This should be flexible to enable sensitivity analysis and consider.

(i) Inflows (provided by Arrow)

(ii) Current tank levels (provided by Arrow)

(iii) Rainfall and evaporation.

(iv) Effects of RO

(v) Outflows of treated water and brine

b. Layouts / GA's

c. Cadastral map of the property (provided by Arrow)

d. Discussion with vendors.

e. Execution, EPC or EPCM scope of work and Cost Estimate for items included in section 4.2

f. Input into Regulatory Briefing Paper.

g. Technical specification and bid evaluation for reverse osmosis plant.

The key deliverables from the FEED will include:

a. Input into Regulatory Briefing Paper.

b. RO Technical Specification.

c. RO Tender/Bid Evaluation/ Bid Clarification / Tender.

d. Project PFD.

e. Preliminary Plant Layout.

f. Project Single Line Diagram.

g. Preliminary Equipment Datasheets (balance of plant).

h. Detailed Scope of Work (Execution).

i. Project Execution Plan.

j. Target Cost Estimate ± 15%.

k. Execution Schedule ± 15%.

l. Operating Cost Estimate ± 15%.

The following were excluded from URS's scope:

a. DERM approvals

b. DA approvals where required

c. Property details (lot, plan and property owner details) if it is not on a property owned by MGP JV; written approval from the landowner;

d. Cultural heritage clearance, in writing (when, where, who and the results); and

e. The Q100 flood maps.

(2) The execution phase will be based on the deliverables during the FEED.

4.5.4 STAGE 2 EXECUTION

The execution phase will be based on the deliverables produced during FEED Phase and shall comprise at least:

a. Detailed Engineering Design and multi-disciplinary workpacks necessary to fabricate and construct all facilities determined in the FEED Study;

b. Procurement for all materials necessary to fabricate and construct the facilities determined in the FEED Study;

c. Fabrication and Construction of all facilities determined in the FEED Study according to the Contracting Strategy describe in this document;

d. Project Management and Construction Management Services associated with Execution Phase Life Cycle;

e. Pre-commissioning works; and

f. Commissioning assistance.

5. EXECUTION METHEDOLOGY

The Dams are sized to manage the Produced Field Water (PFW) flow rates anticipated at the MGP. This section describes how the water will be managed during Stage 1 and Stage 2, and how the Stage 1 facilities address the short term need, and align to the anticipated longer term water management. Chart 1 shows Dam levels over time and is useful to depict what is described below.

5.1 STAGE 1

(1) Dam 10 was completed in early December 2009. Dam 10 was sized at 130ML, to provide a "quick to construct" storage buffer prior to the construction of Dam 11. (Due to delays in Dam 11 as noted elsewhere in this Plan, some throttling of water and gas from the field has had to occur) .

(2) Dam 11 is planned to be completed on 16 November 2010. Dam 11 is sized at 370ML in order to meet long term brine management and salt reclamation requirements. Initially, Dam 11 will receive and store PFW, until the RO plant can be installed. This is indicated by the higher volume of flow into the Dam prior to the RO installation in July 2011 (The RO plant reduces the volume flow into the storage facility by approximately five times).

5.2 STAGE 2

(1) An RO Plant is installed in July 2011, to considerably reduce the volume of CSG water within the existing dams, and comply with regulatory requirements.

(2) Dam 12 is required to accept the first brine from the RO plant, therefore it is required to be commissioned prior to RO plant commissioning, ie May 2011. With discharge of the brine initially to Dam 12 only, a decision can be taken whether to let Dam 11 evaporate the stored PFW, or transfer the PFW back to Dam 1/10. (The FEED allows for both options). At the anticipated water production levels, Dams 11 & 12 are required to work in unison to store and evaporate all the brine from the RO plant over the life of the facility.

(3) Dam 14 is required to accept the first RO permeate and is to be commissioned by May 2011. It will act as a buffer for wet periods when irrigation and dust suppression activities are unable to proceed.

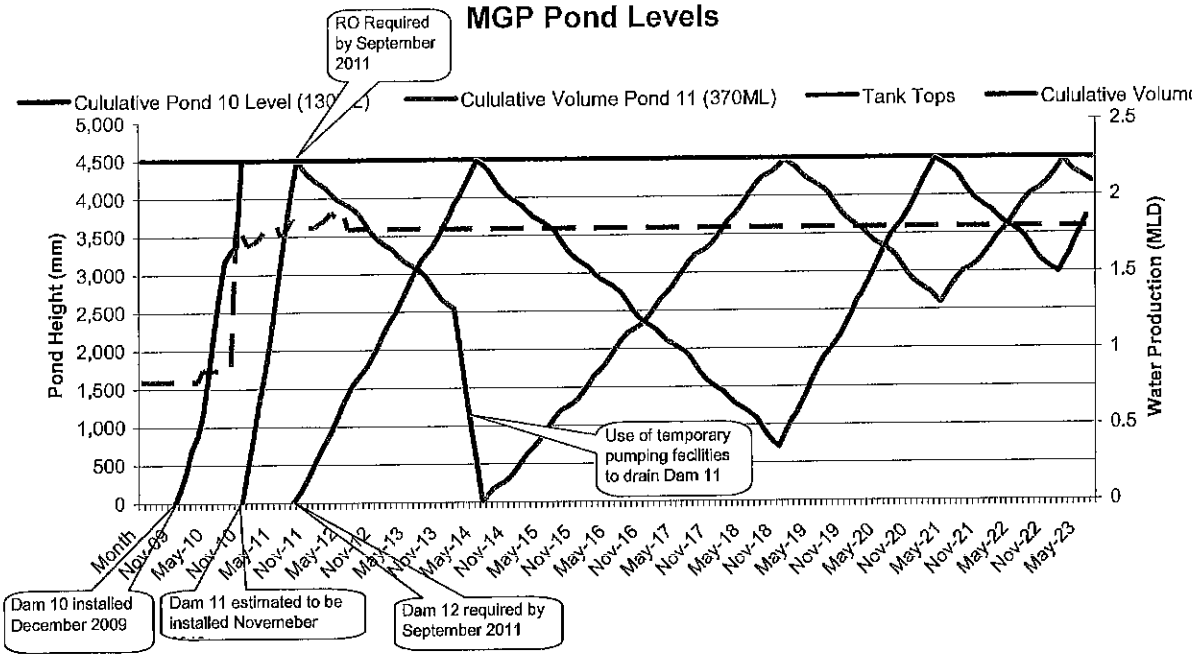
(4) To cater for the ebbs and flows of field dewatering, Dam 10, will act as a buffer. PFW flow rates can vary by as much as 100% over several months, so it is expected that Dam 10 will be required as part of the longer term strategy.

(5) The permeate from the RO will have several uses including:

a. Irrigation of share farming scheme

b. Blending the permeate with PFW for dust suppression and civil works.

c. Additional time is required to investigate alternate uses for the water as beneficial uses are limited in the Moranbah region.



Notes:

(1) The flow rates are based on water forecast supplied from reservoir, are set at 1.5ML/d once it rate reduced to that level for purposes of graph (see dotted line).

(2) The existing 87,000m2 of Dams surface area evaporation is considered in the Nett holding volume.

(3) Evaporation rates and rainfall rates were taken from the Site Conditions Specification (5456-GEN-101).

(4) Factor used for reduction in evaporation efficiency on Brine was 0.6.

(5) RO Recovery rates of 77% assumed.

(6) All figures must be validated by a FEED Study.

(7) Dam 10 will continue to be filled with CSG Water to act as feed dam for RO Plant

6. RESPONSIBILITIES

Broad responsibilities will be as per the following table.

Function	Company	Responsible Person
Field Operations	Arrow	[redacted]
Project Delivery	Arrow	
Field Development	Arrow	
Project Engineering	Arrow	
Project Controls	Arrow	
Scheduling	Arrow	
Farm Management	Arrow	
Engineering Management Approval	Arrow	
Mechanical Engineering Approval	Arrow	
Pipeline Engineering Approval	Arrow	
Instrument & Electrical Engineering Approval	Arrow	
Finance Approvals	Arrow	
Construction Management	Arrow	
Construction Supervision	Arrow	
Contract Preparation	Arrow	
Legal Sign-off	Arrow	
Safety Advisor	Arrow	
Environmental Approvals	Arrow	
Land Owner Approvals	Arrow	

NB. For complete Engineering Authorisation Matrix refer to document 99-G-LS-0001

7. RESOURCES

The project execution organisation chart is shown in Appendix B.

8. TIMING

	Task	Timing
Stage 1	Prepare Water Management Plan	Aug-09 (Actual)
	Approval to proceed with Dam Construction	Sep-09 (Actual)
	Dam 10 Constructed	Dec-09 (Actual)
	Dam 11 Constructed	Nov-10
Stage 2	RO Installed	Jul-11
	Dam 12 Constructed	May-11
	Dam 14 Constructed	Feb-11 (Plan) / May-10 (Latest)

The timing of the execution relies heavily on:

a. Approval for funding for each AFE.

b. The development and approval of detailed design drawings.

c. Submission of the water management plan to the DERM for approval and to begin construction shortly after approval.

d. Tendering of the Dams will begin following AFE approval, and will not be reliant on DERM approval.

9. CAPITAL COST

9.1 AFE

AFE No	Purpose	Amount	Status
03-G-AFE-2014	Stage 1 Water Management - Execution	$3,844,096.00	Approved
03-G-AFE-2011	Stage 2 Water Management - FEED	$ 363,327.00	Approved
00131	Stage 1 Water Management – Dam 11	$4,316,122.00	Approved
00206	Stage 2 Water Management - Execution	$18,550,996.15	To be issued in August 2010

In general, each project component has been divided in two different AFE's, the first for a Study (Concept Select Phase followed by Front-End Engineering Design), and the second for Execute (Detailed Engineering, Procurement, Fabrication, Construction, and Pre-commissioning). A refined cost estimate will be included in the Execute AFEs.

9.2 STAGE 1

Area	Cost	Basis of estimate
Mobilisation	$71,580	Based on WDS P5457 TCE
Dam 10 Earthworks	$553,775	Based on WDS P5457 TCE
Dam 10 Liner	$272,000	Based on WDS P5457 TCE 34,000m2 @ $8 per square meter installed
Dam 11 Earthworks	$1,052,173	Based on Dam 10 x 1.9 (Dam 10 is approximately 32,000m3 of earth moved versus Dam 11 at approximately 70,000m3 earth moved = ratio 1: 2.2 less 15% for economies of scale. Ratio = 1:1.9.
Dam 11 Liner	$592,000	Based on WDS P5457 TCE 74,000m2 @ $8 per square meter installed
Fence	$170,000	1700m @ $100 per meter
PE Pipe	$80,000	400m @ $200 per meter
Owner's Costs	$249,050	Based on Arrow calculated hours
Scoping Study	$150,000	Define RO lease, design temporary balance of plant and detailed design Dam 10 & Dam 11.
Sub Total	$3,190,578	
Contingency 1 (5%)	$159,528	Wet weather standby
Contingency 2	$493,990	20% contingency for Dam construction and lining – due to budget quote only
Total	$3,844,096	

Table A – Anticipated Costs Stage 1

9.3 STAGE 1 – DAM 11

Dam 11 Estimate Costs		
Scope	**Cost**	**Basis of Estimate**
Earthworks	$2,184,000	Refer to Appendix G of AFE 00131 for Basis of Estimate.
HDPE Lining	$1,829,000	
PE Piping	$ 527,000	
Roads	$ 95,000	
Botanist Survey	$ 15,000	
Geotech	$ 40,000	
Owners Costs	$ 377,000	
Portable LSL (0.75%)	$ 20,858	
Sub Total	**$5,087,858**	
Contingency (10%)	$ 508,786	
Total	**$5,596,643**	
Remaining Budget	$1,280,521	Remaining Stage 1 WM budget ($1,339,600) minus outstanding purchase orders ($59,079).
Total for this AFE	**$4,316,122**	

Table B – Anticipated Costs Stage 1 Additional Piping.

9.4 STAGE 2 FEED STUDY

Area	*Cost*	*Basis of estimate*
FEED		
FEED (Contractor)	*$189,370*	*URS Quote*
Owner's Costs	*$137,625*	*See spreadsheet from AH*
Contingency (10%)	*$36,332*	
Total	*$363,327*	

9.5 STAGE 2 EXECUTION

Stage 2 Water Management - Estimate Summary			
WBS	**Infrastructure**	**Costs**	**Scope**
29271	Dam 11	$ 236,161.00	Temporary Pump Station at Dam 11
29272	Dam 12	$ 3,955,108.00	Construction of Brine Storage Dam and Brine pipeline
29273	Dam 14	$ 4,878,715.67	Construction of Treated Water Dam, Treated water pipeline and Irrigation Infrastructure
29374	RO Plant	$ 5,695,470.00	RO Procurement, Balance of Plant, Feed Pipeline/Pump Station
54100	RO Plant Operator Training	$ 50,000.00	Allowance for training Operations by the vendor
79110	IDM Contractor Services	$ 326,440.00	Owners costs for Arrow employees contracted through IDM
79120	Detailed Design Engineering Services	$ 163,900.00	Detailed Design engineering services for pump stations, irrigation works and powerlines
89110	Owners Costs - Project Management	$ 561,988.00	Webtime hours for Arrow Project Management team and Project Controls plus travel and accommodation
89120	Owners Costs - Procurement & Contract Services	$ 40,000.00	Webtime hours for Arrow Procurement and Contract team excluding IDM contractors.
89150	Owners Costs - Approvals & Environmental	$ 103,295.00	Webtime hours for Arrow Approvals and Environmental team.
89230	Owners Costs - Field Development	$ 506,772.00	Webtime hours for Arrow Field Development team.
89240	Owners Costs - Engineering	$ 182,425.00	Webtime hours for Arrow Engineering team.
89260	Owners Costs - Operations	$ 91,110.00	Webtime hours for Arrow Operations team.
99120	Contingency	$ 1,686,454.20	10% Contingency Level
99150	Portable LSL	$ 73,157.28	0.4% of Project costs + 10% GST (GST excluded on owner costs)
Total		**$ 18,550,996.15**	

Table C – Anticipated Costs Stage 2

10. CONTRACTS

There are several contracts to be put in place in order to execute the works these are shown in the Appendix A.

11. OCCUPATION HEALTH AND SAFETY

MGPX shall strictly adhere to Arrow's Occupational Health and Safety Management System. Project Team including: Consultants, Contractors, Subcontractors, Vendors and Services Providers shall be required to align themselves with and demonstrate compliance with the Arrow's OHSMS.

Arrow Project Management Team shall ensure that the Project Team fully understand and support Target Zero Policy which ultimately looks to achieve a Zero Incidents and Zero Injuries throughout all Project phases. The primary concern shall be to deliver the Project in a safe manner.

A Hazard and Operability Study has been carried out during the FEED Study between Arrow Project Team and URS. The HAZOP close-out Report shall be completed prior to commencement of Detailed Engineering Design. A HAZOP of the RO plant shall be performed with the RO vendor. This shall cover anything not adequately closed out in, or changed since, the FEED HAZOP with URS.

Arrow Project Management Team shall ensure that OHSMS is implemented, fully resourced and Project hazards and risks are identified and managed down to as low as reasonably practical (ALARP).

12. QUALITY

A detailed Project Quality Plan shall be issued in accordance with Arrow Engineering Corporate Standards to ensure implementation and compliance of:

(1) Reviews of design inputs to ensure accuracy;

(2) Perform design reviews to confirm that requirements are met; and

(3) Perform design validation to demonstrate Project Systems and Components work as designed.

A Value Assurance Review shall be carried out at end of the Select and FEED phase.

Consultants, Contractors, Subcontractors, Vendors and Services shall be required to issue their Quality Management Systems for Arrow's review.

13. PROJECT CONTROL

Monthly reviews of the actual cost and fortnightly reviews of the Project schedule shall be conducted during the Project life cycle. This will be reported per element of the execution WBS and compared against the approved budget and baseline schedule. The system will also be setup to register total project commitments. Forecasts shall be required for reimbursable contracts to allow the Arrow Project Management Team a prediction of any possible overrun.

14. RISKS

Key project risks have been initially identified and shown in the table below. A further risk review shall be conducted prior to Stage 2 Execute. The risks have been crudely costed in a top down approach to contingency. A more defined approach could be taken in the pre-Execute risk review.

Risk	Description	Planned Mitigation Action
Scope changes	Major changes in scope during the Execution phase	Stage 1 scope is tailored to Stage 2, (not yet been defined). Should Stage 1 not suit the future plans of the MGP's water management, then there is potential for sunk costs. This risk must be considered when weighing up the limited options that exist now before entering Stage 1.
Funding Approval	Delay to access to the required funds to timely execute the Project	Escalate throughout the organisation the sense of urgency at appropriate levels of approval and Arrow projects team to chase up status of approval until its approved
Project Sanction	Late receipt of sanction threatens contractual delivery commitment of FEED Contractor and Vendors	Secure early placement of the Purchase Orders.
Insufficient construction resources	Unavailability of suitable construction resources threatens schedule	According to Contracting Strategy, split contracts or include a clause in the Construction Contract to provided resources as required
Long Lead Items	Inability to manufacture long lead items to meet with Project schedule	Ensure that items are identified early and ordered as soon as possible
Budget constraints	Materials and services prices exceed budget	Confirm budget following detailed design, include budget contingency for cost escalations and control scope creep
Schedule	Resources unavailable to install facilities to meet project schedule	Ensure immediate start for procurement of materials and services. Prepare construction contracts early
Design interfaces and late delivery of the FEED Report	Dislocation of design and procurement due to interface issues resulting from different parties' involvement	Monitor deliverables on a weekly basis and Project Management Team to manage interface between involved parties
Poor RO Plant design	Design basis throughput, efficiency or reliability is not achieved.	Ensure scope and requirements are well defined
Risk of Delay to the Execution of the Contract	Contract agreement takes longer than estimated.	Obtain Agreement from all on the timing of Execution of each activity to ensure timely execution of the Contract.
Delay in commencing FEED	Delivery of Study report is late	Monitor deliverables on a weekly basis.
Unable to dispose of permeate.	Irrigation is not allowed, either because the landowner reneges on his verbal agreement, or due to an unforeseen DERM ruling	Contract for shared farming agreement must be created and signed asap. Project to expedite. DERM approval in principle must be sought on an ongoing basis; then formally asap.
Crossing approvals	Delays in obtaining easement crossing approvals.	Ensure that crossing drawings are completed and Arrow projects to chase up on status until it is approved
DERM Approval	Unable to obtain approval for new storage Dams	Establish pre-design meeting to prepare for the approval of the new storage Dams and explaining the entire strategy for water management.

15. OPPORTUNITIES

Potential Opportunity	Planned Actions	Status
Divert water to Millennium	Millennium will not accept more water now, and can not take the PFW quality water in the future.	CLOSED
Moranbah Council	Previously approached. The council were "lukewarm" to the idea at the time. Sun Water said that the council has a water arrangement already in place.	CLOSING
Utilise the Dyno Nobel 50ML as Stage 1 storage.	Raise with Arrow Commercial to see if possible to identify opportunity with Dyno.	CLOSING
Hornery's	Hornery's will use 0.5ML/week for construction. Insufficient ability to utilise all of the discharge volume.	IN PLACE
Dust Suppression	Current requirement is 0.1MLD	IN PLACE
Discharge to the Isaac	Discharge a combination of PFW and permeate to the Isaac. Need to approach DERM as the Isaac may not flow at required rates for some months.	OPEN
Send/sell permeate or combination of PFW and Permeate to Sun Water.	Awaiting a proposal	OPEN

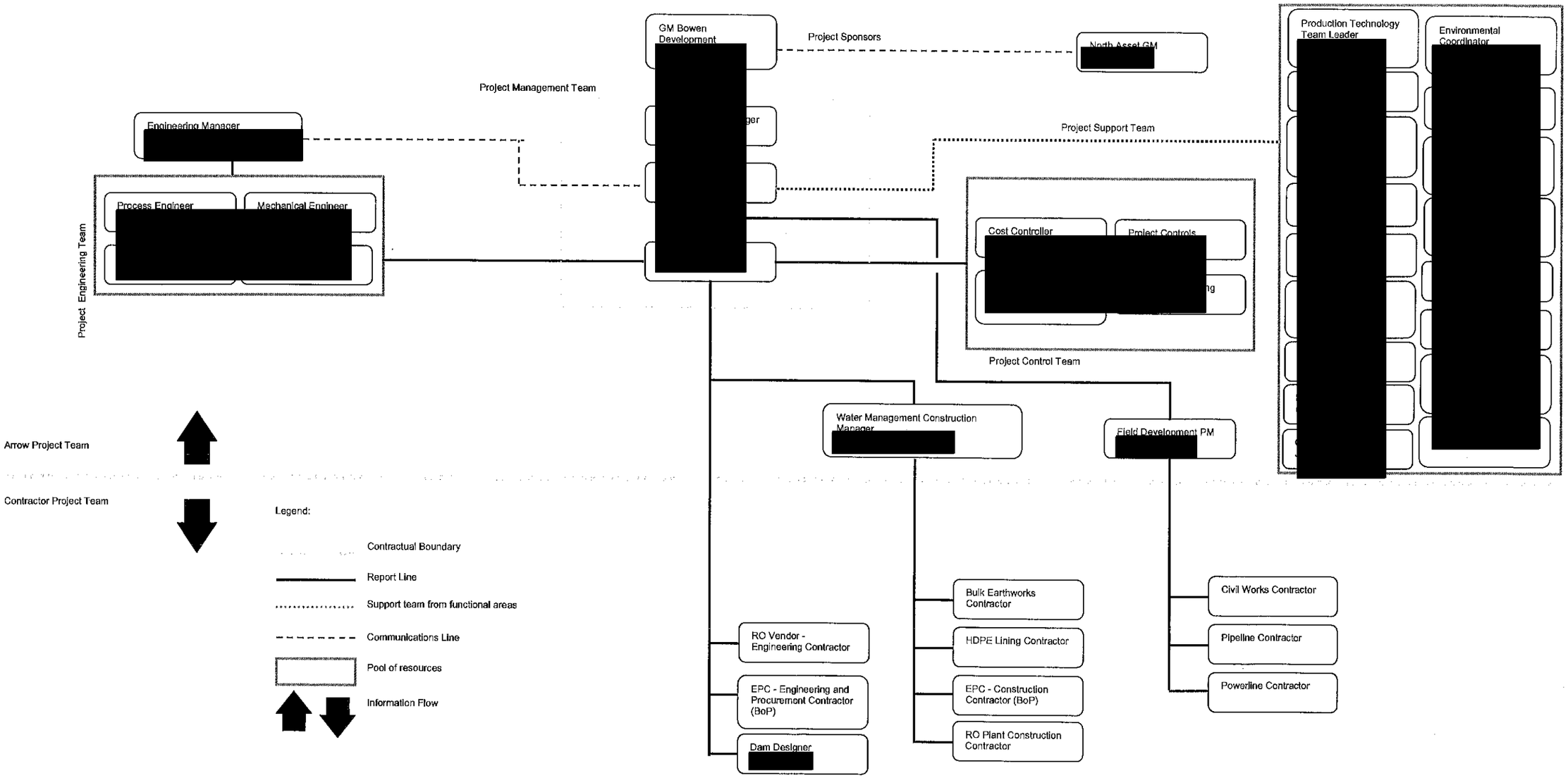
APPENDIX A – CONTRACTING STRATEGY

STAGE 1 WATER MANAGERMENT – ENGINEERING and CONTRACTING STRATEGY				
Scope→ Phase↓	**Dam 10 (incl earthworks, liner, fence)**	**Dams 11 (incl earthworks, liner, fence)**	**Pipelines**	**Roads**
Select	Arrow (Done)	Arrow (Done)	Arrow (Done)	Arrow. (Done)
Overall Project Management	Arrow Project Team	Arrow Project Team	Arrow Project Team	Arrow Project Team
FEED	Arrow (with Stafford Adamson) (Done)	Arrow (with Stafford Adamson) (Done)	URS (Done)	Arrow / URS (Done)
Detailed Engineering	Stafford Adamson (Arrow oversight)	Stafford Adamson (Arrow oversight)	Arrow Project team to verify line sizes / pump specs, confirm valve locations, etc. All info to be collated through GIS in standard format. This will then be passed on to contractor established by Field Development (see Note)	Arrow Project team to pick type A/B/C/D, and do single line route.
Procurement	Arrow Project Team / Supply	Arrow Project Team / Supply	Arrow Project to develop MTO, and pass to Arrow Supply, to order through call off agreement established by Field Development	Small scale work can be arranged through site. Larger scale through Field Development. (See Note)
Fabrication	N/A	N/A	Integrated into Field Development scope (see Note)	N/A
Construction	Lindley Mining Maintenance, Fabtech SA	By earthworks contractor, then lining contractor	Integrated into Field Development scope (see Note)	Looked after by Site or Field Development (See Note)
Commissioning	N/A	N/A	Integrated into Field Development scope (see Note)	N/A
Notes			- Costs for procurement and installation of Water Management pipelines will be charged to the Water Management budget.	Costs for Water Management roads will be charged to the Water Management budget.

STAGE 2 WATER MANAGERMENT – ENGINEERING and CONTRACTING STRATEGY								
Scope→ Phase↓	**RO Plant**	**Dams 12 & 14 (incl earthworks, liner, fence)**	**Pipelines**	**Irrigation system**	**Roads**	**Power Lines (incl pole-mounted transformers)**	**Pump stations (Civils, pumps, piping, switchgear, control systems, electrical termination)**	**Dam 11 Temporary Pump Station**
Select	Arrow (Done)	Arrow (Done)	Arrow (Done)	Arrow (Done)	Arrow. (Done)	Arrow (Done)	Arrow (Done)	Arrow (Done)
Overall Project Management	Arrow Project Team	Arrow Project Team	Arrow Project Team	Arrow Project Team	Arrow Project Team	Arrow Project Team	Arrow Project Team	Arrow Project Team
FEED	URS & Arrow (Done)	Arrow (with Stafford Adamson) (Done)	URS (Done)	Arrow Landholdings / URS (preliminary, done)	Arrow / URS (Done)	Arrow / URS (Done)	URS (Done)	URS (Done)
Detailed Engineering	By vendor, against Arrow-written spec	Stafford Adamson (Arrow oversight)	Arrow Project team to verify line sizes / pump specs, confirm valve locations, etc. All info to be collated through GIS in standard format. This will then be passed on to contractor established by Field Development (see Note)	Will be managed in consultation between Arrow Landholdings and Arrow Project Team	Arrow Project team to pick type A/B/C/D, and do single line route.	- SLD / loads to be finalised by Arrow Project - Electrical Load / Protection Study required. Arrow to let through Field Development (see Note) - Contract for detailed design / supply / construct will be let (probably to PLD) by Field Development (see Note)	- Arrow to develop full construction contractor scope of work definition at "FEED" level. - Some LV elec design, and some control system design done by Arrow Project team - All remaining detailed engineering / design done by construction contractor	- Arrow to develop full construction contractor scope of work definition at "FEED" level. - Detailed engineering / design done by construction contractor
Procurement	- Arrow Project Team / Supply let contract - Vendor does all procurement	Arrow Project Team / Supply	Arrow Project to develop MTO, and pass to Arrow Supply, to order through call off agreement established by Field Development	Will be managed in consultation between Arrow Landholdings, Arrow Project Team and Arrow Supply	Small scale work can be arranged through site. Larger scale through Field Development. (See Note)	Contract for design / supply / construct will be let by Field Development (see Note)	Scope of Work to be passed to construction contractors for competitive bid by Arrow Supply. Contract placed. - Construction contractor procures all items associated with the works	Will not be bought / installed at time of main Stage 2 works.

STAGE 2 WATER MANAGERMENT – ENGINEERING and CONTRACTING STRATEGY								
Scope→ **Phase↓**	**RO Plant**	**Dams 12 & 14 (incl earthworks, liner, fence)**	**Pipelines**	**Irrigation system**	**Roads**	**Power Lines (incl pole-mounted transformers)**	**Pump stations (Civils, pumps, piping, switchgear, control systems, electrical termination)**	**Dam 11 Temporary Pump Station**
Fabrication	Vendor	N/A	Integrated into Field Development scope (see Note)	Centre Pivot Vendor (if applicable)	N/A	Integrated into Field Development scope (see Note)	Construction contractor does all fabrication	Will not be bought / installed at time of main Stage 2 works.
Construction	Vendor. (See Note)	By earthworks contractor, then lining contractor	Integrated into Field Development scope (see Note)	Will be managed in consultation between Arrow Landholdings and Arrow Project Team	Looked after by Site or Field Development (See Note)	Integrated into Field Development scope (see Note)	Construction contractor does all construction	Will not be bought / installed at time of main Stage 2 works.
Commissioning	Vendor / Arrow Projects / Arrow Ops	N/A	Integrated into Field Development scope (see Note)	Will be managed in consultation between Arrow Landholdings, Arrow Ops, and landholder	N/A	Integrated into Field Development scope (see Note)	Construction contractor does all pre-commissioning. Commissioning by Arrow Ops with Arrow Project team oversight, and contractor assistance as necessary	- Will not be bought / installed at time of main Stage 2 works. - This transfer will probably be done by Ops, with Project Team oversight, in 2012.
Notes	- RO vendor scope includes 11kV transformer - Option of Arrow doing construction exists (if vendor LSTK offers are unreasonable)		- Costs for procurement and installation of Water Management pipelines will be charged to the Water Management budget. - BMA crossings require special attention by Arrow Project Team and Legal	Pump, pipeline & LV electrical supply from transformer are all covered in the respective columns	Costs for Water Management roads will be charged to the Water Management budget.	- This scope covers everything up to and including the 11kV transformer. LV is covered elsewhere. - All costs will be borne by the Water Management budget	Excludes Dam 11 temporary pump station. Includes LV power supply to centre pivot.	It is envisaged that this will be a temporary diesel pump (hired, or from Arrow warehouse). It will need to operate for a few months to empty the dam.

APPENDIX B – PROJECT TEAM ORGANISATION CHART



Department of Environment and Resource Management

Environmental Protection Act 1994
Level 1 Environmental Authority (chapter 5A activities)

DERM Permit[1] Number: PEN100015907

Under section 310M of the *Environmental Protection Act 1994* this permit is issued to:

Principal Holder
CH4 Pty Ltd
AM-60
Level 19
42 Albert Street
BRISBANE QLD 4000

Joint Holders
AGL Energy Limited
Level 22
101 Miller Street
NORTH SYDNEY NSW 2060

Arrow CSG (ATP364) Pty Ltd
AM-60
Level 19
42 Albert Street
BRISBANE QLD 4000

in respect to carrying out a Level 1 chapter 5A activity(ies) as per Section 23 of the *Environmental Protection Regulation 2008* on the relevant resource authorities listed below:

Project Name	Resource Authority Type(s) and Number(s)
Moranbah Gas Project	Petroleum Lease (PL) 191 Petroleum Lease (PL) PL196 Petroleum Pipeline Licence (PPL) 115 Petroleum Pipeline Licence (PPL)116

This environmental authority takes effect from 10 December 2010

The anniversary date of this environmental authority is 1 October.

This environmental authority is subject to the attached schedule of conditions.

[redacted] 10/12/10
Date

[redacted]
Delegate of Administering Authority
Department of Environment and Resource Management

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

Additional advice about the approval

1. This approval is for the carrying out the following level 1 chapter 5A activity(ies):

Level 1 chapter 5A activity(ies):
6. A petroleum activity carried out on a site containing a high hazard dam or a significant hazard dam
8. A petroleum activity, other than a petroleum activity mentioned in items 1 to 7, that includes 1 or more chapter 4 activities for which an aggregate environmental score is stated, namely: ERA 8 (3)(a) – Chemical storage ERA 9(c) – Hydrocarbon gas refining ERA 15 – Fuel burning (500kg/hr or more) ERA 60 (1)(d)– Waste disposal ERA 63 (2)(b) – Sewage treatment

2. This approval pursuant to the *Environmental Protection Act 1994* does not remove the need to obtain any additional approval for this activity which might be required by other State and/or Commonwealth legislation. Other legislation administered by DERM for which a permit may be required includes but is not limited to the:

   - *Aboriginal Cultural Heritage Act 2003*;
   - The contaminated land provisions of the *Environmental Protection Act 1994*;
   - *Nature Conservation Act 1992*; and
   - *Water Act 2000.*
   - *Forestry Act 1959*
   - *Water Supply (Safety and Reliability) Act 2008*

   Applicants are advised to check with all relevant statutory authorities and comply with all relevant legislation.

3. This approval for the carrying out of a level 1 petroleum activity is not an acceptance of impacts on water levels or pressure heads in groundwater aquifers in or surrounding coal seams. The holder of this environmental authority may have obligations to minimise or mitigate these impacts under other state legislation.

4. This environmental authority consists of the following Schedules

Schedule A	General Conditions	Schedule G	Waste
Schedule B	Water	Schedule H	Rehabilitation
Schedule C	Regulated Dams	Schedule I	Monitoring Programs
Schedule D	Land	Schedule J	Community Issues
Schedule E	Environmental Nuisance	Schedule K	Notification Procedures
Schedule F	Air	Schedule L	Definitions

SCHEDULE A – GENERAL CONDITIONS

Authorised Petroleum Activities

(A1) In the carrying out of the petroleum activity(ies), the holder of this environmental authority must not exceed the numbers and maximum size(s) for each of the specified petroleum activities listed in Schedule A - Table 1 for each petroleum tenure.

Schedule A, Table 1 – Authorised Petroleum Activities

Tenure No.	Petroleum Activity	Number	Maximum size (where applicable)
PL191	Seismic (kms)	N/A	N/A
	Core Well(s)	N/A	N/A
	Exploration Wells	N/A	N/A
	Production Well(s)	210	N/A
	Compressor Station(s)	25	N/A
	Evaporation Dam(s)	0	N/A
	Regulated Dam(s) >401 megalitres	0	N/A
	Regulated Dam(s) <400 megalitres	14	<400 megalitres
	Reverse Osmosis Plants	1	2ML/day
	Brine Encapsulation Facilities	0	N/A
	Sewage Treatment Plant(s)	1	56KL/day/plant
PL196	Seismic (kms)	N/A	N/A
	Core Well(s)	N/A	N/A
	Exploration Wells	N/A	N/A
	Production Well(s)	20	N/A
	Compressor Station(s)	0	N/A
	Evaporation Dam(s)	0	N/A
	Regulated Dam(s) >400 megalitres	0	N/A
	Regulated Dam(s) <400 megalitres	1	<400 megalitres
	Reverse Osmosis Plants	0	N/A
	Sewage Treatment Plant(s)	0	N/A

Prevent or Minimise Likelihood of Environmental Harm

(A2) This environmental authority does not authorise environmental harm unless a condition contained in this environmental authority explicitly authorises that harm. Where there is no condition, the lack of a condition shall not be construed as authorising harm.

Maintenance of Measures, Plant and Equipment

(A3) The holder of this environmental authority must:

(a) install all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority;
(b) maintain such measures, plant and equipment in their proper and effective condition; and
(c) operate such measures, plant and equipment in a proper and effective manner.

(A4) No change, replacement or alteration of any plant or equipment is permitted if the change, replacement or alteration materially increases, or is likely to increase, the environmental harm caused by the petroleum activity.

Operational Plan

(A5) The holder of this environmental authority must develop an Operational Plan (the Plan) that provides detailed information about the activities to be carried out under this environmental authority.

(A6) The activities identified in the Plan must incorporate, but not be limited to, the petroleum activities set out in the approved Development Plan for the relevant petroleum authorities as required under the *Petroleum Act (1923)* or the *Petroleum and Gas (Production and Safety) Act 2004.*

(A7) The Plan must be consistent with the requirements of this environmental authority and include, but not be limited to:

(a) a stated period, not exceeding three (3) years, to which the Plan applies;
(b) a description of the existing infrastructure for conducting the petroleum activity(ies);
(c) a description of proposed infrastructure that will be developed during the term of the Plan
(d) a map or maps that:
    i. record the location of the infrastructure in place for conducting the petroleum activity(ies) that exists at the commencement of the period of the Plan, including but not limited to:
        - regulated dams;
        - wells;
        - transmission flow lines;
        - gas processing facilities; and
        - water treatment facilities;
    ii. record the location of approved additional infrastructure that will be developed for the conduct of the petroleum activities during the period of the Plan.
(e) for proposed disturbance or vegetation clearing in an Environmentally Sensitive Area (ESA) provide details on the scale and extent of the disturbance or clearing and if required a commitment to provide an environmental offset
(f) for each site to be disturbed, a description of the rehabilitation activities to be performed during the period of the Plan, including but not limited to:
    i. location (e.g. tenure, coordinates) and disturbance type (e.g. well lease, flow line, access track);
    ii. area to be rehabilitated;
    iii. use of reference sites;
    iv. species compositions; and
    v. post-disturbance land use;
(g) a description of progressive rehabilitation carried out including performance in relation to the requirements set out in the environmental authority and the proposed rehabilitation activities set out in the previous Plan; and
(h) the calculation of the financial assurance for the proposed maximum disturbance expected during the period of the Plan.

(A8) The initial Plan must be submitted to the administering authority within three months after the granting of this environmental authority.

(A9) Revised Plans must be submitted to the administering authority not less than three months prior to the expiry of the current Plan.

Financial Assurance

(A10) The holder of this environmental authority must:

(a) provide to the administering authority financial assurance in the amount and form required from time to time by the administering authority for the authorised petroleum activity(ies); and
(b) review and maintain the amount of financial assurance based on the activities and rehabilitation to be undertaken during the period of the Plan.

(A11) The calculation of financial assurance must be in accordance with the most recent version of the Department of Environment and Resource Management's Guideline "Financial assurance for petroleum activities".

(A12) 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.

Third Party Audit

(A13) Compliance with the conditions of this environmental authority must be audited by an appropriately qualified third party auditor, nominated by the holder of this environmental authority and accepted by the administering authority, for each period of the Operational Plan required under Conditions A5 – A9.

(A14) Notwithstanding Condition A13, the holder of this environmental authority may, prior to undertaking the third party audit, negotiate with the administering authority the scope and content of the third party audit

(A15) The report of the third party auditor for the relevant prior period must be submitted to the administering authority by the holder of this environmental authority with each revised Operational Plan submitted in accordance with Condition A8 and Condition A9.

(A16) The third party auditor must certify (including a statutory declaration) the findings of the audit in the report.

(A17) The financial cost of the third party audit is to be borne by the holder of this environmental authority.

(A18) The holder of this environmental authority must immediately act upon any recommendations arising from the audit report by:

(a) investigating any non-compliance issues identified; and
(b) as soon as practicable, implementing measures or taking necessary action to ensure compliance with the requirements of this environmental authority.

(A19) Subject to Condition A18, and not more than three (3) months following the submission of the audit report, the holder of this environmental authority must provide a written report to the administering authority addressing the:

(a) actions taken by the holder of this environmental authority to ensure compliance with this environmental authority; and
(b) actions taken to prevent a recurrence of any non-compliance issues identified.

Cultural Heritage

(A20) In the carrying out of the petroleum activity(ies) the holder of this environmental authority must not adversely impact on the cultural heritage values of any place registered on the Queensland Heritage Register.

SCHEDULE B – WATER

Contaminant Release

(B1) Contaminants must not be directly or indirectly released to any waters except as permitted under this environmental authority.

Erosion and Sediment Control

(B2) Erosion protection measures and sediment control measures must be implemented and maintained to minimise erosion and the release of sediment and contaminated stormwater to waters.

(B3) An Erosion and Sediment Control Plan must be developed and implemented for all stages of the petroleum activity(ies) and which has been certified by a professional with appropriate experience and/or qualifications accepted by the administering authority and must include but not be limited to:

(a) diverting uncontaminated stormwater run-off around areas disturbed by petroleum activity(ies) or where contaminants or wastes are stored or handled that may contribute to stormwater;
(b) contaminated stormwater runoff and incident rainfall is collected; and treated, reused, or released in accordance with the conditions of this environmental authority;
(c) roofing or minimising the size of areas where contaminants or wastes are stored or handled;
(d) revegetating the disturbed area as soon as practicable after the completion of works;
(e) using alternate materials and or processes (such as dry absorbents) to clean up spills that will minimise the generation of contaminated waters;
(f) erosion and sediment control structures are placed to minimise erosion of disturbed areas and prevent the contamination of any waters;
(g) an inspection and maintenance program for the erosion and sediment control features;
(h) provision for adequate access to maintain all erosion and sediment control measures especially during the wet season months from December to March;
(i) erosion and sediment control measures for construction of wells and pipelines on slopes >10%; and
(j) identification of remedial actions that would be required to ensure compliance with the conditions of this environmental authority.

(B4) A copy of the Erosion and Sediment Control Plan must be submitted to the administering authority upon request.

Maintenance and Cleaning

(B5) The maintenance and cleaning of vehicles and any other equipment or plant must be carried out in areas from where the resultant contaminants cannot be released into any waters, roadside gutter or stormwater drainage system.

Watercourses, Wetlands and Springs

(B6) In the carrying out of the petroleum activity(ies) the holder of this environmental authority must not clear vegetation, excavate or place fill, except for the construction of roads and pipelines, in or within:

(a) 200 metres from any natural significant wetland;
(b) 100 metres from any natural wetland, lakes or springs; or
(c) 100 metres of the high bank of any other watercourse.

(B7) The holder of this environmental authority must not excavate or place fill in a way that interferes with the flow of water in a watercourse, wetland, or spring, including works that divert the course of flow of the water or works that impound the water.

(B8) Despite Condition B7 pipeline and road construction works may be undertaken in watercourses, wetlands or springs where there is no practicable alternative such as the use of horizontal directional drilling methods, for a maximum period of ten (10) days, provided that the works are conducted in accordance with the following order of preference:

(a) conducting work in times of no flow; and
(b) using all reasonable and practical measures to reduce impacts in times of flow.

(B9) Activities or works resulting in significant disturbance to the bed or banks of a watercourse or wetland, or a spring must:

(a) only be undertaken where necessary for the construction and/or maintenance of roads, tracks and pipelines that are essential for carrying out the authorised petroleum activity(ies) and no reasonable alternative location is feasible;
(b) be no greater than the minimum area necessary for the purpose of the significant disturbance;
(c) be designed and undertaken by a suitably qualified and experienced person taking into account the matters listed in Section 5. Planning Activities and Section 6 Impact Management During Activities of DERM's "*Guideline – Activities in a watercourse, lake or spring associated with mining operations*" dated April 2008, or more recent editions as such become available; and
(d) upon cessation of the activities or works, commence rehabilitation immediately such that the final rehabilitation is to a condition that will ensure the ongoing physical integrity and the natural ecosystem values of the site.

(B10) Sediment control measures must be implemented to minimise any increase in water turbidity due to carrying out petroleum activity(ies) in the bed or banks of a watercourse or wetland, or a spring.

(B11) Routine, regular and frequent visual monitoring must be undertaken while carrying out construction work and/or any maintenance of completed works in a watercourse, wetland or spring. If, as a result of the petroleum activity(ies), water turbidity increases in the watercourse, wetland or spring outside contained areas, works must cease and the sediment control measures must be rectified to limit turbidity before activities recommence.

(B12) Petroleum activity(ies) must not be carried out in River Improvement Trust Asset Areas without the approval of the relevant River Improvement Trust.

Groundwater

(B13) The extraction of groundwater as part of the petroleum activity(ies) from underground aquifers must not directly or indirectly cause environmental harm to any spring, wetland or other surface waters.

Wild Rivers

(B14) In a declared Wild River Area, petroleum activity(ies) must be consistent with the conditions stated in the relevant Wild River declaration and in circumstances where there is any inconsistency or conflict the conditions of the Wild River declaration prevail.

Floodplains

(B15) The holder of this environmental authority must ensure that petroleum activity(ies), excluding limited petroleum activity(ies) do not significantly:
(a) concentrate flood flows;
(b) divert flood flows from natural drainage paths and alter flow distribution;
(c) increase the local duration of floods;
(d) increase the risk of detaining flood flows;
(e) increase the risk to the safety of persons from flooding; or
(f) increase the risk of damage to property from flooding.

Contaminant Release

(BA1) The release of contaminants to waters must only occur from the release points specified in Schedule BA, Table 1 – Contaminant Release Points, Sources and Receiving Waters and depicted in Figure 1 attached to this environmental authority.

Schedule BA, Table 1 - Contaminant Release Points, Sources and Receiving Waters

Release Point (RP)	Latitude or northing (GDA94)	Longitude or easting (GDA94)	Contaminant Source and Location	Monitoring Point	Receiving waters description
RP 1	-21° 57' 42"	148° 2' 35"	Treated CSG water from the reverse osmosis plant located on PL191 after 31 July 2011.	End of pipe for temperature and dissolved oxygen For all parameters in Schedule BA, Table 2, excluding temperature and dissolved oxygen; RO Facility Location -21° 58' 20" 148° 1' 0"	Isaac River – Dam 5 Discharge Point
RP2	-21° 57' 58"	148° 2' 45"			Isaac River (downstream) – Blair Athol Railway Bridge

(BA2) The release of contaminants to waters must not exceed the release limits stated in Schedule BA, Table 2 – Contaminant Release Limits for Release Point RP1 and RP2 when measured at the monitoring points specified in Schedule BA, Table 1 - Contaminant Release Points, Sources and Receiving Waters for each quality characteristic.

Schedule BA Table 2 – Contaminant Release Limits for Release Point RP1 and RP2

Physicochemical Parameters	Release Limits	Limit Type	Monitoring frequency
Electrical conductivity (µS/cm)	No limit	N/A	Daily during discharge events and for two days after cessation of discharge
pH (pH Unit)	6.5- 8.5	Range	
Dissolved oxygen (mg/L)	2	Minimum	
Turbidity (NTU)	25	Maximum	
Chloride (mg/L)	22 – 120	Range	
Sulphate (mg/L)	3 – 9	Range	
Calcium (mg/L)	>5	Minimum	
Magnesium (mg/L)	>1	Minimum	
Sodium (mg/L)	50	Maximum	
Chlorophyll-a (µg/L)	5	Maximum	

(BA3) The release of contaminants to waters from the release points must be monitored at the locations specified in Table 1 - Contaminant Release Points, Sources and Receiving Waters for

each quality characteristics and at the frequency specified in Table 2 – Contaminant Release Limits for Release Point RP1 and RP2.

Contaminant Release

(BA4) The holder must install, operate and maintain a stream flow gauging station(s) as specified in Schedule BA Table 3 – Contaminant Release during Flow Events to determine and record stream flows at the locations upstream of each Release Point(s) as shown in Schedule BA Table 1 - Contaminant Release Points, Sources and Receiving Waters, for any receiving water into which a release occurs.

(BA5) Notwithstanding any other condition of this environmental authority, the release of contaminants to waters must only take place during periods of natural flow events specified as minimum flow in Schedule BA Table 3 – Contaminant Release during Flow Events for the contaminant release point(s) specified in Schedule BA Table 1 - Contaminant Release Points, Sources and Receiving Waters.

Schedule BA, Table 3 – Contaminant Release during Flow Events

Receiving water description	Gauging station description	Latitude or northing (GDA94)	Longitude or easting (GDA94)	Minimum Flow in Receiving Water Required for a Release Event	Flow recording Frequency
Isaac River	Gauging station 1	-21° 57' 37"	148° 2' 17"	> or = 5 m^3/sec	Continuous (minimum daily)

(BA6) The total volume release through the release points must not exceed 0.023 m^3/s and 2 ML/day.

(BA7) The environmental authority holder must install and maintain a measuring device to measure/ meter the volume of treated CSG water released under this environmental authority.

(BA8) The measuring device/ meter must be installed prior to commencement of release of treated CSG water and its installation must comply with the most recent version of *'Draft standards and specifications for measuring /metering disposal of treated CSG water'.*

(BA9) Upon practical completion of the meter installation, the environmental authority holder must provide a completed 'Meter Installation Form" signed by the installer and the environmental authority holder confirming that the installation complies with the manufacturer's specifications and/or national standards and/or DERM's metering standards.

(BA10) The environmental authority holder must provide the administering authority with safe access to facilitate inspections, and comply with the manufacturer's instructions or best practice for the operation of the pump and meter installation.

(BA11) The releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build up of sediment in such waters.

Characterisation of Other Contaminants

(BA12) Prior to the release of water, the environmental authority holder must have prior written approval from the Office of the Water Supply Regulator (OWSR).

(BA13) If water has been released from authorised release points listed in Schedule BA, Table 1 – Contaminant Release Points, Sources and Receiving Waters authorised release points, the environmental authority holder must undertake an annual assessment of the contaminants of treated CSG water to determine the risk of environmental harm from release of treated CSG water to surface waters. This should consider the contaminants mentioned in the ANZECC & ARMCANZ 2000 guidelines. This annual assessment must be included in the Annual Return.

Notification of Release Event Exceedance

(BA14) If the release limits defined in Schedule BA, Table 2 – Contaminant Release Limits for Release Point RP1 and RP2 are exceeded, the holder of the environmental authority must notify the administering authority within twenty-four (24) hours of receiving the results.

(BA15) The environmental authority holder must, within twenty-eight (28) days of a release that exceeds the conditions of this environmental authority, provide a report to the administering authority detailing:

(a) the reason for the release;
(b) the location of the release;
(c) all water quality monitoring results;
(d) any general observations;
(e) all calculations;
(f) measures taken to prevent a repeat of the exceedance taking place; and
(g) any other matters pertinent to the water release event.

Event Based Surface Water Monitoring

(B16) Each monitoring and release point as specified in Schedule BA, Table 1 and Schedule BA, Table 3 must be marked and readily identifiable from the banks of the Isaac River.

(B17) The water quality of the Isaac River must be monitored for the physiochemical parameters and at the frequency specified in Schedule BA, Table 2 Contaminant Release Limits for Release Point RP1 and RP2 at a monitoring point 50 - 100 metres upstream; in addition to 200 metres and 1000 metres downstream of release point R2.

(B28) The holder of this environmental authority must keep written records of all discharge events to the Isaac River. The records must include, but not be limited to:

(a) The volume of water released through the release point(s);
(b) The release rate;
(c) date and time of discharge;
(d) flow rate at Gauging Station 1 during the discharge event;
(e) water quality characteristics monitoring results; and
(f) details of any observed impacts.

Water General

(BA19) The release of contaminants directly or indirectly to waters:
(a) must not produce any visible discolouration of receiving waters; nor
(b) must not produce any slick or other visible or odorous evidence of oil, grease or petrochemicals nor contain visible floating oil, grease, scum, litter or other objectionable matter.

Sewage Treatment Works

Release of Treated Sewage Effluent Contaminants to Land

(BC1) The peak design capacity of the sewage treatment plant must not exceed 216 equivalent persons based on a waste water generation rate of 250L/person/day.

(BC2) Sewage pump stations must be fitted with a stand-by pump and a visible or audible high level alarm.

(BC3) Treated effluent may only be released to land at the designated, fenced and delineated contaminant release area/s.

(BC4) Treated effluent must be not released to land within 100 metres of any residential area, watercourse, wetland, spring or protection area.

(BC5) The contaminant release area/s must be maintained in a proper and efficient condition so as to provide adequate assimilation, percolation, evaporation and transpiration of the released contaminants.

(BC6) Treated effluent must not be applied by spray irrigation and must be applied in a manner that does not cause damming or runoff of effluent beyond the contaminant release area/s.

(BC7) When weather conditions or soil conditions preclude the release of contaminants, for example, during and immediately after rainfall, the contaminants must be directed to on-site storage or lawfully disposed of off-site.

Quality of Contaminants Released from the Sewage Treatment Works

(BC8) Treated effluent must comply, at the sampling and in-situ measurement point(s), with each of the release limits specified in Schedule BC, Table 1 - Treated Sewage Effluent Standards for each quality characteristic.

(BC9) The release of contaminants to land must be monitored at the frequency and at the sampling and in-situ measurement point specified in Schedule BC, Table 1 - Treated Sewage Effluent Standards and records of the monitoring results kept for at least five years and made available to the administering authority on request.

Schedule BC, Table 1 - Treated Sewage Effluent Standards

Quality Characteristic	Sampling and in-situ measurement Point Location	Limit Type	Release Limit	Frequency
5-day Biochemical Oxygen Demand (inhibited)	Release pipe from sewage treatment plant after disinfection	maximum	20 mg/L	Monthly
Suspended Solids		maximum	30 mg/L	
pH		range	6.0 to 9.0	
E-Coli		80 percentile	1000 cfu per 100 mL	
		maximum	10000 cfu per 100 ml	

SCHEDULE C – REGULATED DAMS

(C1) The name of each regulated dam must be clearly signed at the dam location at all times.

(C2) Construction of any dam or modifications to an existing dam determined to be in the high hazard or significant hazard category in accordance with the most recent version of *"Manual for Assessing Hazard Categories and Hydraulic Performance of Dams"* is prohibited unless the required design plan details have been entered into the Regulated Dam Register and approved by the chief executive officer for the holder of the environmental authority, or their delegate, as being accurate and correct.

Regulated Dam Register

(C3) The holder of this environmental authority must maintain a Register of Regulated Dams that must include, as a minimum, the following information for each Regulated Dam:

(a) dam name, the coordinates for its location and date of entry in the register;
(b) dam purpose and its proposed/actual contents;
(c) hazard category assessed using the most recent version of *"Manual for Assessing Hazard Categories and Hydraulic Performance of Dams"* ;
(d) details of the composition and construction of any liner;
(e) dimensions (metres) and surface area (hectares) measured at the footprint of the dam;
(f) maximum operational volume (megalitres);
(g) design storage allowance at 1 November each year (megalitres);
(h) mandatory reporting level (metres);
(i) date construction was certified as compliant with the design plan;
(j) name and qualifications of certifier;
(k) dates on which the dam was inspected for structural and operational adequacy;
(l) date on which the report of the annual structural and operational adequacy inspection was provided to the administering authority;
(m) dates on which the dam was inspected for the detection of leakage through any liner; and
(n) dates on which the dam was inspected for the purpose of annually ascertaining the available storage capacity on the 1 November each year.

(C4) The holder of this environmental authority must provisionally enter the required information in the Register of Regulated Dams when a design plan for a Regulated Dam is submitted to the administering authority.

(C5) The holder of this environmental authority must make a final entry of the required information in the Register of Regulated Dams once compliance with Condition C16 has been achieved.

(C6) The holder of this environmental authority must ensure that the information contained in the Register of Regulated Dams is complete and current on any given day.

(C7) The holder of this environmental authority must submit the Register of Regulated Dams or information contained in the Register available to the administering authority at each annual return and when requested to do so in the form requested by the administering authority.

Construction and Operational Requirements for New Dams

(C8) All aggregation dams must:

(a) be designed with a floor and sides of material that will contain the wetting front and any entrained contaminants within the bounds of the containment system during its operational life including any period of decommissioning and rehabilitation; and
(b) have a system that will detect any passage of the wetting front or entrained contaminants through the floor or sides of the dam and enable the repair of the containment system or its decommissioning and rehabilitation.

(C9) All new aggregation dams must be designed and operated so that during any period of thirty (30) days, following the first ninety (90) days of operation of the dam, the total volume of water leaving the dam other than by evaporation must not be less than 85% of the volume of water that has entered the dam.

(C10) By 1 October 2011, all brine dams must:

(a) be designed with a floor and sides of material that will contain the wetting front and any entrained contaminants within the bounds of the containment system during its operational life including any period of decommissioning and rehabilitation;
(b) have a system that will detect any passage of the wetting front or entrained contaminants through the floor or sides of the dam, enable the repair of the containment system or its decommissioning and rehabilitation; and
(c) the collection and proper disposal of any contaminants that move beyond the bounds of the containment system.

(C11) All Regulated Dams must be designed in accordance with the requirements of the most recent version of *"Manual for Assessing Hazard Categories and Hydraulic Performance of Dams"* by and constructed under the supervision of a suitably qualified and experienced person.

(C12) The hazard category of any dam must be determined by a suitably qualified and experienced person, prior to its design and construction, upon any change in its purpose or its stored contents, and at least once in each two (2) year period after its construction.

(C13) The construction and operation of all new Regulated Dams, is prohibited unless the holder of this environmental authority has submitted to the administering authority a copy of the design plan, together with the certification of a suitably qualified and experienced person that the regulated dam:

(a) will deliver the performance stated in the design plan;
(b) has had its hazard category assessed and been designed in accordance with the requirements of the most recent version of *"Manual for Assessing Hazard Categories and Hydraulic Performance of Dams"*; and
(c) when constructed and operated, will be compliant in all respects with the relevant conditions of this environmental authority subject to specific exemptions provided in C29.

(C14) The design plan must include, but not be limited to:

(a) a statement of the relevant legislation, regulatory documents and engineering practice relied upon in the design plan;
(b) a statement of the facts and data being used in the design plan and the limitations to the application and interpretation of that material;
(c) an assessment of the hazard category of the proposed dam based on the indentification of potential impacts on any sensitive receptors for any applicable dam failure scenarios, including the cumulative impact should all dams fail at once;
(d) detailed specifications for the design, operation, maintenance and decommissioning of the dam(s);
(e) an operational plan that includes contingency / emergency response procedures designed to avoid / minimise discharges resulting from any overtopping or loss of structural integrity of the dam;
(f) design, specification and operational rules for any related structures and systems used to prevent the overtopping of the proposed dam;
(g) a detailed plan for the decommissioning and rehabilitation of the dam at the end of its operational life;
(h) any other matter required by the certifying suitably qualified and experienced person; and
(i) evidence supporting the claims of the certifier that they are a suitably qualified and experienced person.

(C15) If, within the 20 business days following the lodgement of a certified design plan the administering authority notifies the holder of this environmental authority, in writing, that the design plan is not compliant with either:

(a) the conditions of this environmental authority; or
(b) the requirements set out in the most recent version of "*Manual for Assessing Hazard Categories and Hydraulic Performance of Dams*"

then the construction and operation of the Regulated Dam is prohibited until the administering authority provides written advice that its construction may proceed.

(C16) When construction of any Regulated Dam is complete, the holder of this environmental authority must submit to the administering authority one hard copy and one electronic copy of a set of 'as constructed' drawings, together with the certification of a suitably qualified and experienced person that the dam 'as constructed' will deliver the performance stated in the design plan and at the time of certification it is compliant in all respects with the conditions of this environmental authority.

(C17) Each Regulated Dam must be maintained and operated in a manner that is consistent with the design plan and the certified 'as constructed' drawings for the duration of its operational life and until decommissioned and rehabilitated.

Livestock and Wildlife

(C18) The holder of this environmental authority must ensure reasonable and practicable control measures are in place to ensure that harm is not caused to livestock or wildlife through the construction and operation of a Regulated Dam.

Mandatory Reporting Level

(C19) The Mandatory Reporting Level must be marked on each Regulated Dam in such a way that it is clearly observable during routine inspections of each dam.

(C20) The holder of this environmental authority must notify the administering authority immediately when the level of the contents of any Regulated Dam reaches the Mandatory Reporting Level, and immediately act to prevent or, if unable to prevent, to minimise any actual or potential environmental harm.

Annual Inspection and Report

(C21) Each Regulated Dam must be inspected annually by a suitably qualified and experienced person.

(C22) 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 contained in the certified design plan.

(C23) An assessment of the adequacy of the available storage in each Regulated Dam is to be made, based on an actual dam level observed in the month of October in each year, and the resultant estimate of the level in that dam as at 1 November in each year must be equal or less than the design storage allowance for the dam.

(C24) Where the assessment of the adequacy of the available storage in any Regulated Dam indicates that the design storage allowance will be exceeded, or at any other time the holder of this environmental authority becomes aware that the design storage allowance has been or will be exceeded, the holder of this environmental authority must notify the administering authority within 24 hours, and immediately act to prevent or, if unable to prevent, to minimise any actual or potential environmental harm.

(C25) For each annual inspection, a copy 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 upon request.

(C26) The holder of this environmental authority must, upon receipt of the annual inspection report, consider the report and its recommendations, take action to ensure that each Regulated Dam will safely perform its intended function, and within one month of receiving the report, notify the administering authority in writing of the recommendations of the inspection report and the actions taken to ensure the integrity of each Regulated Dam.

Requirements for Existing Dams

(C27) By 1 October 2011, all existing aggregation dams must:

(a) Have a floor and sides constructed with material that will contain the wetting front and any entrained contaminants within the bounds of the containment system during its operational life including any period of decommissioning and rehabilitation; and
(b) have a system that will detect any passage of the wetting front or entrained contaminants through the floor or sides of the dam; and
(c) either be capable of repair to rectify any passage of the wetting front through the floor or sides of the dam or be decommissioned and rehabilitated.

(C28) By 1 October 2011, all existing CSG aggregation dams must be operated so that during any period of thirty (30) days, the total volume of water leaving the dam other than by evaporation must not be less than 85% of the volume of water that has entered the dam.

Specific authorisation for Dam 11

(C29) Despite Condition D8, Dam 11 may be constructed within Category B and C ESA buffer zones provided that the dam is located within the control points (CP) listed in Schedule C, Table 1.

Schedule C, Table 1 – Control Points for Dam 11

Control Point	Easting (MGA Zone 55)	Northing (MGA Zone 55)
1	603957	7572921
2	604344	7572921
3	604342	7572533
4	603957	7572534

SCHEDULE D — Land

General

(D1) Contaminants must not be directly or indirectly released to land except as permitted under this environmental authority.

Disturbance to Land – General

(D2) Prior to conducting petroleum activity(ies) that involve significant disturbance to land, an assessment must be undertaken of the condition, type and ecological value of any vegetation in such areas where the activity is proposed to take place.

(D3) The assessment required by Condition D2 must be undertaken by a suitably qualified person and include the carrying out of field validation surveys, observations and mapping of any category A, B or C Environmentally Sensitive Areas (ESA's) and the presence of species classed as endangered, vulnerable, rare or near threatened under the *Nature Conservation Act 1992*.

(D4) The holder of this environmental authority, when carrying out (a) petroleum activity(ies) must:

(a) avoid, minimise or mitigate (in order of preference) any impacts on areas of vegetation or other areas of ecological value;
(b) minimise the risk of injury, harm, or entrapment to wildlife and stock;
(c) minimise disturbance to land that may otherwise result in land degradation;
(d) ensure that for land that is to be significantly disturbed by (a) petroleum activity(ies):
    i. the top layer of the soil profile is removed;
    ii. stockpiled in a manner that will preserve its biological and chemical properties; and
    iii. used for rehabilitation purposes (in accordance with Condition H6) and
(e) prior to carrying out field based activities, make all relevant staff, contractors or agents carrying out those activities, aware of the location of any category A, B or C ESA's and the requirements of this environmental authority.

(D5) In accordance with Condition (D4) above, if significant disturbance to land is unavoidable, the holder of this environmental authority must not clear vegetation, excavate or place fill:

(a) in a way which significantly isolates, fragments or dissects tracts of vegetation resulting in a reduction in the current level of ecosystem functioning, ecological connectivity (i.e. stepping stone or contiguous bioregional/local corridor networks) and/or results in an increase in threatening processes (e.g. potential impacts associated with edge effects or introduced species);
(b) on slopes greater than 10% for activities other than pipelines and wells; or
(c) in discharge areas.

(D6) Clearing of remnant vegetation shall not exceed ten (10) metres in width for the purpose of establishing tracks and 20 metres in width for dual carriageway roads unless otherwise approved by the administering authority in writing.

(D7) Cleared vegetation must be stockpiled in a manner that facilitates respreading or salvaging and does not impede vehicle, stock or wildlife movements.

Disturbance to Land – Environmentally Sensitive Areas

(D8) Notwithstanding Conditions D2 to D7 inclusive, the holder of this environmental authority must ensure that the petroleum activity(ies):

(a) are not conducted in or within 200 metres of any listed category A, B or C ESA's; and
(b) do not involve activities other than (a) limited petroleum activity(ies) within 1km of a listed category A ESA, or within 500m of a listed category B or C ESA.

(D9) (A) limited petroleum activity(ies) carried out in accordance with Condition D8(b) must be preferentially located in pre-existing areas of clearing or significant disturbance to the greatest practicable extent.

Disturbance to Land – Endangered and Of Concern Regional Ecosystems

(D10) Despite Condition D8, where it can be demonstrated that no reasonable or feasible alternative exists, (a) limited petroleum activity(ies) may be undertaken within an endangered/of concern regional ecosystem (RE) and its associated buffer zone, provided that the area is not part of another listed category A, B or C ESA (e.g. a National Park) or associated buffer zone, subject to the following:

(a) the limited petroleum activity(ies) is/are located and carried out in areas according to the following order of preference:
   i. pre-existing cleared areas or significantly disturbed areas less than 200m from an Endangered/Of Concern RE;
   ii. undisturbed areas less than 200m from an Endangered/Of Concern RE;
   iii. pre-existing areas of significant disturbance within an endangered/of concern regional ecosystem (e.g. areas where significant clearing or thinning has been undertaken within a regional ecosystem, and/or areas containing high densities of weed or pest species which has inhibited re-colonisation of native regrowth);
   iv. areas where clearing of an endangered or of concern regional ecosystem is unavoidable;

(b) any vegetation clearing in an Endangered/Of Concern RE or associated buffer zone must not exceed any of the following areas:
   i. 10% of the remnant unit of Endangered/Of Concern regional ecosystem as ground truthed and mapped before any activity commences as per condition D2 and D3 of this environmental authority for the life of the project; or
   ii. more than $30m^2$ for the construction of a sump; or
   iii. six (6) metres in width for tracks; or
   iv. twelve (12) metres in width for pipeline construction purposes; and

(c) all reasonable and practical measures are taken to minimise the area cleared and to avoid the clearing of mature trees, which must include but not be limited to, for each well site, a risk assessment to determine the minimum amount of disturbance possible.

(D11) Details of any significant disturbance to land in or within 200m of Endangered or Of Concern regional ecosystems, along with a record of the assessment required by Conditions D2 and D3 must be kept and submitted to the administering authority upon request.

(D12) If the assessment required by Conditions D2 and D3 indicates that an ecosystem mapped as Endangered or Of Concern regional ecosystem by the Queensland Herbarium should be in a lower conservation value classification and the holder of this environmental authority wishes to undertake activities as if the ecosystem is of the lower conservation value they must notify the administering authority in writing before any significant disturbance to land takes place.

(D13) If, within the 20 business days following the lodgement of the notification under Condition D12 the administering authority notifies the holder of this environmental authority, in writing, that the regional ecosystem mapping requires further validation, then significant disturbance to land in the mapped regional ecosystem is prohibited until the administering authority provides written advice that significant disturbance to land may proceed.

(D14) When requested by the administering authority, the holder of this environmental authority must enter into an agreement with the administering authority to provide an environmental offset to counterbalance the impacts of the activity on Endangered or Of Concern regional ecosystem.

(D15) The holder of this environmental authority must comply with any environmental offset agreement made in accordance with the conditions of this environmental authority.

Disturbance to Land – State Forests and Timber Reserves

(D16) Despite Condition D8, activities may be undertaken within State Forests or Timber Reserves provided the holder of the environmental authority has written approval from the authority responsible for the administration of the *Forestry Act 1959*.

(D17) Where activities are to be undertaken in a State Forest or Timber Reserve that are also Endangered or Of Concern Regional Ecosystems, such activities may be undertaken in accordance with Condition D10 of this environmental authority, provided the holder of this environmental authority has written approval from the authority responsible for the administration of the *Forestry Act 1959*.

Soil Management

(D18) The holder of this environmental authority must develop and implement soil management procedures for areas to be disturbed by (a) petroleum activity(ies) prior to commencement of (a) petroleum activity(ies) in these areas to prevent or minimise the impacts of soil disturbance. These procedures must include but not be limited to:

(a) establishment of baseline soil information for areas to be disturbed including soil depth, pH, electrical conductivity (EC), chloride, cations (calcium, magnesium and sodium), exchangeable sodium percentage (ESP), particle size and soil fertility (including nitrogen, phosphorous, potassium, sulphur and micronutrients);
(b) a soils monitoring program outlining parameters to be monitored, frequency of monitoring and maximum limits for each parameter;
(c) identification of soil units within areas to be disturbed by petroleum activities at a scale of 1:100000, in accordance with the *"Guidelines for Surveying Soil and Land Resources, 2nd Edition"* (McKenzie *et al.* 2008), *"Australian Soil and Land Survey Handbook, 3rd Edition"* (National Committee on Soil and Terrain 2009) and *"The Australian Soil Classification"* (Isbell 2002);
(d) development of soil descriptions that are relevant to assessment for agricultural suitability, topsoil assessment, erodibility and rehabilitation, for example:
    i. shallow cracking clay soils;
    ii. deep cracking clay soils;
    iii. deep saline and/or sodic cracking clay soils with melonholes;
    iv. thin surface, sodic duplex soils;
    v. medium to thick surface (say >15 cm), sodic duplex soils; and
    vi. non-sodic duplex soils;
(e) detailed mitigation measures and procedures to manage the risk of adverse soil disturbance in the carrying out of the petroleum activity; and
(f) for areas of good quality agricultural land, detailed methods to be undertaken to minimise potential impacts.

(D19) A copy of the soil management procedures must be made available to the administering authority upon request.

Acid Sulfate Soils

(D20) The holder of this environmental authority must, when clearing in areas with acid sulfate soils or potential acid sulphate soils, develop and implement an acid sulfate soil environmental management plan prepared in accordance with Appendix 4 of the "*State Planning Policy 2/02 Guideline Acid Sulfate Soils"* and the Department of Environment and Resource Management's *"Queensland Acid Sulphate Soil Technical Manual" (Version 2.2 September 2004)* or more recent editions or supplements to these documents as such become available.

Fauna Management

(D21) The holder of this environmental authority must develop and implement fauna management procedures for the carrying out of the petroleum activity(ies), in particular pipeline construction,

construction and use of dams, to prevent or minimise harm or the potential risk of causing harm to fauna.

(D22) The fauna management procedures must include training and awareness of staff and contractors and ensure that any planned fauna handling is undertaken by a suitably qualified person.

(D23) A copy of the fauna management procedures must be made available to the administering authority upon request.

Pest management

(D24) In carrying out the petroleum activity(ies) the holder of this environmental authority must develop and implement an effective pest management program that includes but is not limited to the following:

(a) identification of pest species and infestation areas;
(b) prevents and/or minimises the introduction and/or spread of pests; and
(c) control and management of pest outbreaks as a result of petroleum activities.

(D25) A copy of the pest management program must be made available to the administering authority upon request.

Chemical and Fuel Storage

(D26) 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.

(D27) 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 bunded so that the capacity and construction of the bund 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 bunded so that the capacity and construction of the bund is sufficient to contain at least 25% of the maximum design storage volume within the bund.

(D28) All containment systems must be designed to minimise rainfall collection within the system.

Well Drilling, Completion and Stimulation

(D29) Hydraulic fracturing fluids must not contain benzene, ethylbenzene, toluene, xylene, naphthalene, phenanthrene or diesel.

(D30) A hydraulic fracturing chemical risk assessment is required to be carried out and submitted to the administering authority prior to hydraulic fracturing on PL191 and PL196.

(D31) The hydraulic fracturing chemical risk assessment required by Condition D30 must be reviewed:

a) when new or additional toxicological information becomes available for the chemicals used; and

b) when new chemicals, chemical concentrations or mixtures are used in hydraulic fracturing fluids.

(D32) The updated risk assessment required by Condition D31(a) must be submitted to the administering authority upon request .

(D33) The updated risk assessment required by Condition D31(b) must be submitted to the administering authority prior to the use of the new chemicals, chemical concentrations or mixtures for hydraulic fracturing on PL191 and PL196.

(D34) The holder of this environmental authority must monitor for the chemicals used in hydraulic fracturing fluids used on PL191 and PL196 and keep a record of the groundwater quality in any landholder's bore, subject to access being permitted by the landholder, that is located within a one (1) kilometre radius of a well subject to hydraulic fracturing.

(D35) The monitoring required under Condition D34 must be undertaken at least:

(a) within 2 months of hydraulic fracturing being undertaken;
(b) weekly for the first month subsequent to hydraulic fracturing being undertaken;
(c) monthly for the first six (6) months subsequent to hydraulic fracturing being undertaken; and
(d) annually for the first five (5) years subsequent to hydraulic fracturing.

(D36) The results of the monitoring required by Conditions D34 and D35 must be made available upon request to:
(a) the administering authority; and
(b) the landholder.

(D37) If the results of the monitoring required by Conditions D34 and D35 indicate that there has been a material impact caused by petroleum activities on groundwater quality, the holder of this environmental authority must notify:
(a) the administering authority within 24 hours; and
(b) any affected landholders within 24 hours or as per written agreement between the holder of this environmental authority and the landholder.

(D38) The holder of this environmental authority must ensure that the hydraulic fracturing process is carried out in such a manner that hydraulic fractures are only contained within the target coal seam.

SCHEDULE E – ENVIRONMENTAL NUISANCE

Odour, Dust and other Airborne Contaminants

(E1) The release of odour, dust or any other airborne contaminant(s), or light from the petroleum activity(ies) must not cause an environmental nuisance at any sensitive place or commercial place.

Noise

(E2) In the event of a complaint about noise from the carrying out of the petroleum activity(ies) being made to the administering authority and that the administering authority considers is not frivolous nor vexatious nor based on mistaken belief, then the emission of noise from the licensed place must not result in total noise levels at any sensitive or commercial place greater than those specified in Schedule E, Table 1 – Noise limits or Schedule E, Table 2 - Noise Limits for Main NQGP Compressor Station.

Schedule E, Table 1 – Noise limits

Time period	Noise level at a sensitive place measured as the Adjusted Maximum Sound Pressure Level $L_{A,max,adj,T}$
7am– 6 pm	Background noise level plus 5 dB(A)
6pm–10pm	Background noise level plus 5 dB(A)
10pm–7am	Background noise level plus 3 dB(A)
Time period	**Noise level at a commercial place measured as the Adjusted Maximum Sound Pressure Level $L_{A,max,adj,T}$**
7am –6 pm	Background noise level plus 10 dB(A)
6pm–10pm	Background noise level plus 10 dB(A)
10pm–7am	Background noise level plus 8 dB(A)

General note: In no case is the background noise level, $L_{A90,15\ mins}$ to be less than 25 dB(A). In the event that measured background noise level is less than 25 dB(A), then 25 dB(A) is to be used.

Schedule E, Table 2 - Noise Limits for Main NQGP Compressor Station

Noise level dB(A) measured as	Monday to Saturday			Sundays and Public Holidays		
	7am - 6pm	6pm - 10pm	10pm - 7am	9am - 6pm	6pm - 10pm	10pm - 9am
	Noise Measured at a Noise Sensitive Place in Zones 1, 2, 4, 5, 9, 12, 13*					
$L_{A10,\ adj,\ 10\ mins}$	40	35	28	40	35	28
$L_{A1,\ adj,\ 10\ mins}$	45	40	33	45	40	33
	Noise measured at a Commercial place in Zones 1, 2, 4, 5, 9, 12, 13*					
$L_{A10,\ adj,\ 10\ mins}$	45	40	33	45	40	33
$L_{A1,\ adj,\ 10\ mins}$	50	45	38	50	45	38
	Noise Measured at a Noise Sensitive Place in Zones 3, 6, 7, 8, 10, 11, 14*					
$L_{A10,\ adj,\ 10\ mins}$	45			45		

$L_{A1, adj, 10 mins}$	50	50
$L_{Aeq, 10 mins}$ in sleeping areas (interior)	35	

* Refers to the Planning Scheme of the Shire of Belyando (Moranbah and environs) approved 23 February 1995

General note: In no case is the background noise level, $L_{A90, 15 mins}$ to be less than 25 dB(A). In the event that measured background noise level is less than 25 dB(A), then 25 dB(A) is to be used.

(E3) In the event of a complaint about noise from the carrying out of temporary petroleum activity(ies) being made to the administering authority and that the administering authority considers is not frivolous nor vexatious nor based on mistaken belief, then total noise emitted from the temporary petroleum activities must not exceed the noise acoustic quality objective of 55 dB(A)at any sensitive or commercial place between 7.00 am and 6.00 pm and background plus 3 dB(A) at other times.

(E4) In the event of a complaint about noise nuisance that the administering authority considers is not frivolous or vexatious then the holder of the environmental authority must prepare and submit a noise management plan to the administering authority within the reasonable and practicable timeframe specified in writing by the administering authority.

(E5) The noise management plan must address, but not be limited to, the following matters:

(a) identification of component noise sources and activities at the place(s) which impact on noise sensitive areas;
(b) the measured and/or predicted component and total level from Condition E5(a) at noise sensitive places;
(c) the reasonable and practicable control or abatement measures (including hours of operation) that can be undertaken to reduce identified intrusive noise sources;
(d) the level of noise at noise sensitive places that would be achieved from implementing these measures.
(e) the handling of future noise complaints;
(f) community liaison and consultation; and
(g) training of staff and contractors in noise management practices.

(E6 The holder of this environmental authority must commence implementation of the noise abatement measures recommended in the noise management plan not more that 30 days following its submission to the administering authority, accounting for any comments made by the administering authority within that time.

SCHEDULE F – AIR

(F1) Fuel burning or combustion equipment that is capable of burning at least 500kg of fuel in an hour must only release contaminants to the atmosphere as provided for in Schedule F – Table 1.

(F2) Contaminants must be directed vertically upwards.

Schedule F – Table 1 (release of contaminants)

Release point number		Minimum release height (meters)	Minimum velocity (m/sec)	Contaminant released	Maximum release limit (g/sec)
A1	Node 1 compressor stack	8	25	NOx	0.25
A2	Node 1 compressor stack	8	25	NOx	0.25
A3	Node 1 compressor stack	8	25	NOx	0.25
A4*	Node 2 compressor stack	TBA	TBA	NOx	TBA
A5*	Node 3 compressor stack	TBA	TBA	NOx	TBA
A6*	Node 3 compressor stack	TBA	TBA	NOx	TBA
A7*	Node 3 compressor stack	TBA	TBA	NOx	TBA
A8*	Node 4 compressor stack	TBA	TBA	NOx	TBA
A9*	Node 4 compressor stack	TBA	TBA	NOx	TBA
A10	MGPF compressor stack	8	25	NOx	0.8
A11	MGPF compressor stack	8	25	NOx	0.8
A12	MGPF compressor stack	8	25	NOx	0.8
A13	MGPF compressor stack	8	25	NOx	0.8

* Planned at the date of authority issue

1 The NOx limits are applicable at all times except start-up, shut down and calibration of emission monitoring devices. The maximium start-up period allowed is 30 minutes

TBA Contaminant release parameters to be finalised and advised in the Annual return due October 2010.

(F3) The holder of this environmental authority must maintain a Register of Fuel Burning or Combustion Equipment that is capable of burning at least 500kg of fuel in an hour and must include, as a minimum, the following information for each item of equipment:

(a) fuel burning or combustion equipment name and location;
(b) stack emission height (metres);
(c) minimum efflux velocity (metres /sec); and
(d) mass emission rates (g/s) / contaminant concentrations (mg/Nm^3 @ 5% O_2).

(F4) The holder of this environmental authority must ensure that the information contained in the Register of Fuel Burning or Combustion Equipment is complete and current on any given day.

(F5) The holder of this environmental authority must make the Register of Fuel Burning or Combustion Equipment or information contained in the Register available to the administering authority on request.

SCHEDULE G – WASTE

General

(G1) All general waste must be removed from the site and sent to a recycling facility or disposal facility licensed to accept the waste.

(G2) All regulated waste must be removed from the site 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 recycling facility or disposal facility licensed to accept the waste.

(G3) Waste must not be burned or allowed to be burned on the licensed site.

(G4) All waste fluids and muds resulting from drilling and exploration activities must be contained in a dam or containment structure for disposal, remediation or reuse where applicable.

(G5) Oil based drilling muds must not be used in the carrying out of the petroleum activity.

(G6) Synthetic based drilling muds must not be used in the carrying out of the petroleum activity other than with the written approval of the administering authority.

(G7) The holder of this environmental authority must ensure that coal seam gas water is contained, is not released to land or waters unless used for purposes specifically authorised:

(a) under this environmental authority; or
(b) under Section 186 of the *Petroleum and Gas (Production and Safety) Act 2004*; or
(c) under Section 86 of the *Petroleum Act 1923*; or
(d) under an approval of resource for beneficial use as provided for under the *Environmental Protection Act 1994*.

Coal seam gas water use for dust suppression

(G8) CSG water produced from the authorised petroleum activities may be used for dust suppression within tenures covered by this environmental authority, provided the water quality meets the limits specified in Schedule G, Table 1 – Road dust suppression water contaminant release limits for each of the water quality characteristics.

Schedule G, Table 1 – Road dust suppression water contaminant release limits.

Water Quality Characteristics	Unit	Limit	Limit Type
pH	pH Units	6.0 to 9.0	range
Total Suspended Solids	mg/L	30	maximum
Total Dissolved Salts	mg/L	2000	maximum
Total Petroleum Hydrocarbons	mg/L	10	maximum

(G9) Use of CSG water for dust suppression activities must be carried out in a manner that:

(a) vegetation is not damaged;
(b) soil erosion and soil structure damage is avoided;
(c) there is no surface damming of the CSG water;
(d) minimises deep drainage below the root zone of any vegetation;
(e) quality of shallow aquifers is not adversely affected; and
(f) there are no releases of CSG waters to any surface waters.

(G10) The holder of this environmental authority must ensure that the coal seam gas water to be used for domestic or stock purposes meets the ANZECC 2000 Water Quality Guidelines, or subsequent versions thereof, for stock and domestic purposes.

(G11) Coal seam gas water released to the environment in accordance with Condition G7 must not have any properties that could cause, nor contain any contaminants in concentrations that are capable of causing environmental harm.

Third Party Use

(G12) Wastewater generated from the authorised activities may be piped to Millennium Coal Mine ML70313 and ML7012 for use in coal washing and dust suppression.

(G13) The authority holder when discharging to Millennium Coal Mine must record daily the following details:

a) time and date of the discharge;

b) TDS and pH levels of the discharge; and

c) total volume discharged.

Water Release Reduction Strategy

(G14) As part of the Coal Seam Gas Water Management Plan ((CSGWMP) contained within the Environmental Management Plan)), the holder of the environmental authority must develop and implement an on-going Release Reduction Strategy to maximise CSG water use and minimise any release to waters . The strategy must address the following matters:

(a) implementation of schemes to achieve maximum use of the water;
(b) specific targets for achieving increased use of CSG water both treated and untreated;
(c) a market analysis at least every three (3) years to identify existing and future opportunities for water use;
(d) on-going review of emerging technologies and/or re-use options that could achieve significant reductions in mass loads of contaminants released to the environment;
(e) investigation of the feasibility of alternative options, practices and procedures to further minimise the volume and concentration of contaminants released to waters; and
(f) programs to implement feasible options to achieve increased water use and reduction in contaminant loads, including actions and timeframes for completion.

(G15) A progress report on the strategy required by Condition G14 is to be included in the Annual Return and address at least the following matters:

(a) details of the specific options, practices and procedures investigated;
(b) details of new practices, procedures and programs implemented since the last reporting period and targets met;
(c) where alternative options, practices and procedures are not considered feasible, the provision of justification to support that determination; and
(d) details of the option(s) yet to be implemented, including the timeframes for implementation, and justification for the chosen option(s).

(G16) Where any inconsistency exists between the conditions of this environmental authority and the Coal Seam Gas Water Management Plan, the conditions of this environmental authority prevail.

Salt Management

Brine Salt Reuse, Recycle or Off Site Disposal

(G17) Following cessation of petroleum activities, any residual brine or solid salt present in a CSG water dam must be removed and transported to a facility that can lawfully reuse, recycle or dispose of such waste.

SCHEDULE H – REHABILITATION

(H1) The holder of this environmental authority must not abandon any dam but must decommission each dam so as to prevent and/or minimise any environmental harm.

(H2) As a minimum, decommissioning must be conducted such that each dam either:

(a) becomes a stable landform similar to that of surrounding undisturbed areas, that no longer contains substances that will migrate into the environment, or
(b) is approved or authorised by the administering authority for use by the landholder following cessation of the petroleum activities.

(H3) Progressive rehabilitation of disturbed areas must commence as soon as practicable following the completion of any construction or operational works associated with the petroleum activity(ies).

(H4) As soon as practicable, but no later than twelve (12) months (or a longer period agreed in writing by the administering authority) after the end of petroleum activity(ies) causing significant disturbance to land, the holder of this environmental authority must:

(a) remediate contaminated land (e.g. dams containing salt);
(b) reshape all significantly disturbed land to a stable landform similar to that of surrounding undisturbed areas;
(c) on all significantly disturbed land, take all reasonable and practicable measures to:
i. re-establish surface drainage lines;
ii. reinstate the top layer of the soil profile; and
iii. promote establishment of vegetation.
(d) undertake rehabilitation in a manner such that any actual and potential acid sulfate soils in or on the site are either not disturbed, or submerged, or treated so as to not be likely to cause environmental harm; and
(e) decommission all inactive buried pipelines in accordance with the requirements of AS2885 and ensuring that there will not be any subsequent subsidence of land along the pipeline route.

(H5) All significantly disturbed land caused by the carrying out of the petroleum activity(ies) 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.

(H6) 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.

(H7) Rehabilitation can be considered successful when:

(a) the site can be managed for its designated land-use (e.g. similar to that of surrounding undisturbed areas);

(b) no greater management input than for other land in the area being used for a similar purpose is required and there is evidence that the rehabilitation has been successful for at least three (3) years;
(c) the rehabilitation is carried out in accordance with the goals, objectives indicators and completion criteria as specified in Schedule H, Table 1 – Planned rehabilitation specifications; or
(d) written agreement is obtained from the landowner/holder and administering authority.

Schedule H, Table 1 – Planned rehabilitation specifications

Petroleum activity feature	Relevant Resource Authority	Rehabilitation Goal	Rehabilitation objectives	Indicators	Completion criteria
All petroleum activity features	PL191 and PL196	1. Safe	Site safe for humans and animals	(a) Landform re-established	(a) No subsidence or major erosion gullies
		2. Non-polluting	Sediment and erosion control structures in place	(a) Sediment traps and design of erosion control measures	(a) Certification from suitably qualified and experience person and performance of control structures
			Storm water runoff does not pollute nearby watercourses	(b) Surface water monitoring	(b) Monitoring meeting release limits
			Encapsulated salt does not seep outside the monocell	(c) Groundwater monitoring	(c) Monitoring shows no adverse impacts on groundwater quality
		3. Stable	Minimise erosion	(a) Re-establish surface drainage lines	(a) no subsidence or areas of major erosion for at least 3 years
				(b) Vegetation cover	(b)(i) 50% cover (flat to sloping) and (b)(ii) 75% cover (moderate to steep slopes) consisting of vegetation similar to immediate surrounding area. (b)(iii) vegetation cover is equivalent to immediate surrounding area where land use is cultivation.

Petroleum activity feature	Relevant Resource Authority	Rehabilitation Goal	Rehabilitation objectives	Indicators	Completion criteria
		4. Self-sustaining	Describe post activity land use or land suitability or land capability	(a) Floral Species diversity	(a)(i) Evidence that 80% of the immediate surrounding species diversity is achieved and maintained for 3 years. (a)(ii) If soil can be demonstrated as being substantially different after operations, objective is to establish other vegetation which fulfils the function of the vegetation immediately surrounding the area.
				(b) Presence of key floral species	(b)(i) Evidence that 80% of key species in the immediate surrounding area are present and maintained for 3 years. (b)(ii) Where agriculture is the planned final land use, the species should be those commonly used for pasture or crops known to be successful in soils of similar texture, drainage, pH and fertility.

SCHEDULE I – MONITORING PROGRAMS

General

(I1) The holder of this environmental authority must develop and implement a monitoring program, the result of which will demonstrate compliance with the conditions of this environmental authority.

(I2) All monitoring under this environmental authority must be conducted by a suitably qualified person.

(I3) All instruments, equipment and measuring devices used for measuring or monitoring in accordance with any condition of this environmental authority must be calibrated, and operated and maintained effectively.

(I4) The method of water sampling required by this environmental authority must comply with the most recent edition of the Department of Environment and Resource Management – Water Quality Sampling Manual.

(I5) All determinations of water quality must be:

(a) performed by a person or body possessing appropriate experience and qualifications to perform the required measurements; and
(b) made in accordance with methods prescribed in the latest edition of the Department of Environment and Resource Management - Water Quality Sampling Manual; and
(c) carried out on representative samples.

(I6) All analyses and tests required to be conducted under this environmental 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.

(I7) If monitoring conducted in accordance with this environmental authority indicated a condition or contaminant level that has caused, or has potential to cause, environmental harm, the environmental authority holder must:

(d) as soon as is practicable, take the necessary actions to rectify the condition or contaminant level so as to avoid or minimise environmental harm; and
(e) notify the administering authority of the condition or contaminant level and the actions taken to rectify it.

(I8) Any management or monitoring plans, systems or programs required to be developed and implemented by a condition of this environmental authority must be reviewed for performance and amended if required on an annual basis.

(I9) The holder of this environmental authority must record, compile and keep for a minimum of five years all monitoring results required by this environmental authority and make available for inspection all or any of these records upon request by the administering authority.

(I10) An annual monitoring report must be prepared each year and presented to the administering authority when requested. This report shall include but not be limited to:

(a) a summary of the previous twelve (12) months monitoring results obtained under any monitoring programs required under this environmental authority and, a comparison of the previous twelve (12) months monitoring results to both the limits set in this environmental authority and to relevant prior results; and
(b) an evaluation/explanation of the data derived from any monitoring programs; and
(c) a summary of any record of quantities of releases required to be kept under this environmental authority; and

(d) an outline of actions taken or proposed to minimise the risk of environmental harm from any condition or elevated contaminant level identified by the monitoring or recording programs.

Groundwater Monitoring

(I11) The holder of this environmental authority must prepare and implement a groundwater monitoring program within 40 business days of this environmental authority taking effect.

(I12) The groundwater monitoring program must be developed and implemented by a person possessing appropriate qualifications and experience in the fields of hydrogeology and groundwater sampling design.

(I13) The groundwater monitoring program must be able to detect any significant risks and changes to groundwater quality caused by petroleum activity(ies) authorised under this environmental authority. As a minimum the program must include:

(a) a groundwater monitoring network designed and installed for the petroleum activities; and
(b) a sufficient number of monitoring sites to provide information on the following:
  (i) seepage to groundwater and surrounding soils from any regulated dam authorised under this environmental 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 the activities authorised under this environmental authority).
(c) the location of monitoring points, parameters to be measured, frequency of monitoring, monitoring methodology used, trigger values; and
(d) the development of procedures to establish background ground water quality.

(I14) The groundwater monitoring program must provide for monitoring of groundwater quality as often as necessary to detect impacts of the petroleum activities authorised under this environmental authority, but not less frequently than biannually (every six months) for the first year of carrying out the petroleum activities and annually thereafter.

(I15) If groundwater contamination caused by the petroleum activities is encountered, the following must be considered to satisfy requirements under Condition I17.

(a) the level of environmental harm caused as a result of such contamination to soils and groundwater;
(b) the conduct of a geodetic survey of all monitoring bores to determine the relative water 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.

(I16) The holder of this environmental authority must ensure that the groundwater monitoring data gathered in accordance with this environmental 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 with each Annual Return.

(I17) If groundwater monitoring indicates that any significant changes in groundwater quality caused by petroleum activities are detected, then information must be submitted to the administering authority within ten (10) business days of receipt of the analysis indicating these changes, including any proposed actions to mitigate the changes in groundwater quality.

Air Monitoring (Point Source)

(I18) The holder of this environmental authority must conduct a monitoring program of contaminants released to the atmosphere at each release point recorded in the Register of Fuel Burning or Combustion Equipment (Condition F3) for the contaminants and at the frequency listed in Schedule I – Table 1 – Monitoring Frequency for Contaminants.

Schedule I, Table 1 – Monitoring Frequency for contaminants

Contaminant	Monitoring frequency
NOx as Nitrogen Dioxide	Within 3 months after commissioning of the fuel burning equipment; and Twice a year for the first two (2) years of operation; and Thereafter, annually
Carbon monoxide	

(I19) The monitoring program must comply with the following:

(a) Monitoring provisions for the release points must comply with the most recent edition of AS4323.1 Stationary source emissions method 1: Selection of sampling provisions.
(b) The following tests must be performed for each sample taken at each release point specified in the Register of Fuel Burning or Combustion Equipment (Condition F3):
  i. Gas velocity, volume and mass flow rate.
  ii. Temperature.
  iii. Water vapour concentration (for non-continuous sampling).
(c) Samples taken must be representative of the contaminants discharged when operating under maximum operating conditions.
(d) During the sampling period the following additional information must be gathered:
  i. Production rate.
  ii. Plant status.
(e) Monitoring of contaminant release must be carried out in accordance with the latest edition of the administering authority's Air Quality Sampling Manual.

Noise Monitoring

(I20) The holder of this environmental authority must undertake noise monitoring when requested by the administering authority to investigate a complaint of environmental nuisance at a sensitive or commercial place within the reasonable and practicable timeframe nominated by the administering authority, and report the results to the administering authority within three (3) business days of completion of the monitoring.

(I21) Noise monitoring and recording must include the following descriptor, characteristics and matters:

(a) $L_{AN,T}$ (where N equals the statistical levels of 1, 10 and 90 and T = 15 mins);
(b) background noise $L_{A90,T}$;
(c) the level and frequency of occurrence of impulsive or tonal noise and any adjustment and penalties to statistical levels;
(d) atmospheric conditions including temperature, relative humidity and wind speed and directions;
(e) effects due to any extraneous factors such as traffic noise;
(f) location, date and time of monitoring;
(g) if the complaint concerns low frequency noise, Max $L_{PZ,15\ min}$; and
(h) If the complaint concerns low frequency noise, one third octave band measurements in dB(LIN) for centre frequencies in the 10 – 200 Hz range for both the noise source and the background noise in the absence of the noise source.

(I22) The method of measurement and reporting of noise levels and background sound pressure levels must comply with the latest edition of the administering authority's *Noise Measurement Manual* or the most recent version of AS1055 Acoustics – description and measurement of environmental noise.

Nuisance Monitoring (other than Noise)

(I23) When the administering authority advises the holder of this environmental authority of a complaint alleging nuisance other than noise, the holder must investigate the complaint and advise the administering authority in writing of the action proposed or undertaken to resolve the complaint.

(I24) When requested by the administering authority, the holder of this environmental authority must undertake monitoring as specified by the administering authority, within a reasonable and practical timeframe nominated by the administering authority to investigate any complaint of environmental harm at any sensitive or commercial place.

(I25) 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 ten (10) business days of completion of the investigation, or receipt of the monitoring results, whichever is the latter.

(I26) If monitoring in accordance with Condition I24 and I25 indicates that emissions exceed the limits set in this environmental authority or are causing environmental nuisance, then the holder of this environmental authority must:

(a) address the complaint including the use of alternative dispute resolution services if required; and/or
(b) as soon as practicable implement abatement or attenuation measures so that light, dust, particulate or odour emissions from the authorised activities do not result in further environmental nuisance.

Annual Water Monitoring Reporting

(I27) The following information must be recorded in relation to all water monitoring required under the conditions of this environmental authority and submitted to the administering authority in the specified format with each annual return:

(a) the date on which the sample was taken;
(b) the time at which the sample was taken;
(c) the monitoring point at which the sample was taken;
(d) the measured or estimated daily quantity of the contaminants released from all release points;
(e) the release flow rate at the time of sampling for each release point;
(f) the results of all monitoring and details of any exceedances with the conditions of this environmental authority; and
(g) water quality monitoring data must be provided to the administering authority in the specified electronic format upon request.

SCHEDULE J – COMMUNITY ISSUES

(J1) The holder of this environmental authority must maintain a record of complaints and incidents causing environmental harm, and actions taken in response to the complaint or incident.

(J2) The holder of this environmental authority must record the following details for all complaints received and provide this information to the administering authority on request:

(a) name, address and contact number for complainant;
(b) time and date of complaint;
(c) reasons for the complaint as stated by the complainant;
(d) investigations undertaken in response to the complaint;
(e) conclusions formed;
(f) actions taken to resolve complaint;
(g) any abatement measures implemented to mitigate the cause of the complaint; and
(h) name and contact details of the person responsible for resolving the complaint.

(J3) The holder of this environmental authority must retain the record of complaints required by this condition for five (5) years.

SCHEDULE K - NOTIFICATION PROCEDURES

(K1) The holder of this environmental authority must telephone the administering authority's Pollution Hotline (1300 130 372) or local office and the landholder or their nominated representative within 24 hours of becoming aware of any release of contaminants not in accordance with the conditions of this environmental authority or any event where environmental harm has been caused or may be caused.

(K2) Subject to condition K1, the holder of this environmental authority is required to report in the case of uncontained spills of contaminants (including but not limited to hydrocarbon, CSG water or mixtures of both) of the following volumes or kind:

(a) releases of any volume of contaminants to water; and
(b) releases of volumes of contaminants greater than 200 litres of hydrocarbon, 2000 litres of brine or 10 000 litres of coal seam gas water to land; and
(c) releases of any volumes of contaminants where potential serious or material environmental harm has occurred or may occur.

(K3) The notification of emergencies or incidents as required by Conditions K1 and K2 must include but not be limited to the following information:

(a) the environmental authority number and name of the holder of this environmental authority;
(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 this environmental 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 any environmental harm that has occurred or may occur as a result of 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.

(K4) Within ten (10) business days following the initial notification of an emergency or incident or receipt of monitoring results, whichever is the later, a written report must be provided to the administering authority, including the following:

(a) results and interpretation of any samples taken at the time of the incident and analysed;
(b) the outcomes of actions taken at the time of the incident to prevent or minimise environmental harm; and
(c) proposed actions to prevent a recurrence of the emergency or incident.

(K5) 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 environmental authority, a written report on the results of any such monitoring must be provided to the administering authority.

SCHEDULE L - DEFINITIONS

Note: Where a term is not defined in this environmental authority the definition in the Environmental Protection Act 1994, *its regulations and Environmental Protection Policies or the* Petroleum and Gas (Production and Safety) Act 2004 *and its regulations must be used in that order.*

"acid sulfate soils" means soil or sediment containing highly acidic soil horizons or layers affected by the oxidation of iron sulfides (*actual acid sulfate soils*) and/or soil or sediment containing iron sulfides or other sulfidic material that has not been exposed to air and oxidised (*potential acid sulfate soils*).

"associated works" in relation to a dam, means:

- operations of any kind and all things constructed, erected or installed for that dam; and
- any land used for those operations.

"background noise level" means the sound pressure level, measured in the absence of the noise under investigation, as the L A90,T being the A-weighted sound pressure level exceeded for 90 percent of the measurement time period T of not less than 15 minutes, using Fast response.

"bed and banks" for a watercourse or wetland means land over which the water of the watercourse or wetland normally flows or that is normally covered by the water, whether permanently or intermittently; but does not include land adjoining or adjacent to the bed or banks that is from time to time covered by floodwater.

"beneficial use" means

- with respect to dams, that the current or proposed owner of the land on which a dam stands, has found a use for that dam that is:
  - of benefit to that owner in that it adds real value to their business or to the general community,
  - in accordance with relevant provisions of the *Environmental Protection Act 1994*,
  - 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. Or
- with respect to coal seam gas water, refer the DERM's Operational Policy *Management of water produced in association with petroleum activities (CSG water)* and *Notice of decision to approve a resource for beneficial use – CSG water* which can be accessed on DERM's website at www.derm.qld.gov.au.

"brine" means either saline water with a total dissolved solid concentration greater than 40 000mg/l or CSG water after it has been concentrated through water treatment processes and/or evaporation.

"bund or bunded" in relation to spill containment systems for fabricated or manufactured tanks or containers designed to a recognised standard means an embankment or wall of brick, stone, concrete or other impervious material which may form part or all of the perimeter of a compound and provides a barrier to retain liquid. Since the bund is the main part of a spill containment system, the whole system (or bunded area) is sometimes colloquially referred to within industry as the bund. The bund is designed to contain spillages and leaks from liquids used, stored or processed above ground and to facilitate clean-up operations. As well as being used to prevent pollution of the receiving environment, bunds are also used for fire protection, product recovery and process isolation.

"category A ESA" means any area listed in Section 25 of the *Environmental Protection Regulation 2008.*

"category B ESA" means any area listed in Section 26 of the *Environmental Protection Regulation 2008.*

"category C ESA" means any of the following areas:

- Nature Refuges as defined under the *Nature Conservation Act 1992*;
- Koala Habitat Areas as defined under the *Nature Conservation Act 1992*;
- State Forests or Timber Reserves as defined under the *Forestry Act 1959*;
- Declared catchment areas under the *Water Act 2000*;
- Resources reserves under the *Nature Conservation Act 1992*
- An area identified as "Essential Habitat" for a species of wildlife listed as endangered, vulnerable, rare or near threatened under the *Nature Conservation Act 1992*;
- Any wetland shown on the Map of Referable Wetlands available from DERM's website; or
- "Of concern" regional ecosystems identified in the database maintained by DERM called 'Regional ecosystem description database' containing regional ecosystem numbers and descriptions.

"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:

- exactly what is being certified and the precise nature of that certification.
- the relevant legislative, regulatory and technical criteria on which the certification has been based;
- 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
- 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.

"clearing" means:

- in relation to grass, scrub or bush—the removal of vegetation by disturbing root systems and exposing underlying soil (including burning), but does not include—
  - the flattening or compaction of vegetation by vehicles if the vegetation remains living; or
  - the slashing or mowing of vegetation to facilitate access tracks; or
  - the clearing of noxious or introduced plant species; and
- in relation to trees—cutting down, ringbarking, pushing over, poisoning or destroying in any way.

"commercial place" means a work place used as an office or for business or commercial purposes, which is not part of the petroleum activities and does not include employees accommodation or public roads.

"construction" in relation to a dam includes building a new dam and modifying or lifting an existing dam.

"CSG water" means groundwater that is necessarily or unavoidably brought to the surface in the process of coal seam gas exploration or production. CSG water typically contains significant concentrations of salts, has a high sodium adsorption ratio (SAR) and may contain other contaminants that have the potential to cause environmental harm if released to land or waters through inappropriate management. CSG water is a waste, as defined under s13 of the EP Act.

"CSG water concentrate" is the concentration of saline water waste stream from a water treatment process that does not exceed a total dissolved solid concentration of 40 000mg/L.

"CSG evaporation dams" is defined as an impoundment, enclosure or structure that is designed to be used to hold CSG water for evaporation.

"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.

"design plan" means 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 design and investigation reports, specifications and certifications, together with the planned decommissioning and rehabilitation works and outcomes. A design plan may include 'as constructed' drawings.

"discharge area" means:

(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 Environment and Resource Management.

"ecosystem functioning" means the interactions between and within living and nonliving components of an ecosystem and generally correlates with the size, shape and location of an area of vegetation.

"end" means the stopping of the particular activity that has caused a significant disturbance in a particular area. It refers to, among other things, the end of a seismic survey or the end of a drilling operation. It does not refer to the end of all related activities such as rehabilitation. In other words, it does not refer to the 'completion' of the petroleum activity, the time at which the petroleum authority ends or the time that the land in question ceases to be part of an authority.

"equivalent person or EP" means an equivalent person under volume 1, section 2 of the *Guidelines for Planning and Design of Sewerage Schemes*, October 1991, published by the Water Resources Commission, Department of Primary Industries, Fisheries and Forestry.

"existing CSG dams" means Dam 1, Dam 2, Dam 3, Dam 4, Dam 5, Dam 6, Dam 7, Dam 9, Dam 10 and Dam 13.

"fill" means any kind of material in solid form (whether or not naturally occurring) capable of being deposited at a place but does not include material that forms a part of, or is associated with, a structure constructed in a watercourse, wetland or spring including a bridge, road, causeway, pipeline, rock revetment, drain outlet works, erosion prevention structure or fence.

"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' means 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 acceptably low probability of failure before that time.

"hazard" in relation to a dam as defined, 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.

"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 *DERM's Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (Version 1.0, 2008)* or any updated version of the Manual that becomes available from time to time

"heritage place" means any place that may be of cultural heritage significance, or any place with potential to contain archaeological artefacts that are an important source of information about Queensland's history.

"high bank" means the defining terrace or bank or, if no bank is present, the point on the active floodplain, which confines the average annual peak flows in a watercourse.

"highly erodible soils" means very unstable soils that are generally described as Sodosols with hard – setting, fine sandy loam to silty clay loam surfaces (solodics, solodised solonetz and solonetz) or soils with a dispersible layer located less than 25cm deep or soils less than 25cm deep.

"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)* published by DERM on its website.

"impulsive sound" means sound characterised by brief excursions of sound pressure (acoustic impulses) that significantly exceed the background sound pressure. The duration of a single impulsive sound is usually less than one second.

"infrastructure" means water storage dams, roads and tracks, equipment, buildings and other structures built for the purpose and duration of the conduct of 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 (e.g. evaporation dams), pipelines and assets, that have been decommissioned, rehabilitated, and lawfully recognised as being subject to subsequent transfer with ownership of the land.

"itinerant activities" means activities that are carried out at various locations using transportable plant or equipment and carried out at one location and for less than 14 consecutive days and on more than two occasions in each calendar year.

"lake" means:

(a) a lagoon, swamp or other natural collection of water, whether permanent or intermittent; and
(b) the bed and banks and any other element confining or containing the water.

"landfill monocell" means a specialised, isolated landfill facility where a single specific waste type is exclusively disposed (i.e. salt).

"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 a dyke or bund 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 unplanned releases from other works of infrastructure, during the progress of those stormwater or flood flows or those unplanned releases; and does not store any significant volume of water or flowable substances at any other times.

"limited petroleum activities mean activities including geophysical surveys (including seismic activities), well sites, well pads, sumps, flare pits, flow lines and supporting access tracks. Limited petroleum activities do not include the construction of production infrastructure for processing or storing petroleum or by-products, dams, compressor stations, campsites/workforce accommodation, power supplies, waste disposal or other supporting infrastructure for the project.

"material impact" for the purposes of Condition D37 means an increase in concentration of a chemical used in fracturing fluids on PL191 and PL196 of >10% above background, detection of a chemical that was not present in the background sample or a chemical present at a concentration in excess of drinking water quality guidelines.

"max $L_{pZ,16\ min}$" means the maximum value of the Z-weighted sound pressure level measured over 15 minutes.

"mg/L" means milligrams per litre.

"Oil based drilling muds"- Oil-based mud where the base fluid is a petroleum product such as diesel fuel.

"overland flow water" means water, including floodwater, flowing over land, otherwise than in a watercourse or lake:

- after having fallen as rain or in any other way; or
- after rising to the surface naturally from underground.

"permanent infrastructure" includes any infrastructure (roads, tracks, bridges, culverts, dams, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads, pipelines etc), which is to be left by agreement with the landowner.

"pest" means species:
(a) declared under the *Land Protection (Pest and Stock route Management) Act 2002*;
(b) declared under Local Government model local laws; and
(c) which may become invasive in the future.

"regulated dam" means any dam in the significant or high hazard category as assessed using the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (Version 1.0, 2008)* or any updated version of the Manual that becomes available from time to time

"rehabilitation" means 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

"remnant unit" means a continuous area of remnant vegetation representative of a single Regional Ecosystem type or a single heterogeneous unit (multiple Regional Ecosystem types that cannot be distinguished individually due to the scale of mapping).

"River Improvement Trust Asset Area" means an area within a River Improvement Area declared under the *River Improvement Trust Act 1940* that is or has been subject to restoration or flood mitigation works. The locations and details of these areas can be obtained from the relevant River Improvement Trust.

"sensitive place" means

- a dwelling (including residential allotment, mobile home or caravan park, residential marina or other residential premises, motel, hotel or hostel; or
- a library, childcare centre, kindergarten, school, university or other educational institution;
- a medical centre, surgery or hospital; or
- a protected area; or
- a public 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.

"significantly disturbed land or significant disturbance to land" means disturbance to land as defined in section 28 of the *Environmental Protection Regulation 2008*.

"site" means the petroleum authority(ies) to which the environmental authority relates.
"spring" means the land to which water rises naturally from below the ground and the land over which the water then flows.
"stable" in relation to land, means landform 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.
"state heritage place" means a place entered in the Queensland heritage register under Part 4 of the *Queensland Heritage Act 1992*.
"suitably qualified person" means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis to performance relative to the subject matter using the relevant protocols, standards, methods or literature.
"suitably qualified and experienced person" in relation to 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:

- knowledge of engineering principles related to the structures, geomechanics, hydrology, hydraulics, chemistry and environmental impacts of dams; and
- 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
- 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.

"Synthetic based drilling muds"- Synthetic-based fluid is a mud where the base fluid is a synthetic oil.
"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
"threatening processes" means processes, features and actions that can have a detrimental effect upon the health and viability of an area of vegetation. For example altered hydrology, land use practices, invasion by pest and weed species, land degradation, edge effects and fragmentation.
"Temporary petroleum activities" means a petroleum activity that does not involve permanent fixture of equipment or infrastructure and includes (but not limited to) drilling, fraccing, construction and decommissioning of infrastructure.

"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 damage and limiting infiltration and percolation.
"topsoil" means the surface (top) layer of a soil profile, which is 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 the natural surface.
"void" means any man-made, open excavation in the ground (includes borrow pits, drill sumps, frac pits, flare pits, cavitation pits and trenches).
"waters" includes all or any part of a creek, river, stream, lake, lagoon, dam, swamp, wetland, spring, unconfined surface water, unconfined water in natural or artificial watercourses, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and underground water.
"watercourse" means a river, creek or stream in which water flows permanently or intermittently:

(a) in a natural channel, whether artificially improved or not; or
(b) in an artificial channel that has changed the course of the watercourse;
but, in any case, only:
(c) unless a regulation under paragraph (d), (e) or (f) declares otherwise-at every place upstream of the point (point A) to which the high spring tide ordinarily flows and reflows, whether due to a natural cause or to an artificial barrier; or
(d) if a regulation has declared an upstream limit for the watercourse-the part of the river, creek or stream between the upstream limit and point A; or
(e) if a regulation has declared a downstream limit for the watercourse-the part of the river, creek or stream upstream of the limit; or
(f) if a regulation has declared an upstream and a downstream limit for the watercourse-the part of the river, creek or stream between the upstream and the downstream limits.

Watercourse includes the bed and banks and any other element of a river, creek or stream confining or containing water.

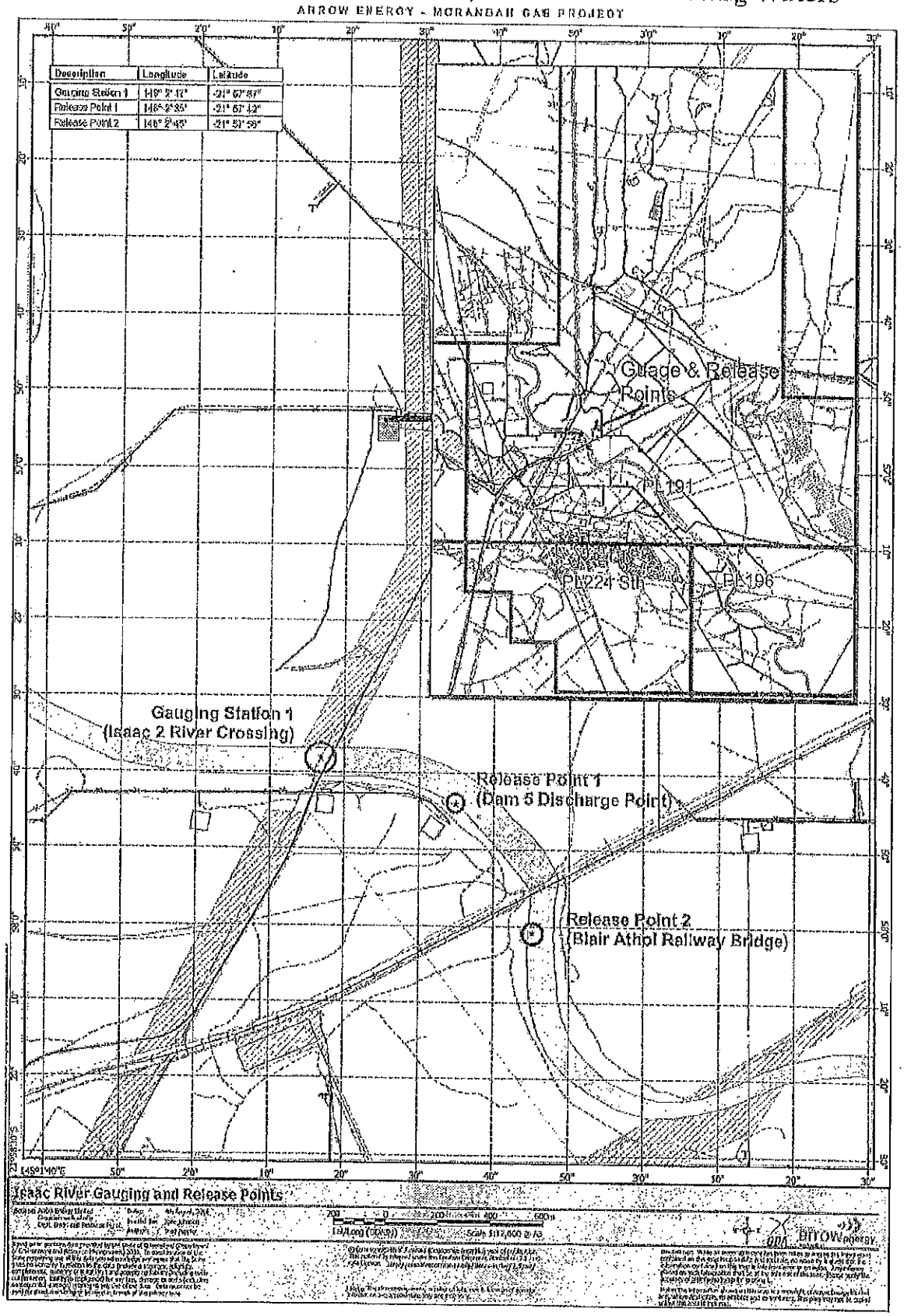
"wetland" means an area shown as a wetland on a 'Map of referable wetlands', a document approved by the chief executive (environment). A map of referable wetlands can be viewed at www.derm.qld.gov.au .

"wild river declaration" means a statutory instrument under the *Wild Rivers Act 2005*. A declaration lists the relevant natural values to be preserved and delineates certain parts of the wild river area and the different constraints that may apply in these areas. With reference to environmental authorities for petroleum, each declaration also specifies conditions to be included in a new authority if the activity is to be located within the wild river area.

"80th percentile release limits" means that not more than one (1) of the measured values is to exceed the stated release limit for any five (5) consecutive samples where:
(1) the consecutive samples are taken over a 5 month period; and
(2) the consecutive samples are taken at approximately equal periods.

End of Conditions

Figure 1 - Contaminant Release Points, Sources and Receiving Waters



Author [redacted]
File / Ref number PL 191
Central West Region
Phone [redacted]
Mobile [redacted]
Email [redacted]

Queensland Government

Department of
Natural Resources and Mines

15 November 2004

Manager Land and Government Relations
CH4 Pty Ltd
PO Box 214
Albert Street Post Office
Brisbane Q 4002

Dear Sir or Madam:

Petroleum Lease 191 – Amendment to Environmental Authority 170 524 for ERA 75b(iv)

Assessment of your application for an amendment to the Environmental Authority for the level 1 Environmentally Relevant Activity 75 b (iv) - Waste disposal – operating a facility for disposing of regulated waste (other than limited regulated waste) if the facility is designed to receive waste at the rate of 200,000t or more per year has been granted.

Approval has been given to discharge the waste water via the methods outlined in the Environmental Authority under conditions C5 and C6. I draw to your attention the monitoring requirements of Conditions H6 and H7.

Changes in scale or intensity of activities in operation may trigger further licensing requirements and if you have any question about this or other matters relating to environmental licensing requirements please contact [redacted] (Project Officer – Mining Operations) on [redacted]

Yours sincerely,

[redacted]

Manager – Industry Liaison Unit
Delegate of the Administering Authority
Environmental Protection Act 1994

Central West Region and
Rockhampton District Office
209 Bolsover Street Rockhampton
PO Box 1762 Rockhampton
Queensland 4700 Australia
Telephone +61 7 4938 4600
Facsimile +61 7 4938 4310
Website www.nrm.qld.gov.au
ABN 83 705 537 586

Author [redacted]
File / Ref number PL 191
Central West Region
Phone [redacted]
Mobile [redacted]
Email [redacted]

Queensland Government

Department of
Natural Resources and Mines

15 November 2004

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Changes in scale or intensity of activities in operation may trigger further licensing requirements and if you have any question about this or other matters relating to environmental licensing requirements please contact [redacted] (Project Officer – Mining Operations) on [redacted]

Yours sincerely,

[redacted]

Manager – Industry Liaison Unit
Delegate of the Administering Authority
Environmental Protection Act 1994

Central West Region and
Rockhampton District Office
209 Bolsover Street Rockhampton
PO Box 1762 Rockhampton
Queensland 4700 Australia
Telephone +61 7 4938 4600
Facsimile +61 7 4938 4310
Website www.nrm.qld.gov.au
ABN 83 705 537 586

ENVIRONMENTAL PROTECTION ACT 1994

Queensland Government
Environmental Protection Agency
Department of Natural Resources and Mines

Central West Region (Mines)
Natural Resources & Mines
PO Box 19
EMERALD QLD 4720
Ph – 07 4987 9300
Fax: 07 4987 9333

Environmental Authority (Approval) No. 170,524

Sections 93 & 311 *Environmental Protection Act 1994*

This licence to carry out one or more level 1 environmentally relevant activities is issued in accordance with sections 93 & 311 of the Environmental Protection Act 1994.

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

CH4 Pty Ltd
Level 17, 80 Albert Street
Brisbane QLD 4000

In respect of carrying out the following level 1 environmentally relevant activities (ERAs) of Schedule 1 of the *Environmental Protection Regulation 1998*:

ERA	Description
75 (b)(iv)	Waste disposal – operating a facility for disposing of regulated waste (other than limited regulated waste) if the facility is designed to receive waste at the rate of 200,000t or more per year

on the relevant petroleum lease(s) identified below:

Relevant petroleum tenement(s)	Project (where applicable)	Location description
Petroleum Lease PL 191	**Grosvenor CSM Project**	**Moranbah**

This licence is subject to the conditions set out in the attached schedules.
The anniversary date of this licence is 1 October 2005.
This licence takes effect from 1 October 2004.
The amended Environmental Authority takes effect from 15 November 2004

This environmental authority (approval) is subject to the conditions that the holder carry out the above environmentally relevant activities in accordance with the conditions of the relevant petroleum lease(s) and in compliance with the approved 5-year Environmental Management Plan dated October 2001 (as amended 9th September 2003) and the *Interim Policy - Environmental Management for Activities under Petroleum Tenures* (dated 4 September 1995).

This environmental authority takes effect from *15 November 2004* and remains in force until a relevant petroleum tenement is either renewed, transferred, surrendered or cancelled or until the environmental authority is transferred, surrendered, cancelled or suspended

[redacted]

Signed

15/11/04
Date

Mr [redacted]

Manager – Industry Liaison Unit
Delegate of Administering Authority
Environmental Protection Act 1994

Note: This environmental authority document is not proof of the current status of the environmental authority. The current status of the environmental authority may be ascertained by contacting the Administering Authority.

Schedule of conditions

The aforementioned description of the ERA for which this authority is issued is simply a restatement of the activity in the legislation at the time of issuing of the authority. Where there is conflict between the above description of the ERA for which this authority is issued and the conditions as specified in this authority as to the scale, intensity or manner of carrying out of the ERA, then such conditions prevail to the extent of the inconsistency.

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

Schedule A - General conditions
Schedule B - Air
Schedule C - Water
Schedule D - Stormwater management
Schedule E - Land application
Schedule F - Noise
Schedule G - Waste management
Schedule H - Self monitoring and reporting
Schedule I - Definitions

Schedule A - General conditions

The following conditions are prescribed:

(A1) In carrying out the environmentally relevant activities, you must take all reasonable and practicable measures to prevent and/or to minimise the likelihood of environmental harm being caused. Any environmentally relevant activity, that, if carried out incompetently, or negligently, may cause environmental harm, in a manner that could have been prevented, shall be carried out in a proper manner in accordance with the conditions of this authority.

NOTE: This authority authorises the environmentally relevant activity. It 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. Emissions that may cause material or serious environmental harm and not specifically authorised by this environmental authority must not be released beyond the boundary of the activity except where they are authorised under an environmental authority (approval) for the mining authority.

(A2) Any record required to be kept by a condition of this environmental authority must be kept at the licensed place and be available for examination by an authorised person.

(A3) Copies of any record required to be kept by a condition of this environmental authority must be provided to any authorised person or the Administering Authority on request.

(A4) A copy of this environmental authority must be kept in a location readily accessible to personnel carrying out the activity.

(A5) All complaints received by the holder of this environmental authority relating to operations at the licensed place must be recorded.

(A6) As soon as practicable after becoming aware of any emergency or incident which results in emissions not in accordance with the conditions of this environmental authority, the holder of this environmental authority must notify the administering authority of the release by telephone or facsimile and in writing within 14 days following the initial notification.

(A7) Where regulated waste is removed from within the boundary of the environmental authority (other than by a release as permitted under another schedule of this environmental authority), the holder of this environmental authority must monitor and record the following:

(a) the date, quantity and type of waste removed; and
(b) name of the waste transporter and/or disposal operator that removed the waste.

(A8) The holder of this environmental authority must notify the regulatory authority at the above address, in writing, of any monitoring result which indicates an exceedance of any licence limit, within 28 days of completion of analysis.

(A9) On approval or amendment of an Environmental Protection Policy, provisions will be made for the revision of related conditions within this environmental authority.

(A10) The licensee will comply with the relevant control strategies and standards detailed in the current Environmental Management Plan (9th September 2003) to manage environmental impacts caused by the undertaking of the Environmentally Relevant Activity authorised under this licence.

(A11) This licence is granted on the condition that breach of the terms of this licence in respect of one Environmentally Relevant Activity at a location will not affect this licence in relation to any other ERA at the same or any other location.

END OF CONDITIONS FOR SCHEDULE A

Schedule B - Air

The following conditions are prescribed:

Dust nuisance

(B1) Subject to Conditions (B2) and (B3) the release of dust or particulate matter or both resulting from the activities must not cause an environmental nuisance, at any sensitive or commercial place.

(B2) When requested by the administering authority, dust and particulate 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 sensitive or commercial place, and the results must be notified within 14 days to the administering authority following completion of monitoring.

(B3) If the environmental authority holder can provide evidence through monitoring that the following limits are not being exceeded then the holder is not in breach of (B1):

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; and

b) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM10) suspended in the atmosphere of 150 micrograms per cubic metre over a 24 hour averaging time, at a sensitive or commercial place downwind of the operational land, when monitored in accordance with:

- Particulate matter - Determination of suspended particulate PM10 high-volume sampler with size-selective inlet - Gravimetric method, when monitored in accordance with AS 3580.9.6 Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - PM (sub) 10 high volume sampler with size-selective inlet - Gravimetric method of 1990;

or

- Any alternative method of sampling PM10, which may be permitted by the 'Air Quality Sampling Manual' as published from time to time by the administering authority.

NOTE: You must propose which monitoring method is appropriate in accordance with condition (B3) (a) or (b) or both.

(B4) If monitoring indicates exceedence of the relevant limits in Condition (B3), then the environmental authority holder must:

a) address the complaint including the use of appropriate dispute resolution if required; or

b) immediately implement dust abatement measures so that emissions of dust from the activity do not result in further environmental nuisance.

END OF CONDITIONS FOR SCHEDULE B

Schedule C - Water

The following conditions are prescribed:

(C1) Waste water generated from licensed activities will be contained and managed in evaporation ponds designed to protect quality of a groundwater resource.

(C2) The only waters permitted to be released from the site of the licensed activity are runoff waters from undisturbed areas, overflows as prescribed in Condition C3 and formation water as prescribed in Conditions C4 or C5 or C6.

(C3) Evaporation ponds will be designed and operated to prevent spillage/overflow of contaminated waste water at a probability higher than 1 chance in 20 (based on the 5% AEP design storm rainfall) to minimise contaminating surrounding soil and storm-water runoff.

(C4) Waste water generated from licensed activities, may be discharged from designated evaporation ponds via pipes directly to the Isaacs River under the following conditions:

a) The river must be flowing in the reach between the upstream discharge point and the downstream quality monitoring point.

b) Electrical conductivity of the river water is to be monitored daily at the Blair Athol Railway bridge whilst discharges are taking place and for two days after cessation of discharge.

c) Rate of discharge of waste water is to be adjusted to ensure that the monitored electrical conductivity does not exceed 1500 µS/cm.

d) Methods of discharge via condition C5 or condition C6 must be exhausted before discharge via this condition can occur.

(C5) Waste water generated from licensed activities, may be discharged from designated evaporation ponds via water trucks for use under the following conditions:

a) The quality of water to be discharged must be adjusted through a mixing process to ensure that monitored electrical conductivity does not exceed 13450 µS/cm (9000 mg/l Total Dissolved Solids).

b) The total quantity of waste water to be discharged must not exceed 100 kilo litres per day.

c) The discharged water is only to be used for civil construction works and dust suppression, it is not to be used as a potable supply.

d) The waste water shall not be discharged from the water trucks into water courses or near sensitive place.

e) Water Discharge must occur within requirements of condition (H6).

f) Traffic generated by discharge of waste water under this condition must be undertaken in accordance with Schedule B (Air).

g) Changes in the requirements to discharge via this method including the desire to increase discharge volumes or cessations of activities, the Administering Authority shall be notified.

(C6) Waste water generated from licensed activities, may be discharged from designated evaporation ponds via water pipeline for use under the following conditions:

a) The discharge waste water is only to be transported by pipeline to ML70313 and ML 70312 (Proposed Millennium Coal Mine).
Note: If end point for discharge changes, i.e. water use is negotiated for additional or different locations, the administering authority shall be notified so amendments can be made to the licence conditions.

b) The quality of water to be discharged must be adjusted through a mixing process to ensure that monitored electrical conductivity does not exceed 13450 µS/cm (9000 mg/l Total Dissolved Solids).

c) The water use at the receiving location shall be undertaken in accordance with the EMOS conditions at the site. The water is not to be used for Potable Use or discharged in a manner to affect any water course.

d) Water Discharge must occur within requirements of condition (H7).

e) The holder of this authority is responsible for water pipeline within bounds of this authority area as far as limiting any environmental harm that may happen as the result of a transmission failure.

END OF CONDITIONS FOR SCHEDULE C

Schedule D - Stormwater

The following conditions are prescribed:

END OF CONDITIONS FOR SCHEDULE D

Schedule E – Land application

The following conditions are prescribed:

END OF CONDITIONS FOR SCHEDULE E

Schedule F – Noise

The following conditions are prescribed:

(F1) In the event of a complaint about noise that the administering authority considers is reasonable, then the emission of noise from the activity must not result in levels greater than those specified in Schedule F Table 1 until the circumstances which gave rise to the complaint are resolved.

(F2) In the event of complaint of noise nuisance from a noise sensitive place, an acceptable noise monitoring investigation may be required by the Administering Authority.

(F3) all determinations of noise emissions as required by conditions F1 and F2 must be carried out in accordance with the Environmental Protection Agency's Noise Measurement Manual, third edition, March 2000, or more recent additions or supplements to that document as they become available.

Schedule F table 1

NOISE LIMITS AT A NOISE SENSITIVE PLACE	
Period	*Noise Level at a Noise sensitive Place Measured as the Adjusted Maximum Sound Pressure Level* Lamax adj, T

7 am – 6 pm	Background noise level plus 5 dB(A)
6 pm – 10 pm	Background noise level plus 5 dB(A)
10 pm – 7 am	Background noise level plus 3 dB(A)

END OF CONDITIONS FOR SCHEDULE F

Schedule G – Waste management

The following conditions are prescribed:

(G1) Site infrastructure plans are to be produced and kept for the duration of the life of the activity and/or updated as necessary to maintain a record of the location of regulated waste disposal sites.

(G2) Site contamination will be assessed prior to the relinquishment of the petroleum tenure according to the *Environmental Protection Act 1994*.

(G3) The areas used for licensed activities will be remediated and rehabilitated using best practice technology to a standard consistent with final land-use criteria at end of tenure life should infrastructure not being required by the background landowner.

(G4) Waste must not be released to the environment, stored, transferred or disposed of contrary to this environmental authority.

(G5) An adequate stockpile of suitable covering material must be on hand at all times.

(G6) Regulated waste disposal areas will be capped and revegetated in accordance with best practice technology following cessation of their use as disposal areas in a manner that will encourage rainfall runoff.

END OF CONDITIONS FOR SCHEDULE G

Schedule H – Self monitoring and reporting

The following conditions are prescribed:

(H1) All complaints received by the holder of this environmental authority relating to releases of contaminants from operations at the licensed place must be recorded and kept with the following details:

(a) time, date and nature of complaint;

(b) type of communication (telephone, letter, personal etc.);

(c) name, contact address and contact telephone number of complainant (Note: if the complainant does not with to be identified then "Not identified" is to be recorded);

(d) response and investigation undertaken as a result of the complaint;

(e) name of person responsible for investigating complaint; and

(f) action taken as a result of the complaint investigation and signature of responsible person;

(H2) All determinations of the quality of contaminants released to waters must be made in accordance with methods prescribed in the Environmental Protections Agency Water Quality Sampling Manual, 3rd Edition, December 1999, or more recent additions or supplements to that document as such become available.

(H3) The freeboard (measured in millimetres between the water level and the overflow invert level) in each evaporation pond is to be recorded weekly.

(H4) The holder of this environmental authority must ensure that the results of the monitoring performed in accordance with this environmental authority for the period covered by the return are submitted with the Annual Return and are available on request by the Administering Authority.

(H5) A record must be maintained of at least the following events:

a) the time, date and duration of equipment malfunctions where the failure of the equipment resulted in the release of contaminants reasonably likely to cause environmental harm;

b) any uncontrolled release of contaminants reasonably likely to cause environmental harm and

c) any emergency involving the release of contaminants reasonably likely to cause material or serious environmental harm requiring the use of fire fighting equipment.

d) The time periods and monitoring results of controlled discharges carried out under Schedule C condition C3.

(H6) For the events covered by Schedule C condition C5, the following records must be maintained:

a) The time, date and Total Disolved Solids or Electrical Conductivity levels of the discharge water is to be recorded weekly.

b) A record of the total volume discharged via water truck must be kept.

(H7) For the events covered by Schedule C condition C6, the following records must be maintained:

a) The time, date and Total Disolved Solids or Electrical Conductivity levels of the discharge water is to be recorded monthly.

b) A record of the total volume discharged via the pipeline must be kept.

END OF CONDITIONS FOR SCHEDULE H

Schedule I – Definitions

Some of the words and phrases used throughout this licence are defined below:

"Administering Authority" means –

(a) for a matter, the administration and enforcement of which has been devolved to a local government under section 196 (Devolution of powers) - the local government; or
(b) for another matter – the chief executive.

"authorised person" means a person holding office as an authorised person under an appointment under this Act by the chief executive.

"best practice" means the management of an activity to achieve an ongoing minimisation of the activity's environmental harm through cost-effective measures assessed against the measures currently used nationally and internationally for the activity.

"chief executive" means the chief executive of the Department of Environment or its successor.

"commercial place" means a work place used as an office or for business or commercial purposes, which is not part of the Petroleum and Gas activity and does not include employees accommodation or public roads.

"complaint" in the context of this environmental authority must be in a written form submitted to the Administering Authority.

"contaminant" can be –

(a) a gas, liquid or solid: or
(b) a odour; or
(c) an organism (whether alive or dead), including a virus; or
(d) energy, including noise, heat, radioactivity and electromagnetic radiation; or
(e) a combination of contaminants.

"environment" includes –

(a) ecosystems and their constituent parts, including people and communities; and
(b) all natural and physical resources; and
(c) the qualities and characteristics of locations, places and areas, however large or small, that contribute to their biological diversity and integrity, intrinsic or attributed scientific value or interest, amenity, harmony and sense of community; and
(d) the social, economic, aesthetic and cultural conditions that affect, or are affected by, things mentioned in paragraphs (a) to (c).

"environment authority" means a licence or approval issued pursuant to the *Environmental Protection Act (1994).*

"groundwater" is that portion of the water beneath the surface of the earth that can be collected with wells, tunnels, or drainage galleries, or that flows naturally to the earth's surface via seeps or springs.

"mining project" means mining carried on under 1 or more mining leases (and or special leases granted for industrial (coal mining) purposes) as a single integrated undertaking.

"receiving waters" means waters into which waste waters emanating from an environmentally relevant activity are released or discharged.

"sensitive place"

(a) immediately outside a dwelling, mobile home or caravan park, residential marina or other residential premises; or
(b) immediately outside a motel, hotel or hostel; or
(c) immediately outside a kindergarten, school, university or other educational institution; or
(d) immediately outside a medical centre or hospital; or
(e) immediately outside a protected area; or
(f) immediately outside a park or gardens.

"waste" includes anything that is

(a) left over, or an un-wanted by-product, from an industrial, commercial, domestic or other activity; or
(b) surplus to the industrial, commercial, domestic or the activity generating the waste.

"waste water" means a liquid waste.

"waters" includes the bed and banks of a watercourse or lake.

END OF CONDITIONS FOR SCHEDULE I

END OF ENVIRONMENTAL AUTHORITY

Department of Environment and Resource Management

Application form

Environmental Protection Act

OFFICIAL USE ONLY

DATE RECEIVED

FILE REF

PROJECT REF

COMPLETE FORM ☐ CORRECT AA ☐

ENTERED BY [SIGNATURE]

DATE

Program notice of relevant event

This form is to be used where a person wishes to provide a program notice under section 350 of the *Environmental Protection Act 1994* of an act or omission that has caused or threatened environmental harm.

Program notice details

1. Provider of program notice of relevant event

CH4 Pty Ltd

2. Responsible person

Tim Dean

3. Current registration certificate or environmental authority number (if applicable)

PEN100015907

A relevant event is an act or omission that has caused or threatened environmental harm in the carrying out of an activity by the person, and is lawful apart from the *Environmental Protection Act 1994*.

4. When did the relevant event occur?

The period between October 2010 to present

For example, you might provide details of the general activities that you were undertaking at the time, the act or omission and how it occurred, and any further action that was taken.

5. Description of the relevant event

Rainfall has recently contributed to the elevation of existing dam levels in the area covered by the relevant EA. If dam levels continue to rise, this will result in an overflow of untreated coal seam gas water to land. Arrow is seeking permission to discharge directly to the Isaac River.

The rainfall has caused construction delays which has prevented Arrow from making additional storage available via the completion of Dam 11. This has exacerbated the potential for dam breaches.

Department of Environment and Resource Management
www.derm.qld.gov.au ABN 46 640 294 485

Queensland Government

6. Location of relevant event

NAME OR TYPE OF PLACE	Petroluem Lease 191/196
STREET ADDRESS	via Lot 9 Thorpe Street Moranbah QLD 4744
LOT(S)	L61 SP195395 L1 SP216414 L1 SP216414 L1 SP192459
PLAN(S)	SP195395 SP216414 SP216414 SP192459
LOCAL GOVERNMENT	Moranbah Regional Council

For example, you might provide details of the proximity of the relevant event to sensitive places (e.g. parks or nearby waterways).

7. Description of the nature and extent of environmental harm caused or threatened as a direct or indirect result of the relevant event

Arrow has insufficent water storage to cope with such rainfall events, until dam 11 is completed.

At this point there have been no dam overflows (and associated environmental impacts), however potential impacts could result if heavy rainfall continues, leading to overflow event/s.

Impacts associated with dam breaches could include erosion and sedimentation (through physical flow effects) and contamination of land and waterways (through introduction of salt and other chemicals).

8. What action has been taken to contain, clean up, rehabilitate and restore the environmental impact in relation to the relevant event?

The construction of Dam 11 is a key component of our water statergy in developing additional storage until benefitial uses are developed for our coal seam water

Arrow is also in the process of modifying any non compliant dams to achieve compliance with relevant EA conditions. This includes achieving compliance with the Manual for Assessing the Hazard Category and Hydaulic Performance of Dams.

With respect to the potential event (the subject of this notice), DERM have been notified as required under the conditions of our Environment Authority PEN100015907. Potentially affected landholders within the tenure area will also be notified of any likely breach of the dam Design Storage Allowance (DSA).

Arrow intends to submit a transitional environmental program with respect to achieving dam compliance under PEN100015907.

9. Declaration

Note: If you have not told the truth in this application you may be liable for prosecution under the relevant Acts or Regulations.

- I am aware that section 351 of the *Environmental Protection Act 1994* states:

  "(1) If the relevant event stated in the program notice constitutes an offence against this Act (the "original offence"), the giving of the program notice, the program notice and any documents submitted with it are not admissible in evidence against the person in a prosecution for the original offence.

  "(2) Subsection (1) does not prevent other evidence obtained because of the giving of the program notice, the program notice or any documents submitted with it being admitted in any legal proceeding against the person."

- I will prepare and submit to the administering authority a transitional environmental program in accordance with section 333 of the *Environmental Protection Act 1994* for the relevant event.
- I do solemnly and sincerely declare that the information provided is true and correct to the best of my knowledge. I understand that it is an offence under s480 of the EP Act to give to the administering authority or an authorised person a document containing information that I know is false, misleading or incomplete in a material particular.
- I understand that all information supplied on or with this application form may be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.

APPLICANTS SIGNATURE [redacted]	
APPLICANTS NAME Tim Dean	DATE 02/12/2010

10. Provider checklist

☒ Notice completed and signed

☒ Supporting information attached (if applicable), including

- ☐ Reports
- ☐ Analysis and monitoring results

Please return your completed application to:

Permit and Licence Management
Implementation Support Unit
Department of Environment and Resource Management
GPO Box 2454
Brisbane Queensland 4001.

Enquiries: 1300 130 372
Facsimile: (07) 3896 3342
Email: palm@derm.qld.gov.au

Department of Environment and Resource Management

Notice

Environmental Protection Act

Receipt of program notice

This statutory notice is issued by the administering authority pursuant to section 352 of the Environmental Protection Act 1994, *to advise you of a decision or action.*

Your reference : PL191, PL196, PPL115, PPL116, PEN100015907
Our reference : BNE 36595 / 315517

CH4 Pty Ltd

AM-60

Level 19

42 Albert Street

Brisbane QLD 4000

Attention: [redacted]

Re: Program notice submitted by CH4 Pty Ltd for PL191 and PL196 and PPL115 and PPL116, at place on land described as Lot 61 on Plan SP195395 and Lot 1 on Plan SP 216414, and Lot 1 on Plan SP 192459, located at via Lot 9 Thorpe Street MORANBAH QLD 4744.

Your program notice was received on 3 December 2010.

Department of Environment and Resource Management
www.derm.qld.gov.au ABN 46 640 294 485

Queensland Government

Notice

Receipt of program notice

A draft transitional environmental program (TEP) dealing with the activity must be submitted for approval to the Department of Environment and Resource Management (DERM), at the address at the end of this notice, by 14 January 2011. Fees apply for the assessment of a draft TEP and any subsequent annual returns. The fees are outlined in the attached operational policy *transitional environmental program (TEP) fees.*

Should you have any queries in relation to this Notice, please contact [redacted] of on telephone [redacted]

[redacted]

SIGNATURE

10 December 2010

DATE

[redacted]
Manager
Gas and Petroleum Unit
Environmental and Natural Resource Regulation
Department of Environment and Resource Management

Enquiries:

Petroleum and Gas Unit
Department of Environment and Resource Management
Floor 7, 400 George Street
BRISBANE QLD 4000
GPO Box 2454
BRISBANE QLD 4001
Phone: (07) 3330 5349
Fax: (07) 3330 5634

Department of Environment and Resource Management

Operational policy

Fees

Transitional Environmental Program (TEP) fees

Operational policies provide a framework for consistent application and interpretation of legislation by the Department of Environment and Resource Management (DERM). Operational policies will not be applied inflexibly to all circumstances. Individual circumstances may require an alternative application of policy. This policy concerns Section 140 under the Environmental Protection Regulation 2008.

Policy issue

What are DERM's fees for considering a Transitional Environmental Program (TEP)?

Background

Section 334 of the *Environmental Protection Act 1994* (EP Act) provides for the administering authority to charge a person or public authority, the fee prescribed by regulation, for submitting a draft TEP for approval.

This section applies, with any necessary amendments, to an application to amend a TEP under section 344 of the EP Act.

Section 140(1) of the *Environmental Protection Regulation 2008* (EP Reg) prescribes that the fees for consideration of draft TEPs, or an amendment of an approval for TEPs, is the amount that:

- the authority considers to be reasonable; and
- is not more than the reasonable cost of deciding the application for approval of the program or the amendment of the approval.

Section 140(3) of the EP Reg prescribes that the fees for assessing the holder's annual returns and monitoring compliance with the program is the amount that:

- the authority considers to be reasonable; and
- is not more than the reasonable cost of the assessment and monitoring.

Determination

Fees for the assessment of a draft TEP are a minimum of $362.40[1] (includes GST), plus an additional $181 per hour (includes GST) or part thereof, charged after the first two hours.

Fees for assessment of an TEP annual return and monitoring of a compliance program of a draft TEP are charged at a rate of $181 per hour (includes GST), or part thereof, plus any reasonable costs for analysis and travel.

The reasonable cost of analysis cost will be the actual cost of the analysis to the Agency, plus GST.

The reasonable cost of travel will be the cost of travel[2], plus GST.

Department of Environment and Resource Management
www.derm.qld.gov.au

Queensland Government

The fee for assessing an application to amend a TEP is $185.80 (includes GST).

Other issues to consider

The person having a draft TEP considered should be advised at the time of approval of the TEP that the administering authority will require payment of a fee for assessment of the annual return and monitoring compliance of the TEP.

[1] The $362.40 fee covers the administration costs incurred by the Agency when assessing that the TEP satisfies the criteria set by the *Environmental Protection Act 1994* and the first two hours of technical evaluation of the TEP.

[2] The reasonable cost of travel will be calculated as outlined in section 4 (Employees who choose to use their own vehicles) of the schedule in the Queensland Government's *Directive No. 8/09 Motor Vehicle Allowances* September 2009 issued by the Attorney-General and Minister for Industrial Relations. For an automobile this is set at 37.5 cents per kilometre.

Department of Environment and Resource Management

Application form

Environmental Protection Act

OFFICIAL USE ONLY

DATE RECEIVED

FILE REF

PROJECT REF

COMPLETE FORM ☐ CORRECT AA ☐

ENTERED BY [SIGNATURE]

DATE

Program notice of relevant event

This form is to be used where a person wishes to provide a program notice under section 350 of the *Environmental Protection Act 1994* of an act or omission that has caused or threatened environmental harm.

Program notice details

1. Provider of program notice of relevant event

CH4 Pty Ltd

2. Responsible person

[redacted]

3. Current registration certificate or environmental authority number (if applicable)

PEN100015907

A relevant event is an act or omission that has caused or threatened environmental harm in the carrying out of an activity by the person, and is lawful apart from the *Environmental Protection Act 1994*.

4. When did the relevant event occur?

The period between October 2010 to present

For example, you might provide details of the general activities that you were undertaking at the time, the act or omission and how it occurred, and any further action that was taken.

5. Description of the relevant event

Rainfall has recently contributed to the elevation of existing dam levels in the area covered by the relevant EA. If dam levels continue to rise, this will result in an overflow of untreated coal seam gas water to land. Arrow is seeking permission to discharge directly to the Isacc River.

The rainfall has caused construction delays which has prevented Arrow from making additional storage available via the completion of Dam 11. This has exacerbated the potential for dam breaches.

Department of Environment and Resource Management
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Queensland Government

6. Location of relevant event

NAME OR TYPE OF PLACE	Petroluem Lease 191/196
STREET ADDRESS	via Lot 9 Thorpe Street Moranbah QLD 4744
LOT(S)	L61 SP195395 L1 SP216414 L1 SP216414 L1 SP192459
PLAN(S)	SP195395 SP216414 SP216414 SP192459
LOCAL GOVERNMENT	Moranbah Regional Council

For example, you might provide details of the proximity of the relevant event to sensitive places (e.g. parks or nearby waterways).

7. Description of the nature and extent of environmental harm caused or threatened as a direct or indirect result of the relevant event

Arrow has insufficent water storage to cope with such rainfall events, until dam 11 is completed.

At this point there have been no dam overflows (and associated environmental impacts), however potential impacts could result if heavy rainfall continues, leading to overflow event/s.

Impacts associated with dam breaches could include erosion and sedimentation (through physical flow effects) and contamination of land and waterways (through introduction of salt and other chemicals).

8. What action has been taken to contain, clean up, rehabilitate and restore the environmental impact in relation to the relevant event?

The construction of Dam 11 is a key component of our water statergy in developing additional storage until benefitial uses are developed for our coal seam water

Arrow is also in the process of modifying any non compliant dams to achieve compliance with relevant EA conditions. This includes achieving compliance with the Manual for Assessing the Hazard Category and Hydaulic Performance of Dams.

With respect to the potential event (the subject of this notice), DERM have been notified as required under the conditions of our Environment Authority PEN100015907. Potentially affected landholders within the tenure area will also be notified of any likely breach of the dam Design Storage Allowance (DSA).

Arrow intends to submit a transitional environmental program with respect to achieving dam compliance under PEN100015907.

9. Declaration

Note: If you have not told the truth in this application you may be liable for prosecution under the relevant Acts or Regulations.

- I am aware that section 351 of the *Environmental Protection Act 1994* states:

  "(1) If the relevant event stated in the program notice constitutes an offence against this Act (the "original offence"), the giving of the program notice, the program notice and any documents submitted with it are not admissible in evidence against the person in a prosecution for the original offence.

  "(2) Subsection (1) does not prevent other evidence obtained because of the giving of the program notice, the program notice or any documents submitted with it being admitted in any legal proceeding against the person."

- I will prepare and submit to the administering authority a transitional environmental program in accordance with section 333 of the *Environmental Protection Act 1994* for the relevant event.
- I do solemnly and sincerely declare that the information provided is true and correct to the best of my knowledge. I understand that it is an offence under s480 of the EP Act to give to the administering authority or an authorised person a document containing information that I know is false, misleading or incomplete in a material particular.
- I understand that all information supplied on or with this application form may be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.

APPLICANTS SIGNATURE [redacted]	
APPLICANTS NAME Tim Dean	DATE 02/12/2010

10. Provider checklist

☒ Notice completed and signed

☒ Supporting information attached (if applicable), including

- ☐ Reports
- ☐ Analysis and monitoring results

Please return your completed application to:

Permit and Licence Management
Implementation Support Unit
Department of Environment and Resource Management
GPO Box 2454
Brisbane Queensland 4001.

Enquiries: **1300 130 372**
Facsimile: (07) 3896 3342
Email: palm@derm.qld.gov.au

Department of Environment and Resource Management

Notice

Environmental Protection Act

Receipt of program notice

This statutory notice is issued by the administering authority pursuant to section 352 of the Environmental Protection Act 1994, *to advise you of a decision or action.*

Your reference : PL191, PL196, PPL115, PPL116, PEN100015907
Our reference : BNE 36595 / 315517

CH4 Pty Ltd
AM-60
Level 19
42 Albert Street
Brisbane QLD 4000

Attention: [redacted]

Re: Program notice submitted by CH4 Pty Ltd for PL191 and PL196 and PPL115 and PPL116, at place on land described as Lot 61 on Plan SP195395 and Lot 1 on Plan SP 216414, and Lot 1 on Plan SP 192459, located at via Lot 9 Thorpe Street MORANBAH QLD 4744.

Your program notice was received on 3 December 2010.

Department of Environment and Resource Management
www.derm.qld.gov.au ABN 46 640 294 485

Department of Environment and Resource Management

Notice

Receipt of program notice

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Should you have any queries in relation to this Notice, please contact Mr Shamaul Alam of on telephone (07) 3330 6294.

[redacted]

SIGNATURE

10 December 2010

DATE

[redacted]
Manager
Gas and Petroleum Unit
Environmental and Natural Resource Regulation
Department of Environment and Resource Management

Enquiries:

Petroleum and Gas Unit
Department of Environment and Resource Management
Floor 7, 400 George Street
BRISBANE QLD 4000
GPO Box 2454
BRISBANE QLD 4001
Phone: (07) 3330 5349
Fax: (07) 3330 5634

Department of Environment and Resource Management

Operational policy

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Department of Environment and Resource Management
www.derm.qld.gov.au

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The person having a draft TEP considered should be advised at the time of approval of the TEP that the administering authority will require payment of a fee for assessment of the annual return and monitoring compliance of the TEP.

[1] The $362.40 fee covers the administration costs incurred by the Agency when assessing that the TEP satisfies the criteria set by the *Environmental Protection Act 1994* and the first two hours of technical evaluation of the TEP.

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Department of Environment and Resource Management

Notice

Environmental Protection Act

Decision to grant an approval for a draft transitional environmental program

This statutory notice is issued by the administering authority pursuant to section 340 of the Environmental Protection Act 1994, *to advise you of a decision or action.*

Your reference :
Our reference : CH4 Moranbah TEP

[redacted]
CH4 Pty Ltd
AM-60
42 Albert Street
Brisbane QLD 4000

Attention: [redacted]

Re: Application for an approval for a transitional environmental program for management and release of produced coal seam gas water at the Moranbah Gas Project site located on tenures PL191 and PL196.

Thank you for your application for an approval for a transitional environmental program.

Your application, which was received by this office on 23 December 2010, has been approved.

A copy of the certificate of approval is attached.

Fees apply for the assessment of a draft transitional environmental program and any subsequent annual returns. The fees are outlined in the attached operational policy *Transitional Environmental Program (TEP) fees.*

The Department will calculate this fee and invoice CH4 Pty Ltd during February 2011.

Department of Environment and Resource Management
www.derm.qld.gov.au ABN 46 640 294 485

Queensland Government

Department of Environment and Resource Management

Notice

Decision notice regarding a transitional environmental program

Should you have any queries in relation to this notice, contact [redacted] of the Department of Environment and Resource Management on telephone [redacted]

[redacted]	4/02/2011
SIGNATURE	DATE

[redacted]
Manager Coal Seam Gas Assessment
Department of Environment and Resource Management
Delegate of the administering authority
Environmental Protection Act 1994

Enquiries:
Department of Environment and Resource Management
GPO Box 2454
BRISBANE QLD 4001
Phone: 3330 5527
Fax: 3330 5634

DRAFT TRANSITIONAL ENVIRONMENTAL PROGRAM UNDER SECTION 333 OF THE *ENVIRONMENTAL PROTECTION ACT 1994*

Principal Holder:	CH4 Pty Ltd **AM-60** Level 19 42 Albert Street Brisbane QLD 4000
EA Number:	PEN100015907
Title:	**Coal Seam Water Management Moranbah Gas**
Project	**Moranbah Gas Project PL191/196**
Program notice submitted:	3 December 2010
Revision date	Version 4, 4 February 2011
Finish Date:	31 May 2011

Introduction

The Moranbah Gas Project lacks sufficient water storage capacity as previously indicated in correspondence to DERM (dated 25 October 2010) and subsequent responses to information requests and the program notice documentation submitted by Arrow (dated 3 December 2010). This has been caused by an early start to the wet season contributing to existing dam levels and causing construction delays. This has prevented Arrow from making additional storage available via the completion of dam 11. The synthetic lining for the dam cannot be installed during periods of rainfall; the civil engineering also requires careful control of the moisture content of the construction materials to achieve the required specifications.

Dam 11 has been designed and is being constructed in line with the most current dam standards stipulated by DERM and contained in the previously submitted and assessed dam design report. It is a large lined dam – intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, develop beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies.

The continued rain has delayed the completion of dam 11. This has put Arrow in a position where it cannot comply with the current EA conditions. Arrow intends to employ this transitional environmental program (TEP) as defined in Chapter 7, Part 4 of the *Environmental Protection Act 1994 to bring our operation back into compliance with its current Environmental Authority*. In initiating this process Arrow intends to work with DERM to minimise the potential for environmental harm.

Background

Arrow currently employs a network of 10 dams across PL191 and PL196. Dams 1 through to 7 are shown in the attached drawing (Appendix C). Dams 8 and 9 in the network are SW of the main area depicted in the provided drawing. Approximately 90% of the total storage capacity for coal seam water is held in Arrow's major storage dams 1, 2 and 10. The other dams are employed to move water between groups of remote wells and the major storage dams. Dam 3 is employed to store more concentrated brine. An important feature of the petroleum lease is the Isaac River which divides the lease along a NW to SE axis and its tributary Teviot Brook. Isaac River is an ephemeral river; during periods of high flow it limits access to infrastructure on the north eastern side of the petroleum lease via river crossings.

Situation

Our strategy is to maintain low levels in the older and less accessible dams (particularly dams 6,7, 8 and 9) by moving water to dams 1 and 10. Dam 10 is our most recently constructed dam and has an engineered spillway, dam 1 is in reasonable condition and adjacent to dam 10 which allows water to be transferred readily between dams.

Our risk assessment process and an independent third party geotechnical evaluation by URS has identified particular concerns with the integrity of dam 2 (refer to Appendix E). Arrow has concerns regarding the condition of dam 2 – it is scheduled to be brought out of service on the completion of Dam 11. Based on geotechnical evaluation we intend to lower the level of water in Dam 2 to 4m below DSA. The goal of this strategy is to maintain pond integrity and minimise discharge to the environment when a suitable plan to restore the operational integrity of dam 2 is developed or the dam is retired from operational duty.

Arrow believes that a controlled discharge during high flow conditions in the Isaac River via the existing infrastructure would result in the least environmental impact whilst preserving the integrity of the existing dams. This option prevents the overland flow of untreated coal seam water reaching the Isaac River and minimises the risk of damaging older dams which are built prior to the new standards and lacking engineered spillways. When the facility was originally developed the water management scheme was significantly different to now and included a wet weather discharge. At present our existing infrastructure is not sufficient to comply with the conditions of the current Environmental Authority particularly during extended wet periods.

Our system of dams has an area of 125,100 m^2, this equates to a gain of 0.125ML per mm of rainfall. The system is designed to transfer water to the major storage dams 1, 2 and 10 this contribute to the catchments of these structures, each 1 mm of rainfall will cause an increase in dam height of 1.6 mm in dams 1, 2 and 10. When all the input rainfall is directed to dam 10 each 1 mm of rainfall causes an increase in dam height of 2.7 mm in dam 10.

Table 1 Key Dam Variables Dams 1, 2, 5 and 10

Dam		1	2	5	10
Volume at Spill level	ML	119.66	92.64	7.64	203.70
Spillway		No	No	No	Yes
Liner type		CCL	CCL	0.5mm HDPE	1.5mm HDPE
Hydraulic height	m	5.60	5.50	3.5	4.75
MRL	m	5.25	5.15	3.15	4.40
DSA	m	4.75	4.65	2.65	3.90
Target dam fill height[b]	m	4.75	0.65	2.65	3.90
Current level (below MRL)[a]	mm	**100**	**870**	**Varies**[c]	**40**
Remaining rainfall *(to spill)*[d]	mm	281	762	>800	244

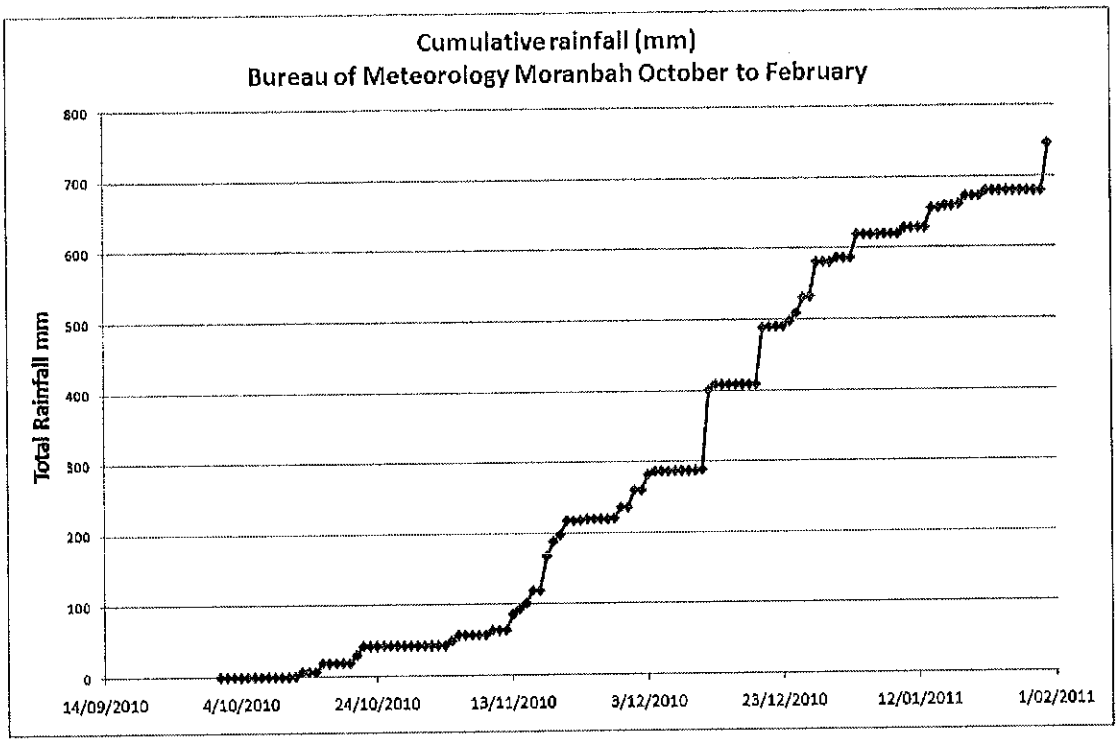
[a] Levels 27 December 2010, negative denotes level above MRL

[b] Target dam fill height is DSA for dams 1 and 10, 4m below DSA for dam 2. Current target height for dam 2 is based on 3rd party civil engineering assessment completed by URS.

[c] This dam is much smaller than the major storage dams its level can change rapidly during operations

[d] Rainfall based on approximate catchment ratio of 1.6 (based on total catchment area including transfer dams)

Figure 1 Cumulative rainfall between October to December Moranbah



Future water levels will be a product of the rainfall, coal seam water production and evaporation. Our goal is to maintain dams 1 and 10 at DSA levels by employing a discharge to the Isaac River. Dam 2 will be lowered to a level determined by independent third party engineering risk assessment.

Arrow has evaluated 2 scenarios for water requiring discharge from the storage system:

- Scenario 1 – Mean rainfall until end of wet season
- Scenario 2 – 95th percentile rainfall until end of wet season

Rainfall to date is very close to the 95th percentile rainfalls on average from October through to December. We have had a cumulative total of 586mm from the 1st of October to end of December (Figure 1), 95th percentile cumulative rainfall for the period from the start of October to the end of December totals 522mm.

Based on the current progress of the wet season Arrow believes that the next few months will produce above average rainfall. Long range forecasts from the Bureau of Meteorology give a 55% chance of rainfall at or above the 95% percentile values. In determining the water balance for the facility has evaluated 2 scenarios – mean and 95th Percentile rainfall (refer to Table 2).

Table 2 Discharge scenarios

Scenario	Volume to reach DSA (ML)	Additional removal from Dam 2 (ML) [b]	Expected Net [a] Water to Storage (ML)	Total (ML)
Mean Rainfall	69	75	54.5	198.5
95th Percentile	69	75	130	274

[a] *Net water to storage is produced water, less evaporation plus expected rainfall.*
[b] *This is based on a dam 2 target of 4000mm below DSA.*

Arrow proposes a discharge of up to 7.5ML/day when dams are above the target dam fill height shown in Table 1. The release will commence when the Isaac River is flowing above 12.6m^3/s (at this starting flow only 2.4ML/day could be discharged) measured upstream at the Goonyella river gauge (operated by DERM). Discharge will be maintained at a 400:1 dilution ratio on the basis of maintaining Australian drinking water guidelines (NHMRC,2004) downstream of the discharge. Based on a predicted salinity impact as detailed in Appendix B. This discharge rate and the dilution factor will be reviewed throughout the TEP in consultation with DERM and informed on the basis of the upstream/downstream river monitoring in line with the proposed conditions detailed within this document.

Sampling will be conducted in line with the conditions detailed in this TEP under the procedure attached as Appendix D. Appendix A contains indicative water quality to characterise the coal seam water to be discharged.

Supporting Information

Consideration of the management hierarchy for the management of coal seam water at the MGP

Evaluation as per the management hierarchy of preferred procedures from Environmental Protection (Water) Policy 2009:

Step 1—evaluate water conservation measures to reduce the use of water and the production of waste water or contaminants;
Water is not employed in the coal seam gas production process but must be removed from the coal seam to allow the gas to be extracted. Water conservation measures will not reduce the amount of coal seam water associated with the gas extracted.

Step 2—evaluate waste prevention options and implement appropriate waste prevention measures;
The key waste prevention measure employed is maximisation of the coal seam gas to water ratio. The coal seams targeted by MGP have relatively low ratios of water to gas in comparison to other fields. In an effort to manage our recent water storage constraints Arrow has shut in a large number of wells, targeting the wells with high water to gas ratios to minimise the production of coal seam water associated with our operations.

Whilst this has reduced our coal seam water production, shutting in further wells will yield limited benefits in terms of water reduction but will cause significant reduction in gas output.

Use of dam 11 in its current uncompleted, unlined state has been investigated. The pipe work and major civil infrastructure is complete but the floor of the dam is incomplete – as discussed (in our meeting on the 1st of December) it lacks its intended second liner, more importantly the clay liner has not been sufficiently compacted to allow its use. Key elements of the pipework connecting dam 11 to the rest of the network remain incomplete. Employing dam 11 would require its use for an extended period to allow subsequent emptying and upgrade of the existing dam infrastructure.

Step 3—if waste prevention does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate treatment and recycling options and implement appropriate treatment and recycling;
The construction of Dam 11 is the first component of our coal seam water management strategy. It is a large lined dam, intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies. Rainfall is delaying the construction of dam 11 and contributing to the current water storage problems.

Installation of water treatment (such as a mobile RO plant) is limited by the logistics (such as civil engineering, chemical storage and power supply), cost and the challenges posed during current wet conditions. Another option considered was employing water entitlements to dilute the untreated coal seam water to the current environmental authority specification. This option was ruled out since a large quantity of good quality water would be required to dilute and dispose of a limited amount of coal seam water from our dams.

Step 4—if treatment and recycling does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate the following options
for waste water or contaminants, in the order in which they are listed—
(i) appropriate treatment and release to a waste facility or sewer;
(ii) appropriate treatment and release to land;
(iii) appropriate treatment and release to surface waters or ground waters.

I) We cannot practically truck water from the dams given the large quantities and the lack of disposal options. Wet weather is likely to complicate trucking of water by limiting access to some points within the MGP. Infrastructure does not exist to process this water via sewer or other industrial water treatment options. Our landholders have expressed concern of minimising truck movements during the wet season.

II) Until our water treatment management strategy is implemented we cannot treat the water to a standard that is suitable for use on land.

III) We consider the water in its current state is suitable for discharge into the Isaac – this was the water management strategy employed by the facility until earlier EA conditions were amended, we are seeking permission from DERM to allow this discharge as previously authorised until we can implement our water management strategy for the MGP. We consider a temporary discharge to the Isaac river during high flow conditions to be compliant with section 51 of the Environmental Protection Regulation 2008.

Objectives

To achieve compliance with the Environmental Authority with respect to coal seam water management and dam standards by April 2011.

This will be achieved in the short term by the release of water to the Isaac River. This measure will protect the integrity of our storage infrastructure and is consistent with the operational philosophy that our existing infrastructure was designed to accommodate.

In the medium term compliance with the new EA will be achieved by the completion of Dam 11. Completion of dam 11 will require Arrow energy to utilise the cleared area north of dam 11.

In the long term, compliance with our EA will be achieved by completion of water treatment facilities that allow beneficial use and disposal within Arrows Environmental Authority conditions. Arrow is to provide DERM with a detailed plan concerning future water management for approval.

Table 3 – Achieving TEP objectives

OBJECTIVE	ACTION	RESPONSIBILITY	TIME FRAME	PERFORMANCE INDICATOR
1. Lower dam levels for (dams 1, 2, 5, 10) to below the 'Target dam fill height" as shown in Table 1.	Manage via discharge (RP1) to Isaac river	Arrow site personnel	Immediate	Manage dams within appropriate levels as detailed in Tables 1 and 2. Discharge is to be subject to monitoring and reporting requirements
2. Monitor Discharge	Monitor discharge in accordance with Table 5, for the contaminants listed in Table 6 and Table 7	Arrow site personnel	During discharge	Lab results to be reported to DERM within 10 business days of collection.
3. Pond 2	Develop management plan to restore dam integrity or remove from service	Arrow	15 March 2010	Submission of management plan to DERM
4. Cease discharge	Cease discharge to Isaac river under TEP	Arrow	31 March 2011	Cease discharge to Isaac river
5. TEP report submission	Provide DERM with final TEP report detailing how the objectives of this TEP have been met	Arrow	31 May 2011	Submission of TEP report to DERM

Monitoring

Table 4 Contaminant release points, sources and receiving waters

Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point	Receiving waters
TEP RP 1	148° 2' 35"	-21° 57' 41"	untreated CSG water from PL191/196	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
				Upstream from discharge – Isaac River Crossing	
				Downstream from discharge – Blair Athol Bridge	

Table 5 Contaminant release monitoring points

Monitoring point (TEP MP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point location	Receiving waters
TEP MP 1	148° 2' 35"	-21° 57' 41"	Untreated CSG water from PL191	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
TEP MP 2	148° 2' 46"	-21° 57' 55"	Downstream from discharge – Blair Athol Bridge	Blair Athol Railway Bridge	na
TEP MP 3	148° 2' 20"	-21° 57' 41"	Upstream from discharge	Isaac River Crossing	
TEP MP 4	148° 1' 10"	-21° 58' 00"	Untreated CSG water dam 1	Dam 1	
TEP MP 5	148° 2' 8"	-21° 58' 01"	Untreated CSG water dam 2	Dam 2	
TEP MP 6	148° 2' 32"	-21° 57' 44"	Untreated CSG water dam 5	Dam 5	
TEP MP 7	148° 1' 14"	-21° 58' 4"	Untreated CSG water dam 10	Dam 10	

Table 6 Contaminant release limits

Quality characteristic	Release Limit	Monitoring Frequency	Sample Type	Monitoring Point
Electrical conductivity (uS/cm)	13000	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1 TEP MP2 TEPMP3
			Samples require laboratory analysis[2]	TEP MP 1 TEP MP2 TEPMP3
pH (pH Unit)	6.5 (minimum) 9.5 (maximum)	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1 TEP MP 2 TEP MP 3
			Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3
Turbidity (NTU)	500	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3
BTEX Benzene, Ethylbenzene, Toluene and Xylene (mg/L)	Benzene 0.001 Ethylbenzene 0.3 Toluene 0.8 Xylene 0.02	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3

[1] *In situ samples can be taken using electronic sampling equipment.*
[2] *Samples are required to be analysed at a NATA accredited facility in accordance with this Transitional Environmental Program.*

Table 7 Downstream contaminant trigger investigation levels

Quality characteristic	Trigger levels (µg/L)	Monitoring frequency	Monitoring Point
Aluminium	55	Commencement of release and thereafter weekly during release	TEP MP 2 TEP MP 3
Arsenic	10		
Cadmium	0.2		
Chromium	1.0		
Copper	2.0		
Iron	300		
Lead	10		
Mercury	0.2		
Nickel	11		
Zinc	8.0		
Boron	370		
Cobalt	90		
Manganese	500		
Molybdenum	34		
Selenium	10		
Silver	1.0		
Uranium	1.0		
Vanadium	10		
Ammonia	900		
Nitrate	1100		
Petroleum hydrocarbons (C6-C9)	20		
Petroleum hydrocarbons (C10-C36)	100		
Fluoride (total)	1500		
EC	350µs/cm		
Chloride	250mg/L		
Sodium	180mg/L		

Table 8 Contaminant release during flow events

Receiving waters	Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Minimum flow in receiving water required for a release event	Flow recording frequency
Isaac River	TEP RP1	148° 2' 35"	-21° 57' 41"	1090ML/day	Twice Daily from Goonyella Gauging station

Table 9 Receiving water downstream monitoring points

Monitoring points (TEP MP)	Receiving waters location description	Easting (GDA94)	Northing (GDA94)
TEP MP 2	Blair Athol Bridge 500 metres downstream of RP1	148° 2' 46"	-21° 57' 55"

Conditions

In carrying out this Transitional Environmental Program, CH4 Ltd (Arrow Energy) will undertake all activities in accordance with the following conditions.

Undertaking the release of untreated coal seam methane water

1 Contaminants that will, or have the potential to cause environmental harm must not be released directly or indirectly released to any waters except as permitted under this Transitional Environmental Approval.

2 The release of contaminants to waters must only occur from the release points specified in Table 4 and depicted in Appendix C attached to this Transitional Environmental Program.

3 The release of contaminants to waters must not exceed the release limits stated in Table 6 at the monitoring points specified in Table 5 and Table 6 of this Transitional Environmental Program.

4 The release of contaminants to waters from the release points must be monitored at the locations specified in Table 5 and Table 9 for each quality characteristic and at the frequency specified in Table 7 and Table 8 of this Transitional Environmental Program.

5 If quality characteristics of the release exceed any of the trigger levels specified in Table 7 during a release event, the Transitional Environmental Program holder must compare MP2 to the trigger values specified in Table 7 and:

a) where the trigger values are not exceeded then no action is to be taken

b) where the downstream results exceed the trigger values specified Table 7 for any quality characteristic, compare the results of the downstream site to the data from the upstream monitoring sites (MP3)

i) if the result is less than that recorded at Monitoring Point 3 (MP3), then no action is to be taken or

ii) if the result is greater than the background monitoring site data, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology, into the potential for environmental harm and provide a written report 20 business days after receiving results, outlining

- details of the investigations carried out
- actions taken to prevent environmental harm.

6 If an exceedance in accordance with condition 5(b)(ii) is identified, the holder of the Transitional Environmental Program must notify the administering authority within 24 hours of receiving the result. The notification must include written verification of the exceedance forwarded to the administering authority.

Contaminant Release Events

7 The release of coal seam water from the release point shown in Table 4 will not occur until -

a) - flow in the Isaac River flow reaches 1090 ML/day as shown in Table 8 (at Goonyella Gauging Station); and

b) – At least one dam in Table 1 has exceeded the 'Target Dam Fill Height' shown in Table 1; and

c) – A dilution of at least 400 parts river flow to 1 part discharge can be maintained at all times (0.25% of receiving flow).

8 The daily quantity of contaminants released from each release point must be measured and recorded at the monitoring points in Table 4

9 The daily quantity of contaminants is not to exceed 7.5ML/day in total.

10 Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build up of sediment in such waters.

Notification of Release Events

11 The Transitional Environmental Program holder must notify the administering authority within 24hours of having commenced releasing coal seam water to the receiving environment. Notification must include the submission of written verification to the administering authority of the following information:

a) release commencement date/time
b) expected release cessation date/time
c) release point/s
d) release volume (estimated)

e) receiving water/s including the natural flow rate
f) any details (including available data) regarding likely impacts on the receiving water(s).

12 The Transitional Environmental Program holder must provide the administering authority daily during the release of coal seam water, the following information:
a) all in situ monitoring data for that day
b) the receiving water flow rate
c) the release flow rate.

13 The Transitional Environmental Program holder must notify the administering authority as soon as practicable, (no later than within 24 hours after cessation of a release) of the cessation of a release notified under condition 11 and within 15 business days provide the following information in writing:
a) release cessation date/time
b) natural flow volume in receiving water
c) volume of water released
d) details regarding the compliance of the release with the conditions of this Transitional Environmental Program (i.e. contamination limits, natural flow, discharge volume)
e) all in-situ water quality monitoring results
f) any other matters pertinent to the water release event.

Notification of release event exceedence

14 If the release limits defined in Table 6 are exceeded, the holder of the Transitional Environmental Program must notify the administering authority within 2 business days of receiving the results.

15 The Transitional Environmental Program holder must, within 28 days of a release that exceeds the conditions of this Transitional Environmental Program, provide a report to the administering authority detailing:
a) the reason for the release
b) the location of the release
c) all water quality monitoring results
d) any general observations
e) all calculations

f) any other matters pertinent to the water release event.

Requirements to cease the release of coal seam water

16 The coal seam water discharge must cease immediately if any water quality limit as specified in Table 6 is exceeded or if a dilution of 400 parts river flow to 1 part discharge (0.25% of receiving flow) cannot be achieved.

17 The Department of Environment and Resource Management may require CH4 Pty to cease discharge if the department's water monitoring stations detect any water quality limit exceedance.

18 The release of coals seam water must cease immediately if identified that the release of coal seam waters is causing erosion of the bed and banks of the receiving waters, or is causing a material build up of sediment in such waters.

19 The release of coal seam water will cease immediately if Isaac River flow decreases below 1090ML/day (at Goonyella Gauging Station).

20 The release of coal seam water will cease immediately from any dam in Table 1 once the dams level is more than 100mm lower than the 'Target Dam Fill Height' shown in Table 1.

Monitoring Requirements

21 Where monitoring is a requirement of this Transitional Environmental Program, ensure that a competent person(s) conducts all monitoring.

22 Monitoring will occur at the frequencies identified in Table 6 and Table

23 All monitoring undertaken as a requirement of this Transitional Environmental Program must be undertaken in accordance with the administering authority's Water Sampling Manual.

Notification of emergencies, incidents and exceptions

24 As soon as practicable after becoming aware of any 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 Transitional Environmental Program, the administering authority must be notified of the release by telephone, facsimile or email.

25 The notification of emergencies or incidents must include but not be limited to the following:

a) the holder of the Transitional Environmental Program
b) the location of the emergency or incident
c) the number of the Transitional Environmental Program
d) the name and telephone number of the designated contact person
e) the time of the release
f) the time the holder of the Transitional Environmental Program became aware of the release
g) the suspected cause of the release
h) the environmental harm caused, threatened, or suspected to be caused by the release, and
i) actions taken to prevent any further release and mitigate any environmental harm caused by the release.

26 Not more than 10 business days following the initial notification of an emergency or incident, written advice must be provided of the information supplied to the administering authority in relation to:

a) proposed actions to prevent a recurrence of the emergency or incident, and

b) outcomes of actions taken at the time to prevent or minimise environmental harm.

Appendix A
ALS & Qld Health water sampling results

Client Reference	Collected Date	Received Date	Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmiun	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	3.8	< 0.0001	0.0011	0.076	< 0.0001	0.05	< 0.0001	0.0027	0.0011	0.003	1.7	0.0013	0.056	< 0.0001	0.0007
Discharge_Point	14-Dec-10	17-Dec-10	0.18	< 0.0001	0.0012	4.5	< 0.0001	1.1	< 0.0001	0.0003	0.0002	0.002	0.08	0.0004	0.0046	< 0.0001	0.0019
Pond_2a	16-Dec-10	17-Dec-10	0.1	< 0.0001	0.0015	6.1	< 0.0001	1	< 0.0001	0.0002	0.0003	0.001	0.066	< 0.0001	0.007	< 0.0001	0.0013
Pond_2	16-Dec-10	17-Dec-10	0.09	< 0.0001	0.0014	6	< 0.0001	1	< 0.0001	0.0002	0.0003	< 0.001	0.044	< 0.0001	0.0065	< 0.0001	0.0012
POND1_1	17-Dec-10	20-Dec-10	0.37	< 0.0001	0.0021	5.8	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.18	< 0.0001	0.0057	< 0.0001	0.0028
POND1_2	17-Dec-10	20-Dec-10	0.43	< 0.0001	0.0023	6	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.2	0.0002	0.0065	< 0.0001	0.0031
POND10_1	17-Dec-10	20-Dec-10	0.2	< 0.0001	0.0018	7.7	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.069	< 0.0001	0.0039	< 0.0001	0.0031
POND10_2	17-Dec-10	20-Dec-10	0.18	< 0.0001	0.0019	7.6	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.067	< 0.0001	0.0041	< 0.0001	0.0034

Client Reference	Collected Date	Received Date	Nickel	Selenium	Silver	Stroniu m	Thallium	Titani um	Uranium	Vanadium	Zinc	Benzen e	Toluene	Ethylbenzon e	Meta&Para-Xylenes	Ortho-Xylene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	0.0031	< 0.0010	< 0.001	0.2	< 0.0001	0.14	0.0002	0.012	0.003	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Discharge_Point	14-Dec-10	17-Dec-10	0.0008	< 0.0010	< 0.001	7.3	< 0.0001	0.006	0.0003	0.0029	0.013	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2a	16-Dec-10	17-Dec-10	0.0012	< 0.0010	< 0.001	9.6	< 0.0001	0.003	0.0003	0.0051	0.006	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2	16-Dec-10	17-Dec-10	0.0011	< 0.0010	< 0.001	9.4	< 0.0001	0.002	0.0003	0.005	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_1	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	10	< 0.0001	0.017	0.0009	0.0059	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_2	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	11	< 0.0001	0.015	0.0009	0.0062	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_1	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.026	0.0008	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_2	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.01	0.0007	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

ALS	21/12/2010	Sample ID	LOR	DAM 1	DAM 10	DAM 4	DAM 3	D1	D2	DAM 5	DAM2	TRIP BLANK
ES1025292	Results	Date Sampled		6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010
Analyte	CAS #	Units	LOR	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
EA005: pH												
pH Value		pH Unit	0.01	9.17	9.28	9.34	9.38	9.4	9.42	9.27	9.15	-
EA010P: Conductivity by PC Titrator												
Electrical Conductivity @ 25°C		µS/cm	1	12600	14000	16400	25900	25800	26100	10700	10600	-
EG020T: Total Metals by ICP-MS												
Arsenic	7440-38-2	mg/L	0.001	0.003	0.003	0.002	<0.001	0.004	0.004	<0.001	0.002	-
Barium	7440-39-3	mg/L	0.001	6.54	8.33	4.35	1.93	1.92	1.98	6.4	9.31	-
Beryllium	7440-41-7	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cadmium	7440-43-9	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Cobalt	7440-48-4	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	-
Chromium	7440-47-3	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	-
Copper	7440-50-8	mg/L	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004	-
Manganese	7439-96-5	mg/L	0.001	0.008	0.003	0.002	0.001	0.001	0.003	0.002	0.038	-
Nickel	7440-02-0	mg/L	0.001	0.001	<0.001	0.001	0.002	0.002	0.002	<0.001	0.003	-
Lead	7439-92-1	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Vanadium	7440-62-2	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Zinc	7440-66-6	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	-
EG035T: Total Recoverable Mercury by FIMS												
Mercury	7439-97-6	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
EK055G: Ammonia as N by Discrete Analyser												
Ammonia as N	7664-41-7	mg/L	0.01	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
EK057G: Nitrite as N by Discrete Analyser												
Nitrite as N		mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EK058G: Nitrate as N by Discrete Analyser												
Nitrate as N	14797-55-8	mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser												
Nitrite + Nitrate as N		mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser												
Total Kjeldahl Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser												
Total Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK067G: Total Phosphorus as P by Discrete Analyser												
Total Phosphorus as P		mg/L	0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EP080: BTEX												
Benzene	71-43-2	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	108-88-3	µg/L	2	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	100-41-4	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
EP080S: TPH(V)/BTEX Surrogates												
1.2-Dichloroethane-D4	17060-07-0	%	surrogate	113	111	103	112	105	110	110	106	106
Toluene-D8	2037-26-5	%	surrogate	110	106	103	109	105	106	107	103	102
4-Bromofluorobenzene	460-00-4	%	surrogate	106	99.7	97.9	104	97.1	98.6	101	97	101

Appendix B
Dilution calculation basis

Table 10 Dilution calculation at 400:1 release

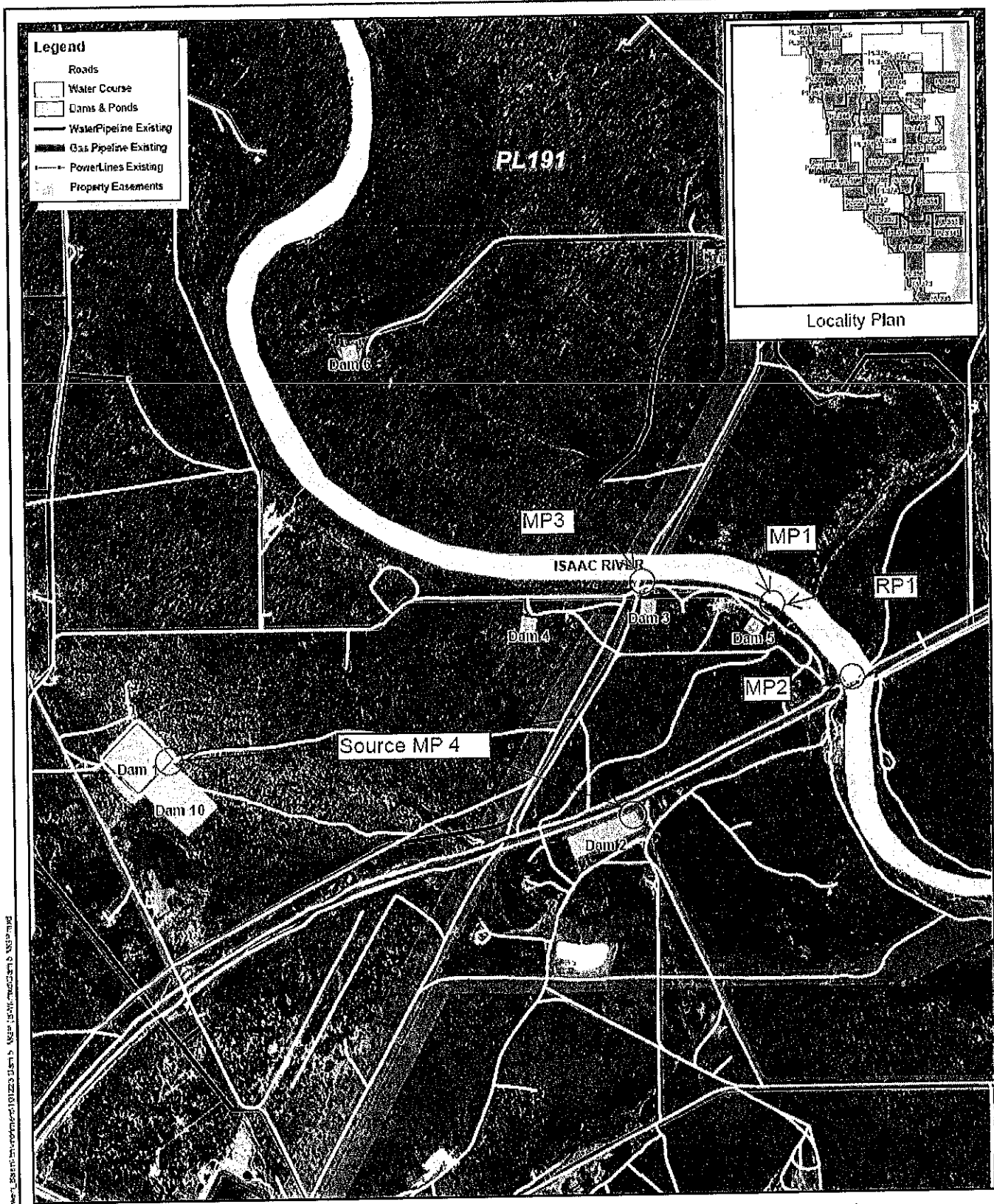
Parameter	Unit	Surface Water Concentration	Concentration of Discharge	Dilution X:1	Surface Concentration after dilution	Guideline[1]
EC	µs/cm	250	13000	400	282.5	746
Sodium	mg/L	65	2970	400	72.4	180
Chloride	mg/L	80	4280	400	90.7	250

[1] *Australian drinking water guidelines (NHMRC,2004)*
Sodium and Chloride based on EC, common soil quality (run off) and historical data from upstream

Appendix C

Mapping showing PL191 and location of key Dams

ARROW ENERGY - BOWEN BASIN GAS PROJECT



Moranbah Gas Project - Dam 5

Source:
Arrow Energy Limited
Geosciences Australia
Dept. Envir. and Resource Mgmt.

Date: 23/12/2010
Issued To: [redacted]
Author: tsbinger

0 0.5 1
Kilometres
Scale: 1:18,702 @ A4
Coordinate System: GDA 1994 MGA Zone 55

N

arrowenergy go further

NOT FOR CONSTRUCTION

Appendix D
Sampling Procedure

SURFACE WATER SAMPLING – ISAAC RIVER - DAM DISCHARGE MONITORING PROGRAM	PROCEDURE DATE : 21/12/2010

SUMMARY

1.1	This procedure outlines general sampling protocols and work practices to be followed during the sampling of surface water, during the discharge of untreated CSG well water to the Isaac River. This procedure includes details on: ▪ Sampling equipment requirements; ▪ Surface water sampling techniques; ▪ Quality control requirements. ▪ Sample locations (Figure 1) ▪ Analytical requirements

EQUIPMENT

2.1	▪ Documentation o Sampling and analysis plan. o Health and safety plan o Personal protective equipment (PPE) as identified in the HSP, inc. Life Jacket and other specialised PPE, as per the HSP. ▪ Water sampling equipment o sample collection device, (Swing Arm Sampler/extension sampler) o decontamination solution (e.g. Decon 90^{TM}) or use new sample collection container in the swing arm sampler at each location. o Calibrated water quality meter (ensure parameter ranges are suitable for the water being tested), o laboratory supplied sample containers, o Chilled ice chest. o Field sample Record Sheet o Chain of Custody Form (Attached).

3.0 REFERENCES & PROFORMA

3.1	▪ AS NZS 5667.1-1998 *Water quality - Sampling - Guidance on the design of sampling programs sampling techniques* ▪ AS NZS 5667.4-1998 *Water quality - Sampling - Guidance on sampling from lakes natural and man-made* ▪ AS NZS 5667.6-1998 *Water quality - Sampling - Guidance on sampling of rivers and streams* ▪ Monitoring and Sampling Manual 2009 Environmental Protection (Water) Policy 2009, *Monitoring and Sampling Manual 2009*, Version 2 September 2010

4.0 PROCEDURE

4.1	**Safety**
	Unless specifically required, the following general safety requirements should be noted: 1. Appropriate personal protective equipment should be worn as specified in the Health and Safety Plan (HSP). When working in or around water bodies, a life jacket is required to be worn and a minimum of two persons to be present should be assessed. 2. Assess hidden hazards (eg. trip hazards, snakes, leeches, etc.). 3. Assess risks from slippery or unstable banks. 4. Assess whether the water body / drain may constitute a confined space. 5. Assess the likelihood that surface conditions within and around the water body may change rapidly in the event of heavy rainfall or tidal change.

4.2	**Sampling**

1. The sampling frequency during and following discharge to the Isaac River shall be as follows:
   - daily during discharge; and
   - daily for two days following discharge stopping.
2. The sampling sequence should commence where the lowest likely contaminant concentrations are expected (e.g. downstream and work upstream), to reduce the risk of cross contamination between samples. On this basis, the samples shall be collected at the following locations (in order): (See **Figure 1** for sampling locations)
   I. **River crossing** (upstream), (One **primary sample (S1)**, plus **one duplicate sample (QC1)**)
   II. **Blair Athol Bridge** (downstream), One **primary sample (S2)**, plus **one duplicate sample (QC2)**)
   III. At the **Discharge Point**, One **primary sample (S3)**, plus **one duplicate sample (QC3)**)
   IV. At the **Source (Dam)** One **primary sample (S4)**, plus **one duplicate sample (QC4)**)
   V. QC samples – Field/Trip Blank **(QC5)** and rinsate blank **(QC6)** (if required)
3. At each location, a water sample should be collected for standard field parameters using a calibrated water quality meter. The following parameters should be recorded:
   a. pH,
   b. conductivity,
   c. dissolved oxygen,
   d. redox potential,
   e. temperature and
   f. turbidity.

Notes:

- Follow the manufacturer's instructions for use and calibration of instruments to measure water parameters. A calibration record must be kept.
- When recording dissolved oxygen readings, it is important to note whether the results are reported as % saturation or ppm.
- With conductivity, record whether units are mS or µS.

4. Based on the nature of the sampling locations, heterogeneous distribution of potential contaminants in the water samples is considered likely. Therefore, the following Quality Control Samples should be collected and analysed for this program:
    a. One duplicate sample per sample location for TPH, BTEX and 8 Metals analysis **(QC1 – QC4).**
    b. One Blank Sample per esky (laboratory prepared DI Water for TPH (C6 – C9) and BTEX analysis) **(QC5)**.
5. One rinsate sample per day (unless using new sample collection medium between sample locations i.e. a new container in the swing arm sampler) for TPH (C6 – C9) and BTEX analysis) **(QC6)**.
6. At each location sample bottles should be filled based on a decreasing order of potential volatility (i.e. VOCs, BTEX and TPH first, followed by metals and other inorganic samples).
7. Note: **DO NOT** field filter samples for total metals. Perform field filtering for dissolved metals samples only.
8. When sampling shallow waters, contamination from bottom sediments should be avoided. Samples should be collected by submerging a clean sample collection container (up-side down) into the water and to approximately 100mm below the surface, rotate the container to allow it to fill.
9. The sampling location should be as representative as possible of the event being monitored. i.e. do not sample stagnant water at the edge, attempt to sample .
10. Record the appearance of the water body, i.e. colour, turbidity, odour, surface crusts, films or floating material, algae, water velocity, etc. In addition, record the weather conditions at the time of sampling and note any other relevant observations, e.g. dead or distressed flora/fauna, surface rubbish, spills, etc.
11. All measurements and field notes should be documented on the field sheet (**Attachment A**)

5.0 ANALYTICAL/SAMPLE CONTAINER REQUIREMENTS

5.1	1. The analytical suite includes the following: a. pH, EC, TDS, Turbidity b. Ions: Magnesium, Calcium, Sodium, Sulphate, Chloride, Ammonia, Nitrate, Fluoride (total). c. Metals, Aluminium, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Zinc, Boron, Cobalt, Manganese, Molybdenum, Selenium, Silver, Uranium, Vanadium. d. Organics: BTEX, PAH, TPH 2. Each Sample Requires the following containers: a. 60ml Plastic Bottle for metals (with red and green striped label border) (tick 'Total Metals') b. 500ml Plastic Bottle for anions/cations (with green label border) c. 250ml Amber Glass Bottle (with purple label border) d. One pair of BTEX vials (40 mL glass cylindrical containers with purple label border).
	Notes: • The selection of sample containers depends on the laboratories being used. The above list is based on ALS requirements only. When ultra trace analysis is being requested, additional sample volume may be required. Always check with the laboratory prior to submitting samples to the laboratory. • When filling the vials it is important that they are filled to the top with no air space remaining. • Use new sample gloves between sample locations.
5.2	1. Place samples immediately in a chilled ice chest 2. Complete sample request form and include in sealed bag in the cooler 3. Courier samples to the receiving laboratory.

12	**Surface Water Sampling**							**Form**
Site				Sampling Method:				
Job Number				Local Air Temperature:				
Date:	Time:			Wind Force:				
Weather:		Cloudiness %		Direction of Wind:				
Location	**Sample No.**	**Water Flow (l/s)**	**Field Readings**				**Depth (m)**	**Comments: including turbidity (plankton and/or sediment), colour, water plants, weather conditions, etc**
			pH	**Conductivity**	**Temperature**	**Dissolved Oxygen**		
Comments concerning treatment of samples, especially preservation:								
Name:		**Signed:**			**Project Manager:**			adapted from AS 5667.4

Analytes

Quality characteristic	
pH	
EC	Ammonia
Turbidity	Nitrate
Magnesium	Fluoride (total)
Calcium	BTEX
Sodium	PAH
Sulphate	TPH
Chloride	
Aluminium	
Arsenic	
Cadmium	
Chromium	
Copper	
Iron	
Lead	
Mercury	
Nickel	
Zinc	
Boron	
Cobalt	
Manganese	
Molybdenum	
Selenium	
Silver	
Uranium	
Vanadium	

Appendix E
URS Dam 2 Assessment

Graham Cordingley

From: [redacted]
Sent: Tuesday, 14 December 2010 5:24 PM
To: Tim Dean
Cc: [redacted] Ben McMahon
Subject: RE: Incident notification

Follow Up Flag: Follow up
Flag Status: Flagged

Categories: Red Category

Tim

As discussed in our phone conversation at 4.55pm after our meeting today, I briefed my Associate Director General [redacted] on the current situation, including the current unauthorised discharge and the proposed TEP.

In regards to the discharge, I briefed [redacted] that a major concern for all State Government stakeholders present, is that no definitive water quality information is available for the untreated CSG well water being released.

Another factor of concern is that the Isaacs River is currently dropping in flow and based on DERM records will drop very sharply in the coming days, thus reducing dilution. Additionally Arrow has not been able to advise how much water, over what time period needs to be discharged, to achieve a safe level (as determined by Arrow) in pond 2.

As discussed verbally, DERM considers the current release to be a highly inappropriate breach of Arrows Environmental Approval.

Arrow should consider ceasing this discharge, after careful consideration of other available options for the untreated CSG water contained in dams at the site.

Your response indicating Arrow's decision to cease or continue this discharge by 12 noon Wednesday 15 December 2010 is requested.

Regards

[redacted]
Manager
[redacted]

From: [redacted]
Sent: Tuesday, 14 December 2010 8:58 AM

Annexure-GDC13

ALS			Analyte	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Nickel	Zinc	Boron	Silver	Uranium	Vanadium
ALS Sample ID	Lab ID	Monitoring Point	Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			Date Sampled/LOR	0.01	0.01-0.001	0.005 - 0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.01-0.001	0.01-0.005	0.1-0.05	0.001	0.001	0.01
Draft TEP Trigger/Investigation Level				0.055	0.015	0.0002	0.001	0.002	0.3	0.01	0.011	0.008	0.37	0.001	0.001	0.01
DISCHARGE POINT		Discharge Point (MP1)	21/12/2010	15.6	<0.01	<0.005	0.04	0.02	23.5	0.01	0.03	0.04	<0.1		<0.001	0.06
ISAAC 1		Up Stream (MP3)	21/12/2010	13.3	<0.01	<0.005	0.04	0.02	29	0.01	0.03	0.03	<0.1		<0.001	0.05
ISAAC 2		Downstream (MP2)	21/12/2010	13.1	0.02	<0.005	0.03	0.02	28.1	<0.01	0.03	0.05	<0.1		<0.001	0.05
DISCHARGE POINT			21/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-
ISAAC 1			21/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-
ISSAC 2		Downstream (MP2) QC	21/12/2010	15.3	<0.01	<0.005	0.02	0.02	20.1	<0.01	0.02	0.03	<0.1		<0.001	0.04
DISCHARGE POINT		Discharge Point (MP1)	23/12/2010	-	0.001	<0.0001	0.012	0.009	-	0.006	0.014	0.022	-	-	-	
Downstream		Downstream (MP2)	23/12/2010	-	0.002	<0.0001	0.013	0.009	-	0.006	0.015	0.018	-	-	-	
ISAAC 2		Downstream (MP2) QC	23/12/2010	-	0.001	<0.0001	0.013	0.01	-	0.006	0.015	0.019	-	-	-	
ISAAC 1-S1	EB1100019	Up Stream (MP3)	24/12/2010	15.2	<0.001	<0.0001	0.012	0.013	10.7	0.006	0.013	0.016	<0.05	<0.001	-	0.02
ISAAC 1-QC1	EB1100019	Up Stream (MP3) QC	24/12/2010	9.13	0.001	<0.0001	0.012	0.009	10.9	0.006	0.013	0.02	<0.05	<0.001	-	0.02
ISAAC 2- S2	EB1100019	Downstream (MP2)	24/12/2010	16.4	0.002	<0.0001	0.017	0.012	19.7	0.009	0.02	0.034	<0.05	<0.001	-	0.03
ISAAC 2- QC2	EB1100019	Downstream (MP2) QC	24/12/2010	11.1	0.002	<0.0001	0.017	0.013	15.6	0.007	0.016	0.026	<0.05	<0.001	-	0.03
DISCHARGE-S3	EB1100019	Discharge Point (MP1)	24/12/2010	10.9	0.001	<0.0001	0.021	0.011	13.4	0.007	0.016	0.021	<0.05	<0.001	-	0.03
DISCHARGE-QC3	EB1100019	Discharge Point (MP1) QC	24/12/2010	11	0.002	<0.0001	0.023	0.016	12.8	0.007	0.016	0.019	<0.05	<0.001	-	0.02
QC 5	EB1100019		24/12/2010													
S5	EB1100019		25/12/2010													
ISAAC 1-S1	EB1100019	Up Stream (MP3)	24/12/2010	8.83	<0.001	<0.0001	0.012	0.01	10	0.006	0.014	0.017	<0.05	<0.001	<0.001	0.02
ISAAC 1-QC1	EB1100019	Up Stream (MP3) QC	24/12/2010	9.16	0.001	<0.0001	0.012	0.01	10.5	0.006	0.014	0.018	<0.05	<0.001	<0.001	0.02
ISAAC 2- S2	EB1100019	Downstream (MP2)	24/12/2010	11.9	0.002	<0.0001	0.017	0.012	14.4	0.007	0.017	0.034	<0.05	<0.001	<0.001	0.03
ISAAC 2- QC2	EB1100019	Downstream (MP2) QC	24/12/2010	11.1	0.001	<0.0001	0.016	0.011	13.5	0.007	0.016	0.026	<0.05	<0.001	<0.001	0.03
DISCHARGE-S3	EB1100019	Discharge Point (MP1)	24/12/2010	10.1	0.001	<0.0001	0.014	0.011	11.9	0.007	0.016	0.02	<0.05	<0.001	<0.001	0.02
DISCHARGE-QC3	EB1100019	Discharge Point (MP1) QC	24/12/2010	11	0.001	<0.0001	0.015	0.011	12.8	0.007	0.016	0.02	<0.05	<0.001	<0.001	0.03
ISAAC 1-S1	EB1100019	Up Stream (MP3)	25/12/2010	13.2	0.002	<0.0001	0.021	0.015	18.4	0.009	0.023	0.03	<0.05	<0.001	<0.001	0.04
ISAAC 1-QC1	EB1100019	Up Stream (MP3) QC	25/12/2010	15.2	0.001	<0.0001	0.021	0.016	17.5	0.009	0.023	0.035	<0.05	<0.001	<0.001	0.03
ISAAC 2- S2	EB1100019	Downstream (MP2)	25/12/2010	16.4	0.002	<0.0001	0.023	0.016	19.7	0.009	0.024	0.055	<0.05	<0.001	<0.001	0.04
ISAAC 2- QC2	EB1100019	Downstream (MP2) QC	25/12/2010	16.2	0.002	<0.0001	0.023	0.016	19.5	0.009	0.024	0.03	<0.05	<0.001	<0.001	0.04
DISCHARGE-S3	EB1100019	Discharge Point (MP1)	25/12/2010	15.1	0.001	<0.0001	0.021	0.015	17.7	0.008	0.022	0.027	0.17	<0.001	<0.001	0.04
DISCHARGE-QC3	EB1100019	Discharge Point (MP1) QC	25/12/2010	16.3	0.002	<0.0001	0.023	0.016	19.1	0.009	0.023	0.029	0.16	<0.001	<0.001	0.04
ISAAC 1-S1	EB1100019	Up Stream (MP3)	27/12/2010	9.41	0.002	<0.0001	0.012	0.01	10.7	0.006	0.013	0.016	0.05	<0.001	<0.001	0.02
ISAAC 1-QC1	EB1100019	Up Stream (MP3) QC	27/12/2010	9.13	0.001	<0.0001	0.012	0.009	10.9	0.006	0.013	0.02	<0.05	<0.001	<0.001	0.02
ISAAC 2- S2	EB1100019	Downstream (MP2)	27/12/2010	14.3	0.002	<0.0001	0.019	0.014	17.5	0.009	0.02	0.03	<0.05	<0.001	<0.001	0.03
ISAAC 2- QC2	EB1100019	Downstream (MP2) QC	27/12/2010	12.7	0.001	<0.0001	0.017	0.013	15.6	0.009	0.018	0.026	<0.05	<0.001	<0.001	0.03
DISCHARGE-S3	EB1100019	Discharge Point (MP1)	27/12/2010	10.9	0.001	<0.0001	0.014	0.011	13.4	0.007	0.016	0.021	<0.05	<0.001	<0.001	0.03

Annexure-GDC14

DISCHARGE-QC3	EB1100019	Discharge Point (MP1) QC	27/12/2010	7.76	0.001	<0.0001	0.012	0.01	11.7	0.006	0.014	0.013	<0.05	<0.001	<0.001	0.02
TRIP-S5			29/12/2010													
S5			25/12/2010													
QC 5			24/12/2010													
QC 5			25/12/2010													
ISAAC1-S1	ES1100200	Up Stream (MP3)	29/12/2010	-	<0.001	<0.0001	0.007	0.003	-	0.004	0.01	0.015	-	-	-	0.02
ISAAC1-QC1	ES1100200	Up Stream (MP3)QC	29/12/2010	-	<0.001	0.0002	0.008	0.003	-	0.004	0.01	0.014	-	-	-	0.02
ISAAC2-S2	ES1100200	Downstream (MP2)	29/12/2010	-	<0.001	0.0001	0.01	0.003	-	0.005	0.012	0.017	-	-	-	0.02
ISAAC2-QC2	ES1100200	Downstream (MP2) QC	29/12/2010	-	<0.001	<0.0001	0.008	0.003	-	0.004	0.01	0.015	-	-	-	0.02
DISCHARGE-S3	ES1100200	Discharge Point (MP1)	29/12/2010	-	0.003	<0.0001	<0.001	0.002	-	<0.001	0.001	<0.005	-	-	-	<0.01
DISCHARGE-QC3	ES1100200	Discharge Point (MP1) QC	29/12/2010	-	0.002	<0.0001	<0.001	0.002	-	<0.001	0.001	<0.005	-	-	-	<0.01
TRIP-QC5			29/12/2010													
TRIP-S5			29/12/2010													
DISCHARGE POINT	ES1100200	Discharge Point (MP1)	31/12/2010	-	<0.001	<0.0001	<0.001	0.002	-	<0.001	0.002	0.007	-	-	-	<0.01
ISAAC 1	ES1100200	Up Stream (MP3)	31/12/2010	-	<0.001	<0.0001	0.008	0.005	-	0.004	0.009	0.014	-	-	-	0.01
ISAAC 2	ES1100200		31/12/2010	-	0.001	<0.0001	0.009	0.007	-	0.004	0.01	0.016	-	-	-	0.02
TRIP 1 2	ES1100200		31/12/2010													
Issac 1 - s1	EB1100132	Up Stream (MP3)	02/01/2011	7.94	0.002	<0.0001	0.011	0.005	10.2	0.012	0.206	0.02	0.09	<0.01	<0.001	<0.001
Issac 2 - s2	EB1100132	Downstream (MP2)	02/01/2011	8.36	0.001	<0.0001	0.01	0.004	9.2	0.012	0.208	0.02	<0.05	<0.01	<0.001	<0.001
Discharge point - s3	EB1100132	Discharge Point (MP1)	02/01/2011	0.14	0.002	<0.0001	0.001	<0.001	0.16	<0.001	0.008	<0.01	1.15	<0.01	<0.001	<0.001
Issac 1 - qc1	EB1100132	Up Stream (MP3) QC	02/01/2011	7.25	0.001	<0.0001	0.011	0.004	9.65	0.012	0.199	0.02	0.09	<0.01	<0.001	<0.001
Issac 2 - qc2	EB1100132	Downstream (MP2)QC	02/01/2011	8.94	0.001	<0.0001	0.01	0.005	9.23	0.012	0.209	0.02	<0.05	<0.01	<0.001	<0.001
Discharge point = qc3	EB1100132	Discharge Point (MP1) QC	02/01/2011	0.17	0.002	<0.0001	0.001	<0.001	0.19	0.001	0.008	<0.01	1.17	<0.01	<0.001	<0.001
Trip - QC5			02/01/2011	-	-	-	-	-	-	-	-	-	-	-	-	-
Issac 1 - s1	EB1100130	Up Stream (MP3)	03/01/2011	7.07	0.001	<0.0001	0.017	0.006	9.96	0.015	0.186	0.02	0.05	<0.01	<0.001	<0.001
Issac 2 - s2	EB1100130	Downstream (MP2)	03/01/2011	8.48	0.001	<0.0001	0.022	0.008	13.7	0.019	0.253	0.03	<0.05	<0.01	<0.001	<0.001
Discharge point - s3	EB1100130	Discharge Point (MP1)	03/01/2011	0.14	0.002	<0.0001	<0.001	<0.001	0.14	0.001	0.01	<0.01	1.06	<0.01	<0.001	<0.001
Issac 1 - qc1	EB1100130	Up Stream (MP3) QC	03/01/2011	8.47	0.001	<0.0001	0.023	0.008	13.6	0.019	0.226	0.03	0.06	<0.01	<0.001	<0.001
Issac 2 - qc2	EB1100130	Downstream (MP2)QC	03/01/2011	9.04	0.001	<0.0001	0.022	0.008	14.3	0.02	0.257	0.03	<0.05	<0.01	<0.001	<0.001
Discharge point - qc3	EB1100130	Discharge Point (MP1) QC	03/01/2011	0.13	0.002	<0.0001	<0.001	<0.001	0.15	0.001	0.01	<0.01	1.12	<0.01	<0.001	<0.001
Trip - QC5			03/01/2011	-	-	-	-	-	-	-	-	-	-	-	-	-
Isaac 1 - s1	EB1100282	Up Stream (MP3)	04/01/2011	8.43	0.002	<0.0001	0.015	0.008	11.2	0.005	0.014	0.015	0.08	<0.001	<0.001	0.02
Isaac 2 - s2	EB1100282	Downstream (MP2)	04/01/2011	7.1	0.002	<0.0001	0.013	0.007	9.41	0.004	0.011	0.012	0.06	<0.001	<0.001	0.02
Discharge point - s3	EB1100282	Discharge Point (MP1)	04/01/2011	0.03	0.002	<0.0001	<0.001	0.002	0.12	<0.001	<0.001	<0.005	1.39	<0.001	<0.001	<0.01
Isaac 1 - qc1	EB1100282	Up Stream (MP3) QC	04/01/2011	8.57	0.002	<0.0001	0.016	0.009	11.7	0.005	0.014	0.017	0.08	<0.001	<0.001	0.02
Isaac 2 - qc2	EB1100282	Downstream (MP2)QC	04/01/2011	8.13	0.002	<0.0001	0.015	0.008	10.3	0.006	0.012	0.014	0.06	<0.001	<0.001	0.02
Discharge point - s3	EB1100282	Discharge Point (MP1) QC	04/01/2011	0.09	0.002	<0.0001	<0.001	0.002	0.12	<0.001	<0.001	<0.005	1.33	<0.001	<0.001	<0.01
Trip - s5			04/01/2011	-	-	-	-	-	-	-	-	-	-	-	-	-
Isaac 1 - s1	EB1100279	Up Stream (MP3)	05/01/2011	6.07	0.001	<0.0001	0.009	0.006	7.64	0.004	0.009	0.011	0.05	<0.001	<0.001	0.02
Isaac 2 - s2	EB1100279	Downstream (MP2)	05/01/2011	6.44	0.001	<0.0001	0.009	0.006	7.91	0.004	0.009	0.012	<0.05	<0.001	<0.001	0.02
Discharge point - s3	EB1100279	Discharge Point (MP1)	05/01/2011	0.09	0.002	<0.0001	<0.001	0.002	0.12	<0.001	<0.001	0.003	1.33	<0.001	<0.001	<0.01
Isaac 1 - qc1	EB1100279	Up Stream (MP3) QC	05/01/2011	6.37	0.002	<0.0001	0.01	0.007	8.51	0.004	0.01	0.012	0.08	<0.001	<0.001	0.02
Isaac 2 - qc2	EB1100279	Downstream (MP2)QC	05/01/2011	6.36	0.001	<0.0001	0.009	0.007	7.91	0.004	0.01	0.011	0.06	<0.001	<0.001	0.02
Discharge point - s3	EB1100279	Discharge Point (MP1) QC	05/01/2011	0.09	0.002	<0.0001	<0.001	0.002	0.13	<0.001	<0.001	0.003	1.39	<0.001	<0.001	<0.01

S1	EB1100506	Up Stream (MP3)	06/01/2011	6.57	<0.001	<0.0001	0.009	0.007	7.99	0.004	0.009	0.01	<0.05	<0.001	<0.001	0.02
S2	EB1100506	Downstream (MP2)	06/01/2011	6.16	<0.001	<0.0001	0.008	0.006	7.86	0.004	0.008	0.01	<0.05	<0.001	<0.001	0.02
S3	EB1100506	Discharge Point (MP1)	06/01/2011	0.11	<0.001	<0.0001	0.001	0.002	0.13	<0.001	0.001	<0.005	1.09	<0.001	<0.001	<0.01
QC1	EB1100506	Up Stream (MP3) QC	06/01/2011	6.33	<0.001	<0.0001	0.009	0.007	7.84	0.004	0.009	0.01	0.06	<0.001	<0.001	0.02
QC2	EB1100506	Downstream (MP2)QC	06/01/2011	5.68	<0.001	<0.0001	0.008	0.006	6.7	0.004	0.008	0.009	<0.05	<0.001	<0.001	0.02
QC3	EB1100506	Discharge Point (MP1) QC	06/01/2011	0.12	<0.001	<0.0001	0.001	0.002	0.15	<0.001	0.001	<0.005	1.03	<0.001	<0.001	<0.01
QC4			06/01/2011													
S1	EB1100507	Up Stream (MP3)	07/01/2011	10.6	0.002	<0.0001	0.015	0.01	13.7	0.006	0.015	0.021	0.07	<0.001	<0.001	0.03
S2	EB1100507	Downstream (MP2)	07/01/2011	9.11	0.002	<0.0001	0.013	0.009	11.6	0.005	0.012	0.016	0.06	<0.001	<0.001	0.02
S3	EB1100507	Discharge Point (MP1)	07/01/2011	0.14	<0.001	<0.0001	0.001	0.003	0.28	<0.001	0.003	0.005	1.04	<0.001	<0.001	<0.01
QC1	EB1100507	Up Stream (MP3) QC	07/01/2011	12.1	0.002	<0.0001	0.017	0.011	15.9	0.006	0.016	0.019	0.09	<0.001	<0.001	0.03
QC2	EB1100507	Downstream (MP2)QC	07/01/2011	9.39	0.002	<0.0001	0.012	0.009	12	0.005	0.013	0.016	0.07	<0.001	<0.001	0.02
QC3	EB1100507	Discharge Point (MP1) QC	07/01/2011	0.18	<0.001	<0.0001	0.002	0.003	0.3	<0.001	0.003	0.006	1.03	<0.001	<0.001	<0.01
QC4			07/01/2011													
S1	EM1101133	Up Stream (MP3)	31/01/2011	2.1	<0.010	0.002	<0.05	0.021	29.4	0.046	<0.0001	0.844	0.043	0.07	0.014	0.047
S2	EM1101133	Downstream (MP2)	31/01/2011	2.12	<0.010	0.001	<0.05	0.019	28.8	0.047	<0.0001	0.81	0.045	0.07	0.014	0.041
S3	EM1101133	Discharge Point (MP1)	31/01/2011	0.55	<0.010	0.002	1.01	<0.001	0.62	0.003	<0.0001	0.028	<0.005	0.02	<0.001	0.001
QC1	EM1101133	Up Stream (MP3) QC	31/01/2011	1.74	<0.010	0.001	<0.05	0.017	25.4	0.036	<0.0001	0.724	0.034	0.06	0.011	0.035
QC2	EM1101133	Downstream (MP2)QC	31/01/2011	1.22	<0.010	0.002	<0.05	0.02	28.3	0.046	<0.0001	0.822	0.046	0.07	0.014	0.044
QC3	EM1101133	Discharge Point (MP1) QC	31/01/2011	0.44	<0.010	0.002	0.96	<0.001	0.56	0.002	<0.0001	0.025	<0.005	0.02	<0.001	<0.001
QC4			31/01/2011													
S1 ISAC 2	EM1101101	Up Stream (MP3)	01/02/2011	1.3	<0.010	0.002	<0.05	0.009	17.3	0.025	<0.0001	0.433	0.022	0.05	0.008	0.021
S2 ISAC 1	EM1101101	Downstream (MP2)	01/02/2011	1.7	<0.010	0.002	0.05	0.014	23.6	0.032	<0.0001	0.588	0.035	0.05	0.012	0.031
S3 DISCHARGE	EM1101101	Discharge Point (MP1)	01/02/2011	0.04	<0.010	0.002	1.4	<0.001	0.08	0.001	<0.0001	0.005	0.011	0.01	<0.001	<0.001
QC1 ISAC 2	EM1101101	Up Stream (MP3) QC	01/02/2011	1.67	<0.010	0.002	0.05	0.009	24.4	0.021	<0.0001	0.422	0.018	0.04	0.008	0.019
QC2 ISAC 1	EM1101101	Downstream (MP2)QC	01/02/2011	1.71	<0.010	0.002	0.06	0.013	22.8	0.032	<0.0001	0.567	0.034	0.05	0.011	0.029
QC3 DISCHARGE	EM1101101	Discharge Point (MP1) QC	01/02/2011	0.04	<0.010	0.002	1.33	<0.001	0.07	<0.001	<0.0001	0.004	0.009	0.01	<0.001	<0.001
QC4 TRIP			01/02/2011													
S1	EM1101103	Up Stream (MP3)	02/02/2011	1.19	<0.010	0.002	0.07	0.008	15.6	0.02	0.0002	0.341	0.022	0.04	0.007	0.018
S2	EM1101103	Downstream (MP2)	02/02/2011	1.05	<0.010	0.001	0.05	0.006	13.4	0.017	<0.0001	0.295	0.017	0.04	0.006	0.015
QC1	EM1101103	Up Stream (MP3) QC	02/02/2011	1.26	<0.010	0.002	0.06	0.007	16.4	0.02	<0.0001	0.321	0.02	0.04	0.007	0.018
QC2	EM1101103	Downstream (MP2)QC	02/02/2011	1.1	<0.010	0.002	0.06	0.006	14	0.016	<0.0001	0.264	0.016	0.04	0.006	0.015
QC4			02/02/2011													
ISAC 2 S1	EM1101104	Up Stream (MP3)	03/02/2011	1.71	0.002	<0.0001	0.02	0.007	13.4	0.3	0.007	0.002	0.06	<0.001	0.04	0.013
ISAC 1 S1	EM1101104	Downstream (MP2)	03/02/2011	1.28	0.002	<0.0001	0.021	0.008	16.7	0.357	0.007	0.001	0.06	<0.001	0.04	0.024
ISAC 2 QC1	EM1101104	Up Stream (MP3) QC	03/02/2011	1.25	0.002	<0.0001	0.02	0.007	16.2	0.322	0.007	0.001	0.06	<0.001	0.04	0.021
ISAC 1 QC1	EM1101104	Downstream (MP2)QC	03/02/2011	1.96	0.002	<0.0001	0.022	0.008	17.6	0.366	0.008	0.001	0.06	<0.001	0.04	0.026
TRIP QC4			03/02/2011													
Isaac 1-S1	EB1102433	Upstream MP3 - S1	5/02/2011	6.03	<0.001	<0.0001	0.007	0.008	7.3	0.005	0.01	0.015	0.1	<0.001	<0.001	0.02
Isaac 1-QC1	EB1102433	Upstream QC1	5/02/2011	5.81	<0.001	<0.0001	0.007	0.008	7.07	0.004	0.009	0.013	0.09	<0.001	<0.001	0.02
Isaac 2-S1	EB1102433	Downstream - MP2 - S2	5/02/2011	0.92	<0.001	<0.0001	0.001	0.005	0.8	0.003	0.004	0.006	<0.05	<0.001	<0.001	<0.01
Isaac 2-QC1	EB1102433	Downstream QC2	5/02/2011	8.3	<0.001	<0.0001	0.011	0.01	10.5	0.006	0.013	0.019	<0.05	<0.001	<0.001	0.02
Discharge-S1	EB1102433	Discharge - MP1 - S3	5/02/2011	7.86	<0.001	<0.0001	0.01	0.009	10.5	0.005	0.012	0.02	0.27	<0.001	<0.001	0.02
Discharge-QC1	EB1102433	Discharge QC3	5/02/2011	7.72	0.001	<0.0001	0.01	0.009	10	0.005	0.012	0.019	0.28	<0.001	<0.001	0.02

Trip S1	EB1102433	Trip QC4	5/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trip QC1	EB1102433	Rinsate QC5	5/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Issac 1-S1	EB1102434	Upstream MP3 - S1	6/02/2011	10.7	0.001	<0.0001	0.019	0.013	15.2	0.01	0.019	0.022	0.07	<0.001	<0.001	0.03
Issac 1-QC1	EB1102434	Upstream QC1	6/02/2011	11.1	0.001	<0.0001	0.019	0.013	15.9	0.008	0.019	0.022	0.07	<0.001	<0.001	0.03
Issac 2-S1	EB1102434	Downstream - MP2 - S2	6/02/2011	9.23	0.001	<0.0001	0.015	0.012	12.6	0.007	0.016	0.02	<0.05	<0.001	<0.001	0.03
Issac 2-QC1	EB1102434	Downstream QC2	6/02/2011	8.92	0.001	<0.0001	0.014	0.012	12.4	0.007	0.015	0.018	<0.05	<0.001	<0.001	0.02
Discharge-S1	EB1102434	Discharge - MP1 - S3	6/02/2011	7.96	0.001	<0.0001	0.013	0.01	11.1	0.006	0.014	0.02	0.18	<0.001	<0.001	0.02
Discharge-QC1	EB1102434	Discharge QC3	6/02/2011	8.96	0.001	<0.0001	0.014	0.011	12.7	0.006	0.015	0.02	0.18	<0.001	<0.001	0.02
Trip S1	EB1102434	Trip QC4	6/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-
Trip QC1	EB1102434	Rinsate QC5	6/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-
Issac 1-S1	EB1102435	Upstream MP3 - S1	7/02/2011	8.26	0.001	<0.0001	0.011	0.009	10.1	0.005	0.012	0.023	0.09	<0.001	<0.001	0.02
Issac 1-QC1	EB1102435	Upstream QC1	7/02/2011	8.01	<0.001	<0.0001	0.011	0.009	9.66	0.005	0.012	0.015	0.09	<0.001	<0.001	0.02
Issac 2-S1	EB1102435	Downstream - MP2 - S2	7/02/2011	8.79	<0.001	<0.0001	0.012	0.01	10.6	0.006	0.013	0.018	<0.05	<0.001	<0.001	0.02
Issac 2-QC1	EB1102435	Downstream QC2	7/02/2011	9.2	<0.001	<0.0001	0.012	0.01	11.2	0.006	0.014	0.017	<0.05	<0.001	<0.001	0.02
Discharge-S1	EB1102435	Discharge - MP1 - S3	7/02/2011	8.49	<0.001	<0.0001	0.012	0.01	10.8	0.005	0.014	0.018	0.3	<0.001	<0.001	0.02
Discharge-QC1	EB1102435	Discharge QC3	7/02/2011	8.59	0.001	<0.0001	0.012	0.01	10.9	0.005	0.013	0.017	0.3	<0.001	<0.001	0.02
Trip S1	EB1102435	Trip QC4	7/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-
Trip QC1	EB1102435	Rinsate QC5	7/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-
S1	EB1102436	Upstream MP3 - S1	8/02/2011	4.86	<0.001	<0.0001	0.006	0.006	5.35	0.004	0.008	0.01	<0.05	<0.001	<0.001	0.01
S2	EB1102436	Downstream - MP2 - S2	8/02/2011	4.47	<0.001	<0.0001	0.005	0.006	4.89	0.004	0.007	0.011	0.08	<0.001	<0.001	0.01
S3	EB1102436	Discharge - MP1 - S3	8/02/2011	4.35	0.001	<0.0001	0.006	0.006	5.3	0.003	0.007	0.013	0.45	<0.001	<0.001	0.01
QC1	EB1102436	Upstream QC1	8/02/2011	5.37	<0.001	<0.0001	0.007	0.007	5.99	0.004	0.008	0.012	<0.05	<0.001	<0.001	0.01
QC2	EB1102436	Downstream QC2	8/02/2011	3.83	0.001	<0.0001	0.004	0.007	4.18	0.004	0.007	0.011	0.08	<0.001	<0.001	0.01
QC3	EB1102436	Discharge QC3	8/02/2011	3.24	0.002	<0.0001	0.004	0.005	3.64	0.003	0.006	0.009	0.44	<0.001	<0.001	0.01
QC5	EB1102436	Trip QC4	8/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-
QC6	EB1102436	Rinsate QC5	8/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-
Upstream MP3 - S1	EB1102552	Upstream MP3 - S1	9/02/2011	6.49	0.001	<0.0001	0.008	0.007	7.93	0.004	0.009	0.022	<0.05	<0.001	<0.001	0.02
Downstream - MP2 - S2	EB1102552	Downstream - MP2 - S2	9/02/2011	5.94	0.001	<0.0001	0.008	0.007	7.32	0.004	0.009	0.027	<0.05	<0.001	<0.001	0.02
QC2	EB1102552	QC2	9/02/2011	5.69	<0.001	<0.0001	0.007	0.007	6.69	0.004	0.009	0.022	<0.05	<0.001	<0.001	0.01
QC3	EB1102552	Trip QC3	9/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-
Upstream MP3 - S10	EB1102552	Upstream MP3 - S1	09/02/2011	6.49	0.001	<0.0001	0.008	0.007	7.93	0.004	0.009	0.022	<0.05	<0.001	<0.001	0.02
Downstream - MP2 - S2	EB1102552	Downstream - MP2 - S2	09/02/2011	5.94	0.001	<0.0001	0.008	0.007	7.32	0.004	0.009	0.027	<0.05	<0.001	<0.001	0.02
QC2	EB1102552	QC2	09/02/2011	5.69	<0.001	<0.0001	0.007	0.007	6.69	0.004	0.009	0.022	<0.05	<0.001	<0.001	0.01
QC3	EB1102552	QC3	09/02/2011													
Upstream MP3 - S1	EB1102554	Up Stream (MP3)	10/02/2011	4.9	<0.001	<0.0001	0.006	0.006	5.85	0.004	0.008	0.013	<0.05	<0.001	<0.001	0.01
Downstream - MP2 - S2	EB1102554	Downstream (MP2)	10/02/2011	5.99	<0.001	<0.0001	0.007	0.007	7.23	0.004	0.009	0.017	<0.05	<0.001	<0.001	0.02
QC2	EB1102554	Downstream (MP2)QC	10/02/2011	6.82	<0.001	<0.0001	0.008	0.008	8.5	0.004	0.01	0.023	<0.05	<0.001	<0.001	0.02
QC3	EB1102554		10/02/2011													
March 2011 Discharge																
Upstream MP3 - S1	EB105951	Upstream MP3 - S1	25/03/2011	17.9	0.001	<0.0001	0.029	0.036	18.9	0.016	0.054	0.066	0.08	<0.001	0.001	0.05
Downstream - MP2 - S2	EB105951	Downstream - MP2 - S2	25/03/2011	3.44	0.001	<0.0001	0.004	0.018	2.86	0.011	0.028	0.025	0.1	<0.001	0.001	0.04

Discharge - MP1 - S3	EB105951	Discharge - MP1 - S3	25/03/2011	<0.01	<0.001	0.0002	<0.001	0.003	<0.05	<0.001	0.003	<0.005	1.28	<0.001	<0.001	<0.01
QC1	EB105951	Discharge QC3	25/03/2011	<0.01	<0.001	0.0002	0.001	0.003	<0.05	<0.001	0.004	0.007	1.25	<0.001	<0.001	<0.01
		Discharge RPD	RPD (in %)	0%	0%	0%	NC	0%	0%	0%	29%	NC	2%	0%	0%	0%
QC2	EB105951	Downstream QC2	25/03/2011	9.4	0.002	0.0002	0.017	0.025	1.03	0.012	0.046	0.042	0.1	<0.001	0.001	0.05
		Downstream RPD	RPD (in %)	96%	67%	NC	124%	33%	116%	9%	49%	51%	0%	0%	0%	22%
QC3	EB105951	Upstream QC1	25/03/2011	2.1	0.002	0.0001	0.039	0.036	2.42	0.017	0.069	0.068	0.07	<0.001	0.002	0.07
		Upstream RPD	RPD (in %)	16%	67%	0%	29%	0%	25%	6%	24%	3%	-13%	0%	67%	15%
QC4	EB105951	Trip QC4	25/03/2011													
QC5	EB105951	Rinsate QC5	25/03/2011													
Upstream MP3-S1	EB1105942	Upstream MP3-S1	26/03/2011	17.5	0.001	<0.0001	0.023	0.015	16.2	0.007	0.027	0.033	0.06	<0.001	<0.001	0.03
Downstrream-MP2-S2	EB1105942	Downstrream-MP2-S2	26/03/2011	16.7	0.001	<0.0001	0.023	0.016	18.7	0.007	0.029	0.034	0.1	<0.001	<0.001	0.03
Discharge-MP1-S3	EB1105942	Discharge-MP1-S3	26/03/2011	0.03	<0.001	0.0004	0.001	0.003	0.11	<0.001	0.006	0.007	1.22	<0.001	<0.001	<0.01
Upstream QC1	EB1105942	Upstream QC1	26/03/2011	19	0.002	<0.0001	0.025	0.016	18.6	0.007	0.03	0.04	0.08	<0.001	<0.001	0.03
Downstream QC2	EB1105942	Downstream QC2	26/03/2011	17.6	0.002	<0.0001	0.026	0.016	19.1	0.008	0.029	0.034	0.09	<0.001	<0.001	0.03
Discharge QC3	EB1105942	Discharge QC3	26/03/2011	0.04	0.001	0.0002	<0.001	0.004	0.08	<0.001	0.003	0.01	1.27	<0.001	<0.001	<0.01
TRip QC4	EB1105942	Trip QC4	26/03/2011													
Rinsate QC5	EB1105942	Rinsate QC5	26/03/2011													
March 2011 Discharge Dam Monitoring Program																
Pond 1	EB1105946	P1-S1	26/03/2011	0.06	0.003	<0.0001	<0.001	0.002	0.09	<0.001	<0.001	<0.005	1.14	<0.001	0.001	<0.01
Pond 2 (Discharge)	EB1105946	P2-S2	26/03/2011	0.24	0.003	<0.0001	0.001	0.004	0.32	<0.001	0.002	<0.005	0.86	<0.001	<0.001	<0.01
Pond 5	EB1105946	P5-S5	26/03/2011	0.02	0.002	0.0002	<0.001	0.002	0.05	<0.001	0.003	<0.005	1.16	<0.001	<0.001	<0.01
Pond 10	EB1105946	P10-S10	26/03/2011	0.03	0.002	<0.0001	<0.001	0.002	<0.05	<0.001	<0.001	<0.005	1.19	<0.001	<0.001	<0.01
Pond 1 Duplicate	EB1105946	P1-QC1	26/03/2011	0.07	0.003	<0.0001	<0.001	0.002	0.12	<0.001	<0.001	<0.005	1.15	<0.001	0.001	<0.01
Pond 2 Duplicate	EB1105946	P2-QC2	26/03/2011	0.27	0.003	<0.0001	0.001	0.003	0.34	<0.001	0.002	<0.005	0.9	<0.001	<0.001	<0.01
Pond 5 Duplicate	EB1105946	P5-QC5	26/03/2011	0.02	0.002	0.0001	<0.001	0.002	<0.05	<0.001	0.002	<0.005	1.2	<0.001	<0.001	<0.01
Pond 10 Duplicate	EB1105946	P10-QC10	26/03/2011	0.01	0.002	<0.0001	<0.001	0.002	<0.05	<0.001	<0.001	<0.005	1.2	<0.001	<0.001	<0.01
Trip Blank	EB1105946	Trip QC4	26/03/2011													
Rinsate Sample	EB1105946	Rinsate QC5	26/03/2011													
March 2011 Discharge Continued																
Upstream MP3-S1	EB1105944	Upstream MP3-S1	27/03/2011	15	0.002	<0.0001	0.02	0.019	17.3	0.008	0.03	0.041	0.08	<0.001	<0.001	0.03
Downstream-MP2-S2	EB1105944	Downstream-MP2-S2	27/03/2011	10.4	0.002	<0.0001	0.019	0.017	15.4	0.007	0.027	0.035	0.07	<0.001	<0.001	0.03
Upstream QC1	EB1105944	Upstream QC1	27/03/2011	10.5	0.002	<0.0001	0.018	0.017	15.1	0.007	0.027	0.033	0.07	<0.001	<0.001	0.03
Downstream QC2	EB1105944	Downstream QC2	27/03/2011	10.3	0.002	<0.0001	0.019	0.017	16.1	0.007	0.027	0.035	0.07	<0.001	<0.001	0.03
Trip QC4	EB1105944		27/03/2011													
Rinsate QC5	EB1105944		27/03/2011													

Upstream MP3 - S1	EB1105983	Upstream MP3 - S1	28/03/2011	5.43	<0.001	<0.0001	0.007	0.007	6.77	0.004	0.009	0.015	0.06	<0.001	<0.001	0.02
Downstream - MP2 - S2	EB1105983	Downstream - MP2 - S2	28/03/2011	5.45	<0.001	<0.0001	0.007	0.007	6.76	0.004	0.009	0.016	0.06	<0.001	<0.001	0.02
Upstream QC1	EB1105983	Upstream QC1	28/03/2011													
Downstream QC2	EB1105983	Downstream QC2	28/03/2011													
Trip QC4	EB1105983		28/03/2011													
Rinsate QC5	EB1105983		28/03/2011													
Upstream MP3- S1	EB1106761	Upstream MP3- S1	05/04/2011	11	0.002	<0.0001	0.014	0.011	13.1	0.006	0.015	0.027	0.05	<0.001	<0.001	0.03
Downstream MP2 - S2	EB1106761	Downstream MP2 - S2	05/04/2011	6.07	0.001	<0.0001	0.007	0.008	7.02	0.004	0.008	0.017	0.11	<0.001	<0.001	0.02
Discharge MP1 - S3	EB1106761	Discharge MP1 - S3	05/04/2011	<0.01	0.002	0.0003	<0.001	0.003	<0.05	<0.001	0.003	0.006	1.24	<0.001	<0.001	<0.01
Upstream QC1	EB1106761	Upstream QC1	05/04/2011	9.25	0.001	<0.0001	0.011	0.01	10.7	0.005	0.012	0.022	0.06	<0.001	<0.001	0.02
Downstream QC2	EB1106761	Downstream QC2	05/04/2011	8.48	0.001	<0.0001	0.01	0.009	10.3	0.005	0.042	0.02	0.11	<0.001	<0.001	0.02
Discharge QC3	EB1106761	Discharge QC3	05/04/2011	<0.01	0.002	0.0003	0.002	0.003	<0.05	<0.001	0.004	<0.005	1.22	<0.001	<0.001	<0.01
Trip QC4	EB1106761	Trip QC4	05/04/2011													
Upstream MP3 - S1	EB1106763	Upstream MP3 - S1	06/04/2011	8.78	0.001	<0.0001	0.01	0.009	9.76	0.005	0.01	0.019	0.06	<0.001	<0.001	0.02
Downstream MP2- S2	EB1106763	Downstream MP2- S2	06/04/2011	7.85	0.002	<0.0001	0.009	0.009	9.01	0.005	0.01	0.018	0.05	<0.001	<0.001	0.02
Upstream QC1	EB1106763	Upstream QC1	06/04/2011	7.59	0.002	<0.0001	0.008	0.008	9.18	0.005	0.01	0.016	0.06	<0.001	<0.001	0.02
Downstream QC2	EB1106763	Downstream QC2	06/04/2011	7.03	0.002	0.0001	0.007	0.008	7.83	0.005	0.009	0.014	0.05	<0.001	<0.001	0.02
Trip QC4	EB1106763	Trip QC4	06/04/2011													
Rinsate QC5	EB1106763	Rinsate QC5	06/04/2011													
Upstream MP3 - S1	EB1106850	Upstream MP3 - S1	07/04/2011	6.44	0.001	<0.0001	0.008	0.009	7.21	0.004	0.008	0.016	<0.05	<0.001	<0.001	0.02
Downstream - MP2 - S2	EB1106850	Downstream - MP2 - S2	07/04/2011	7.02	0.001	<0.0001	0.008	0.008	8.04	0.005	0.009	0.012	<0.05	<0.001	<0.001	0.02
Upstream QC1	EB1106850	Upstream QC1	07/04/2011	9.54	0.002	<0.0001	0.012	0.011	12.6	0.006	0.013	0.021	<0.05	<0.001	<0.001	0.02
Downstream QC2	EB1106850	Downstream QC2	07/04/2011	7.82	0.001	<0.0001	0.009	0.012	9.39	0.005	0.01	0.015	<0.05	<0.001	<0.001	0.02
Trip QC4	EB1106850	Trip QC4	07/04/2011													
Rinsate QC5	EB1106850	Rinsate QC5	07/04/2011													

ALS			Analyte	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene		Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenz(a,h)anthracene	Benzo(g,h,i)perylene
ALS Sample ID	Lab ID	Monitoring Point	Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
			Date Sampled/LOR	20	50	100	50	50	1	2	2	2	2		1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1
[redacted]																														
DISCHARGE POINT		Discharge Point (MP1)	21/12/2010	<20	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ISAAC 1		Up Stream (MP3)	21/12/2010	<20	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ISAAC 2		Downstream (MP2)	21/12/2010	<20	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DISCHARGE POINT			21/12/2010	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ISAAC 1			21/12/2010	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ISSAC 2		Downstream (MP2) QC	21/12/2010	<20	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DISCHARGE POINT		Discharge Point (MP1)	23/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Downstream		Downstream (MP2)	23/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 2		Downstream (MP2) QC	23/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 1-S1	EB1100019	Up Stream (MP3)	24/12/2010	<20	<50	<100	<50	60	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 1-QC1	EB1100019	Up Stream (MP3) QC	24/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 2- S2	EB1100019	Downstream (MP2)	24/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 2- QC2	EB1100019	Downstream (MP2) QC	24/12/2010	<20	<50	<100	50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
DISCHARGE-S3	EB1100019	Discharge Point (MP1)	24/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
DISCHARGE-QC3	EB1100019	Discharge Point (MP1) QC	24/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
QC 5	EB1100019	[redacted]	24/12/2010	[redacted]	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S5	EB1100019		25/12/2010	<20	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ISAAC 1-S1	EB1100019	Up Stream (MP3)	24/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 1-QC1	EB1100019	Up Stream (MP3) QC	24/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 2- S2	EB1100019	Downstream (MP2)	24/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 2- QC2	EB1100019	Downstream (MP2) QC	24/12/2010	<20	<50	<100	50	50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
DISCHARGE-S3	EB1100019	Discharge Point (MP1)	24/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
DISCHARGE-QC3	EB1100019	Discharge Point (MP1) QC	24/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 1-S1	EB1100019	Up Stream (MP3)	25/12/2010	<20	<50	<100	60	60	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 1-QC1	EB1100019	Up Stream (MP3) QC	25/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 2- S2	EB1100019	Downstream (MP2)	25/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 2- QC2	EB1100019	Downstream (MP2) QC	25/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
DISCHARGE-S3	EB1100019	Discharge Point (MP1)	25/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
DISCHARGE-QC3	EB1100019	Discharge Point (MP1) QC	25/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 1-S1	EB1100019	Up Stream (MP3)	27/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 1-QC1	EB1100019	Up Stream (MP3) QC	27/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 2- S2	EB1100019	Downstream (MP2)	27/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 2- QC2	EB1100019	Downstream (MP2) QC	27/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
DISCHARGE-S3	EB1100019	Discharge Point (MP1)	27/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
DISCHARGE-QC3	EB1100019	Discharge Point (MP1) QC	27/12/2010	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
TRIP-S5			29/12/2010	[redacted]					<1	<2	<2	<2	<2																	
S5			25/12/2010	<20					<1	<2	<2	<2	<2																	
QC 5			24/12/2010	[redacted]					<1	<2	<2	<2	<2																	
QC 5			25/12/2010	[redacted]					<1	<2	<2	<2	<2																	
ISAAC1-S1	ES1100200	Up Stream (MP3)	29/12/2010	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC1-QC1	ES1100200	Up Stream (MP3)QC	29/12/2010	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC2-S2	ES1100200	Downstream (MP2)	29/12/2010	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC2-QC2	ES1100200	Downstream (MP2) QC	29/12/2010	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
DISCHARGE-S3	ES1100200	Discharge Point (MP1)	29/12/2010	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
DISCHARGE-QC3	ES1100200	Discharge Point (MP1) QC	29/12/2010	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
TRIP-QC5			29/12/2010						<1	<5	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRIP-S5			29/12/2010						<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DISCHARGE POINT	ES1100200	Discharge Point (MP1)	31/12/2010	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 1	ES1100200	Up Stream (MP3)	31/12/2010	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
ISAAC 2	ES1100200		31/12/2010	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
TRIP 1 2	ES1100200		31/12/2010						<1	<5	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Issac 1 - s1	EB1100132	Up Stream (MP3)	02/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Issac 2 - s2	EB1100132	Downstream (MP2)	02/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Discharge point - s3	EB1100132	Discharge Point (MP1)	02/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Issac 1 - qc1	EB1100132	Up Stream (MP3) QC	02/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Issac 2 - qc2	EB1100132	Downstream (MP2)QC	02/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Discharge point - qc3	EB1100132	Discharge Point (MP1) QC	02/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Trip - QC5			02/01/2011	40	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Issac 1 - s1	EB1100130	Up Stream (MP3)	03/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Issac 2 - s2	EB1100130	Downstream (MP2)	03/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Discharge point - s3	EB1100130	Discharge Point (MP1)	03/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Issac 1 - qc1	EB1100130	Up Stream (MP3) QC	03/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Issac 2 - qc2	EB1100130	Downstream (MP2)QC	03/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Discharge point - qc3	EB1100130	Discharge Point (MP1) QC	03/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Trip - QC5			03/01/2011	<20					<1	<2	<2	<2	<2																	
Issac 1 - s1	EB1100282	Up Stream (MP3)	04/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
Issac 2 - s2	EB1100282	Downstream (MP2)	04/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	

Discharge point - s3	EB1100282	Discharge Point (MP1)	04/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Isaac 1 - qc1	EB1100282	Up Stream (MP3) QC	04/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Isaac 2 - qc2	EB1100282	Downstream (MP2)QC	04/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Discharge point - s3	EB1100282	Discharge Point (MP1) QC	04/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Trip - s5			04/01/2011	<20					<1	<2	<2	<2	<2																	
Isaac 1 - s1	EB1100279	Up Stream (MP3)	05/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Isaac 2 - s2	EB1100279	Downstream (MP2)	05/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Discharge point - s3	EB1100279	Discharge Point (MP1)	05/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Isaac 1 - qc1	EB1100279	Up Stream (MP3) QC	05/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Isaac 2 - qc2	EB1100279	Downstream (MP2)QC	05/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Discharge point - s3	EB1100279	Discharge Point (MP1) QC	05/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
S1	EB1100506	Up Stream (MP3)	06/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
S2	EB1100506	Downstream (MP2)	06/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
S3	EB1100506	Discharge Point (MP1)	06/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC1	EB1100506	Up Stream (MP3) QC	06/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC2	EB1100506	Downstream (MP2)QC	06/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC3	EB1100506	Discharge Point (MP1) QC	06/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC4			06/01/2011	[redacted]					<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
S1	EB1100507	Up Stream (MP3)	07/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2																	
S2	EB1100507	Downstream (MP2)	07/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
S3	EB1100507	Discharge Point (MP1)	07/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC1	EB1100507	Up Stream (MP3) QC	07/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC2	EB1100507	Downstream (MP2)QC	07/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC3	EB1100507	Discharge Point (MP1) QC	07/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC4			07/01/2011	<20					<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
S1	EM1101133	Up Stream (MP3)	31/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2																	
S2	EM1101133	Downstream (MP2)	31/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
S3	EM1101133	Discharge Point (MP1)	31/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC1	EM1101133	Up Stream (MP3) QC	31/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC2	EM1101133	Downstream (MP2)QC	31/01/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC3	EM1101133	Discharge Point (MP1) QC	31/01/2011	<20	<50	[redacted]	80	[redacted]	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC4			31/01/2011	<20					<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
S1_ISAC 2	EM1101101	Up Stream (MP3)	01/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2																	
S2_ISAC 1	EM1101101	Downstream (MP2)	01/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
S3_DISCHARGE	EM1101101	Discharge Point (MP1)	01/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC1_ISAC 2	EM1101101	Up Stream (MP3) QC	01/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC2_ISAC 1	EM1101101	Downstream (MP2)QC	01/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC3_DISCHARGE	EM1101101	Discharge Point (MP1) QC	01/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC4_TRIP			01/02/2011	<20					<1	<2	<2	<2	<2																	
S1	EM1101103	Up Stream (MP3)	02/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
S2	EM1101103	Downstream (MP2)	02/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC1	EM1101103	Up Stream (MP3) QC	02/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC2	EM1101103	Downstream (MP2)QC	02/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC4			02/02/2011	<20					<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
ISAC 2 S1	EM1101104	Up Stream (MP3)	03/02/2011	<20	<50	[redacted]			<1	<2	<2	<2	<2																	
ISAC 1 S1	EM1101104	Downstream (MP2)	03/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
ISAC 2 QC1	EM1101104	Up Stream (MP3) QC	03/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
ISAC 1 QC1	EM1101104	Downstream (MP2)QC	03/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
TRIP QC4			03/02/2011	<20					<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Isaac 1-S1	EB1102433	Upstream MP3 - S1	5/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isaac 1-QC1	EB1102433	Upstream QC1	5/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isaac 2-S1	EB1102433	Downstream - MP2 - S2	5/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isaac 2-QC1	EB1102433	Downstream QC2	5/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Discharge-S1	EB1102433	Discharge - MP1 - S3	5/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Discharge-QC1	EB1102433	Discharge QC3	5/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trip S1	EB1102433	Trip QC4	5/02/2011	[redacted]	-	-	-	-	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trip QC1	EB1102433	Rinsate QC5	5/02/2011	<20	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Issac 1-S1	EB1102434	Upstream MP3 - S1	6/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Issac 1-QC1	EB1102434	Upstream QC1	6/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Issac 2-S1	EB1102434	Downstream - MP2 - S2	6/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Issac 2-QC1	EB1102434	Downstream QC2	6/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Discharge-S1	EB1102434	Discharge - MP1 - S3	6/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Discharge-QC1	EB1102434	Discharge QC3	6/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trip S1	EB1102434	Trip QC4	6/02/2011	<20	-	-	-	-	<1	<2	<2	2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trip QC1	EB1102434	Rinsate QC5	6/02/2011	<20	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Issac 1-S1	EB1102435	Upstream MP3 - S1	7/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Issac 1-QC1	EB1102435	Upstream QC1	7/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Issac 2-S1	EB1102435	Downstream - MP2 - S2	7/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Issac 2-QC1	EB1102435	Downstream QC2	7/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Discharge-S1	EB1102435	Discharge - MP1 - S3	7/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Discharge-QC1	EB1102435	Discharge QC3	7/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trip S1	EB1102435	Trip QC4	7/02/2011	<20	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trip QC1	EB1102435	Rinsate QC5	7/02/2011	<20	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S1	EB1102436	Upstream MP3 - S1	8/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
S2	EB1102436	Downstream - MP2 - S2	8/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
S3	EB1102436	Discharge - MP1 - S3	8/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
QC1	EB1102436	Upstream QC1	8/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

QC2	EB1102436	Downstream QC2	8/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
QC3	EB1102436	Discharge QC3	8/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
QC5	EB1102436	Trip QC4	8/02/2011	<20	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
QC6	EB1102436	Rinsate QC5	8/02/2011	<20	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Upstream MP3 - S1	EB1102552	Upstream MP3 - S1	9/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Downstream - MP2 - S2	EB1102552	Downstream - MP2 - S2	9/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
QC2	EB1102552	QC2	9/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
QC3	EB1102552	Trip QC3	9/02/2011	<20	-	-	-	-	<1	<2	<2	<2	<2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Upstream MP3 - S10	EB1102552	Upstream MP3 - S1	09/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream - MP2 - S2	EB1102552	Downstream - MP2 - S2	09/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC2	EB1102552	QC2	09/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC3	EB1102552	QC3	09/02/2011	<20					<1	<2	<2	<2	<2																			
Upstream MP3 - S1	EB1102554	Up Stream (MP3)	10/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream - MP2 - S2	EB1102554	Downstream (MP2)	10/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC2	EB1102554	Downstream (MP2)QC	10/02/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC3	EB1102554		10/02/2011	<20					<1	<2	<2	<2	<2																			
March 2011 Discharge																															
Upstream MP3 - S1	EB105951	Upstream MP3 - S1	25/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream - MP2 - S2	EB105951	Downstream - MP2 - S2	25/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Discharge - MP1 - S3	EB105951	Discharge - MP1 - S3	25/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
QC1	EB105951	Discharge QC3	25/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
		Discharge RPD	RPD (in %)																												
QC2	EB105951	Downstream QC2	25/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
		Downstream RPD	RPD (in %)																												
QC3	EB105951	Upstream QC1	25/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
		Upstream RPD	RPD (in %)																												
QC4	EB105951	Trip QC4	25/03/2011			<20			<1	<2	<2	<2	<2																			
QC5	EB105951	Rinsate QC5	25/03/2011			<20			<1	<2	<2	<2	<2																			
Upstream MP3-S1	EB1105942	Upstream MP3-S1	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream-MP2-S2	EB1105942	Downstream-MP2-S2	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Discharge-MP1-S3	EB1105942	Discharge-MP1-S3	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Upstream QC1	EB1105942	Upstream QC1	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream QC2	EB1105942	Downstream QC2	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Discharge QC3	EB1105942	Discharge QC3	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Trip QC4	EB1105942	Trip QC4	26/03/2011	<20					<1	<2	<2	<2	<2																			
Rinsate QC5	EB1105942	Rinsate QC5	26/03/2011	<20					<1	<2	<2	<2	<2																			
March 2011 Discharge Dam Monitoring Program																															
Pond 1	EB1105946	P1-S1	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Pond 2 (Discharge)	EB1105946	P2-S2	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Pond 5	EB1105946	P5-S5	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Pond 10	EB1105946	P10-S10	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Pond 1 Duplicate	EB1105946	P1-QC1	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Pond 2 Duplicate	EB1105946	P2-QC2	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Pond 5 Duplicate	EB1105946	P5-QC5	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Pond 10 Duplicate	EB1105946	P10-QC10	26/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Trip Blank	EB1105946	Trip QC4	26/03/2011	<20					<1	<2	<2	<2	<2																			
Rinsate Sample	EB1105946	Rinsate QC5	26/03/2011	<20					<1	<2	<2	<2	<2																			
March 2011 Discharge Continued																															
Upstream MP3-S1	EB1105944	Upstream MP3-S1	27/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream-MP2-S2	EB1105944	Downstream-MP2-S2	27/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Upstream QC1	EB1105944	Upstream QC1	27/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream QC2	EB1105944	Downstream QC2	27/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Trip QC4	EB1105944		27/03/2011	<20					<1	<2	<2	<2	<2																			
Rinsate QC5	EB1105944		27/03/2011	<20					<1	<2	<2	<2	<2																			
Upstream MP3 - S1	EB1105983	Upstream MP3 - S1	28/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream - MP2 - S2	EB1105983	Downstream - MP2 - S2	28/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Upstream QC1	EB1105983	Upstream QC1	28/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream QC2	EB1105983	Downstream QC2	28/03/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Trip QC4	EB1105983		28/03/2011	<20					<1	<2	<2	<2	<2																			
Rinsate QC5	EB1105983		28/03/2011	<20					<1	<2	<2	<2	<2																			
Upstream MP3- S1	EB1106761	Upstream MP3- S1	05/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream MP2 - S2	EB1106761	Downstream MP2 - S2	05/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Discharge MP1 - S3	EB1106761	Discharge MP1 - S3	05/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Upstream QC1	EB1106761	Upstream QC1	05/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream QC2	EB1106761	Downstream QC2	05/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0

Discharge QC3	EB1106761	Discharge QC3	05/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Trip QC4	EB1106761	Trip QC4	05/04/2011	<20					<1	<2	<2	<2	<2																				
Upstream MP3 - S1	EB1106763	Upstream MP3 - S1	06/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream MP2- S2	EB1106763	Downstream MP2- S2	06/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Upstream QC1	EB1106763	Upstream QC1	06/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream QC2	EB1106763	Downstream QC2	06/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Trip QC4	EB1106763	Trip QC4	06/04/2011	<20					<1	<2	<2	<2	<2																				
Rinsate QC5	EB1106763	Rinsate QC5	06/04/2011	<20					<1	<2	<2	<2	<2																				
Upstream MP3 - S1	EB1106850	Upstream MP3 - S1	07/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream - MP2 - S2	EB1106850	Downstream - MP2 - S2	07/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Upstream QC1	EB1106850	Upstream QC1	07/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Downstream QC2	EB1106850	Downstream QC2	07/04/2011	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0
Trip QC4	EB1106850	Trip QC4	07/04/2011	<20					<1	<2	<2	<2	<2																				
Rinsate QC5	EB1106850	Rinsate QC5	07/04/2011	<20					<1	<2	<2	<2	<2																				

Monitoring Point	Analyte	pH Value	Electrical Conductivity @ 25°C	Turbidity	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4 2-	Chloride	Calcium	Magnesium	Sodium	Potassium	Fluoride	Volatile Acids as Acetic Acid	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N	Reactive Phosphorus as P	Ammonia as N
	Units	pH Unit	µS/cm	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	Date Sampled/LOR	0.00	0	0.0	1	1	1	1	1	1	1	1	1	1	0.1	5	0.01	0.01	0.01	0.01	0.01
Investigation Level															2						0.9
Discharge Point (MP1)	21/12/2010	-	-	-	-	-	-	-	8	53	10	5	45	4	-	14	<0.01	0.08	0.06	-	-
Up Stream (MP3)	21/12/2010	-	-	-	-	-	-	-	8	47	8	5	27	4	-	10	<0.01	0.06	0.06	-	-
Downstream (MP2)	21/12/2010	-	-	-	-	-	-	-	8	21	8	4	23	3	-	7	<0.01	0.06	0.06	-	-
	21/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	21/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Downstream (MP2) QC	21/12/2010	-	-	-	-	-	-	-	11	38	10	5	35	3	-	10	<0.01	0.09	0.09	-	-
Discharge Point (MP1)	23/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Downstream (MP2)	23/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Downstream (MP2) QC	23/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Up Stream (MP3)	24/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Up Stream (MP3) QC	24/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Downstream (MP2)	24/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Downstream (MP2) QC	24/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Discharge Point (MP1)	24/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Discharge Point (MP1) QC	24/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	24/12/2010	-	-	-	-	-	-	-							-					-	-
	25/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Up Stream (MP3)	24/12/2010																				
Up Stream (MP3) QC	24/12/2010																				
Downstream (MP2)	24/12/2010																				
Downstream (MP2) QC	24/12/2010																				
Discharge Point (MP1)	24/12/2010																				
Discharge Point (MP1) QC	24/12/2010																				
Up Stream (MP3)	25/12/2010																				
Up Stream (MP3) QC	25/12/2010																				
Downstream (MP2)	25/12/2010																				
Downstream (MP2) QC	25/12/2010																				
Discharge Point (MP1)	25/12/2010																				
Discharge Point (MP1) QC	25/12/2010																				
Up Stream (MP3)	27/12/2010																				
Up Stream (MP3) QC	27/12/2010																				
Downstream (MP2)	27/12/2010																				
Downstream (MP2) QC	27/12/2010																				
Discharge Point (MP1)	27/12/2010																				
Discharge Point (MP1) QC	27/12/2010																				
	29/12/2010																				
	25/12/2010																				
	24/12/2010																				
	25/12/2010																				
Up Stream (MP3)	29/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Up Stream (MP3)QC	29/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Downstream (MP2)	29/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Downstream (MP2) QC	29/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Discharge Point (MP1)	29/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Discharge Point (MP1) QC	29/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	29/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	29/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Discharge Point (MP1)	31/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Up Stream (MP3)	31/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	31/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	31/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Up Stream (MP3)	02/01/2011	8.63	735	438	<1	11	92	102	15	158	11	6	128	4	IS		IS	IS	IS	IS	<0.01
Downstream (MP2)	02/01/2011	8.06	345	422	<1	<1	69	69	16	51	11	6	44	4	IS		IS	IS	IS	IS	0.08
Discharge Point (MP1)	02/01/2011	9.25	11200	3.3	<1	342	754	1100	<10	3460	8	20	2470	11	IS		IS	IS	IS	IS	0.12
Up Stream (MP3) QC	02/01/2011	8.69	744	417	<1	12	88	101	17	164	11	6	126	4	IS		IS	IS	IS	IS	<0.01
Downstream (MP2)QC	02/01/2011	8.12	345	484	<1	<1	67	67	18	58	12	6	43	4	IS		IS	IS	IS	IS	<0.01
Discharge Point (MP1) QC	02/01/2011	9.26	11200	3.9	<1	346	753	1100	<10	3460	7	19	2510	12	IS		IS	IS	IS	IS	0.14
	02/01/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Up Stream (MP3)	03/01/2011	7.89	370	1890	<1	<1	53	53	9	74	6	3	57	4	0.1		0.03	0.06	0.1	<0.01	<0.01
Downstream (MP2)	03/01/2011	7.5	185	920	<1	<1	43	43	9	30	5	3	31	4	<0.1		0.04	0.06	0.09	<0.01	<0.01
Discharge Point (MP1)	03/01/2011	9.23	10700	4	<1	293	666	960	<1	3320	7	16	2620	9	1.8		<0.01	0.03	0.03	0.03	0.09
Up Stream (MP3) QC	03/01/2011	8.38	368	1190	<1	2	54	56	9	80	6	3	68	4	0.1		0.03	0.08	0.12	<0.01	<0.01
Downstream (MP2)QC	03/01/2011	7.65	1850	940	<1	<1	46	46	9	30	5	3	20	4	<0.1		0.03	0.06	0.08	<0.01	<0.01
Discharge Point (MP1) QC	03/01/2011	9.23	10700	3.6	<1	292	670	963	<1	3330	9	19	2500	10	1.9		<0.01	<0.01	<0.01	0.02	0.06
	03/01/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Up Stream (MP3)	04/01/2011	7.6	370	400	<1	<1	51	51	20	60	11	6	51	4	0.1		<0.01	0.14	0.14	0.02	0.01
Downstream (MP2)	04/01/2011	7.66	382	400	<1	<1	63	63	19	51	10	6	47	4	0.1		<0.01	0.15	0.15	<0.01	0.02
Discharge Point (MP1)	04/01/2011	9.2	11100	5.8	<1	331	578	909	5	3690	13	27	2420	15	1.6		<0.01	<0.01	<0.01	0.03	0.22
Up Stream (MP3) QC	04/01/2011	8.14	367	390	<1	<1	60	60	20	61	10	6	51	4	0.1		<0.01	0.14	0.14	<0.01	0.02
Downstream (MP2)QC	04/01/2011	7.7	336	450	<1	<1	50	50	18	50	10	6	46	4	0.1		<0.01	0.15	0.15	<0.01	0.02
Discharge Point (MP1) QC	04/01/2011	9.2	11100	6.1	<1	329	585	914	5	3690	13	26	2380	15	1.6		<0.01	<0.01	<0.01	0.02	0.22
	04/01/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Up Stream (MP3)	05/01/2011	8.14	387	280	<1	<1	59	59	16	68	10	7	50	4	0.1		<0.01	0.05	0.05	0.01	0.02
Downstream (MP2)	05/01/2011	7.33	341	280	<1	<1	68	68	15	52	11	6	46	4	0.2		<0.01	0.05	0.05	<0.01	0.04
Discharge Point (MP1)	05/01/2011	9.25	11000	11	<1	331	567	898	5	3650	14	27	2520	15	1.6		<0.01	<0.01	<0.01	0.03	0.06
Up Stream (MP3) QC	05/01/2011	8.27	391	260	<1	<1	70	70	14	70	11	6	55	4	0.1		<0.01	0.05	0.05	<0.01	0.02
Downstream (MP2)QC	05/01/2011	7.9	352	280	<1	<1	58	58	17	50	10	6	41	4	0.1		<0.01	0.05	0.05	0.01	0.02
Discharge Point (MP1) QC	05/01/2011	9.25	11000	11	<1	331	558	889	5	3630	12	26	2600	13	1.6		<0.01	<0.01	<0.01	0.02	0.09
Up Stream (MP3)	06/01/2011	7.97	215	270	<1	<1	60	60	4	19	10	6	20	4	0.1		<0.01	0.01	0.01	<0.01	0.01
Downstream (MP2)	06/01/2011	7.89	211	250	<1	<1	65	65	4	24	12	6	21	4	0.1		<0.01	0.01	0.01	<0.01	0.02
Discharge Point (MP1)	06/01/2011	9.07	9190	10	<1	121	313	434	1	2780	19	27	1930	11	1.5		<0.01	<0.01	<0.01	0.04	0.06
Up Stream (MP3) QC	06/01/2011	7.92	218	320	<1	<1	61	61	4	19	11	6	20	4	0.1		<0.01	0.01	0.01	<0.01	0.02
Downstream (MP2)QC	06/01/2011	7.82	211	260	<1	<1	57	57	4	19	11	6	19	4	0.1		<0.01	0.01	0.01	<0.01	0.02
Discharge Point (MP1) QC	06/01/2011	9.16	9250	4.8	<1	178	248	426	2	2940	19	27	1940	11	1.4		<0.01	<0.01	<0.01	0.04	0.06
	06/01/2011																				
Up Stream (MP3)	07/01/2011	8.16	207	330	<1	<1	58	58	3	17	11	6	18	4	0.1		<0.01	0.03	0.03	0.02	0.02
Downstream (MP2)	07/01/2011	7.95	206	280	<1	<1	56	56	3	17	11	6	17	4	<0.1		<0.01	0.03	0.03	0.02	0.01
Discharge Point (MP1)	07/01/2011	9.16	9550	7.8	<1	178	258	434	2	2890	19	27	1950	11	1.4		<0.01	<0.01	<0.01	0.04	0.1
Up Stream (MP3) QC	07/01/2011	8.19	210	370	<1	<1	61	61	3	18	11	6	18	4	0.1		<0.01	0.03	0.03	0.02	0.02
Downstream (MP2)QC	07/01/2011	7.95	206	340	<1	<1	57	57	3	17	11	6	17	4	<0.1		<0.01	0.03	0.03	0.01	0.04
Discharge Point (MP1) QC	07/01/2011	9.17	9560	13	<1	171	261	432	2	2960	19	27	1970	11	1.4		<0.01	<0.01	<0.01	0.04	0.07
	07/01/2011																				
Up Stream (MP3)	31/01/2011	7.9	220	1550	<1	<1	62	62	51	32	7	4	28	4	<0.1		<0.01	0.1	0.1	0.02	<0.01
Downstream (MP2)	31/01/2011	7.82	210	1380	<1	<1	60	60	50	35	7	4	27	4	<0.1		<0.01	0.09	0.09	0.02	<0.01
Discharge Point (MP1)	31/01/2011	9.32	9370	20	<1	282	202	484	3	2930	13	24	2270	12	1.9		<0.01	0.07	0.07	0.04	0.18
Up Stream (MP3) QC	31/01/2011	8.05	200	1080	<1	<1	60	60	48	29	8	4	30	4	<0.1		<0.01	0.08	0.08	0.02	<0.01
Downstream (MP2)QC	31/01/2011	7.89	215	1690	<1	<1	60	60	48	33	8	4	32	4	<0.1		<0.01	0.09	0.09	0.02	<0.01
Discharge Point (MP1) QC	31/01/2011	9.33	9410	16.4	<1	287	190	477	1	3010	12	24	2100	13	1.9		<0.01	<0.01	<0.01	0.04	0.17
	31/01/2011																				
Up Stream (MP3)	01/02/2011	7.99	260	890	<1	<1	60	60	57	40	10	5	49	4	<0.1		<0.01	0.09	0.09	0.02	<0.01
Downstream (MP2)	01/02/2011	7.98	440	810	<1	<1	70	70	43	91	11	6	79	5	0.1		<0.01	0.09	0.09	0.02	<0.01
Discharge Point (MP1)	01/02/2011	9.41	11800	3.4	<1	524	480	1000	<1	3960	2	20	3150	16	[redacted]		<0.01	<0.01	<0.01	0.04	0.13
Up Stream (MP3) QC	01/02/2011	8.1	250	830	<1	<1	61	61	46	40	10	5	50	5	<0.1		<0.01	0.09	0.09	0.02	<0.01

Downstream (MP2)QC	01/02/2011	8.06	400	790	<1	<1	75	75	46	88	10	5	79	5	0.1		<0.01	0.09	0.09	0.02	<0.01
Discharge Point (MP1) QC	01/02/2011	9.41	11700	3.6	<1	524	461	985	<1	4640	2	20	3610	19	[illegible]		<0.01	<0.01	<0.01	0.04	0.13
	01/02/2011																				
Up Stream (MP3)	02/02/2011	8.19	470	550	<1	<1	72	72	66	87	9	6	57	3	<0.1		0.03	0.11	0.14	<0.01	<0.01
Downstream (MP2)	02/02/2011	8.04	480	540	<1	<1	73	73	68	104	9	6	73	3	0.1		0.02	0.12	0.14	<0.01	<0.01
Up Stream (MP3) QC	02/02/2011	7.98	440	550	<1	<1	70	70	64	90	8	5	62	3	<0.1		0.02	0.13	0.15	<0.01	<0.01
Downstream (MP2)QC	02/02/2011	7.99	455	580	<1	<1	71	71	66	93	8	5	68	3	<0.1		0.02	0.16	0.18	<0.01	<0.01
	02/02/2011																				
Up Stream (MP3)	03/02/2011	7.68	456	630	<1	<1	69	69	66	24	8	6	63	3	<0.1		0.02	0.22	0.23	<0.01	<0.01
Downstream (MP2)	03/02/2011	7.68	456	620	<1	<1	68	68	60	45	10	6	67	3	<0.1		0.03	0.2	0.24	<0.01	0.02
Up Stream (MP3) QC	03/02/2011	7.67	456	860	<1	<1	69	69	67	29	9	6	64	4	<0.1		0.02	0.23	0.25	<0.01	0.03
Downstream (MP2)QC	03/02/2011	7.67	455	770	<1	<1	68	68	63	46	11	7	68	4	<0.1		0.02	0.23	0.25	<0.01	0.05
	03/02/2011																				
Upstream MP3 - S1	5/02/2011	8.41	1000	380	<1	3	85	89	21	256	13	8	182	4	0.2		<0.01	0.15	0.15	<0.01	<0.01
Upstream QC1	5/02/2011	8.16	983	400	<1	<1	88	88	21	250	12	7	178	4	0.3		<0.01	0.15	0.15	<0.01	<0.01
Downstream - MP2 - S2	5/02/2011	7.82	394	380	<1	<1	56	56	22	66	12	7	51	3	0.1		<0.01	0.15	0.15	<0.01	<0.01
Downstream QC2	5/02/2011	7.8	394	450	<1	<1	56	56	22	66	12	7	50	3	0.1		<0.01	0.15	0.15	<0.01	<0.01
Discharge - MP1 - S3	5/02/2011	9.03	2940	290	<1	50	155	205	18	866	12	10	607	6	0.6		<0.01	0.12	0.12	0.02	0.04
Discharge QC3	5/02/2011	9.01	2920	340	<1	48	158	203	18	860	12	10	598	5	0.6		<0.01	0.12	0.12	<0.01	0.02
Trip QC4	5/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Rinsate QC5	5/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Upstream MP3 - S1	6/02/2011	8.08	714	400	<1	<1	75	75	19	164	11	6	122	4	0.2		<0.01	0.14	0.14	0.01	0.02
Upstream QC1	6/02/2011	8.08	715	400	<1	<1	75	75	19	165	11	6	125	4	0.2		<0.01	0.14	0.14	0.01	0.02
Downstream - MP2 - S2	6/02/2011	7.78	342	450	<1	<1	52	52	19	50	11	6	44	4	0.1		<0.01	0.14	0.14	<0.01	0.02
Downstream QC2	6/02/2011	7.77	342	450	<1	<1	52	52	19	51	10	6	45	4	0.1		<0.01	0.14	0.14	0.01	0.02
Discharge - MP1 - S3	6/02/2011	8.8	1670	400	<1	21	115	136	18	469	10	8	332	5	0.4		<0.01	0.12	0.12	<0.01	0.02
Discharge QC3	6/02/2011	8.82	1730	450	<1	24	117	140	18	482	10	8	343	5	0.4		<0.01	0.12	0.12	<0.01	0.02
Trip QC4	6/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Rinsate QC5	6/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Upstream MP3 - S1	7/02/2011	8.47	851	360	<1	5	83	88	4	214	8	5	156	3	0.2		<0.01	0.04	0.04	<0.01	0.02
Upstream QC1	7/02/2011	8.44	849	450	<1	3	83	87	4	214	8	5	153	3	0.2		<0.01	0.04	0.04	<0.01	0.02
Downstream - MP2 - S2	7/02/2011	7.78	185	450	<1	<1	48	48	4	27	9	4	20	3	0.1		<0.01	0.03	0.03	<0.01	0.02
Downstream QC2	7/02/2011	7.75	185	400	<1	<1	48	48	4	26	8	4	20	3	0.1		<0.01	0.03	0.03	<0.01	0.04
Discharge - MP1 - S3	7/02/2011	9.1	2950	390	<1	62	166	228	4	864	9	8	589	5	0.6		<0.01	0.03	0.03	<0.01	0.03
Discharge QC3	7/02/2011	9.14	3220	320	<1	73	174	247	4	941	9	9	644	5	0.7		<0.01	0.04	0.04	<0.01	<0.01
Trip QC4	7/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Rinsate QC5	7/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Upstream MP3 - S1	8/02/2011	7.86	212	350	<1	<1	54	54	6	21	10	5	22	3	0.1		<0.01	0.03	0.03	<0.01	<0.01
Downstream - MP2 - S2	8/02/2011	8.51	727	280	<1	6	80	85	5	173	10	6	128	4	0.2		<0.01	0.04	0.04	<0.01	<0.01
Discharge - MP1 - S3	8/02/2011	9.27	4260	220	<1	139	185	324	5	1100	10	11	908	6	0.8		<0.01	0.02	0.02	<0.01	<0.01
Upstream QC1	8/02/2011	7.73	228	280	<1	<1	53	53	5	29	11	5	24	3	0.1		<0.01	0.03	0.03	<0.01	<0.01
Downstream QC2	8/02/2011	8.45	736	320	<1	4	80	85	5	173	10	6	134	4	0.2		<0.01	0.03	0.03	<0.01	<0.01
Discharge QC3	8/02/2011	9.29	4850	200	<1	163	201	364	5	1230	10	12	1010	6	0.9		<0.01	0.02	0.02	<0.01	<0.01
Trip QC4	8/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Rinsate QC5	8/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Upstream MP3 - S1	9/02/2011	7.82	197	300	<1	<1	53	53	4	25	12	6	21	3	0.1		<0.01	0.05	0.05	0.01	<0.01
Downstream - MP2 - S2	9/02/2011	7.86	201	240	<1	<1	56	56	4	26	11	5	20	3	0.1		<0.01	0.04	0.04	<0.01	<0.01
QC2	9/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Trip QC3	9/02/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Upstream MP3 - S1	09/02/2011	7.82	197	300	<1	<1	53	53	4	25	12	6	21	3	0.1		<0.01	0.05	0.05	0.01	<0.01
Downstream - MP2 - S2	09/02/2011	7.86	201	240	<1	<1	56	56	4	26	11	5	20	3	0.1		<0.01	0.04	0.04	<0.01	<0.01
QC2	09/02/2011																				
QC3	09/02/2011																				
Up Stream (MP3)	10/02/2011	7.91	212	290	<1	<1	57	57	4	28	13	6	22	3	0.1		<0.01	0.03	0.03	<0.01	<0.01
Downstream (MP2)	10/02/2011	7.92	216	290	<1	<1	59	59	5	28	13	6	24	3	0.1		<0.01	0.04	0.04	<0.01	0.01
Downstream (MP2)QC	10/02/2011																				
	10/02/2011																				

Upstream MP3 - S1	25/03/2011	7.9	324	3300	<1	<1	70	70	16	45	10	6	48	3	0.1		<0.01	0.12	0.12	<0.01	<0.01
Downstream - MP2 - S2	25/03/2011	8.07	663	3000	<1	<1	84	84	16	149	10	6	116	3	0.2		<0.01	0.11	0.11	<0.01	<0.01
Discharge - MP1 - S3	25/03/2011	9.37	11500	17	<1	468	403	871	2	3810	9	27	2560	16	2.5		<0.01	<0.01	<0.01	0.05	<0.01
Discharge QC3	25/03/2011																				
Discharge RPD	RPD (in %)																				
Downstream QC2	25/03/2011																				
Downstream RPD	RPD (in %)																				
Upstream QC1	25/03/2011																				
Upstream RPD	RPD (in %)																				
Trip QC4	25/03/2011																				
Rinsate QC5	25/03/2011																				
Upstream MP3-S1	26/03/2011	7.72	324	500	<1	<1	74	74	14	42	12	7	37	4	0.1		<0.01	0.12	0.12	0.01	0.02
Downstrream-MP2-S2	26/03/2011	8.14	666	500	<1	<1	92	92	13	145	13	7	114	4	0.2		<0.01	0.12	0.12	<0.01	0.05
Discharge-MP1-S3	26/03/2011																				
Upstream QC1	26/03/2011																				
Downstream QC2	26/03/2011																				
Discharge QC3	26/03/2011																				
Trip QC4	26/03/2011																				
Rinsate QC5	26/03/2011																				
P1-S1	26/03/2011	9.18	11400	21	<1	445	725	1170	9	3590	12	28	2670	17	2.1		<0.01	0.01	0.01	0.03	0.03
P2-S2	26/03/2011	9.2	9570	37	<1	240	240	480	2	3270	18	27	2070	13	1.8		<0.01	0.02	0.02	0.02	0.08
P5-S5	26/03/2011	9.36	12500	13	<1	515	567	1080	2	3700	9	28	2600	20	2.2		<0.01	0.02	0.02	0.05	0.02
P10-S10	26/03/2011	9.38	12800	13	<1	551	571	1120	2	3980	9	29	2780	22	2.4		<0.01	0.02	0.02	0.05	0.03
P1-QC1	26/03/2011																				
P2-QC2	26/03/2011																				
P5-QC5	26/03/2011																				
P10-QC10	26/03/2011																				
Trip QC4	26/03/2011																				
Rinsate QC5	26/03/2011																				
Upstream MP3-S1	27/03/2011	7.5	552	600	<1	<1	82	82	25	99	16	9	79	4	0.5		<0.01	0.24	0.24	<0.01	0.05
Downstream-MP2-S2	27/03/2011	7.5	553	600	<1	<1	82	82	27	104	16	9	83	4	0.5		<0.01	0.21	0.21	<0.01	0.08
Upstream QC1	27/03/2011																				
Downstream QC2	27/03/2011																				
	27/03/2011																				
	27/03/2011																				
Upstream MP3 - S1	28/03/2011	7.56	326	200	<1	<1	81	81	10	40	13	8	39	4	0.2		<0.01	0.12	0.12	<0.01	0.14
Downstream - MP2 - S2	28/03/2011	7.67	333	220	<1	<1	82	82	11	43	13	8	40	4	0.2		<0.01	0.14	0.14	0.02	<0.01
Upstream QC1	28/03/2011																				
Downstream QC2	28/03/2011																				
	28/03/2011																				
	28/03/2011																				
Upstream MP3- S1	05/04/2011	7.97	408	290	<1	<1	71	71	20	63	13	7	53	4	0.1		<0.01	0.19	0.19	0.02	0.01

Downstream MP2 - S2	05/04/2011	8.53	1050	270	<1	11	107	118	19	242	13	8	183	5	0.3		<0.01	0.2	0.2	<0.01	0.03
Discharge MP1 - S3	05/04/2011	9.3	11800	16	<1	476	625	1100	4	3290	10	28	2530	18	[redacted]		<0.01	<0.01	<0.01	0.04	0.02
Upstream QC1	05/04/2011																				
Downstream QC2	05/04/2011																				
Discharge QC3	05/04/2011																				
Trip QC4	05/04/2011																				
Upstream MP3 - S1	06/04/2011	8.03	290	260	<1	<1	70	70	7	35	12	6	34	4	0.1		<0.01	0.09	0.09	<0.01	0.01
Downstream MP2- S2	06/04/2011	7.96	288	240	<1	<1	69	69	7	36	12	6	32	7	0.1		<0.01	0.08	0.08	<0.01	0.01
Upstream QC1	06/04/2011																				
Downstream QC2	06/04/2011																				
Trip QC4	06/04/2011																				
Rinsate QC5	06/04/2011																				
Upstream MP3 - S1	07/04/2011	7.61	268	250	<1	<1	67	67	6	31	12	6	29	4	0.1		<0.01	0.08	0.08	<0.01	0.03
Downstream - MP2 - S2	07/04/2011	7.78	268	240	<1	<1	68	68	6	31	12	6	29	4	0.1		<0.01	0.07	0.07	<0.01	0.02
Upstream QC1	07/04/2011																				
Downstream QC2	07/04/2011																				
Trip QC4	07/04/2011																				
Rinsate QC5	07/04/2011																				

Ben McMahon

From: Ben McMahon
Sent: Tuesday, 26 October 2010 8:06 AM
To: [redacted]
Cc: [redacted] Tim Dean
Subject: ENV10-245 Threatened or potential environmental harm MGP
Attachments: ENV10-245 Threatened or potential environmental harm MGP.pdf

Categories: Red Category

[redacted]

Please find attached an incident notification in relation to current dam levels within PL191/196 - Moranbah Gas Project (MGP).

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Limited
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
E:
W: www.arrowenergy.com.au

26 October 2010

Ref: ENV10-245

[redacted]

Manager, Petroleum and Gas Unit

Department of Environment & Resource Management

(sent via email 26 October 2010)

RE: Incident Notification - Threatened or Potential Environmental Harm

Dear [redacted]

On the behalf of Arrow Energy Limited (Arrow) I am providing notification of threatened or potential environmental harm on PL191/196 (under PEN100015907) - Moranbah Gas Project (MGP).

Date:
26 October 2010

Location:
Moranbah Gas Project PL191/196

Description:
The Design Storage Allowance (DSA) in Dam 1 has been exceeded. Production of gas and water from wells at the MGP has been curtailed to the point where net evaporation currently exceeds net coal seam water input. Arrow lacks sufficient storage in other dams to transfer sufficient water from Dam 1 to comply with the DSA prior to commissioning of Dam 11. Currently the forecast completion of Dam 11 is estimated to be early December.

Potential Impact:
Arrow will enter the early part of the wet season exceeding the DSA for Dam 1. At present other dams are below DSA levels.

Immediate Actions:
Production of gas and water from wells at the MGP has been curtailed to the point where net evaporation currently exceeds net coal seam water input. Arrow is currently considering a number of options to regain storage capacity. Any plans would be subject to detailed evaluation of safety implications and would comply with the requirements of the relevant Environmental Authority.

Regards,

[redacted]

Manager Compliance & Reporting

T +61 7 3012 4000 ARROW ENERGY LTD LEVEL 19, AM-60, 42-60 ALBERT STREET GPO BOX 5262 BRISBANE QLD 4001 info@arrowenergy.com.au
F +61 7 3012 4001 ABN 73 078 521 936 BRISBANE QLD 4000 ASX CODE AOE arrowenergy.com.au

Ben McMahon

From: Ben McMahon
Sent: Saturday, 20 November 2010 5:48 PM
To: [redacted]
Subject: Incident notification MGP
Attachments: ENV10-263 Threatened or potential environmental harm MGP.pdf

Categories: Red Category

Hi [redacted]

Please find attached an incident notification in relation to dam storage levels at the MGP. Recent rainfall has caused a number of our dams to exceed the DSA levels.

Best regards

Ben McMahon
Manager Compliance and Reporting

20 November 2010

arrowenergy
go further

Ref: ENV10-263

[redacted]

Manager, Petroleum and Gas Unit

Department of Environment & Resource Management

(sent via email 20 November 2010)

RE: Incident Notification - Threatened or Potential Environmental Harm

Dear [redacted]

I am writing on the behalf of Arrow Energy Limited to provide notification of threatened or potential environmental harm on Moranbah PL191/196 (under EA PEN100015907 grated 14th September 2010).

Date:
20 November 2010

Location:
Moranbah Gas Project PL191/196

Description:
Following recent rainfall over the last week, Arrow currently exceeds the Design Storage Allowance (DSA) in Ponds 1, 2, 10, 4, 5 and 6.

Until Dam 11 is commissioned Arrow has no available storage to lower Ponds into compliance with the DSA. Current forecast completion of Dam 11.

Potential Impact:
Arrow will enter the early part of the wet season with inadequate storage capacity in the event of prolonged or heavy rainfall in contradiction to condition C3(n) of EA PEN100015907.

Immediate Actions:
Arrow continues to investigate options for managing storage capacity in line with the conditions of EA PEN100015907.

Regards,

[redacted]

Manager Compliance & Reporting

T +61 7 3012 4000 ARROW ENERGY LTD LEVEL 19, AM-60, 42-60 ALBERT STREET GPO BOX 5262 BRISBANE QLD 4001 info@arrowenergy.com.au
F +61 7 3012 4001 ABN 73 078 521 936 BRISBANE QLD 4000 ASX CODE AOE arrowenergy.com.au

Ben McMahon

From: Ben McMahon
Sent: Friday, 3 December 2010 4:35 PM
To: [redacted]
Cc:
Subject: ENV10-278 MGP Program Notice letter
Attachments: Program notice of relevant event MGP 3 December 2010.pdf; ENV10-278 MGP Program Notice letter.pdf

Categories: Red Category

[redacted]

Please find attached a letter that details the current situation in PL191/196 and a program notice under section 350 of the EP Act in relation to the dam storage levels and the construction of dam 11. Heavy rainfall is forecast for the Moranbah region over this weekend.

Please do not hesitate to contact me with any queries.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Limited
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
E:
W: www.arrowenergy.com.au

Tracking:

DRAFT TRANSITIONAL ENVIRONMENTAL PROGRAM UNDER SECTION 333 OF THE *ENVIRONMENTAL PROTECTION ACT 1994*

Principal Holder: XXXXXXXX
XXXXXXXX
XXXXXXXX

EA Number: XXXXXXXX

Title: XXXXXXXXXXXXXXX

Date: XXXXXXXX

Finish Date: *NOTE: The 'End Date' should be approximately 2 months after the lodgement date of the completion report.*

BACKGROUND

Explains why a TEP is required, as a result of an incident, breach, emergency. I.e. what went wrong

NOTE: Include relevant reporting requirements, monitoring locations and discharge limits from EA conditions, rainfall data, pits and water management structures affected, quantity of water proposed to be discharged, pumping/discharge rates and locations, creeks/rivers to be discharged to, whether creeks/rivers are still flowing naturally, water quality monitoring locations and downstream limits in creeks/rivers during discharge, results of previous sampling, ongoing reporting requirements to the administering authority, downstream water uses and affected properties. Also include contingency plans for possibility of having to cease discharge due to poor water quality or significant flow path erosion etc. Include whether there are other permits involved and status of the applications.

SUPPORTING INFORMATION

The *Environmental Protection Regulation 2008* commenced on 1 January 2009. The regulation consolidated considerations that must be made when making a range of decisions including TEPs into Chapter 4 of the regulation. This has resulted in making the range of matters to be considered clearer to decision makers. These include, but are not limited to:

s51(1) (a) requires the consideration of the management hierarchy, environmental values, quality objectives and management intent specified in an EPP. The *Environmental Protection (Water) Policy 2009* lists a range of values that includes the biological integrity, the agricultural value, the drinking water value, the recreation value and the value for industrial purposes. If these values are correctly identified, the 'beneficial uses' of the waterway will be identified.

s51(1) (d) requires consideration of the impact of the release of contaminants on the environment including the cumulative impact

s51(1) (f) the order of occupancy between the person carrying out the activity and the affected person

s51(1) (g) the remaining capacity of the receiving environment to accept contaminants while protecting the environmental values.

s52(1) (a) requires consideration of imposing a condition requiring the implementation of a system for managing risks to the environment

S52(1) (g) requires consideration of imposing a condition on the way in which contaminants are released for example a condition restricting the release of a contaminant at a particular temperature, velocity or rate or during particular meteorological conditions or water flows.

s53(1) requires consideration of whether to impose monitoring conditions about the release

s56 (2) requires consideration of any available toxicity data relevant to the release and the receiving environment.

Note: Section 330 of the EP Act defines a TEP as:

A transitional environmental program is a specific program that, when approved, achieves compliance with this Act for the matters dealt with by the program by:
(a) reducing environmental harm; or
(b) detailing the transition to an environmental standard.

OBJECTIVES
NOTE: As required under section 331 the transitional environmental program must state the objectives to be achieved and maintained under the program.

The objectives of the TEP must relate to the time frames for mines returning to operation in accordance with / compliance with the EA conditions, and must also include the prevention or re-occurrence in the short, medium and long term of the situation that gave rise to the approval of an TEP

HOW OBJECTIVES ARE TO BE ACHIEVED
NOTE: As required under section 331 the TEP must state how the objectives are to be achieved, and provide a timetable to achieve the objectives, taking into account the application of best practice environmental management and the risks of environmental harm being caused by the activity. The timetable must state appropriate performance indicators that can be measured at various intervals.

As an approved TEP can protect the holder from enforcement action for non-compliances with the Act, the commitments or terms of the TEP made by the client need to be clearly drafted, unambiguous and easily auditable. Please note that a failure to comply with the terms of a TEP is an offence so the terms outlined within the document act in a similar way to conditions contained within an EA.

Table 1 – achieving TEP objectives

OBJECTIVE	ACTION	RESPONSIBILITY	TIME FRAME	PERFORMANCE INDICATOR
XXXXX		Nominate officer/person responsible for fulfilling objective.		
XXXXX				
XXXXX				
XXXXX				

If the table above is not sufficient in size please use in the landscape format.
If the table is insufficient due to the quantity of detail required utilise subheadings e.g. objective, action, responsibility, timeframe and performance indicator with detailed information included below each heading. This information can then be modified in the reporting for successes, issues, incidents and failures.

MONITORING
NOTE: As required under section 331 –
Also include specific upstream and downstream monitoring locations and detailed supporting aerial photographs and maps defining discharge points and monitoring locations.

The following tables are provided as an example on providing the required data and how to apply varying limits to different monitoring points. If you are proposing to meet a specific water quality downstream (i.e. as a compliance point, approximately 500m is acceptable – receiving water monitoring locations should not be utilised), compliance will need to be monitored at both the 'end of pipe' location and the 'compliance point'. Justification of the discharge actions proposed need to be provided in the documentation, considering Chapter 4 of the Environmental Protection Regulation 2008.

Table 2 - Contaminant release points, sources and receiving waters

Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point	Receiving waters
TEP RP 1	xxxx	xxxx	xxxx	TEP MP 1	xxxx
TEP RP 2	xxxx	xxxx	xxxx	TEP MP 2	xxxx
				TEP MP 3	

Table 3 - Contaminant release monitoring points

Monitoring point (TEP MP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point location	Receiving waters
TEP MP 1	xxxx	xxxx	xxxx	xxx dam spillway	xxxx
TEP MP 2	xxxx	xxxx	xxxx	xxx dam spillway	xxxx
TEP MP 3	xxxx	xxxx	xxxx	500m downstream of junction of xxx dam spillway on the xxx receiving waters	xxxx

Table 4 - Contaminant release limits

Quality characteristic	Release Limit	Monitoring Frequency	Sample Type	Monitoring Point
Electrical conductivity (uS/cm)	xxxx (e.g. 1500)	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1
				TEP MP 3
			Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 3
	xxxx (e.g. 3000)	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 2
			Samples require laboratory analysis[2]	TEP MP 2
pH (pH Unit)	6.5 (minimum) 9.0 (maximum)	Daily during release (the first sample must be taken within 2	*In situ*[1]	TEP MP 1
				TEP MP 2

		hours of commencement of release)		TEP MP 3
			Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 2
				TEP MP 3
Turbidity (NTU)	xxxxx	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1
				TEP MP 2
				TEP MP 3
			Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 2
				TEP MP 3
Sulphate (SO_4^{2-}) (mg/L)	xxxxx	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1
				TEP MP 2
				TEP MP 3
			Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 2
				TEP MP 3

[1] In situ samples can be taken using electronic sampling equipment.
[2] Samples are required to be analysed at a NATA accredited facility in accordance with this Transitional Environmental Program.

Table 5 - Release contaminant trigger investigation levels

Quality characteristic	Trigger levels (µg/L)	Monitoring frequency	Monitoring Point
Aluminium	55	Commencement of release and thereafter weekly during release	TEP MP 1 TEP MP 2
Arsenic	13		
Cadmium	0.2		
Chromium	1.0		
Copper	2.0		

Iron	300		
Lead	10		
Mercury	0.2		
Nickel	11		
Zinc	8.0		
Boron	370		
Cobalt	90		
Manganese	1900		
Molybdenum	34		
Selenium	10		
Silver	1.0		
Uranium	1.0		
Vanadium	10		
Ammonia	900		
Nitrate	1100		
Petroleum hydrocarbons (C6-C9)	20		
Petroleum hydrocarbons (C10-C36)	100		
Fluoride (total)	2000		

Table 6 - Contaminant release during flow events

Receiving waters	Release point (TEP RP)	Gauging station description	Easting (GDA94)	Northing (GDA94)	Minimum flow in receiving water required for a release event	Flow recording frequency
XXXX Creek	TEP RP1	WX	XXXXX	XXXXX	= > XXm^3/sec	Continuous (minimum daily)
XXXX Creek	TEP RP2	WX	XXXXX	XXXXX	= > XXm^3/sec	Continuous (minimum daily)

Table 7 - Receiving water downstream monitoring points

Monitoring points (TEP MP)	Receiving waters location description	Easting (GDA94)	Northing (GDA94)
TEP MP X	CX – XXXX Creek XXX metres downstream of RP X	XXXX	XXXX
TEP MP X	CX - XXXX Gully XXXX metres downstream of RP X	XXXX	XXXX

REPORTING

NOTE: The department will require daily reporting of insitu water quality parameters.

Progress reports will be required to be submitted to the department (i.e. monthly) describing activities and issues from previous month and proposed activities for next month and a final report defining how the objectives of the TEP have been achieved.

A final report is required to be submitted to the report upon completion of all actions, and at least 2 months prior to the end date of the TEP.

CONDITIONS

In carrying out this Transitional Environmental Program, 'Client Name (i.e. principal EA holder)' will undertake all activities in accordance with the following conditions.

Undertaking the release of mine effected water

1 Contaminants that will, or have the potential to cause environmental harm must not be released directly or indirectly to any waters except as permitted under this Transitional Environmental Approval.

2 The release of contaminants to waters must only occur from the release points specified in Table 2 and depicted in Figure 1 attached to this Transitional Environmental Program.

3 The release of contaminants to waters must not exceed the release limits stated in Table 4 at the monitoring points specified in Table 2 and Table 3 of this Transitional Environmental Program.

4 The release of contaminants to waters from the release points must be monitored at the locations specified in Table 2 and Table 3 for each quality characteristic and at the frequency specified in Table 4 and Table 5 of this Transitional Environmental Program.

5 If quality characteristics of the release exceed any of the trigger levels specified in Table 5 during a release event, the Transitional Environmental Program holder must compare the downstream results in the receiving waters identified in Table 7 to the trigger values specified in Table 5 and:

   a) where the trigger values are not exceeded then no action is to be taken

   b) where the downstream results exceed the trigger values specified Table 5 for any quality characteristic, compare the results of the downstream site to the data from background monitoring sites and

      i) if the result is less than the background monitoring site data, then no action is to be taken or

      ii) if the result is greater than the background monitoring site data, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology, into the potential for environmental harm and provide a written report to the administering authority in the next annual return, outlining

1) details of the investigations carried out

2) actions taken to prevent environmental harm.

6 If an exceedance in accordance with condition 5(a)(ii)(2) is identified, the holder of the Transitional Environmental Program must notify the administering authority within 24 hours of receiving the result. The notification must include written verification of the exceedance forwarded to the administering authority either via facsimile (INSERT LOCAL OFFICE NUMBER) or email to Manager.MiningCWR@derm.qld.gov.au.

Contaminant Release Events

7 The Transitional Environmental Program holder must install, operate and maintain a stream flow gauging station to determine and record stream flows at the locations upstream of each release point specified in Table 2 for any receiving waters into which a release occurs.

8 Notwithstanding any other condition of this Transitional Environmental Program, the release of contaminants to waters must only take place during periods of natural flow events specified as minimum flow in Table 6 for the contaminant release point(s) specified in Table 2.

9 Contaminant release flow rate must not exceed XXX% of receiving water flow rate.

10 The daily quantity of contaminants released from each release point must be measured and recorded at the monitoring points in Table 2.

11 Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build up of sediment in such waters.

Notification of Release Events

12 The Transitional Environmental Program holder must notify the administering authority within XXX hours of having commenced releasing mine affected water to the receiving environment. Notification must include the submission of written verification to the administering authority (either via facsimile (INSERT LOCAL OFFICE NUMBER) or email to Manager.MiningCWR@derm.qld.gov.au) of the following information:

a) release commencement date/time

b) expected release cessation date/time

c) release point/s

d) release volume (estimated)

e) receiving water/s including the natural flow rate

f) any details (including available data) regarding likely impacts on the receiving water(s).

13 The Transitional Environmental Program holder must provide the administering authority daily during the release of mine affected water, in writing (either via facsimile (INSERT LOCAL OFFICE NUMBER) or email to Manager.MiningCWR@derm.qld.gov.au) of the following information:

a) all in situ monitoring data for that day

b) the receiving water flow rate

c) the release flow rate.

14 The Transitional Environmental Program holder must notify the administering authority as soon as practicable, (no later than within 24 hours after cessation of a release) of the cessation of a release notified under condition 12 and within 28 days provide the following information in writing:

a) release cessation date/time

b) natural flow volume in receiving water

c) volume of water released

d) details regarding the compliance of the release with the conditions of this Transitional Environmental Program (i.e. contamination limits, natural flow, discharge volume)

e) all in-situ water quality monitoring results

f) any other matters pertinent to the water release event.

Notification of release event exceedence

15 If the release limits defined in Table 3 are exceeded, the holder of the Transitional Environmental Program must notify the administering authority within 24 hours of receiving the results.

16 The Transitional Environmental Program holder must, within 28 days of a release that exceeds the conditions of this Transitional Environmental Program, provide a report to the administering authority detailing:

a) the reason for the release

b) the location of the release

c) all water quality monitoring results

d) any general observations

e) all calculations

f) any other matters pertinent to the water release event.

Requirements to cease the release of mine affected water

1. The mine water discharge must cease immediately if any water quality limit as specified in Table 2 is exceeded.

2. The Department of Environment and Resource Management may require the mine to cease discharge if the department's water monitoring stations detect any water quality limit exceedance.

3. The release of mine effected waters must cease immediately if identified that the release of mine affected waters is causing erosion of the bed and banks of the receiving waters, or is causing a material build up of sediment in such waters.

4. The release of mine effected waters must cease immediately if holder of this Transitional Environmental Program is directed to do so by the administering authority.

Monitoring Requirements

Where monitoring is a requirement of this Transitional Environmental Program, ensure that a competent person(s) conducts all monitoring.

All monitoring undertaken as a requirement of this Transitional Environmental Program must be undertaken in accordance with the administering authority's Water Sampling Manual.

Notification of emergencies, incidents and exceptions

As soon as practicable after becoming aware of any 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 Transitional Environmental Program, the administering authority must be notified of the release by telephone, facsimile or email.

The notification of emergencies or incidents must include but not be limited to the following:

a) the holder of the Transitional Environmental Program
b) the location of the emergency or incident
c) the number of the Transitional Environmental Program
d) the name and telephone number of the designated contact person
e) the time of the release
f) the time the holder of the Transitional Environmental Program became aware of the release
g) the suspected cause of the release
h) the environmental harm caused, threatened, or suspected to be caused by the release, and
i) actions taken to prevent any further release and mitigate any environmental harm caused by the release.

Not more than fourteen days following the initial notification of an emergency or incident, written advice must be provided of the information supplied to the administering authority in relation to:

a) proposed actions to prevent a recurrence of the emergency or incident, and

b) outcomes of actions taken at the time to prevent or minimise environmental harm.

Any other conditions that require a response, contingency for matters under this TEP, i.e. if constructing a new regulated structure, design plans will be required to be submitted to the administering authority for approval prior to construction.

NOTES FOR THE CLIENT

These regulatory requirements of Chapter 4 of the *Environmental Protection Regulation 2008*, the Standard Criteria and the requirements of EP Act.

In deciding to accept or refuse a TEP the administering authority is required to consider section 338 of the EP Act, which states:

338 Criteria for deciding draft program

(1) In deciding whether to approve or refuse to approve the draft program or the conditions (if any) of the approval, the administering authority—

(a) must comply with any relevant regulatory requirement; and

(b) subject to paragraph (a), must also consider the following—

(i) the standard criteria;

- *The principles of ecological sustainable development as set out in the 'National Strategy for Ecologically Sustainable Development'.*
- *Any applicable environmental protection policy.*
- *Any applicable Commonwealth, State or local government plans, standards, agreements or requirements.*
- *Any applicable environmental impact study, assessment or report.*
- *The character, resilience and values of the receiving environment.*
- *All submissions made by the applicant and submitters.*
- *The best practice environmental management for activities under any relevant instrument, or proposed instrument, as follows – a transitional environmental program.*
- *The financial implications of the requirements under an instrument, or proposed instrument, mentioned in paragraph (g) (above) as they would relate to the type of activity or industry carried out, or proposed to be carried out, under the instrument.*
- *The public interest.*
- *Any applicable site management plan.*
- *Any relevant integrated environmental management system or proposed integrated environmental management system.*
- *Any other matter prescribed under a regulation.*

(ii) additional information given in relation to the draft program;

(iii) the views expressed at a conference held in relation to the draft program.

As has been demonstrated a significant consideration for the draft TEP is for the standard criteria. Recommendations in relation to a submission of a draft TEP in line with section 338 and the standard criteria are:

- Provide all relevant stakeholders, which may included Local Government and potentially affected landholders, with a copy of the draft TEP, and allow sufficient time for relevant stakeholders to provide comment for consideration.
- The applicant is required to consider Environmental Protection Policies, the character, resilience and values of the receiving environment, any applicable plans and standards, such as ANECC (aquatic ecosystem guidelines), the Queensland Water Quality Guidelines and 'A study of the cumulative impacts on water quality of mining activities in the Fitzroy River Basin'.

In accordance with the legislation, the submitted TEP must adequately address methods to reduce environmental harm (Section 330) and must meet the content requirements detailed in section 331.

Department of Environment and Resource Management

Application form

Environmental Protection Act

OFFICIAL USE ONLY

DATE RECEIVED

FILE REF

PROJECT REF

COMPLETE FORM ☐ CORRECT AA ☐

ENTERED BY [SIGNATURE]

DATE

Program notice of relevant event

This form is to be used where a person wishes to provide a program notice under section 350 of the *Environmental Protection Act 1994* of an act or omission that has caused or threatened environmental harm.

Program notice details

1. Provider of program notice of relevant event

CH4 Pty Ltd

2. Responsible person

Tim Dean

3. Current registration certificate or environmental authority number (if applicable)

PEN100015907

A relevant event is an act or omission that has caused or threatened environmental harm in the carrying out of an activity by the person, and is lawful apart from the *Environmental Protection Act 1994*.

4. When did the relevant event occur?

The period between October 2010 to present

For example, you might provide details of the general activities that you were undertaking at the time, the act or omission and how it occurred, and any further action that was taken.

5. Description of the relevant event

Rainfall has recently contributed to the elevation of existing dam levels in the area covered by the relevant EA. If dam levels continue to rise, this will result in an overflow of untreated coal seam gas water to land. Arrow is seeking permission to discharge directly to the Isacc River.

The rainfall has caused construction delays which has prevented Arrow from making additional storage available via the completion of Dam 11. This has exacerbated the potential for dam breaches.

Department of Environment and Resource Management
www.derm.qld.gov.au ABN 46 640 294 485

Queensland Government

6. Location of relevant event

NAME OR TYPE OF PLACE	Petroluem Lease 191/196
STREET ADDRESS	via Lot 9 Thorpe Street Moranbah QLD 4744
LOT(S)	L61 SP195395 L1 SP216414 L1 SP216414 L1 SP192459
PLAN(S)	SP195395 SP216414 SP216414 SP192459
LOCAL GOVERNMENT	Moranbah Regional Council

For example, you might provide details of the proximity of the relevant event to sensitive places (e.g. parks or nearby waterways).

7. Description of the nature and extent of environmental harm caused or threatened as a direct or indirect result of the relevant event

Arrow has insufficent water storage to cope with such rainfall events, until dam 11 is completed.

At this point there have been no dam overflows (and associated environmental impacts), however potential impacts could result if heavy rainfall continues, leading to overflow event/s.

Impacts associated with dam breaches could include erosion and sedimentation (through physical flow effects) and contamination of land and waterways (through introduction of salt and other chemicals).

8. What action has been taken to contain, clean up, rehabilitate and restore the environmental impact in relation to the relevant event?

The construction of Dam 11 is a key component of our water statergy in developing additional storage until benefitial uses are developed for our coal seam water

Arrow is also in the process of modifying any non compliant dams to achieve compliance with relevant EA conditions. This includes achieving compliance with the Manual for Assessing the Hazard Category and Hydaulic Performance of Dams.

With respect to the potential event (the subject of this notice), DERM have been notified as required under the conditions of our Environment Authority PEN100015907. Potentially affected landholders within the tenure area will also be notified of any likely breach of the dam Design Storage Allowance (DSA).

Arrow intends to submit a transitional environmental program with respect to achieving dam compliance under PEN100015907.

9. Declaration

Note: If you have not told the truth in this application you may be liable for prosecution under the relevant Acts or Regulations.

- I am aware that section 351 of the *Environmental Protection Act 1994* states:

  "(1) If the relevant event stated in the program notice constitutes an offence against this Act (the "original offence"), the giving of the program notice, the program notice and any documents submitted with it are not admissible in evidence against the person in a prosecution for the original offence.

  "(2) Subsection (1) does not prevent other evidence obtained because of the giving of the program notice, the program notice or any documents submitted with it being admitted in any legal proceeding against the person."

- I will prepare and submit to the administering authority a transitional environmental program in accordance with section 333 of the *Environmental Protection Act 1994* for the relevant event.
- I do solemnly and sincerely declare that the information provided is true and correct to the best of my knowledge. I understand that it is an offence under s480 of the EP Act to give to the administering authority or an authorised person a document containing information that I know is false, misleading or incomplete in a material particular.
- I understand that all information supplied on or with this application form may be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.

APPLICANTS SIGNATURE [redacted]	
APPLICANTS NAME Tim Dean	DATE 02/12/2010

10. Provider checklist

☒ Notice completed and signed

☒ Supporting information attached (if applicable), including

- ☐ Reports
- ☐ Analysis and monitoring results

Please return your completed application to:

Permit and Licence Management
Implementation Support Unit
Department of Environment and Resource Management
GPO Box 2454
Brisbane Queensland 4001.

Enquiries: 1300 130 372
Facsimile: (07) 3896 3342
Email: palm@derm.qld.gov.au

3 December 2010

arrowenergy
go further

Ref: ENV10-278

[redacted]

Director, Petroleum and Gas Unit

Department of Environment & Resource Management

(sent via email 3 December 2010)

Attachment: Application form Program notice of relevant event

RE: MGP Dam Management and construction activity authorisation

[redacted]

I am writing on the behalf of Arrow Energy Limited (Arrow), parent company of CH4 Pry Ltd, to discuss the management of water storage at Moranbah Gas Project MGP (PL191/196) under the Environmental Authority PEN100015907 (granted 14th September 2010) and the authorisation of construction activities north of Dam 11.

Introduction

As previously indicated in correspondence to DERM (dated 25 October 2010) and subsequent responses to information requests, MGP (PL191/196) lacks sufficient water storage capacity. The early start to the wet season has contributed to existing dam levels and is also causing construction delays. Since the start of October we have received 260mm of rainfall. This rainfall has contributed some 35.6 ML to our storage based on the catchment of our dam system. This prevents Arrow from making additional storage available via the completion of dam 11. The synthetic lining cannot be installed during periods of rainfall; the civil engineering also requires careful control of the moisture content of the construction materials to achieve the required specifications.

Dam 11 has been designed and will be constructed in line with the most current dam standards stipulated by DERM and contained in the previously submitted and assessed dam design report. It is a large lined dam – intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies.

The continued rain has delayed the completion of dam 11. This has put Arrow in a position where it cannot comply with the current EA conditions. Attached to this letter is a program notice, Arrow intends to employ a transitional environmental program (TEP) as defined in Chapter 7, Part 4 of the *Environmental Protection Act 1994 to bring our operation back into compliance with its current Environmental Authority.* In initiating this process Arrow intends to work with DERM to minimise the potential for environmental harm.

Background

Arrow currently employs a network of 10 dams across PL191 and PL196. Dams 1 through to 7 are shown in the attached drawing (PL191-Dams). The other dams in the network dams 8 and 9 are southwest of the main area depicted in the provided drawing. Approximately 90% of the total storage capacity for coal seam water is held between dams 1, 2 and 10. The other dams are employed to move water between groups of remote wells. An important feature of the petroleum lease is the Isaac River which divides the lease along a north west to south east axis and its tributary Teviot Brook. Isaac River is an ephemeral river; during periods of high flow it limits access to infrastructure on the north eastern side of the petroleum lease via our river crossings.

T +61 7 3012 4000 ARROW ENERGY LTD LEVEL 19, AM-60, 42-60 ALBERT STREET GPO BOX 5262 BRISBANE QLD 4001 info@arrowenergy.com.au
F +61 7 3012 4001 ABN 73 078 521 936 BRISBANE QLD 4000 ASX CODE AOE arrowenergy.com.au

Table 1 Key Dam Variables Dams 1, 2 and 10

Dam		1	2	10
Volume at Spill level	(ML)	119.66	92.64	203.70
Hazard Category		Significant	Significant	
Spillway		No	No	Yes
Liner type		CCL	CCL	1.5mm HDPE
Hydraulic height	(m)	5.60	5.50	4.75
MRL	(m)	5.25	5.15	4.40
DSA	(m)	4.75	4.65	3.90
Current level *	*(mm below MRL)*	270	355	180
Current level*	*(mm above DSA)*	230	145	320
Approx remaining capacity*	(ML)	21.3	18.6	32.5
Approx rainfall to spill*	(mm)	620	705	530

** Levels at 10am 3 December 2010*

Current situation

We have cut gas production in two stages:

1) 49 wells shut in since mid May to reduce the water production from 33ML/month to 21.35 ML/month with a loss of 3.2TJ/day
2) 52 wells shut in since the beginning of August to reduce the water production to 20.4 ML/month with a total loss of 3.7TJ/day

At present we are producing approximately 40TJ/day which constitutes a significant portion of central Queensland supply, further gas production cuts will provide only provide marginal reductions in coal seam water production since we have targeted the high water flow wells to shut in.

Our preference to maintain DSA level in the older and less accessable dams (dams 2, 3, 4, 5,6,7, 8 and 9) by moving water to dams 1 and 10. Dam 10 is our most recently constructed dam and has an engineered spillway, dam 1 is in reasonable condition and adjacent to dam 10 which allows water to be transferred readily between dams readily.

We cannot practically truck water from the dams given the large quantities and the lack of disposal options. Wet weather is likely to complicate trucking of water by limiting access to some points within the MGP. Installation of water treatment (such as a mobile RO plant) is limited by the logistics (such as approvals, clearances, civil engineering, chemical storage and power supply), cost and the challenges posed during current wet conditions. Another option considered was employing water entitlements to dilute the untreated coal seam water to the current environmental authority specification. This option was ruled out since a large quantity of good quality water would be required to dilute and dispose of a limited amount of coal seam water from our dams.

Use of dam 11 in its current uncompleted, unlined state has been investigated. The pipe work and major civil infrastructure is complete but the floor of the dam is incomplete – as discussed (in our meeting on the 1st of December) it lacks its intended second liner, more importantly the clay liner has not been sufficiently compacted to allow its use. Obviously the completion of dam 11 is an important priority to Arrow, to complete Dam 11 Arrow requires approval from DERM to employ the area north of Dam 11.

Based on our assessment a controlled discharge during high flow conditions in the Isaac River via the existing infrastructure when dam 10 reaches the Mandatory Reporting Level (MRL) would result in the least environmental impact whilst preserving the integrity of the existing dams. This option prevents the flow of untreated coal seam water overland to reach the Isaac River and the risk of damaging older dams not to built prior to the current standard and lacking spillways (when our asset was developed the water management scheme included a wet weather discharge, which required different infrastructure to the current conditions). We propose to discharge in line with the previous Environmental Authority conditions whilst there is increased flow in the Isaac River.

We propose to employ the previous discharge conditions as detailed Environmental Authority 170524 dated 23/1/2006 (relevant section have been included below).

Schedule C - Water

Release to Water

(C1-1) End of pipe release limits for process water and storm water contaminated by petroleum activities must be monitored at the locations and frequencies defined in Schedule C - Table 1 and comply with the contaminant limits defined in Schedule C - Table 2. All determinations of the quality of contaminants released must be:

(a) made in accordance with methods prescribed in the latest edition of the Environmental Protection Agency Water Quality Sampling Manual; and

(b) carried out on samples that are representative of the discharge.

Schedule C - Table 1 (Water discharge monitoring locations and frequency)

MONITORING POINT	LATITUDE (GDA 94)	LONGITUDE (GDA 94)	MONITORING FREQUENCY
Pond 6 Discharge Point (Isaac River)	-21° 57' 43.64"	148° 2' 28.09"	Daily During Discharge Events
Blair Athol Railway Bridge (Isaac River Downstream)	-21° 57' 59.81"	148° 2' 42.16"	Daily During Discharge Events
Isaac River Crossing No.2 at the 132kV Powerline (Isaac River Upstream)	-21° 57' 40.5"	148° 2' 10.64"	Daily During Discharge Events

Schedule C - Table 2 (Water discharge contaminant release limits)

PARAMETER	UNITS	MINIMUM	MAXIMUM
Total Dissolved Solids (TDS)	mg/L	0	110% of Upstream Monitoring Point
pH		5.5	9.0

Waste Water

(E2-1) Waste water generated from licensed activities, may be discharged from designated evaporation ponds via pipes directly to the Isaac River under the following conditions:

(a) The river must be flowing in the reach between the upstream discharge point and the downstream quality monitoring point;

(b) Electrical conductivity of the river water is to be monitored daily at the location described in Schedule C Table 1 - Blair Athol Railway bridge whilst discharges are taking place and for two days after cessation of discharge;

(c) Rate of discharge of waste water is to be adjusted to ensure that the monitored electrical conductivity does not exceed the values listed in Schedule C Table 2;

(d) Methods of discharge via condition E2-2 or condition E2-3 must be exhausted before discharge via this condition can occur; and

(e) Water Discharge must occur within requirements of condition (A3-6).

1. A scaled A3 map in colour showing Pond 1, 2, 4, 5, 6 and 10 in relation to any Environmentally Sensitive Areas, essential habitat, and any other applicable sensitive receptors including residences by no later than 24 November 2010.

   This map is attached for reference. Map was provided electronically to DERM and in hard copy during meeting held on the 1 December.

2. Information on all affected landholders and confirmation that CH4 Pty Ltd has notified the landholders of DSA exceedence;

   Landholders have been notified by mail of the DSA exceedence.

   There are three affected landholders:

   [redacted]
   'Natal Downs'
   Charters Towers QLD 4820

   [redacted]
   'Wotonga'
   Nebo QLD 4742

   [redacted]
   'Wotonga'
   Nebo QLD 4742

3. Provide each notified dam how much the DSA has been exceeded;

   Refer to Table 1 – these values are current as of the 3 December

4. Provide for each notified dam how much storage capacity (in litres) is left before it overflows

   Refer to Table 1 – these values are current as of the 3 December

5. Provide data on the water quality in each notified dam; and

   We have organised for an extensive sampling campaign of the ponds commencing on the 6th of December. Historic sampling suggests Total Dissolved Solids between 4000 and 8000 mg/L, pH between 8.2 and 7.8.

6. Identify the potential environmental impacts should the notified dams overflow.

   With ponds that lack spillways there is a risk to dam integrity. The key risk for overflow via spillway is that high TDS water will contaminate the overland drainage path to the river

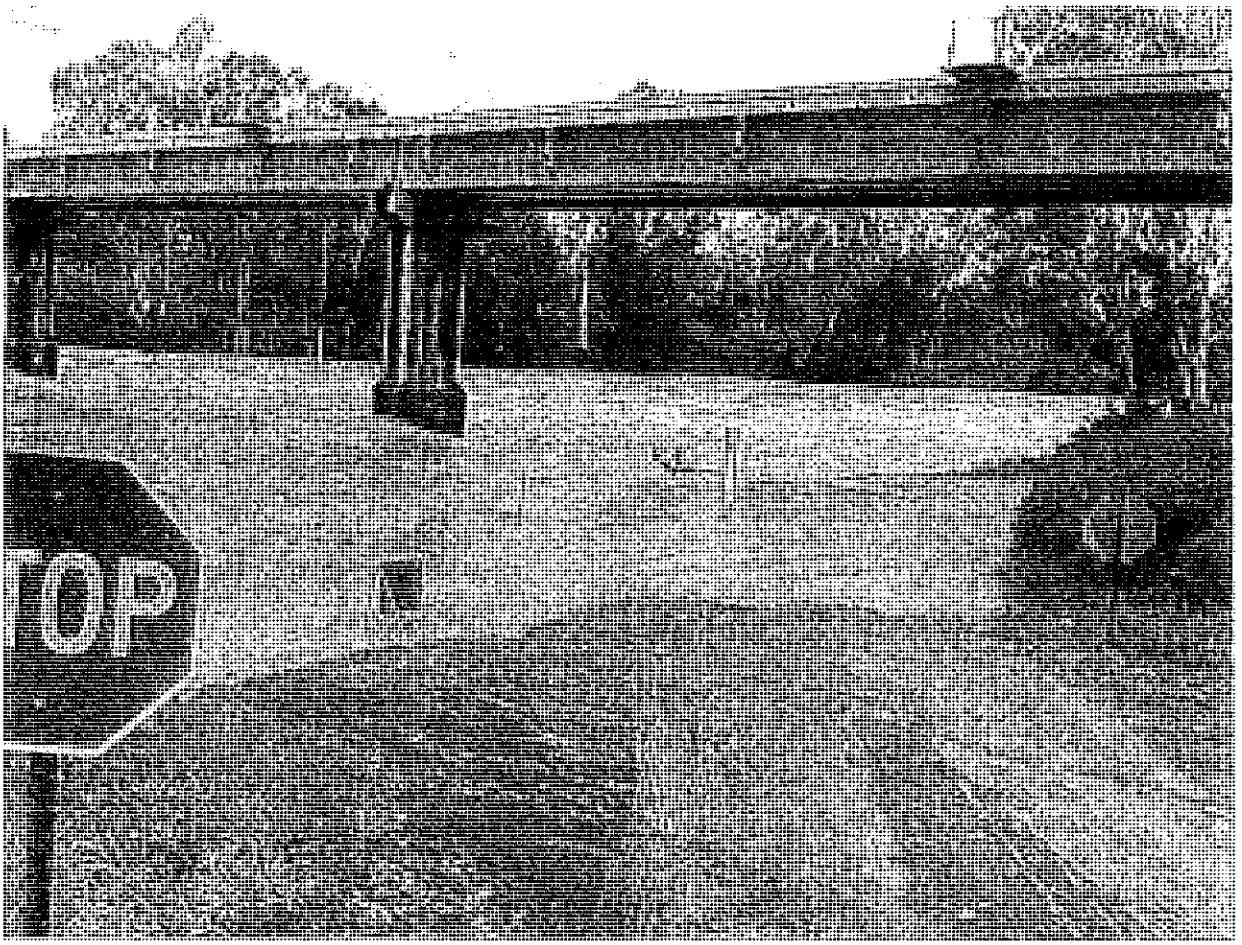


Figure 1 show the current Isaac River flow at river crossing 1. The river is flowing at approximately 3m and rising as of 3/12/2010.

Attached is a completed application form under the Environmental Protection Act *Program notice of relevant event.*

Regards

[redacted]

Ben McMahon
Manager Compliance & Reporting

Ben McMahon

From: Ben McMahon
Sent: Monday, 6 December 2010 4:26 PM
To: [redacted]
Subject: Dam 11 progress
Attachments: Memo_MGPX_Dam11_101206_A.pdf

Categories: Red Category

Hi [redacted]

I had our scheduler pull together a brief memo regarding the project status of Dam 11.

I have organised for the sampling to be completed as discussed earlier today.

Best regards

Ben

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Limited
Level 18, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
E:
W: www.arrowenergy.com.au

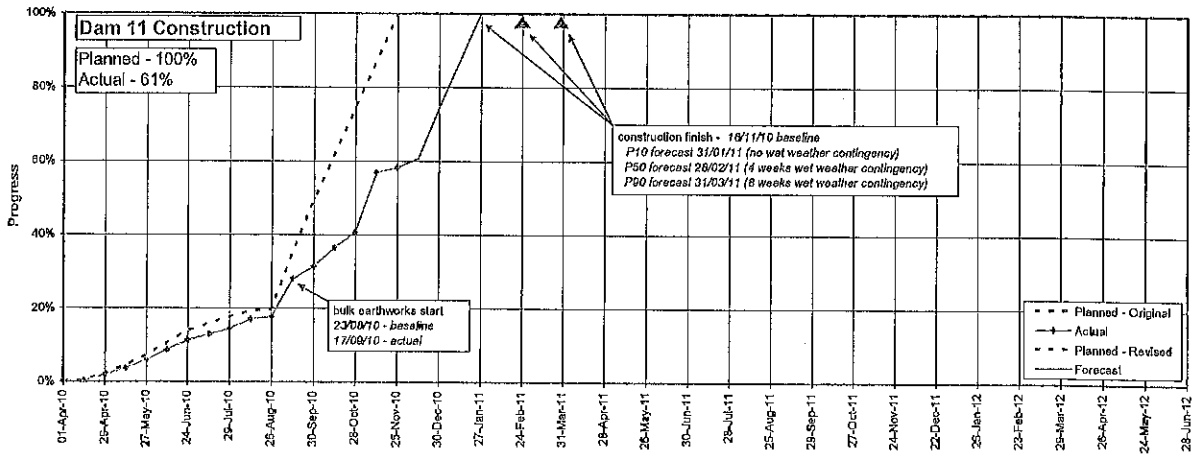
MEMO

arrow energy
go further

TO:	Ben McMahon
FROM:	[redacted] – Project Controls Manager Moranbah Project Expansion
DATE:	8 December 2010
SUBJECT:	Dam 11 Progress

REF:

Progress Chart



Project Status Summary

Protracted heavy unseasonal rain during November has severely delayed progress on Dam 11 construction. This rain has come at the worst possible time which is at the start of HDPE lining activity. The Contractor's resources have been stood down when work was impractical, while small amounts of work have been completed when conditions allowed.

Project status as at end November 2010 was 61 % (against planned progress 100%). Earthworks activities still to be completed include cut/fill (90% complete), dam preparation for lining, gravel capping and spillway activities. Dam lining activities have commenced on the battered areas however the majority of this work is still to be completed.

Latest forecast dam completion dates are as follows:

- P10: 31 January 2011 (assumes no further impact to dam construction from wet weather)
- P50: 28 February 2011 (assumes additional 4 weeks wet weather impacting Project)
- P90: 31 March 2011 (assume additional 8 weeks wet weather impacting Project)

Ben McMahon

From: [redacted]
Sent: Friday, 10 December 2010 3:42 PM
To: [redacted] Ben McMahon
Cc: [redacted]
Subject: Receipt of Program Notice
Attachments: 10-12-10Reciept of Program Notice.pdf

Categories: Red Category

Dear [redacted]

Please find attached the notice of receipt for Program Notice.

FYI: It states that the due date for submitting your draft TEP is 14/01/2011.

Kind Regards,

[redacted]
Environmental Officer, Petroleum and Gas Unit
Telephone [redacted] **Facsimile:** [redacted]
www.derm.qld.gov.au

Department of Environment and Resource Management
400 George Street, Brisbane QLD 4000
GPO Box 2454, Brisbane QLD 4001

<<10-12-10Reciept of Program Notice.pdf>>

Department of Environment and Resource Management

Notice

Environmental Protection Act

Receipt of program notice

This statutory notice is issued by the administering authority pursuant to section 352 of the Environmental Protection Act 1994, *to advise you of a decision or action.*

Your reference : PL191, PL196, PPL115, PPL116, PEN100015907
Our reference : BNE 36595 / 315517

CH4 Pty Ltd

AM-60

Level 19

42 Albert Street

Brisbane QLD 4000

Attention: [redacted]

Re: Program notice submitted by CH4 Pty Ltd for PL191 and PL196 and PPL115 and PPL116, at place on land described as Lot 61 on Plan SP195395 and Lot 1 on Plan SP 216414, and Lot 1 on Plan SP 192459, located at via Lot 9 Thorpe Street MORANBAH QLD 4744.

Your program notice was received on 3 December 2010.

Department of Environment and Resource Management
www.derm.qld.gov.au ABN 46 640 294 485

Queensland Government

Department of Environment and Resource Management

Notice

Receipt of program notice

A draft transitional environmental program (TEP) dealing with the activity must be submitted for approval to the Department of Environment and Resource Management (DERM), at the address at the end of this notice, by 14 January 2011. Fees apply for the assessment of a draft TEP and any subsequent annual returns. The fees are outlined in the attached operational policy *transitional environmental program (TEP) fees.*

Should you have any queries in relation to this Notice, please contac [redacted] of on telephone [redacted]

[redacted]

SIGNATURE

10 December 2010

DATE

[redacted]
Manager
Gas and Petroleum Unit
Environmental and Natural Resource Regulation
Department of Environment and Resource Management

Enquiries:

Petroleum and Gas Unit
Department of Environment and Resource Management
Floor 7, 400 George Street
BRISBANE QLD 4000
GPO Box 2454
BRISBANE QLD 4001
Phone: (07) 3330 5349
Fax: (07) 3330 5634

Department of Environment and Resource Management

Operational policy

Fees

Transitional Environmental Program (TEP) fees

Operational policies provide a framework for consistent application and interpretation of legislation by the Department of Environment and Resource Management (DERM). Operational policies will not be applied inflexibly to all circumstances. Individual circumstances may require an alternative application of policy. This policy concerns Section 140 under the Environmental Protection Regulation 2008.

Policy issue

What are DERM's fees for considering a Transitional Environmental Program (TEP)?

Background

Section 334 of the *Environmental Protection Act 1994* (EP Act) provides for the administering authority to charge a person or public authority, the fee prescribed by regulation, for submitting a draft TEP for approval.

This section applies, with any necessary amendments, to an application to amend a TEP under section 344 of the EP Act.

Section 140(1) of the *Environmental Protection Regulation 2008* (EP Reg) prescribes that the fees for consideration of draft TEPs, or an amendment of an approval for TEPs, is the amount that:

- the authority considers to be reasonable; and
- is not more than the reasonable cost of deciding the application for approval of the program or the amendment of the approval.

Section 140(3) of the EP Reg prescribes that the fees for assessing the holder's annual returns and monitoring compliance with the program is the amount that:

- the authority considers to be reasonable; and
- is not more than the reasonable cost of the assessment and monitoring.

Determination

Fees for the assessment of a draft TEP are a minimum of $362.40[1] (includes GST), plus an additional $181 per hour (includes GST) or part thereof, charged after the first two hours.

Fees for assessment of an TEP annual return and monitoring of a compliance program of a draft TEP are charged at a rate of $181 per hour (includes GST), or part thereof, plus any reasonable costs for analysis and travel.

The reasonable cost of analysis cost will be the actual cost of the analysis to the Agency, plus GST.

The reasonable cost of travel will be the cost of travel[2], plus GST.

Department of Environment and Resource Management
www.derm.qld.gov.au

The fee for assessing an application to amend a TEP is $185.80 (includes GST).

Other issues to consider

The person having a draft TEP considered should be advised at the time of approval of the TEP that the administering authority will require payment of a fee for assessment of the annual return and monitoring compliance of the TEP.

---

[1] The $362.40 fee covers the administration costs incurred by the Agency when assessing that the TEP satisfies the criteria set by the *Environmental Protection Act 1994* and the first two hours of technical evaluation of the TEP.

[2] The reasonable cost of travel will be calculated as outlined in section 4 (Employees who choose to use their own vehicles) of the schedule in the Queensland Government's *Directive No. 8/09 Motor Vehicle Allowances* September 2009 issued by the Attorney-General and Minister for Industrial Relations. For an automobile this is set at 37.5 cents per kilometre.

Ben McMahon

From: [redacted]
Sent: Friday, 10 December 2010 3:16 PM
To: Ben McMahon
Cc: [redacted]
Subject: FW: TEP Template (2).doc
Attachments: TEP Template (2).doc

Categories: Red Category

Ben

As discussed earlier, please find attached the main parts of an email sent to another CSG company with a similar issue.

Arrows situation does not appear as complex as the other CSG operator I am dealing with. In your case from what I understand, any discharge sought under a TEP would be to allow the discharge of untreated well water, as has been previously allowed for under the EA, prior to the approval of the Office of the Water Supply Regulator being required as is the case now.

Please have a look at the template below. In the interim I will set up a meeting of government officers, hopefully for next Tuesday to discuss further.

Regards

[redacted]

From: [redacted]
Sent: Friday, 10 December 2010 9:45 AM
To:

Cc: Loveday Chris; [redacted]
Subject: TEP Template (2).doc

<<TEP Template (2).doc>>

Please find attached a template advising information being requested of Coal mines in the Fitzroy catchment to support possible TEP applications to discharge waters captured in coal pits.

This template can be used as a guide for you to began putting together the information needed for a future TEP application.

It also contains likely conditions that might be imposed on any certificate of approval issued by DERM.

As discussed -

- This template/likely conditions may not specifically match the same issues faced at by your site, given the differences in water quality, your location in the catchment and the situation at hand.
- Given the differences between your sites situation and that facing coal mines it is very likely that the Department will advise specific changes to the information outlined in this document to reflect issues identified as being specific to Spring Gully.

- Your issue is an emerging/potential issue - i.e. you may not need to release under the TEP **(if in the unlikely event)** if there was no further rain this wet season. Given that you need to clearly outline under what circumstances (linked to MRL, engineering concerns, rainfall events etc) a release under any future TEP would occur. This would need to be linked to either ensuring compliance with a EA conditions or preventing environmental harm/potential harm.

I will internally discuss this draft template with the Office of the Water Supply Regulator and with our Regional Officer and advise you early next week of any specific changes or issues contained in the template as it currently stands.

Regards

[redacted]

Ben McMahon

From: [redacted]
Sent: Friday, 10 December 2010 5:52 PM
To: Ben McMahon
Subject: RE: ENV10-278 MGP Program Notice letter

Categories: Red Category

Ben

I have invited government representatives to a meeting at 2.30pm on Tuesday next week.

Location is 3rd Floor, 400 George St, Barrier Reef Room.

Please let me know if this time is suitable.

Regards

From: Ben McMahon [redacted]
Sent: Friday, 10 December 2010 3:26 PM
To: [redacted]
Subject: ENV10-278 MGP Program Notice letter

Hello [redacted]

Arrow Energy has been working with DERM (specifically Rod Kent) in relation to a discharge outside of existing EA conditions into the Isaac River as part of a Transitory Environment Program (TEP)

The program notice letter provides a good outline of the proposed release. The recent wet weather has been causing us problems in relation to bringing additional storage online and dealing with our current dam levels. We have proposed to employ previous environmental authority conditions with respect to volume and discharge location subject to advice from DERM in gaining an approved TEP to discharge water from this facility. We have had reasonably comprehensive water sampling program completed and are currently awaiting results.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Limited
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
E:
W: www.arrowenergy.com.au

From: Ben McMahon
Sent: Friday, 3 December 2010 4:35 PM
To: [redacted]
Cc: [redacted]
Subject: ENV10-278 MGP Program Notice letter

[redacted]

Please find attached a letter that details the current situation in PL191/196 and a program notice under section 350 of the EP Act in relation to the dam storage levels and the construction of dam 11. Heavy rainfall is forecast for the Moranbah region over this weekend.

Please do not hesitate to contact me with any queries.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Limited
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
E:
W: www.arrowenergy.com.au

Ben McMahon

From:	Ben McMahon
Sent:	Monday, 13 December 2010 3:48 PM
To:	[redacted]
Cc:	
Subject:	Incident notification
Attachments:	13 Jan 10 Incident notification.pdf
Categories:	Red Category

[redacted]

Please find attached an incident notification in relation to the MGP on PL191/196.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

13 January 2010

arrowenergy
go further

Ref: ENV10-283

[redacted]

Petroleum and Gas Unit

Department of Environment & Resource Management

(sent via email 13 January 2010)

RE: Incident Notification - Threatened or Potential Environmental Harm

Dea[redacted]

I am writing on the behalf of Arrow Energy Limited to provide notification of threatened or potential environmental harm on Moranbah PL191/196 (under EA PEN100015907 granted 14th September 2010).

Date: 13 January

Location: MGP Isaac River

Description: Very heavy rainfall over the weekend (~125mm) lead to the decision to discharge coal seam water to the Isaac river. This decision was taken based on concerns related to the integrity of dams, flow in the Isaac River, the current forecast for further rain and lack of available storage.

Arrow believes that this measure was necessary to minimise environmental harm.

Regards,

[redacted]

Ben McMahon
Manager Compliance & Reporting

T +61 7 3012 4000 ARROW ENERGY LTD LEVEL 19, AM-60, 42-60 ALBERT STREET GPO BOX 5262 BRISBANE QLD 4001 info@arrowenergy.com.au
F +61 7 3012 4001 ABN 73 078 521 036 BRISBANE QLD 4000 ASX CODE AOE arrowenergy.com.au

Ben McMahon

From: [redacted]
Sent: Monday, 13 December 2010 4:23 PM
To: Ben McMahon
Cc: [redacted]
Subject: RE: Incident notification

Categories: Red Category

Ben

Thanks for the early notification in regards to this.

As discussed I need lab details of the most recent water quality from pond 2, the rate of the discharge and the height of the Isaacs River at/near the discharge point.

You stated that the discharge was occurring because of structural stability concerns with pond 2 that had been identified after the weekend's rainfall. I would imagine this assessment would have concluded the pond needed to be lowered to a certain height to ensure stability.

Please provide the height that Arrow's engineering assessment has identified ponds water level to be lowered to and the likely volume of water that will be discharged to reach that height.

Further information will be required, but in the interim I need the above information urgently given the other discharges occurring and proposed to occur in that wider catchment.

Regards

[redacted]

From: Ben McMahon [redacted]
Sent: Monday, 13 December 2010 3:48 PM
To: [redacted]
Cc: [redacted]
Subject: Incident notification

[redacted]

Please find attached an incident notification in relation to the MGP on PL191/196.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO_2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

Enquiries [redacted]
Telephone
Your reference
Our reference

Queensland Government

ENV10-IN-300

Department of
Environment and Resource
Management

14 December 2010

[redacted]
Arrow Energy Ltd
Level 19 AM-60, 42-60 Albert Street
BRISBANE QLD 4000.

Re: Wet Weather Contingency Plan for Coal Seam Gas Activities

Dear [redacted]

As you would be aware, the State of Queensland is currently experiencing significant rainfall and it is anticipated that 2010 will be the wettest year in recent history.

The Department of Environment and Resource Management (DERM) is aware that many Coal Seam Gas (CSG) fields have been inundated by unprecedented rainfall in recent months and that the management of increased volumes of stormwater from incident rainfall combined with limitations on land disposal systems and dam capacity presents a significant challenge to the majority of CSG operations.

It is anticipated that similar climatic conditions may persist well into the New Year and are likely to impede CSG operators in their capacity to achieve environmental compliance in relation to CSG water management.

DERM is seeking the assistance of all operators to ascertain the current status of CSG-related dams and any mitigation measures that are proposed or in place to prevent or minimise environmental harm. DERM therefore requests that Arrow Energy Ltd provide the following to assist with this process:

- A brief status report of all CSG-related dams including, but not exclusively;
  - relevant GPS co-ordinates of each dam and associated spillways;
  - the respective MRL's of each dam with a focus on dams that have previously overflowed or are close to reaching MRL;
  - the preferential drainage pathway and likely receiving environment in the event of a release; and
  - current water quality data for each dam and its risk potential to cause harm in the event of a release.

- Any emergency or contingency strategy or plan that is currently in place to deal with unauthorised dam releases during wet periods, including procedures for;
  - situation response including protocols for water level management;
  - stakeholder identification and communication
  - investigation, monitoring and reporting of unauthorised releases;
  - post-spill site impact assessment and remediation
  - staff training and awareness of contingency plans

- Notification protocols that are in place with DERM and local government and minimum information that will be provided in the event of a release.

It is requested that the relevant information be submitted to DERM by 22 December 2010.

DERM is committed to achieving beneficial environmental outcomes and looks forward to your co-operation on this matter. If you wish to discuss this matter further please contact [redacted] on telephone [redacted]

Yours sincerely

[redacted]

General Manager – Energy Resources
Strategic Projects
Department of Environment and Resource Management

Ben McMahon

From: [redacted]
Sent: Tuesday, 14 December 2010 8:49 AM
To: Ben McMahon
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Incident notification

Categories: Red Category

Ben

You may have already noticed that the notification is dated 13 **January** 2010.

So that no confusion occurs later on please submit a notification dated 13 December 2010.

Cheers

From: Ben McMahon [redacted]
Sent: Monday, 13 December 2010 3:48 PM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: Incident notification

[redacted]

Please find attached an incident notification in relation to the MGP on PL191/196.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

Ben McMahon

From: Ben McMahon
Sent: Tuesday, 14 December 2010 8:58 AM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Incident notification
Attachments: ENV10-283.pdf

Categories: Red Category

Apologies for the confusion [redacted]

Please find the corrected version of the notification that was sent yesterday.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

From: [redacted]
Sent: Tuesday, 14 December 2010 8:49 AM
To: Ben McMahon
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Incident notification

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You may have already noticed that the notification is dated 13 January 2010.

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Cheers

From: Ben McMahon [redacted]
Sent: Monday, 13 December 2010 3:48 PM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: Incident notification

[redacted]

Please find attached an incident notification in relation to the MGP on PL191/196.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
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T: [redacted]
F:
M:
www.arrowenergy.com.au

13 January 2010

arrowenergy
go further

Ref: ENV10-283

[redacted]

Petroleum and Gas Unit

Department of Environment & Resource Management

(sent via email 13 January 2010)

RE: Incident Notification - Threatened or Potential Environmental Harm

Dear [redacted]

I am writing on the behalf of Arrow Energy Limited to provide notification of threatened or potential environmental harm on Moranbah PL191/196 (under EA PEN100015907 granted 14th September 2010).

Date: 13 January

Location: MGP Isaac River

Description: Very heavy rainfall over the weekend (~125mm) lead to the decision to discharge coal seam water to the Isaac river. This decision was taken based on concerns related to the integrity of dams, flow in the Isaac River, the current forecast for further rain and lack of available storage.

Arrow believes that this measure was necessary to minimise environmental harm.

Regards,

[redacted]

Ben McMahon
Manager Compliance & Reporting

T +61 7 3012 4000
F +61 7 3012 4001
ARROW ENERGY LTD
ABN 73 078 521 936
LEVEL 19, AM-60, 42-60 ALBERT STREET
BRISBANE QLD 4000
GPO BOX 5262 BRISBANE QLD 4001
ASX CODE AOE
info@arrowenergy.com.au
arrowenergy.com.au

Ben McMahon

From: [redacted]
Sent: Wednesday, 15 December 2010 8:39 AM
To: Tim Dean
Cc: [redacted] Ben McMahon
Subject: RE: Incident notification

Categories: Red Category

Tim

As discussed yesterday any samples Arrow has which can be sent to QLD Health for priority analysis should be forwarded to their lab immediately.

The QLD Health Lab contact is [redacted]

[redacted]

I will contact [redacted] and advise her that you might be contacting her to arrange priority sampling.

Regards

[redacted]

From: [redacted]
Sent: Tuesday, 14 December 2010 5:24 PM
To: Tim Dean
Cc: [redacted] Ben McMahon
Subject: RE: Incident notification

Tim

As discussed in our phone conversation at 4.55pm after our meeting today, I briefed my Associate Director General [redacted] on the current situation, including the current unauthorised discharge and the proposed TEP.

In regards to the discharge, I briefed [redacted] that a major concern for all State Government stakeholders present, is that no definitive water quality information is available for the untreated CSG well water being released.

Another factor of concern is that the Isaacs River is currently dropping in flow and based on DERM records will drop very sharply in the coming days, thus reducing dilution. Additionally Arrow has not been able to advise how much water, over what time period needs to be discharged, to achieve a safe level (as determined by Arrow) in pond 2.

As discussed verbally, DERM considers the current release to be a highly inappropriate breach of Arrows Environmental Approval.

Arrow should consider ceasing this discharge, after careful consideration of other available options for the untreated CSG water contained in dams at the site.

Your response indicating Arrow's decision to cease or continue this discharge by 12 noon Wednesday 15 December 2010 is requested.

Regards

[redacted]
Manager
[redacted]

From: Ben McMahon [redacted]
Sent: Tuesday, 14 December 2010 8:58 AM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Incident notification

Apologies for the confusion [redacted]

Please find the corrected version of the notification that was sent yesterday.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

From: [redacted]
Sent: Tuesday, 14 December 2010 8:49 AM
To: Ben McMahon
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Incident notification

Ben

You may have already noticed that the notification is dated 13 January 2010.

So that no confusion occurs later on please submit a notification dated 13 December 2010.

Cheers

From: Ben McMahon [redacted]
Sent: Monday, 13 December 2010 3:48 PM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: Incident notification

[redacted]

Please find attached an incident notification in relation to the MGP on PL191/196.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd

From: [redacted]
Sent: Tuesday, 14 December 2010 8:49 AM
To: Ben McMahon
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Incident notification

Ben

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So that no confusion occurs later on please submit a notification dated 13 December 2010.

Cheers

From: Ben McMahon [redacted]
Sent: Monday, 13 December 2010 3:48 PM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: Incident notification

[redacted]

Please find attached an incident notification in relation to the MGP on PL191/196.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: +[redacted]
F: +[redacted]
M: +[redacted]
www.arrowenergy.com.au

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Ben McMahon

From: [redacted]
Sent: Tuesday, 14 December 2010 5:24 PM
To: Tim Dean
Cc: [redacted] Ben McMahon
Subject: RE: Incident notification

Categories: Red Category

Tim

As discussed in our phone conversation at 4.55pm after our meeting today, I briefed my Associate Director General [redacted] on the current situation, including the current unauthorised discharge and the proposed TEP.

In regards to the discharge, I briefed [redacted] that a major concern for all State Government stakeholders present, is that no definitive water quality information is available for the untreated CSG well water being released.

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As discussed verbally, DERM considers the current release to be a highly inappropriate breach of Arrows Environmental Approval.

Arrow should consider ceasing this discharge, after careful consideration of other available options for the untreated CSG water contained in dams at the site.

Your response indicating Arrow's decision to cease or continue this discharge by 12 noon Wednesday 15 December 2010 is requested.

Regards

[redacted]
Manager
[redacted]

From: [redacted]
Sent: Tuesday, 14 December 2010 8:58 AM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Incident notification

Apologies for the confusion[redacted]

Please find the corrected version of the notification that was sent yesterday.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F: [redacted]
M: [redacted]
www.arrowenergy.com.au

Ben McMahon

From: [redacted]
Sent: Wednesday, 15 December 2010 8:45 AM
To: [redacted] Tim Dean
Cc: [redacted] Ben McMahon
Subject: RE: Incident notification

Categories: Red Category

Slight correction as [redacted] is on leave so please ask for [redacted] [redacted] will pick up calls to [redacted] line.

Regards

[redacted]

From: [redacted]
Sent: Wednesday, 15 December 2010 8:39 AM
To: 'Tim Dean'
Cc: [redacted] 'Ben McMahon'
Subject: RE: Incident notification

Tim

As discussed yesterday any samples Arrow has which can be sent to QLD Health for priority analysis should be forwarded to their lab immediately.

The QLD Health Lab contact is [redacted]

[redacted]

I will contact [redacted] and advise her that you might be contacting her to arrange priority sampling.

Regards

[redacted]

From [redacted]
Sent: Tuesday, 14 December 2010 5:24 PM
To: Tim Dean
Cc: [redacted] Ben McMahon
Subject: RE: Incident notification

Tim

As discussed in our phone conversation at 4.55pm after our meeting today, I briefed my Associate Director General [redacted] on the current situation, including the current unauthorised discharge and the proposed TEP.

In regards to the discharge, I briefed [redacted] that a major concern for all State Government stakeholders present, is that no definitive water quality information is available for the untreated CSG well water being released.

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Regards

[redacted]
Manager
[redacted]

From: Ben McMahon[redacted]
Sent: Tuesday, 14 December 2010 8:58 AM
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Cc: [redacted] Tim Dean;[redacted]
Subject: RE: Incident notification

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Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M
www.arrowenergy.com.au

From: [redacted]
Sent: Tuesday, 14 December 2010 8:49 AM
To: Ben McMahon
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Incident notification

Ben

You may have already noticed that the notification is dated 13 January 2010.

So that no confusion occurs later on please submit a notification dated 13 December 2010.

Cheers

From: Ben McMahon[redacted]
Sent: Monday, 13 December 2010 3:48 PM

To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: Incident notification

[redacted]

Please find attached an incident notification in relation to the MGP on PL191/196.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box [redacted] 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

[redacted]

From: Tim Dean
Sent: Wednesday, 15 December 2010 11:06 AM
To: [redacted]
Cc: [redacted] Ben McMahon
Subject: RE: Incident notification
Attachments: ENV10-285 MGP Discharge advice.doc

[redacted]

Please find attached response to your note below.

Tim Dean
Asset General Manager - North

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

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Tim

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Regards

[redacted]
Manager
[redacted]

From: Ben McMahon [redacted]
Sent: Tuesday, 14 December 2010 8:58 AM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Incident notification

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Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

estimates are a matter of judgement at the time and are subject to change without notice. E-mail transmission cannot be guaranteed to be secure or error-free. No guarantee is made that any attachments are virus free. We reserve the right to monitor all e-mail communications.

From: [redacted]
Sent: Tuesday, 14 December 2010 8:49 AM
To: Ben McMahon
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Incident notification

[redacted]

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Subject: Incident notification

[redacted]

Please find attached an incident notification in relation to the MGP on PL191/196.

Best regards

Ben McMahon
Manager Compliance & Reporting

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Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

+----------+

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

+----------+

15 December 2010

arrow energy
go further

Ref: ENV10-285

[redacted]

Manager, Petroleum and Gas Unit

Department of Environment & Resource Management

(sent via email15 December 2010)

RE: MGP Discharge

Dear [redacted]

I am writing on the behalf of Arrow Energy Limited (Arrow) to address the concerns raised by DERM in the meeting held Tuesday afternoon (14 December 2010) and detailed in subsequent email correspondence and phone conversions between DERM and Arrow.

Arrow wishes to advise that discharge to the Isaac River has ceased as of 17:42 14 December 2010. In total 2.6 ML was discharged. Arrow is working to expedite further information – particularly the water quality as discussed. Arrow will provide this additional information to DERM as a priority.

At present the water from dam 2 is being directed to dam 10, we expect dam to exceed its Mandatory Reporting Limit at some point today.

Regards,

Tim Dean
Asset General Manager - North

T +61 7 3012 4000 ARROW ENERGY LTD LEVEL 10, AM-60, 42-60 ALBERT STREET GPO BOX 5262 BRISBANE QLD 4001 info@arrowenergy.com.au
F +61 7 3012 4001 ABN 73 078 521 930 BRISBANE QLD 4000 ASX CODE AOE arrowenergy.com.au

Graham Cordingley

From: [redacted]
Sent: Wednesday, 15 December 2010 11:11 AM
To: Tim Dean
Cc: [redacted] Ben McMahon
Subject: RE: Incident notification

Tim

Your prompt advice is appreciated.

Regards

[redacted]

From: Tim Dean [redacted]
Sent: Wednesday, 15 December 2010 11:06 AM
To: [redacted]
Cc: [redacted] Ben McMahon
Subject: RE: Incident notification

[redacted]

Please find attached response to your note below.

Tim Dean
Asset General Manager - North

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: +
F: +
M: [redacted]
www.arrowenergy.com.au

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[redacted]

From: Ben McMahon [redacted]
Sent: Tuesday, 14 December 2010 8:58 AM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Incident notification

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Please find the corrected version of the notification that was sent yesterday.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F: [redacted]
M: [redacted]
www.arrowenergy.com.au

From: [redacted]
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Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Incident notification

Ben

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Subject: Incident notification

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Best regards

Ben McMahon
Manager Compliance & Reporting

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F:
M:
www.arrowenergy.com.au

Ben McMahon

From: Ben McMahon
Sent: Wednesday, 15 December 2010 11:14 AM
To: [redacted]
Subject: FW: Your Reference : MGP. COC/SRN for ALSE Workorder : ES1025292
Attachments: ES1025292__COC.pdf; ES1025292_SRN.pdf

Categories: Red Category

[redacted]

Please find attached the Chain of Custody and Sample Receipts for the ALS dam samples that we discussed yesterday.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

From: [redacted]
Sent: Wednesday, 15 December 2010 10:55 AM
To: Ben McMahon
Subject: FW: Your Reference : MGP. COC/SRN for ALSE Workorder : ES1025292

Chain of Custody for Samples taken 07/12/10

[redacted]
Water and Salt Infrastructure Coordinator

Arrow Energy Pty Ltd.
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M
http://www.arrowenergy.com.au/

From: [redacted]
Sent: Wednesday, 15 December 2010 10:53 AM
To: [redacted]
Subject: FW: Your Reference : MGP. COC/SRN for ALSE Workorder : ES1025292

Note that samples were collected on Monday delivered to lab on Tuesday am who then took two more days before they started analyses.

[redacted]
Groundwater Modelling Coordinator

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T [redacted]
F [redacted]
M [redacted]
www.arrowenergy.com.au
[redacted]

From: ALSE Sydney Aus[redacted]
Sent: Friday, 10 December 2010 1:35 PM
To: [redacted]
Subject: Your Reference : MGP. COC/SRN for ALSE Workorder : ES1025292

This e-mail has been automatically generated.

-- PLEASE DO NOT REPLY --

ALS acknowledges the risks associated with supplying electronic media reports based on client requirements. This type of format has the ability to embed viruses within the code and, as such, ALS has introduced a three tier layer of protection throughout their company resources. However, ALS cannot guarantee any attachment is virus free and will not be held liable for any disruption to business. It is highly recommended that all attachments received are scanned prior to opening.

Ben McMahon

From: [redacted]
Sent: Wednesday, 15 December 2010 11:18 AM
To: Ben McMahon
Cc: [redacted]
Subject: RE: Your Reference : MGP. COC/SRN for ALSE Workorder : ES1025292

Categories: Red Category

Thanks Ben

Are you able to advise when Arrow will be able to provide samples to QLD Health for sampling?

Cheers

[redacted]

From: Ben McMahon [redacted]
Sent: Wednesday, 15 December 2010 11:14 AM
To: [redacted]
Subject: FW: Your Reference : MGP. COC/SRN for ALSE Workorder : ES1025292

[redacted]

Please find attached the Chain of Custody and Sample Receipts for the ALS dam samples that we discussed yesterday.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
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F:
M:
www.arrowenergy.com.au

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Chain of Custody for Samples taken 07/12/10

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[redacted]

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Sent: Friday, 10 December 2010 1:35 PM
To: [redacted]
Subject: Your Reference : MGP. COC/SRN for ALSE Workorder : ES1025292

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-- PLEASE DO NOT REPLY --

ALS Laboratory Group
ANALYICAL CHEMISTRY & TESTING SERVICES

Environmental Division

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive Report

Work Order	: ES1025292		
Client	: ARROW ENERGY NL	Laboratory	: Environmental Division Sydney
Contact	: [redacted]	Contact	: [redacted]
Address	: GPO BOX 5262 BRISBANE QLD, AUSTRALIA 4001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: [redacted]	E-mail	: [redacted]
Telephone	: [redacted]	Telephone	: [redacted]
Facsimile	: [redacted]	Facsimile	: [redacted]
Project	: MGP	Page	: 1 of 2
Order number	: ----		
C-O-C number	: ----	Quote number	: EB2010ARRENE0280 (BN/364/10)
Site	: ----		
Sampler	: SH	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Dates

Date Samples Received	: 09-DEC-2010	Issue Date	: 10-DEC-2010 14:28
Client Requested Due Date	: 20-DEC-2010	Scheduled Reporting Date	: **20-DEC-2010**

Delivery Details

Mode of Delivery	: Carrier	Temperature	: 9.9'C - Ice present
No. of coolers/boxes	: 4 HARD	No. of samples received	: 9
Security Seal	: Intact.	No. of samples analysed	: 9

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Requested Deliverables
- **Samples received in appropriately pretreated and preserved containers.**
- **Breaches in recommended extraction / analysis holding times may occur. Please contact ALS for further information.**
- **pH analysis should be conducted within 6 hours of sampling.**
- **E. Coli and Total Coliforms analysis cancelled as per John Herbert on 10/12/10**
- **NO2, NO3 should be analysed within 48 hours of sampling.**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (90 days) from date of completion of work order.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exist.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process neccessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Matrix: WATER

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER - EA005: pH pH	WATER - EA010P Conductivity (PC)	WATER - EP080 BTEX	WATER - NT-08 Total Nitrogen + NO2 + NO3 + NH3 + Total P	WATER - W-03T 13 Metals (Total) (NEPM)
ES1025292-001	06-DEC-2010 15:00	DAM 1	✓	✓	✓	✓	
	09-DEC-2010 15:00	DAM 1					✓
ES1025292-002	06-DEC-2010 15:00	DAM 10	✓	✓	✓	✓	
	09-DEC-2010 15:00	DAM 10					✓
ES1025292-003	06-DEC-2010 15:00	DAM 4	✓	✓	✓	✓	
	09-DEC-2010 15:00	DAM 4					✓
ES1025292-004	06-DEC-2010 15:00	DAM 3	✓	✓	✓	✓	
	09-DEC-2010 15:00	DAM 3					✓
ES1025292-005	06-DEC-2010 15:00	D1	✓	✓	✓	✓	
	09-DEC-2010 15:00	D1					✓
ES1025292-006	06-DEC-2010 15:00	D2	✓	✓	✓	✓	
	09-DEC-2010 15:00	D2					✓
ES1025292-007	06-DEC-2010 15:00	DAM 5	✓	✓	✓	✓	
	09-DEC-2010 15:00	DAM 5					✓
ES1025292-008	06-DEC-2010 15:00	DAM2	✓	✓	✓	✓	
	09-DEC-2010 15:00	DAM2					✓
ES1025292-009	06-DEC-2010 15:00	TRIP BLANK			✓		

Requested Deliverables

[redacted]

- *AU Certificate of Analysis - NATA (COA) Email
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI) Email
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC) Email
- A4 - AU Sample Receipt Notification - Environmental (SRN) Email
- A4 - AU Tax Invoice (INV) Email
- Chain of Custody (CoC) (COC) Email
- EDI Format - ENMRG (ENMRG) Email

[redacted]

[redacted]

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[redacted]

WATER ANALYSES TO BE USED FOR DESIGN OF MORANBAH 2.0 ML/day WTF

	Units	INITIAL FEED WATER	FINAL FEED WATER	
pH				
pH Value	pH Unit	9.3	8.6	
Conductivity by PC Titrator				
Electrical Conductivity @ 25°C	µS/cm	13750	8100	
Total Dissolved Solids				
Total Dissolved Solids @180°C	mg/L	6450	5000	
Suspended Solids				
Suspended Solids (SS)	mg/L	30	30	Occasional excursions possible
Alkalinity by PC Titrator				
Hydroxide Alkalinity as CaCO3	mg/L	<1	<1	
Carbonate Alkalinity as CaCO3	mg/L	420	93	
Bicarbonate Alkalinity as CaCO3	mg/L	838	2450	
Total Alkalinity as CaCO3	mg/L	1250	2550	
Dissolved Major Anions				
Sulfate as SO4 2-	mg/L	2	2	
Chloride	mg/L	4280	1500	
Fluoride	mg/L	2.4	2	
Dissolved Major Cations				
Calcium	mg/L	19	17	
Magnesium	mg/L	30	26	
Sodium	mg/L	2970	2100	
Potassium	mg/L	22	11	
Dissolved Metals by ICP-MS				
Aluminium	mg/L	<0.01	<0.01	
Barium	mg/L	9.4	4	
Manganese	mg/L	0.002	0.02	
Strontium	mg/L	13	6.00	
Boron	mg/L	1.7	1.6	
Iron	mg/L	<0.05	0.1	
Total Metals by ICP-MS				
Aluminium	mg/L	0.18	0.03	
Barium	mg/L	9.5	4.1	
Manganese	mg/L	0.03	0.04	
Strontium	mg/L	13	7	
Boron	mg/L	1.7	1.6	
Iron	mg/L	0.25	1.2	
Silica by Discete Analyser				
Reactive Silica	mg/L	10	17.6	If 17.6 presents problems, please advise during bidding period.
Total Organic Carbon (TOC)				
Total Organic Carbon	mg/L	55	65	
Total Petroleum Hydrocarbons				
C6 - C9 Fraction	µg/L	<20	<20	
C10 - C14 Fraction	µg/L	<50	<50	
C15 - C28 Fraction	µg/L	250	250	
C29 - C36 Fraction	µg/L	800	800	The pre-treatment should be able to tolerate a short-term slug
C10 - C36 Fraction (sum)	µg/L	1050	1050	at 6 mg/L during initial operation.

[redacted]

10-Aug-10

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ Sydney: 277 Woodpark Rd, Smithfield NSW 2164 Ph: 02 8784 8555 E:samples.sydney@alsenviro.com
☐ Newcastle: 5 Rosegum Rd, Warabrook NSW 2304 Ph:02 4968 9433 E:samples.newcastle@alsenviro.com
☐ Brisbane: 32 Shand St, Stafford QLD 4053 Ph:07 3243 7222 E:samples.brisbane@alsenviro.com
☐ Townsville: 14-15 Desma Ct, Bohle QLD 4818 Ph:07 4796 0600 E: townsville.environment@alsenviro.com
☐ Melbourne: 4 Westall Rd, Springvale VIC 3171 Ph:03 8549 9600 E: samples.melbourne@alsenviro.com
☐ Adelaide: 2-4 Burma Rd, Pooraka SA 5095 Ph: 08 8359 0890 E:adelaide@alsenviro.com
☐ Perth: 10 Hod Way, Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsenviro.com
☐ Launceston: 27 Wellington St, Launceston TAS 7250 Ph: 03 6331 2158 E: launceston@alsenviro.com

CLIENT:	Aecom	TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g., Ultra Trace Organics) ☐ Standard TAT (List due date): ☐ Non Standard or urgent TAT (List due date):	FOR LABORATORY USE ONLY (Circle): Custody Seal Intact? Yes No N/A; Free ice / frozen ice bricks present upon receipt: Yes No N/A; Random Sample Temperature on Receipt: °C; Other comments:
OFFICE:	BNE		
PROJECT:	MCP	ALS QUOTE NO.:	COC SEQUENCE NUMBER (Circle): COC: 1 2 3 4 5 6 7; CF: 1 2 3 4 5 6 7
ORDER NUMBER:			
PROJECT MANAGER:		CONTACT PH:	
SAMPLER:	[redacted]	SAMPLER MOBILE: [redacted]	RELINQUISHED BY: [redacted] DATE/TIME: 7.12.10
COC emailed to ALS? (YES / NO)		EDD FORMAT (or default):	RECEIVED BY: [redacted] DATE/TIME: 7/12/10 11:10.
Email Reports to (will default to PM if no other addresses are listed):			RELINQUISHED BY: [redacted] DATE/TIME: 7/12/10 16:00
Email Invoice to (will default to PM if no other addresses are listed):	[redacted]		RECEIVED BY: [redacted] DATE/TIME: 9-12-10 4pm
COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:			

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	OH - SC	NUTRIENT SUITE (10 metals)	SUITE (TOTAL)	BTEX	E. Coli, Total Faecal Coliforms				Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	DAM 1	6.12.10	W			✓	✓	✓	✓	✓				
2	DAM 10	6.12.10	W			✓	✓	✓	✓	✓				
3	DAM 4	6.12.10	W			✓	✓	✓	✓	✓				
4	DAM 3	6.12.10	W			✓	✓	✓	✓	✓				
5	D1	6.12.10	W			✓	✓	✓	✓	✓				
6	D2	6.12.10	W			✓	✓	✓	✓	✓				
7	DAM 5	6.12.10	W			✓	✓	✓	✓	✓				
8	DAM 2	6.12.10	W			✓	✓	✓	✓	✓				
					TOTAL									

Environmental Division Sydney
Work Order
ES1025292

Telephone : +61-2-8784 8555

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

Ben McMahon

From: [redacted]
Sent: Wednesday, 15 December 2010 6:16 PM
To: Ben McMahon
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Transitional Environmental Program template draft

Categories: Red Category

Hi Ben

I will provide comments on this if required, but given yesterday's developments I thought I would ask if Arrow is considering putting other proposals to DERM?

If that is the case, I would rather discuss those proposals, than spend time on this preliminary draft.

Either way I think a meeting before COB Friday is required so that DERM is aware of Arrows situation at the site (dam levels and movement of water etc) and planned actions for this weekend/next week.

Also Tim's letter received this morning suggested that the MRL for dam 10 would be reached today. Please advise if this has occurred.

Please let me know what time on Friday would be suitable for a meeting and I will arrange a room here.

Also please ensure that someone with a sound engineering understanding of structures at the site is also in attendance (an engineer preferably).

Regards

[redacted]

From: Ben McMahon [redacted]
Sent: Tuesday, 14 December 2010 1:34 PM
To: [redacted]
Cc: [redacted]
Subject: Transitional Environmental Program template draft

Hi [redacted]

Attached is an early draft of the TEP.

Best regards

Ben McMahon

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

+----------+

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

+----------+

Ben McMahon

From: [redacted]
Sent: Thursday, 16 December 2010 3:45 PM
To: Tim Dean
Cc: Ben McMahon; [redacted]
Subject: RE: Arrow Sample Emails

Categories: Red Category

Tim

I spoke with Q Health and it is fine for the samples to be dropped off tomorrow morning before 9am.

[redacted](below) will be at the lab from 6am should it be possible for the samples to be dropped off earlier.

Regards

[redacted]
Supervisor - Inorganic Chemistry
Queensland Health Forensic and Scientific Services

Clinical and Statewide Services Division | Queensland Health

39 Kessels Road, Coopers Plains, Qld 4108
PO Box 594
ARCHERFIELD Queensland 4108
Ph: [redacted]
Mol
Fax
Ema
Web: www.health.qld.gov.au/qhcss/qhss/

From: Tim Dean [redacted]
Sent: Thursday, 16 December 2010 1:41 PM
To: [redacted]
Subject: Arrow Sample Emails

[redacted]

FYI

Tim

Ben McMahon

From: [redacted]
Sent: Friday, 17 December 2010 4:13 PM
To: Ben McMahon
Cc: Tim Dean; [redacted]
Subject: FW: Sampling needed for Arrow samples

Categories: Red Category

Ben

As you raised with me earlier, about me using you as key contact, would you please get other Arrow staff to use me (through yourself?) as key government contact in regards to sampling questions with Q Health? The context relates to emails/conversations other Arrow staff have had with Q Health in isolation of DERM.

Please find attached the comments from Q Health on the samples already submitted.

As you know different labs have different requirements based on levels of detection that can be reached.

If Arrow does not have the sample bottles required by Q Health please note Q Health offer to provide bottles.

In regards to getting bottles I spoke with [redacted] from Q Health in Mackay and he advised that there should be at least 6 (possibly more) available, so it is more convenient for Arrow to grab them

[redacted]
Director Environmental Health Services, Mackay
Mackay Public Health Unit
Tropical Regional Services
Division of the Chief Health Officer
Queensland Health
PO Box 5925
MACKAY MC 4741 or

Mackay Base Hospital Campus
475 Bridge Road MACKAY 4740
Phone: [redacted]
Mobile [redacted]

From: [redacted]
Sent: Friday, 17 December 2010 12:01 PM
To: [redacted]
Cc: [redacted]
Subject: Re: Sampling needed for Arrow samples

Hi [redacted]

The samples were received at the Laboratory at 7.30am this morning.

We received 5 samples labelled
Isaac 1 (sampled by) GB 14/12/2010 1600 hrs
Isaac 2 (sampled by) GB 14/12/2010 1630 hrs
Discharge (sampled by) GB 14/12/2010 1630 hrs
Pond 2 No.1 (sampled by) CR 16/12/2010 10.00am
Pond 2 No.2(sampled by) CR 16/12/2010 10.00am

For each site we received 2x40mL vials for BTEX, 1x (approximately)80mL glass bottle and 1x bottle for the Trace metals.

We will be able to do the BTEX testing on the 2x40mL vials, with an estimated time for the reporting of results of Tuesday(currently the Purge and Trap instrument is being serviced today and tomorrow, will be restarted tomorrow and should be operational by Monday)

The ~80 mL glass bottle submitted for PAH's,TPH's and Phenols is not suitable for analysis for these tests as we normally require 1000 mL(2x500mL bottles are ok) of sample for each of these tests, to achieve our normal reporting limits.

The HDPE bottle for the metals analysis is fine and Henry tells me you should have results either late Monday or Tuesday.

Of the other tests listed in the ALS COC form, we will not be able to do either the Total Nitrogen and Phosphorus or the Faecal coliforms/ E.Coli tests as the sample bottles, preservation(TN and TP require freezing) and holding period(Ecoli and faecal coliforms <24hrs) are not appropriate.
We could do the pH and EC on the glass bottle supplied for organics analysis but the result would be indicative only as the sample holding period will have been exceeded(pH).

If we can organise suitably sampled replacement samples we will process them as quickly as possible.

If required we can supply sample bottles.

If you can let me know what you think and we can try to find a way forward with these samples. If we can coordinate what you and QH requires with Arrow before they sample again, I think that we will have the best chance of getting some meaningful results.

Arrow are enquiring about submitting more samples next week, so I will speak to them shortly regarding today's samples and next weeks.

Regards

[redacted]

Acting Chief Chemist

[redacted]

Chemist, Organic Chemistry, Forensic and Scientific Services

Clinical and Statewide Services Division | Queensland Health

PO Box 594
ARCHERFIELD Queensland 4108
Ph: [redacted]
Mo
Fax
Em
Web: www.health.qld.gov.au/qhcss/

>>> [redacted] 16/12/2010 4:07 pm >>>
Hi [redacted] if you could please confirm when these arrive and a possible date by which results will be available that would be appreciated.

After speaking with Arrow I understand the only samples you should receive will relate to pond or dam 2 which was the storage they discharged from.

Attached is the chain of custody documents that arrow submitted to ALS for previous sampling at the site which Janet Cumming has indicated meets Q Health immediate needs.

From DERM s point of view, in addition the sampling listed on the chain of custody we need -

Polynuclear Aromatic Hydrocarbons (PAH)

- Naphthalene
- Acenaphthylene

- Acenaphthene
- Fluorene
- Phenathrene
- Anthracene
- Fluoroanthene
- Pyrene
- Benz(a)anthracene
- Chrysene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Benzo(a)pyrene

Total Petroleum Hydrocarbons (TPH)

- Naphthalene
- Nitrobenzene
- 2,4-dinitrotoluene
- 2,4,6-trinitrotoluene
- Phenol
- 2,4-dinitrophenol

Other
Chloride

Regards

[redacted]

From: [redacted]
Sent: Wednesday, 15 December 2010 11:14 AM
To: [redacted]
Subject: FW: Your Reference : MGP. COC/SRN for ALSE Workorder : ES1025292

[redacted]

Please find attached the Chain of Custody and Sample Receipts for the ALS dam samples that we discussed yesterday.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T [redacted]
F
M
www.arrowenergy.com.au

From: [redacted]
Sent: Wednesday, 15 December 2010 10:55 AM
To: Ben McMahon
Subject: FW: Your Reference : MGP. COC/SRN for ALSE Workorder : ES1025292

Chain of Custody for Samples taken 07/12/10

[redacted]
Water and Salt Infrastructure Coordinator

Arrow Energy Pty Ltd.
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F: [redacted]
M: [redacted]
http://www.arrowenergy.com.au/

From: [redacted]
Sent: Wednesday, 15 December 2010 10:53 AM
To: [redacted]
Subject: FW: Your Reference : MGP. COC/SRN for ALSE Workorder : ES1025292

Note that samples were collected on Monday delivered to lab on Tuesday am who then took two more days before they started analyses.

[redacted]
Groundwater Modelling Coordinator

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F: [redacted]
M: [redacted]
www.arrowenergy.com.au
[redacted]

From: ALSE Sydney Aus[redacted]
Sent: Friday, 10 December 2010 1:35 PM
To: [redacted]
Subject: Your Reference : MGP. COC/SRN for ALSE Workorder : ES1025292

This e-mail has been automatically generated.

-- PLEASE DO NOT REPLY --

+----------+

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

+----------+

Ben McMahon

From: Ben McMahon
Sent: Friday, 17 December 2010 5:41 PM
To: [redacted] Tim Dean
Subject: DERM update MGP 17 dec 10
Attachments: DERM update MGP 17 dec 10.pdf

Categories: Red Category

Hi [redacted]

A response your queries that you posed to us yesterday.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

17 December 2010

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Ref: ENV10-288

[redacted]

Manager, Petroleum and Gas Unit

Department of Environment & Resource Management

(sent via email17 December 2010)

RE: MGP Discharge

Dear [redacted]

Below is our response to your questions posed on Thursday 16 December in relation to the MGP.

Known integrity of pond 2 and its water level since pumping to pond 10?

There is evidence of seepage of saline water from the dam through the embankment. There is some rill erosion on the outer batter of the southern embankment which needs repair.

Arrow has engaged a third party civil engineer (URS) to review our position regarding safe dam operation. Dam 2 is 295 mm under MRL and falling as water is transferred into dam 10.

Level of pond 10 (thanks for update today) and any known concerns about its integrity?

There are no known concerns regarding the integrity of Pond 10. This dam remains 20mm below MRL as of 5pm Friday 17 December. We expect this dam to exceed the MRL over the weekend as water is transferred from dam 2 to dam 10.

Confirmed advice that pumping to dam 11 is not currently possible?

Pumping to dam 11 is not currently possible. Contrary to previous advice some sections of the pipework remain incomplete, pressure testing of the in place pipework has not been completed further progress on completing the required pipework has been delayed by wet weather.

Arrow's proposed management hierarchy if the site is again subject to heavy rainfall this coming weekend/early next week. This would pretty much be the most preferred to least preferred scenarios you raised with me. If Arrow have linked these scenarios to rainfall events this would also be helpful information?

Until we can satisfy concerns regarding water quality to be discharged we will continue to push water to Dam 10 and minimise the water being stored in Dam 2. We continue to investigate options for water management.

Current scenario if there was 120mm of rain over the weekend we estimate that the dams would at the following levels on Monday morning (assuming we do not allow the level in Pond 1 to go any higher than 100mm under MRL)

T +61 7 3012 4000 ARROW ENERGY LTD LEVEL 19, AM-60, 42-60 ALBERT STREET GPO BOX 5262 BRISBANE QLD 4001 info@arrowenergy.com.au
F +61 7 3012 4001 ABN 73 078 521 936 BRISBANE QLD 4000 ASX CODE AOE arrowenergy.com.au

Pond 1: *100mm under MRL*
Pond 2: *295mm under MRL*
Pond 10: *205mm above MRL (107mm under the spillway)*

Once we reach 50mm below spill on dam 10 we would commence discharge to the Isaac River to prevent environmental harm occurring from overland flow. We would endeavour to keep levels at or below MRL in dam 1 since it is not equipped with a spillway.

Status of sampling underway and any news about sampling results from ALS?

We expect further results from ALS this afternoon (EC, pH and mercury). The full suite of results will be available early next week. Samples have been provided to Queensland Health.

Key Arrow contacts over the weekend?

Ben McMahon Manager Compliance and Reporting [redacted]

Regards,

[redacted]

Ben McMahon
Manager Compliance and Reporting

ALS	21/12/2010	Sample ID	DAM 1	DAM 10	DAM 5	DAM2	TRIP BLANK
		ID2					
ES1025292	Results	Date Sampled	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010
Analyte	CAS #	Units	LOR	WATER	WATER	WATER	WATER	WATER
EA005: pH								
pH Value		pH Unit	0.01	9.17	9.28	9.27	9.15	-
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C		µS/cm	1	12600	14000	10700	10600	-
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	mg/L	0.001	0.003	0.003	<0.001	0.002	-
Barium	7440-39-3	mg/L	0.001	6.54	8.33	6.4	9.31	-
Beryllium	7440-41-7	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	-
Cadmium	7440-43-9	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Cobalt	7440-48-4	mg/L	0.001	<0.001	<0.001	<0.001	0.001	-
Chromium	7440-47-3	mg/L	0.001	<0.001	<0.001	<0.001	0.002	-
Copper	7440-50-8	mg/L	0.001	0.002	0.002	0.003	0.004	-
Manganese	7439-96-5	mg/L	0.001	0.008	0.003	0.002	0.038	-
Nickel	7440-02-0	mg/L	0.001	0.001	<0.001	<0.001	0.003	-
Lead	7439-92-1	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	-
Vanadium	7440-62-2	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	-
Zinc	7440-66-6	mg/L	0.005	<0.005	<0.005	<0.005	0.008	-
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	mg/L	0.01	<0.10	<0.10	<0.10	<0.10	-
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N		mg/L	0.01	<0.01	<0.01	<0.01	<0.01	-
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	mg/L	0.01	0.02	0.01	0.01	0.03	-
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N		mg/L	0.01	0.02	0.01	0.01	0.03	-
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N		mg/L	0.1	1.7	0.5	0.9	1.2	-
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
Total Nitrogen as N		mg/L	0.1	1.7	0.5	0.9	1.2	-
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P		mg/L	0.01	<0.02	<0.01	<0.01	<0.01	-
EP080: BTEX								
Benzene	71-43-2	µg/L	1	<1	<1	<1	<1	<1
Toluene	108-88-3	µg/L	2	<5	<5	<5	<5	<5
Ethylbenzene	100-41-4	µg/L	2	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	µg/L	2	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	µg/L	2	<2	<2	<2	<2	<2
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	%	surrogate	113	111	110	106	106
Toluene-D8	2037-26-5	%	surrogate	110	106	107	103	102
4-Bromofluorobenzene	460-00-4	%	surrogate	106	99.7	101	97	101

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17 February 2011

Ref: ENV11-17

[redacted]
Department of Environment & Resource Management
(sent via email 17 February 2011)

RE: MGP TEP Compliance update

Dear [redacted]

Arrow Energy is currently experiencing delays in obtaining lab results in relation to a number of samples collected between the 4/2/2011 to the 7/2/2011. These results were collected during the last period of discharge to the Isaac River under Transitional Environmental Program titled "Coal Seam Water Management Moranbah Gas Project".

The latest advice received from our laboratory is that the results will be available on the 21/2/2011. This will be outside of the 10 business days stipulated in the conditions of the TEP document. At present the site is not discharging water. This delay in obtaining results does not pose any potential to cause environmental harm.

Arrow Energy will provide the results to DERM when they become available

Best regards,

[redacted]

Ben McMahon
Manager Compliance and Reporting

02 February 2010

Ref: ENV11-05

[redacted]

Department of Environment & Resource Management
(sent via email 02 February 2010)

RE: Discharge notification

Dear [redacted]

Further to [redacted] correspondence with yourself and your team yesterday I am writing on the behalf of Arrow Energy Limited to provide clarification regarding discharge under the draft TEP. As detailed in the correspondence provided by [redacted] yesterday discharge commenced from RP1 at 10:50am, 31 January 2011 discharge was ceased at 6pm 1 February 2011. The site has been evacuated in anticipation of the current extreme weather.

We intend to recommence discharge unless advised otherwise once it is safe to return and operate the site. This letter is our formal notification of intent to discharge under a draft TEP relating to Moranbah PL191/196 (under EA PEN100015907 grated 14th September 2010).

Current Dam levels

Dam 10 is currently 60mm below MRL
Dam 2 is currently 910mm below MRL – the target level is to be <4000mm to ensure integrity
Dam 1 is 130mm below MRL
Dam 5 is 1770mm below MRL
We are expecting significant rainfall associated with cyclone Yasi.

Discharge details

Arrow intends to commence discharge into Isaac River from RP 1 from the 4 February at a discharge rate of upto 7.5ML/day (depending on available dilution) for the duration that sufficient flow is available in the Isaac river (i.e. greater than 1090ML/day as per the draft TEP conditions). As of the 1 February 2011 available river monitoring data from the Isaac River monitoring station at Goonyella recorded daily values of 5867 ML/day.

At present this flow is falling but we expect forecast rainfall associated with Yasi to contribute to daily flow and allow for discharge from the site for at least 7 days (Which implies a total discharge of upto 52.5 ML). Daily sampling has recommenced at both upstream and downstream monitoring points.

Cyclone preparation

Due to cyclone Yasi and potential rain to be dumped on the Moranbah site:

- Arrow is in the process of implementing crisis management plans for field staff working in the Moranbah area this plan includes evacuation of staff particularly since our offices and accommodation comprise temporary 'donga' style accommodation.
- Access to the field is now limited - currently the Isaac Crossings are closed and due to the recent rain, field conditions are unstable.
- The Moranbah airport is currently closed this will restrict our ability to move samples from Moranbah during the cyclone. We will maintain samples that can be analysed following a delay some samples with limited retention times may be impacted.

T +61 7 3012 4000 ARROW ENERGY LTD LEVEL 19, AM-60, 42-60 ALBERT STREET GPO BOX 5262 BRISBANE QLD 4001 info@arrowenergy.com.au
F +61 7 3012 4001 ABN 73 078 521 936 BRISBANE QLD 4000 ASX CODE AOE arrowenergy.com.au

- The weather may prevent some samples from being collected due to access and safety requirements. We will monitor conditions and report any ongoing monitoring issues to DERM.

Regards,

[redacted]

Ben McMahon
Manager Compliance & Reporting

Sample ID	Location Description	Analyte	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Nickel	Zinc	Boron	Cobalt	Manganese	Molybdenum	Selenium	Silver	Uranium	Vanadium
		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
		Date Sampled/LOR	0.01	0.01-0.001	0.005 - 0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.0001	0.01-0.001	0.01-0.005	0.1-0.05	0.01-0.001	0.01-0.001	0.01-0.001	0.01	0.001	0.001	0.01
ANZG 2018 Default Trigger Investigation Level 95%			0.055	0.013	0.0002	0.001	0.002	0.3	0.0015	0.0002	0.011	0.008	0.37	0.09	1.9	0.034	0.015	0.001	0.003	0.01
DISCHARGE POINT	Discharge Point (MP1)	21/12/2010		<0.01	<0.005				0.01	<0.0001			<0.1	0.01	0.39	<0.01	<0.01		<0.001	
ISAAC 1	Up Stream (MP3)	21/12/2010		<0.01	<0.005				0.01	<0.0001			<0.1	0.01	0.48	<0.01	<0.01		<0.001	
ISAAC 2	Downstream (MP2)	21/12/2010			<0.005				<0.01	<0.0001			<0.1	0.01	0.5	<0.01	<0.01		<0.001	
DISCHARGE POINT		21/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ISAAC 1		21/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ISSAC 2	Downstream (MP2) QC	21/12/2010		<0.01	<0.005				<0.01	<0.0001			<0.1	<0.01	0.39	<0.01	<0.01		<0.001	
DISCHARGE POINT	Discharge Point (MP1)	23/12/2010	-	0.001	<0.0001			-	0.006	<0.0001			-	-	-	-	-	-	-	-
Downstream	Downstream (MP2)	23/12/2010	-	0.002	<0.0001			-	0.006	<0.0001			-	-	-	-	-	-	-	-
ISAAC 2	Downstream (MP2) QC	23/12/2010	-	0.001	<0.0001			-	0.005	<0.0001			-	-	-	-	-	-	-	-
ISAAC 1-S1	Up Stream (MP3)	24/12/2010		<0.001	<0.0001				0.005	<0.0001			<0.05	0.01	0.252	<0.001	<0.01	<0.001	-	
ISAAC 1-QC1	Up Stream (MP3) QC	24/12/2010		0.001	<0.0001				0.005	<0.0001			<0.05	0.006	0.244	<0.001	<0.01	<0.001	-	
ISAAC 2- S2	Downstream (MP2)	24/12/2010		0.002	<0.0001				0.005	<0.0001			<0.05	0.007	0.289	<0.001	<0.01	<0.001	-	
ISAAC 2- QC2	Downstream (MP2) QC	24/12/2010		0.002	<0.0001				0.007	<0.0001			<0.05	0.008	0.383	<0.001	<0.01	<0.001	-	
DISCHARGE-S3	Discharge Point (MP1)	24/12/2010		0.001	<0.0001				0.007	<0.0001			<0.05	0.007	0.399	<0.001	<0.01	<0.001	-	
DISCHARGE-QC3	Discharge Point (MP1) QC	24/12/2010		0.002	<0.0001				0.007	<0.0001			<0.05	0.01	0.424	<0.001	<0.01	<0.001	-	
QC 5		24/12/2010																		
S5		25/12/2010																		
ISAAC1-S1	Up Stream (MP3)	29/12/2010	-	<0.001	<0.0001			-	0.004	<0.0001			-	0.005	0.235	-	-	-	-	
ISAAC1-QC1	Up Stream (MP3)QC	29/12/2010	-	<0.001	0.0002			-	0.004	<0.0001	0.01		-	0.005	0.242	-	-	-	-	
ISAAC2-S2	Downstream (MP2)	29/12/2010	-	<0.001	0.0001			-	0.005	<0.0001			-	0.005	0.264	-	-	-	-	
ISAAC2-QC2	Downstream (MP2) QC	29/12/2010	-	<0.001	<0.0001			-	0.004	<0.0001	0.01		-	0.006	0.24	-	-	-	-	
DISCHARGE-S3	Discharge Point (MP1)	29/12/2010	-	0.003	<0.0001	<0.001		-	<0.001	<0.0001	0.001	<0.005	-	<0.001	0.008	-	-	-	-	<0.01
DISCHARGE-QC3	Discharge Point (MP1) QC	29/12/2010	-	0.002	<0.0001	<0.001		-	<0.001	<0.0001	0.001	<0.005	-	<0.001	0.008	-	-	-	-	<0.01
TRIP-QC5		29/12/2010																		
TRIP-S3		29/12/2010																		
DISCHARGE POINT	Discharge Point (MP1)	31/12/2010	-	<0.001	<0.0001	<0.001		-	<0.001	<0.0001	0.001	0.007	-	<0.001	0.019	-	-	-	-	<0.01
ISAAC 1	Up Stream (MP3)	31/12/2010	-	<0.001	<0.0001			-	0.004	<0.0001	0.009		-	0.005	0.201	-	-	-	-	
ISAAC 2		31/12/2010	-	0.001	<0.0001			-	0.004	<0.0001			-	0.005	0.184	-	-	-	-	
TRIP 1 2		31/12/2010																		
Issac 1 - s1	Up Stream (MP3)	02/01/2011		0.002	<0.0001				0.012	<0.0001			0.09	0.008	0.005	0.017	<0.001	<0.01	<0.001	<0.001
Issac 2 - s2	Downstream (MP2)	02/01/2011		0.001	<0.0001				0.012	<0.0001			<0.05	0.014	0.005	0.021	<0.001	<0.01	<0.001	<0.001
Discharge point - s3	Discharge Point (MP1)	02/01/2011		0.002	<0.0001		<0.001	0.15	<0.001	<0.0001	0.008	<0.01		0.002	<0.001	0.01	0.005	<0.01	<0.001	<0.001
Issac 1 - qc1	Up Stream (MP3) QC	02/01/2011		0.001	<0.0001				0.012	<0.0001			0.09	0.008	0.005	0.018	<0.001	<0.01	<0.001	<0.001
Issac 2 - qc2	Downstream (MP2)QC	02/01/2011		0.001	<0.0001				0.012	<0.0001			<0.05	0.008	0.005	0.016	<0.001	<0.01	<0.001	<0.001
Discharge point - qc3	Discharge Point (MP1) QC	02/01/2011		0.002	<0.0001		<0.001	0.19	0.001	<0.0001	0.008	<0.01		0.002	<0.001	0.011	0.003	<0.01	<0.001	<0.001
Trip - QC5		02/01/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Issac 1 - s1	Up Stream (MP3)	03/01/2011		0.001	<0.0001				0.015	<0.0001			0.05	0.009	0.004	0.018	<0.001	<0.01	<0.001	<0.001
Issac 2 - s2	Downstream (MP2)	03/01/2011		0.001	<0.0001				0.019	<0.0001			<0.05	0.013	0.005	0.019	<0.001	<0.01	<0.001	<0.001
Discharge point - s3	Discharge Point (MP1)	03/01/2011		0.002	<0.0001	<0.001	<0.001	0.14	0.001	<0.0001	0.01	<0.01		0.002	<0.001	0.006	0.002	<0.01	<0.001	<0.001
Issac 1 - qc1	Up Stream (MP3) QC	03/01/2011		0.001	<0.0001				0.019	<0.0001			0.05	0.011	0.005	0.02	<0.001	<0.01	<0.001	<0.001
Issac 2 - qc2	Downstream (MP2)QC	03/01/2011		0.001	<0.0001				0.02	<0.0001			<0.05	0.011	0.005	0.02	<0.001	<0.01	<0.001	<0.001
Discharge point - qc3	Discharge Point (MP1) QC	03/01/2011		0.002	<0.0001	<0.001	<0.001	0.15	0.001	<0.0001	0.01	<0.01		0.002	<0.001	0.008	0.002	<0.01	<0.001	<0.001
Trip - QC5		03/01/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Issac 1 - s1	Up Stream (MP3)	04/01/2011		0.002	<0.0001				0.005	<0.0001			0.08	0.005	0.178	<0.001	<0.01	<0.001	<0.001	
Issac 2 - s2	Downstream (MP2)	04/01/2011		0.002	<0.0001				0.004	<0.0001			0.06	0.004	0.235	<0.001	<0.01	<0.001	<0.001	
Discharge point - s3	Discharge Point (MP1)	04/01/2011		0.002	<0.001	<0.001		0.12	<0.001	<0.0001	<0.001	<0.005		<0.001	0.006	0.003	<0.01	<0.001	<0.001	<0.01
Issac 1 - qc1	Up Stream (MP3) QC	04/01/2011		0.002	<0.0001				0.005	<0.0001			0.08	0.005	0.186	<0.001	<0.01	<0.001	<0.001	
Issac 2 - qc2	Downstream (MP2)QC	04/01/2011		0.002	<0.0001				0.005	<0.0001			0.06	0.004	0.185	<0.001	<0.01	<0.001	<0.001	
Discharge point - s3	Discharge Point (MP1) QC	04/01/2011		0.002	<0.0001	<0.001		0.12	<0.001	<0.0001	<0.001	<0.005		<0.001	0.006	0.003	<0.01	<0.001	<0.001	<0.01
Trip - s5		04/01/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Issac 1 - s1	Up Stream (MP3)	05/01/2011		0.001	<0.0001				0.004	<0.0001	0.009		0.05	0.003	0.138	<0.001	<0.01	<0.001	<0.001	
Issac 2 - s2	Downstream (MP2)	05/01/2011		0.001	<0.0001				0.004	<0.0001	0.009		<0.05	0.004	0.144	<0.001	<0.01	<0.001	<0.001	
Discharge point - s3	Discharge Point (MP1)	05/01/2011		0.002	<0.0001	<0.001		0.12	<0.001	<0.0001	<0.001			<0.001	0.008	0.003	<0.01	<0.001	<0.001	<0.01
Issac 1 - qc1	Up Stream (MP3) QC	05/01/2011		0.002	<0.0001				0.004	<0.0001	0.01		0.05	0.004	0.148	<0.001	<0.01	<0.001	<0.001	
Issac 2 - qc2	Downstream (MP2)QC	05/01/2011		0.001	<0.0001				0.004	<0.0001	0.01		0.05	0.004	0.156	<0.001	<0.01	<0.001	<0.001	
Discharge point - s3	Discharge Point (MP1) QC	05/01/2011		0.002	<0.0001	<0.001		0.13	<0.001	<0.0001	<0.001			<0.001	0.008	0.003	<0.01	<0.001	<0.001	<0.01
Notes:																				
IS = Insufficient Sample																				

Ben McMahon

From: [redacted]
Sent: Tuesday, 21 December 2010 12:27 PM
To: Ben McMahon
Cc: [redacted]
Subject: RE: CH4: Water Discharge in Moranbah

Categories: Red Category

Ben

I have spoken with the Mayor for Isaacs and Rockhampton this morning.

In regards to landholders I need to know who Arrow has advised and their contact details – **please pass on the details asap.**

It is DERMs intention to speak with any landholders who have Arrow infrastructure on their property i.e. who owns the land pond 2 and pond 10 are on?

We do have some details from the BTEX issue, however I don't see the point in calling upstream landholders or those that don't have dams on their property.

Regards

[redacted]

From: [redacted]
Sent: Monday, 20 December 2010 7:56 PM
To: [redacted]
Cc:
Subject: CH4: Water Discharge in Moranbah

Dear [redacted]

Please see the attached notification from CH4 Pty Ltd. [redacted] and I will call you shortly to discuss.

Kind regards,

[redacted]
VP Legal

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T:
F:
M:
www.arrowenergy.com.au

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

Ben McMahon

From: [redacted]
Sent: Tuesday, 21 December 2010 3:09 PM
To: Ben McMahon
Cc: [redacted] Tim Dean
Subject: RE: FW: Sampling needed for Arrow samples

Categories: Red Category

Hi Ben – sorry thought I had already sent this when we spoke earlier Ben.

Can you update me on this so I can advise QLD Health as to when further samples will arrive? Importantly given the river levels does Arrow have a schedule for when the daily samples will flow through?

Also are duplicates being taken for everything? Q Health advised that samples received 20/12 only had duplicates for BTEX

If there is a need for lab to stay open over the coming weekend, some pre planning will need to be put in place sooner rather than later.

Also as per my request last week, can you please ensure Arrow, goes through yourself to me for any discussions with QLD Health or at least CC DERM in on any emails?

I ask as Q Health are still receiving emails from [redacted] of Arrow, which I am not seeing.

As you would imagine DERM and Q Health are working together on this issue and we need to know what is occurring from a sampling point of view.

Regards

[redacted]

From: [redacted]
Sent: Monday, 20 December 2010 9:44 AM
To: Ben McMahon
Subject: FW: FW: Sampling needed for Arrow samples

Hi Ben

Would you be able to advise me of the answer to [redacted] question? I will pass on your response.

Cheers

From: [redacted]
Sent: Monday, 20 December 2010 9:09 AM
To: [redacted]
Cc: [redacted]
Subject: Re: FW: Sampling needed for Arrow samples

Hi [redacted]

Do you have any idea when any additional samples from Arrow are likely to be submitted, I'm just trying to coordinate resources at the lab around any urgent work that is expected this week.

Thanks for that

[redacted]
Chemist, Organic Chemistry, Forensic and Scientific Services

Clinical and Statewide Services Division | Queensland Health

PO Box 594
ARCHERFIELD Queensland 4108
Ph: [redacted]
Mob
Fax:
Ema
Web: www.health.qld.gov.au/qhcss/

Ben McMahon

From: [redacted]
Sent: Wednesday, 22 December 2010 8:09 AM
To: [redacted] Ben McMahon
Cc: [redacted]
Subject: RE: CH4: Water Discharge in Moranbah

Categories: Red Category

Morning Ben

I noted from the DERM website shows the gauging station at Goonyella is dropping and was flowing at 2705ML per day at 6am this morning.

At what time does Arrow expect the flow to drop below 2000ML/day? Can you please confirm that Arrow still intend to cease discharge at this point?

Regards

[redacted]

http://www.derm.qld.gov.au/water/monitoring/current_data/site_details.php?site_id=130414A

From: [redacted]
Sent: Monday, 20 December 2010 7:56 PM
To: [redacted]
Cc: [redacted]
Subject: CH4: Water Discharge in Moranbah

Dear [redacted]

Please see the attached notification from CH4 Pty Ltd. [redacted] and I will call you shortly to discuss.

Kind regards,

[redacted]
VP Legal

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5808, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

3 sheets of A4 paper = 1 litre of water

Ben McMahon

From: Ben McMahon
Sent: Wednesday, 22 December 2010 1:55 PM
To: [redacted]
Subject: FW: Bureau of Meteorology Urgent Warning
Attachments: EMD Priority Update #1 (3pm 211210).doc

Categories: Red Category

Hi [redacted]

Our current plan is to cease discharge at 1000ML/day but maintaining the 400:1 dilution ratio by reducing the discharge rate appropriately.

The facility is now able to discharge upto 7.5ML/day - at present we are shutting the pumps down for a few hours per day to maintain at 5ML/day. We would like the option to discharge at a higher rate when there is sufficient water to allow dilution at the 400:1 ratio.

Attached is the EMD update that we received earlier today.

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

From: [redacted]
Sent: Wednesday, 22 December 2010 12:27 PM
To: Tim Dean; [redacted]
Subject: Bureau of Meteorology Urgent Warning

Emergency Management Division

Priority Update #1

3pm Tuesday 21/12/10

The Bureau of Meteorology has issued government departments with an urgent warning of heavy rain over widespread areas of the state that is likely between Wednesday 22nd December and 27th December 2010.

Why? – **A trough is currently forming over south east Queensland that will bring lingering heavy rain to the south east corner between Wednesday night and next Monday.**

In the north, lows in the Coral Sea and Gulf of Carpentaria are expected to cross the coast bringing widespread rain to large areas with flooding rains to localised areas. Both lows have the potential to become low grade cyclones, but this is not currently expected.

The Coral Sea low is currently predicted to cross the east coast between Cardwell and Bowen on Friday night or Saturday morning.

South East Queensland
Starting Wednesday night south east Queensland can expect between 50 and 100mm of rain daily for a period of four to five days.

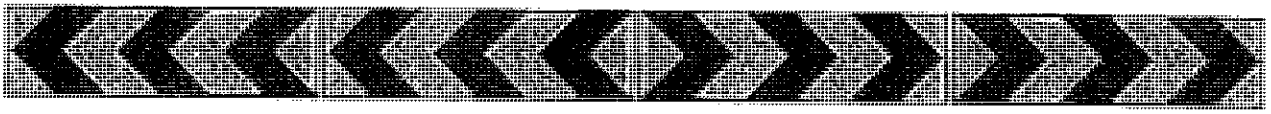
While accurate hydraulic modelling cannot be done until rainfall figures become known, the rain will fall on saturated soils at a time when the dams, despite opening of gates, will have limited capacity for flood mitigation.

Wide Bay
Rain is forecast starting Wednesday with potential for daily falls of between 100mm and 150mm

Central Queensland, Central Highlands and Whitsundays
Daily forecasts of between 100 and 150mm have been predicted between Thursday and next Monday for the Central Coast with rain moving to the west.

Emerald could have up to 100 to 150mm of daily rain, and as far west as Longreach and into the Carnarvons, falls of up to 50mm to 100mm can be expected.

Between Gladstone and Bowen falls could measure between 200mm and 300mm between Wednesday night and Monday with localised falls of 500mm possible on Friday night and Saturday.



Rockhampton could be facing rainfall of 100mm to 200mm between Wednesday and Sunday with the rain then moving into the Fitzroy River catchment, further swelling rivers in that catchment including the Issacs and Connor Rivers.

Tropical North Coast
The BoM has forecast isolated falls of up to 500mm in the Burdekin catchment between Wednesday and Saturday with rain easing through Sunday and Monday.

Maritime
The lows are expected to generate winds of up to 25 knots, and seas and swells of up to 3 metres, but the major impact is expected to be rain.

Preparations

- EMD will again be briefed by the Bureau of Meteorology on Wednesday with more up to date forecasts and river modelling.
- Following this brief EMD will prepare another briefing and a meeting of the Critical Incident Management Team will be convened with invitations to be sent to all regions following that briefing
- The State Disaster Co-ordination Group in conjunction with QPS will be preparing media statements warning of the dangers of flooding in order to provide a consistent message about flood water dangers.
- District Disaster Management Groups and Local Disaster Management Groups are expected to be activated over the next couple of days
- All Regional Emergency Management Teams should meet in preparation for tomorrow's CIMT teleconference

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Please circulate this information as widely as possible with your staff
It is important to ensure TMR is as prepared as possible.

The next report will be Wednesday's *Daily Update* unless the situation alters dramatically.

***Priority Updates* will be issued as required.**

Ben McMahon

From: [redacted]
Sent: Wednesday, 22 December 2010 5:06 PM
To: Ben McMahon
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Bureau of Meteorology Urgent Warning

Categories: Red Category

Ben

Thanks for this advice.

As discussed DERM has not authorised this discharge.

I reiterate my comments that Arrow should ensure it has conducted a thorough risk assessment in regards to this decision, in line with the risk assessment I assume occurred when the decision to commence release on Monday 20 December was made.

Regards

[redacted]

From: Ben McMahon [redacted]
Sent: Wednesday, 22 December 2010 1:55 PM
To: [redacted]
Subject: FW: Bureau of Meteorology Urgent Warning

Hi [redacted]

Our current plan is to cease discharge at 1000ML/day but maintaining the 400:1 dilution ratio by reducing the discharge rate appropriately.

The facility is now able to discharge upto 7.5ML/day - at present we are shutting the pumps down for a few hours per day to maintain at 5ML/day. We would like the option to discharge at a higher rate when there is sufficient water to allow dilution at the 400:1 ratio.

Attached is the EMD update that we received earlier today.

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

From: [redacted]
Sent: Wednesday, 22 December 2010 12:27 PM
To: Tim Dean; Ben McMahon
Subject: Bureau of Meteorology Urgent Warning

+----------+

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

+----------+

Ben McMahon

From: Ben McMahon
Sent: Thursday, 23 December 2010 1:00 PM
To: [redacted]
Subject: Draft TEP MGP 23 December 2010
Attachments: Draft TEP MGP 23 December 2010.docx

Categories: Red Category

[redacted]

As discussed earlier today please find attached a draft TEP in relation to PL191/196.

Please do not hesitate to contact me with any comments or concerns.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

Ben McMahon

From: Ben McMahon
Sent: Thursday, 23 December 2010 4:48 PM
To: [redacted]
Subject: Draft TEP MGP 23 December 2010 word 2003 version
Attachments: Draft TEP MGP 23 December 2010 word 2003 version.doc

Categories: Red Category

Hopefully this version works

b

Ben McMahon

From: Ben McMahon
Sent: Thursday, 23 December 2010 4:49 PM
To: [redacted]
Subject: Draft TEP MGP 23 December 2010 word 2003 version
Attachments: Draft TEP MGP 23 December 2010 word 2003 version.pdf

Categories: Red Category

Here you go [redacted]

B

DRAFT TRANSITIONAL ENVIRONMENTAL PROGRAM UNDER SECTION 333 OF THE *ENVIRONMENTAL PROTECTION ACT 1994*

Principal Holder:	CH4 Pty Ltd **AM-60** Level 19 42 Albert Street Brisbane QLD 4000
EA Number:	PEN100015907
Title:	**Coal Seam Water Management Moranbah Gas Project**
Date:	23 December 2010
Finish Date:	31 May 2011

Introduction

As previously indicated in correspondence to DERM (dated 25 October 2010) and subsequent responses to information requests and the program notice documentation submitted by Arrow (dated 3 December 2010), the Moranbah Gas Project lacks sufficient water storage capacity. This has been caused by an early start to the wet season contributing to existing dam levels and causing construction delays. This has prevented Arrow from making additional storage available via the completion of dam 11. The synthetic lining for the dam cannot be installed during periods of rainfall; the civil engineering also requires careful control of the moisture content of the construction materials to achieve the required specifications.

Dam 11 has been designed and is being constructed in line with the most current dam standards stipulated by DERM and contained in the previously submitted and assessed dam design report. It is a large lined dam – intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies.

The continued rain has delayed the completion of dam 11. This has put Arrow in a position where it cannot comply with the current EA conditions. Arrow intends to employ this transitional environmental program (TEP) as defined in Chapter 7, Part 4 of the *Environmental Protection Act 1994 to bring our operation back into compliance with its current Environmental Authority*. In initiating this process Arrow intends to work with DERM to minimise the potential for environmental harm.

Background

Arrow currently employs a network of 10 dams across PL191 and PL196. Dams 1 through to 7 are shown in the attached drawing (Appendix C). Dams 8 and 9 in the network are SW of the main area depicted in the provided drawing. Approximately 90% of the total storage capacity for coal seam water is held between dams 1, 2 and 10. The other dams are employed to move water between groups of remote wells. An important feature of the petroleum lease is the Isaac River which divides the lease along a NW to SE axis and its tributary Teviot Brook. Isaac River is an ephemeral river; during periods of high flow it limits access to infrastructure on the north eastern side of the petroleum lease via river crossings.

Situation

Based on our risk assessment (refer to Appendix A), our strategy is to maintain DSA level in the older and less accessible dams (particularly dams 5,6,7, 8 and 9) by moving water to dams 1 and 10. Dam 10 is our most recently constructed dam and has an engineered spillway, dam 1 is in reasonable condition and adjacent to dam 10 which allows water to be transferred readily between dams.

Our risk assessment process has identified particular concerns with the integrity of dam 2. This program includes an independent engineering evaluation of dam 2. Arrow has concerns regarding the condition of dam 2 – it is scheduled to be brought out of service on the completion of Dam 11. Based on a precautionary approach we intend to lower the level of water in Dam 2 to 500mm below DSA unless otherwise informed by an independent engineering assessment as a component of this TEP. The goal of this strategy is to maintain pond integrity and minimise discharge to the environment.

Arrow believes that a controlled discharge during high flow conditions in the Isaac River via the existing infrastructure would result in the least environmental impact whilst preserving the integrity of the existing dams. This option prevents the overland flow of untreated coal seam water reaching the Isaac River and minimises the risk of damaging older dams which are built prior to the new standards and lack spillways. When the facility was developed the water management scheme included a wet weather discharge, which required different infrastructure to that necessary to comply with the conditions of the current Environmental Authority

Our system of dams has an area of 125,100 m^2, this equates to a gain of 0.125ML per mm of rainfall. The system is designed to transfer water to the major storage dams 1, 2 and 10 this contribute to the catchments of these structures, each 1 mm of rainfall will cause an increase in dam height of 1.6 mm in dams 1, 2 and 10. When all the input rainfall is directed to dam 10 each 1 mm of rainfall causes an increase in dam height of 2.7 mm in dam 10.

Table 1 Key Dam Variables Dams 1, 2 and 10

Dam		1	2	10
Volume at Spill level	ML	119.66	92.64	203.70
Spillway		No	No	Yes
Liner type		CCL	CCL	1.5mm HDPE
Hydraulic height	n	5.60	5.50	4.75
MRL	m	5.25	5.15	4.40
DSA	m	4.75	4.65	3.90
Target dam fill height	m	4.75	4.15	3.90
Volume to discharge	ML	11.8	15.6	16
Current level (below MRL)[a]	mm	90	300	-110
Remaining capacity	ML	14	17	16
Remaining rainfall *(to spill)*	mm	271	400	148

[a] Levels at 10am 20 December 2010, negative denotes level above MRL

[b] Rainfall based on approximate catchment ratio of 1.6 (based on total catchment area including transfer dams)

[c] Target dam fill height is DSA for dams 1 and 10. Current target height for Dam 2 is based on internal arrow assessment

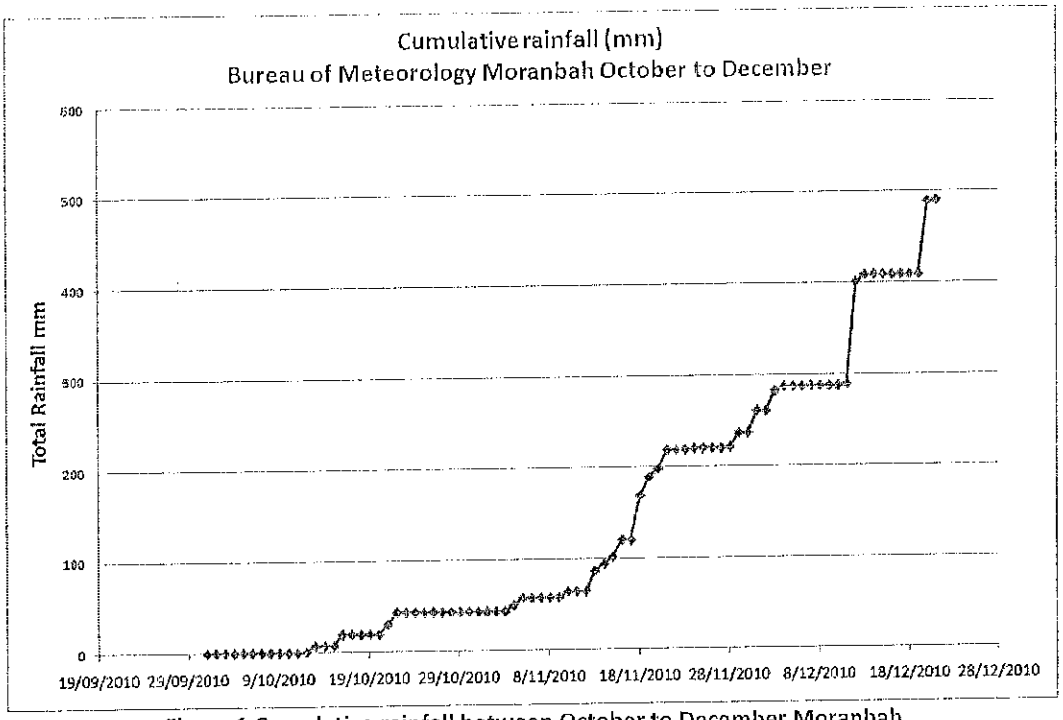


Figure 1 Cumulative rainfall between October to December Moranbah

Future water levels will be a product of the rainfall, coal seam water production and evaporation. Our goal is to maintain dams 1 and 10 at DSA levels by employing a discharge to the Isaac River. Dam 2 will be lowered to a level determined by independent third party engineering risk assessment.

Arrow has evaluated 2 scenarios for water requiring discharge from the storage system:

- Scenario 1 – Mean rainfall until end of wet season
- Scenario 2 – 95th percentile rainfall until end of wet season

Rainfall to date is very close to the 95th percentile rainfalls on average from October through to December. We have had a cumulative total of 490mm from the 1st of October to date (Figure 1), 95th percentile cumulative rainfall for the period from the start of October to the end of December totals 522mm. At present with one week remaining in December the cumulative total is 30mm short of the 95th percentile. Given the current progress of the wet season Arrow believes that the next few months will produce above average rainfall. Long range forecasts from the Bureau of Meteorology give a 55% chance of rainfall at or above the 95% percentile values. In determining the water balance for the facility has evaluated 2 scenarios – mean and 95th Percentile rainfall (refer to Table 2).

Table 2 Discharge scenarios

Scenario	Volume to reach DSA (ML)	Additional removal from Dam 2 (ML) [b]	Expected Net [a] Water to Storage (ML)	Total (ML)	Required Discharge Rate (ML/d)[c]
Mean Rainfall	69	7	54.5	130.5	2.2
95th Percentile	69	7	130	206	3.5

[a] *Net water to storage is produced water, less evaporation plus expected rainfall.*

[b] *This is based on a dam 2 target of 500mm belaw DSA. This target will to be informed via third party engineering evaluation.*

[c] *Calculated discharge is based on continuaus flow this TEP propases discharge based on Isaac River flow at a specified dilution rate.*

Arrow proposes a discharge of up to 7.5ML/day to commence when the Isaac River is at least 1000 m^3/day measured upstream at the Goonyella river gauge (operated by DERM). Discharge will be maintained at a 400:1 dilution ratio on the basis of maintaining Australian drinking water guidelines (NHMRC,2004) downstream of the discharge. Based on a predicted salinity impact as detailed in Appendix B. This discharge rate and the dilution factor will be reviewed thoughout the TEP in consultation with DERM and informed on the basis of the upstream/downstream river monitoring.

Sampling will be conducted in line with the conditions detailed in this TEP under the procedure attached as Appendix D. Appendix A contains detailed results of the sampling completed to date to characterise the coal seam water to be discharged.

Supporting Information

Consideration of the management hierarchy for the management of coal seam water at the MGP

Evaluation as per the management hierarchy of preferred procedures from Environmental Protection (Water) Policy 2009:

Step 1—evaluate water conservation measures to reduce the use of water and the production of waste water or contaminants;
Water is not employed in the coal seam gas production process but must be removed from the coal seam to allow the gas to be extracted. Water conservation measures will not reduce the amount of coal seam water associated with the gas extracted.

Step 2—evaluate waste prevention options and implement appropriate waste prevention measures;
The key waste prevention measure employed is maximisation of the coal seam gas to water ratio. The coal seams targeted by MGP have relatively low ratios of water to gas in comparison to other fields. In an effort to manage our recent water storage constraints Arrow has shut in a large number of wells, targeting the wells with high water to gas ratios to minimise the production of coal seam water associated with our operations.

Whilst this has reduced our coal seam water production, shutting in further wells will yield limited benefits in terms of water reduction but will cause significant reduction in gas output.

Use of dam 11 in its current uncompleted, unlined state has been investigated. The pipe work and major civil infrastructure is complete but the floor of the dam is incomplete – as discussed (in our meeting on the 1st of December) it lacks its intended second liner, more importantly the clay liner has not been sufficiently compacted to allow its use. Key elements of the pipework connecting dam 11 to the rest of the network remain incomplete. Employing dam 11 would require its use for an extended period to allow subsequent emptying and upgrade of the existing dam infrastructure.

Step 3—if waste prevention does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate treatment and recycling options and implement appropriate treatment and recycling;
The construction of Dam 11 is the first component of our coal seam water management strategy. It is a large lined dam, intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies. Rainfall is delaying the construction of dam 11 and contributing to the current water storage problems.

Installation of water treatment (such as a mobile RO plant) is limited by the logistics (such as civil engineering, chemical storage and power supply), cost and the challenges posed during current wet conditions. Another option considered was employing water entitlements to dilute the untreated coal seam water to the current environmental authority specification. This option was ruled out since a large quantity of good quality water would be required to dilute and dispose of a limited amount of coal seam water from our dams.

Step 4—if treatment and recycling does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate the following options
for waste water or contaminants, in the order in which they are listed—
(i) appropriate treatment and release to a waste facility or sewer;
(ii) appropriate treatment and release to land;
(iii) appropriate treatment and release to surface waters or ground waters.

I) We cannot practically truck water from the dams given the large quantities and the lack of disposal options. Wet weather is likely to complicate trucking of water by limiting access to some points within the MGP. Infrastructure does not exist to process this water via sewer or other industrial water treatment options. Our landholders have expressed concern of minimising truck movements during the wet season.

II) Until our water treatment management strategy is implemented we cannot treat the water to a standard that is suitable for use on land.

III) We consider the water in its current state is suitable for discharge into the Isaac – this was the water management strategy employed by the facility until earlier EA conditions were amended, we are seeking permission from DERM to allow this discharge as previously authorised until we can implement our water management strategy for the MGP. We consider a temporary discharge to the Isaac river during

high flow conditions to be compliant with section 51 of the Environmental Protection Regulation 2008.

Objectives

To achieve compliance with the Environmental Authority with respect to coal seam water management and dam standards by April 2011.

This will be achieved in the short term by the release of water to the Isaac River. This measure will protect the integrity of our storage infrastructure and is consistent with the operational philosophy that our existing infrastructure was designed to accommodate.

In the medium term compliance with the new EA will be achieved by the completion of Dam 11. Completion of dam 11 will require Arrow energy to utilise the cleared area north of dam 11.

In the long term, compliance with our EA will be achieved by completion of water treatment facilities that allow beneficial use and disposal within Arrows Environmental Authority conditions. Arrow is to provide DERM with a detailed plan concerning future water management for approval.

Table 3 – Achieving TEP objectives

OBJECTIVE	ACTION	RESPONSIBILITY	TIME FRAME	PERFORMANCE INDICATOR
Evaluate existing dam integrity	Engineer to evaluate current dam integrity	Third party contractor URS has been engaged to complete this evaluation	31st December 2011	Submission of evaluation report to DERM
Gain sufficient storage to implement water strategy	Complete Dam 11	Arrow	31st March 2011	Completion and authorisation of Dam 11 for use
Develop an approved plan to bring storage into line with new Environmental Authority requirements	Complete water management plan for submission to DERM	Arrow	31st March 2011	Submission of water strategy plan to DERM

Monitoring

Table 4 Contaminant release points, sources and receiving waters

Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point	Receiving waters
TEP RP 1	148° 2' 35"	-21° 57' 42"	untreated CSG water from PL191/196	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
				Upstream from discharge – Isaac River Crossing	
				Downstream from discharge – Blair Athol Bridge	

Table 5 Contaminant release monitoring points

Monitoring point (TEP MP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point location	Receiving waters
TEP MP 1	148° 2' 35"	-21° 57' 42"	untreated CSG water from PL191	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
TEP MP 2	Refer to appendix C		Downstream from discharge – Blair Athol Bridge	Blair Athol Railway Bridge	na
TEP MP 3			Upstream from discharge	Isaac River Crossing	
TEP MP 4			Dams 1,2,5 or 10		

Table 6 Contaminant release limits

Quality characteristic	Release Limit	Monitoring Frequency	Sample Type	Monitoring Point
Electrical conductivity (uS/cm)	13000	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1
			Samples require laboratory analysis[2]	TEP MP 1
pH (pH Unit)	6.5 (minimum) 9.5 (maximum)	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1
				TEP MP 2
				TEP MP 3
			Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 2
				TEP MP 3
Turbidity (NTU)	500	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1
			Samples require laboratory analysis[2]	TEP MP 2
				TEP MP 3

[1] In situ samples can be taken using electronic sampling equipment.
[2] Samples are required to be analysed at a NATA accredited facility in accordance with this Transitional Environmental Program.

Table 7 Downstream contaminant trigger investigation levels

Quality characteristic	Trigger levels (µg/L)	Monitoring frequency	Monitoring Point
Aluminium	55	Commencement of release and thereafter weekly during release	TEP MP 1 TEP MP 2 TEP MP 3
Arsenic	13		
Cadmium	0.2		
Chromium	1.0		
Copper	2.0		
Iron	300		
Lead	10		
Mercury	0.2		
Nickel	11		
Zinc	8.0		
Boron	370		
Cobalt	90		
Manganese	1900		
Molybdenum	34		
Selenium	10		
Silver	1.0		
Uranium	1.0		
Vanadium	10		
Ammonia	900		
Nitrate	1100		
Petroleum hydrocarbons (C6-C9)	20		
Petroleum hydrocarbons (C10-C36)	100		
Fluoride (total)	2000		

Table 8 Contaminant release during flow events

Receiving waters	Release point (TEP RP)	Gauging station description	Easting (GDA94)	Northing (GDA94)	Minimum flow in receiving water required for a release event	Flow recording frequency
Isaac River	TEP RP1	Goonyella Gauging station	-147° 58' 21"	21° 51' 20"	= > 11.5 m^3/sec[1]	Continuous (minimum daily)

[1] Equivalent to 1000ML/day, release rate will be adjusted to ensure 400:1 dilution ratio is maintained

Table 9 Receiving water downstream monitoring points

Monitoring points (TEP MP)	Receiving waters location description	Easting (GDA94)	Northing (GDA94)
TEP MP 2	Blair Athol Bridge 500 metres downstream of RP1 1	148° 57' 37"	-21° 2' 45"

Conditions

In carrying out this Transitional Environmental Program, CH4 Ltd (Arrow Energy) will undertake all activities in accordance with the following conditions.

Undertaking the release of untreated coal seam methane water

1 Contaminants that will, or have the potential to cause environmental harm must not be released directly or indirectly released to any waters except as permitted under this Transitional Environmental Approval.

2 The release of contaminants to waters must only occur from the release points specified in Table 4 and depicted in Appendix C attached to this Transitional Environmental Program.

3 The release of contaminants to waters must not exceed the release limits stated in Table 6 at the monitoring points specified in Table 5 and Table 6 of this Transitional Environmental Program.

4 The release of contaminants to waters from the release points must be monitored at the locations specified in Table 5 and Table 9 for each quality characteristic and at the frequency specified in Table 7 and Table 8 of this Transitional Environmental Program.

5 If quality characteristics of the release exceed any of the trigger levels specified in Table 7 during a release event, the Transitional Environmental Program holder must compare the downstream results in the receiving waters identified in Table 9 to the trigger values specified in Table 7and:

a) where the trigger values are not exceeded then no action is to be taken

b) where the downstream results exceed the trigger values specified Table 7 for any quality characteristic, compare the results of the downstream site to the data from background monitoring sites and

i) if the result is less than the background monitoring site data, then no action is to be taken or

ii) if the result is greater than the background monitoring site data, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology, into the potential for environmental harm and provide a written report to the administering authority in the next annual return, outlining

- details of the investigations carried out
- actions taken to prevent environmental harm.

6 If an exceedance in accordance with condition 5(a)(ii)(2) is identified, the holder of the Transitional Environmental Program must notify the administering authority within 24 hours of receiving the result. The notification must include written verification of the exceedance forwarded to the administering authority either via facsimile.

Contaminant Release Events

7 The release of coal seam water will not occur until flow in the Isaac River flow reaches 11.5 m^3/s (at Goonyella Gauging Station).

8 Notwithstanding any other condition of this Transitional Environmental Program, the release of contaminants to waters must only take place during periods of natural flow events specified as minimum flow in Table 8 for the contaminant release point(s) specified in Table 4.

9 Contaminant release flow rate must not exceed 0.25% of receiving water flow rate.

10 The daily quantity of contaminants released from each release point must be measured and recorded at the monitoring points in Table 4

11 The daily quantity of contaminants is not to exceed 7.5ML/day in total.

12 Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build up of sediment in such waters.

Notification of Release Events

12 The Transitional Environmental Program holder must notify the administering authority within 24hours of having commenced releasing coal seam water to the receiving environment. Notification must include the submission of written verification to the administering authority of the following information:

a) release commencement date/time
b) expected release cessation date/time
c) release point/s
d) release volume (estimated)
e) receiving water/s including the natural flow rate
f) any details (including available data) regarding likely impacts on the receiving water(s).

13 The Transitional Environmental Program holder must provide the administering authority daily during the release of coal seam water, the following information:
   a) all in situ monitoring data for that day
   b) the receiving water flow rate
   c) the release flow rate.

14 The Transitional Environmental Program holder must notify the administering authority as soon as practicable, (no later than within 24 hours after cessation of a release) of the cessation of a release notified under condition 12 and within 28 days provide the following information in writing:
   a) release cessation date/time
   b) natural flow volume in receiving water
   c) volume of water released
   d) details regarding the compliance of the release with the conditions of this Transitional Environmental Program (i.e. contamination limits, natural flow, discharge volume)
   e) all in-situ water quality monitoring results
   f) any other matters pertinent to the water release event.

Notification of release event exceedence

15 If the release limits defined in Table 6 are exceeded, the holder of the Transitional Environmental Program must notify the administering authority within 24 hours of receiving the results.

16 The Transitional Environmental Program holder must, within 28 days of a release that exceeds the conditions of this Transitional Environmental Program, provide a report to the administering authority detailing:
   a) the reason for the release
   b) the location of the release
   c) all water quality monitoring results
   d) any general observations
   e) all calculations
   f) any other matters pertinent to the water release event.

Requirements to cease the release of coal seam water

17 The coal seam water discharge must cease immediately if any water quality limit as specified in Table 6 is exceeded.

18 The Department of Environment and Resource Management may require CH4 Pty to cease discharge if the department's water monitoring stations detect any water quality limit exceedance.

19 The release of coals seam water must cease immediately if identified that the release of coal seam waters is causing erosion of the bed and banks of the receiving waters, or is causing a material build up of sediment in such waters.

20 The release of coal seam water must cease immediately if holder of this Transitional Environmental Program is directed to do so by the administering authority.

21 The release of coal seam water will cease immediately if Isaac River flow decreases below 11.5 m^3/s (at Goonyella Gauging Station).

Monitoring Requirements

22 Where monitoring is a requirement of this Transitional Environmental Program, ensure that a competent person(s) conducts all monitoring.

23 Monitoring will occur on a daily basis during release event and two days subsequent to cessation of release at monitoring points described in Table 5.

24 All monitoring undertaken as a requirement of this Transitional Environmental Program must be undertaken in accordance with the administering authority's Water Sampling Manual.

Notification of emergencies, incidents and exceptions

25 As soon as practicable after becoming aware of any 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 Transitional Environmental Program, the administering authority must be notified of the release by telephone, facsimile or email.

26 The notification of emergencies or incidents must include but not be limited to the following:

a) the holder of the Transitional Environmental Program
b) the location of the emergency or incident
c) the number of the Transitional Environmental Program
d) the name and telephone number of the designated contact person
e) the time of the release

f) the time the holder of the Transitional Environmental Program became aware of the release
g) the suspected cause of the release
h) the environmental harm caused, threatened, or suspected to be caused by the release, and
i) actions taken to prevent any further release and mitigate any environmental harm caused by the release.

27 Not more than fourteen days following the initial notification of an emergency or incident, written advice must be provided of the information supplied to the administering authority in relation to:
a) proposed actions to prevent a recurrence of the emergency or incident, and
b) outcomes of actions taken at the time to prevent or minimise environmental harm.

Appendix A
ALS & Qld Health water sampling results

Client Reference	Collected Date	Received Date	Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmiun	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	3.8	< 0.0001	0.0011	0.076	< 0.0001	0.05	< 0.0001	0.0027	0.0011	0.003	1.7	0.0013	0.056	< 0.0001	0.0007
Discharge_Point	14-Dec-10	17-Dec-10	0.18	< 0.0001	0.0012	4.5	< 0.0001	1.1	< 0.0001	0.0003	0.0002	0.002	0.08	0.0004	0.0046	< 0.0001	0.0019
Pond_2a	16-Dec-10	17-Dec-10	0.1	< 0.0001	0.0015	6.1	< 0.0001	1	< 0.0001	0.0002	0.0003	0.001	0.066	< 0.0001	0.007	< 0.0001	0.0013
Pond_2	16-Dec-10	17-Dec-10	0.09	< 0.0001	0.0014	6	< 0.0001	1	< 0.0001	0.0002	0.0003	< 0.001	0.044	< 0.0001	0.0065	< 0.0001	0.0012
POND1_1	17-Dec-10	20-Dec-10	0.37	< 0.0001	0.0021	5.8	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.18	< 0.0001	0.0057	< 0.0001	0.0028
POND1_2	17-Dec-10	20-Dec-10	0.43	< 0.0001	0.0023	6	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.2	0.0002	0.0065	< 0.0001	0.0031
POND10_1	17-Dec-10	20-Dec-10	0.2	< 0.0001	0.0018	7.7	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.069	< 0.0001	0.0039	< 0.0001	0.0031
POND10_2	17-Dec-10	20-Dec-10	0.18	< 0.0001	0.0019	7.6	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.067	< 0.0001	0.0041	< 0.0001	0.0034

Client Reference	Collected Date	Received Date	Nickel	Selenium	Silver	Stroniu m	Thallium	Titani um	Uranium	Vanadium	Zinc	Benzen e	Toluene	Ethylbenzon e	Meta&Para-Xylenes	Ortho-Xylene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	0.0031	< 0.0010	< 0.001	0.2	< 0.0001	0.14	0.0002	0.012	0.003	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Discharge_Point	14-Dec-10	17-Dec-10	0.0008	< 0.0010	< 0.001	7.3	< 0.0001	0.006	0.0003	0.0029	0.013	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2a	16-Dec-10	17-Dec-10	0.0012	< 0.0010	< 0.001	9.6	< 0.0001	0.003	0.0003	0.0051	0.006	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2	16-Dec-10	17-Dec-10	0.0011	< 0.0010	< 0.001	9.4	< 0.0001	0.002	0.0003	0.005	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_1	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	10	< 0.0001	0.017	0.0009	0.0059	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_2	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	11	< 0.0001	0.015	0.0009	0.0062	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_1	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.026	0.0008	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_2	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.01	0.0007	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

ALS	21/12/2010	Sample ID 1	DAM 1	DAM 10	DAM 4	DAM 3	D1	D2	DAM 5	DAM2	TRIP BLANK
		ID 2									
ES1025292	Results	Date Sampled	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010
Analyte	CAS #	Units	LOR	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
EA005: pH											
pH Value		pH Unit	0.01	9.17	9.28	9.34	9.38	9.4	9.42	9.27	9.15	-
EA010P: Conductivity by PC Titrator											
Electrical Conductivity @ 25°C		µS/cm	1	12600	14000	16400	25900	25800	26100	10700	10600	-
EG020T: Total Metals by ICP-MS											
Arsenic	7440-38-2	mg/L	0.001	0.003	0.003	0.002	<0.001	0.004	0.004	<0.001	0.002	-
Barium	7440-39-3	mg/L	0.001	6.54	8.33	4.35	1.93	1.92	1.98	6.4	9.31	-
Beryllium	7440-41-7	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cadmium	7440-43-9	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Cobalt	7440-48-4	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	-
Chromium	7440-47-3	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	-
Copper	7440-50-8	mg/L	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004	-
Manganese	7439-96-5	mg/L	0.001	0.008	0.003	0.002	0.001	0.001	0.003	0.002	0.038	-
Nickel	7440-02-0	mg/L	0.001	0.001	<0.001	0.001	0.002	0.002	0.002	<0.001	0.003	-
Lead	7439-92-1	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Vanadium	7440-62-2	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Zinc	7440-66-6	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	-
EG035T: Total Recoverable Mercury by FIMS											
Mercury	7439-97-6	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
EK055G: Ammonia as N by Discrete Analyser											
Ammonia as N	7664-41-7	mg/L	0.01	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
EK057G: Nitrite as N by Discrete Analyser											
Nitrite as N		mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EK058G: Nitrate as N by Discrete Analyser											
Nitrate as N	14797-55-8	mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser											
Nitrite + Nitrate as N		mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser											
Total Kjeldahl Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser											
Total Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK067G: Total Phosphorus as P by Discrete Analyser											
Total Phosphorus as P		mg/L	0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EP080: BTEX											
Benzene	71-43-2	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	108-88-3	µg/L	2	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	100-41-4	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
EP080S: TPH(V)/BTEX Surrogates											
1,2-Dichloroethane-D4	17060-07-0	%	surrogate	113	111	103	112	105	110	110	106	106
Toluene-D8	2037-26-5	%	surrogate	110	106	103	109	105	106	107	103	102
4-Bromofluorobenzene	460-00-4	%	surrogate	106	99.7	97.9	104	97.1	98.6	101	97	101

Appendix B
Dilution calculation basis

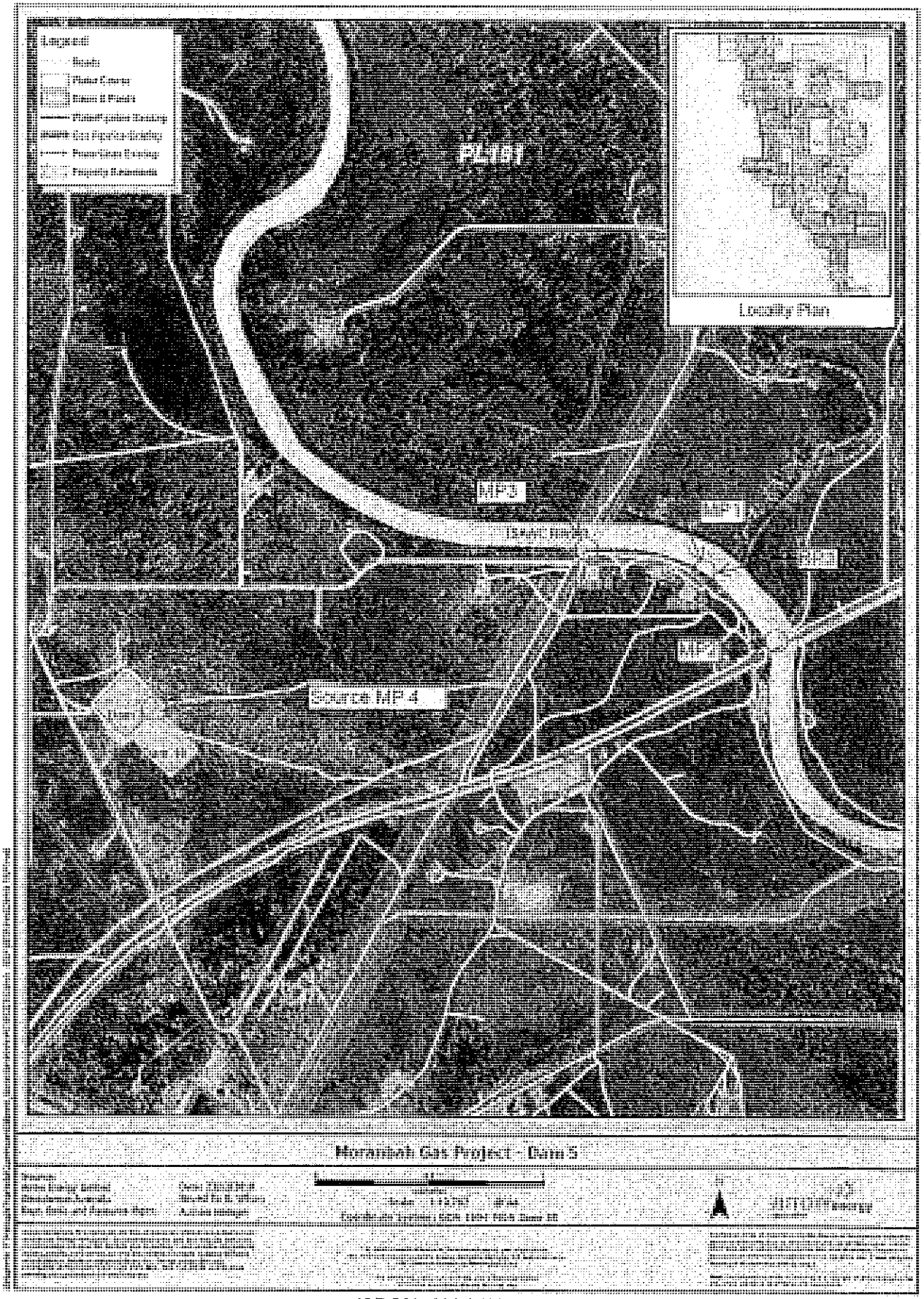
Table 10 Dilution calculation at 400:1 release

Parameter	Unit	Surface Water Concentration	Concentration of Discharge	Dilution X:1	Surface Concentration after dilution	Guideline[1]
EC	µs/cm	250	10600	400	276.5	746
Sodium	mg/L	65	2970	400	72.4	180
Chloride	mg/L	80	4280	400	90.7	250

[1] *Australian drinking water guidelines (NHMRC,2004)*
Sodium and Chloride based on EC, common soil quality (run off) and historical data from upstream

Appendix C
Mapping showing PL191 and location of key Dams

ARROW ENERGY - BOWEN BASIN GAS PROJECT



NOT FOR CONSTRUCTION

Appendix D
Sampling Procedure

SUMMARY

1.1	This procedure outlines general sampling protocols and work practices to be followed during the sampling of surface water, during the discharge of untreated CSG well water to the Isaac River. This procedure includes details on: ▪ Sampling equipment requirements; ▪ Surface water sampling techniques; ▪ Quality control requirements. ▪ Sample locations (Figure 1) ▪ Analytical requirements

EQUIPMENT

2.1	▪ Documentation o Sampling and analysis plan. o Health and safety plan o Personal protective equipment (PPE) as identified in the HSP, inc. Life Jacket and other specialised PPE, as per the HSP. ▪ Water sampling equipment o sample collection device, (Swing Arm Sampler/extension sampler) o decontamination solution (e.g. Decon 90™) or use new sample collection container in the swing arm sampler at each location. o Calibrated water quality meter (ensure parameter ranges are suitable for the water being tested), o laboratory supplied sample containers, o Chilled ice chest. o Field sample Record Sheet o Chain of Custody Form (Attached).

3.0 REFERENCES & PROFORMA

3.1	▪ AS NZS 5667.1-1998 *Water quality - Sampling - Guidance on the design of sampling programs sampling techniques* ▪ AS NZS 5667.4-1998 *Water quality - Sampling - Guidance on sampling from lakes natural and man-made* ▪ AS NZS 5667.6-1998 *Water quality - Sampling - Guidance on sampling of rivers and streams* ▪ Monitoring and Sampling Manual 2009 Environmental Protection (Water) Policy 2009, *Monitoring and Sampling Manual 2009*, Version 2 September 2010

4.0 PROCEDURE

4.1	Safety
	Unless specifically required, the following general safety requirements should be noted: 1. Appropriate personal protective equipment should be worn as specified in the Health and Safety Plan (HSP). When working in or around water bodies, a life jacket is required to be worn and a minimum of two persons to be present should be assessed. 2. Assess hidden hazards (eg. trip hazards, snakes, leeches, etc.). 3. Assess risks from slippery or unstable banks. 4. Assess whether the water body / drain may constitute a confined space. 5. Assess the likelihood that surface conditions within and around the water body may change rapidly in the event of heavy rainfall or tidal change.

4.2	Sampling
	1. The sampling frequency during and following discharge to the Isaac River shall be as follows: • daily during discharge; and • daily for two days following discharge stopping. 2. The sampling sequence should commence where the lowest likely contaminant concentrations are expected (e.g. downstream and work upstream), to reduce the risk of cross contamination between samples. On this basis, the samples shall be collected at the following locations (in order): (See **Figure 1** for sampling locations) I. **River crossing** (upstream), (One **primary sample (S1)**, plus **one duplicate sample (QC1)**) II. **Blair Athol Bridge** (downstream), One **primary sample (S2)**, plus **one duplicate sample (QC2)**) III. At the **Discharge Point**, One **primary sample (S3)**, plus **one duplicate sample (QC3)**) IV. At the **Source (Dam)** One **primary sample (S4)**, plus **one duplicate sample (QC4)**) V. QC samples – Field/Trip Blank **(QC5)** and rinsate blank **(QC6)** (if required) 3. At each location, a water sample should be collected for standard field parameters using a calibrated water quality meter. The following parameters should be recorded: a. pH, b. conductivity, c. dissolved oxygen, d. redox potential, e. temperature and f. turbidity. Notes: • Follow the manufacturer's instructions for use and calibration of instruments to measure water parameters. A calibration record must be kept. • When recording dissolved oxygen readings, it is important to note whether the results are reported as % saturation or ppm. • With conductivity, record whether units are mS or µS.

4. Based on the nature of the sampling locations, heterogeneous distribution of potential contaminants in the water samples is considered likely. Therefore, the following Quality Control Samples should be collected and analysed for this program:
    a. One duplicate sample per sample location for TPH, BTEX and 8 Metals analysis **(QC1 – QC4)**.
    b. One Blank Sample per esky (laboratory prepared DI Water for TPH (C6 – C9) and BTEX analysis) **(QC5)**.
5. One rinsate sample per day (unless using new sample collection medium between sample locations i.e. a new container in the swing arm sampler) for TPH (C6 – C9) and BTEX analysis) **(QC6)**.
6. At each location sample bottles should be filled based on a decreasing order of potential volatility (i.e. VOCs, BTEX and TPH first, followed by metals and other inorganic samples).
7. Note: DO NOT field filter samples for total metals. Perform field filtering for dissolved metals samples only.
8. When sampling shallow waters, contamination from bottom sediments should be avoided. Samples should be collected by submerging a clean sample collection container (up-side down) into the water and to approximately 100mm below the surface, rotate the container to allow it to fill.
9. The sampling location should be as representative as possible of the event being monitored. i.e. do not sample stagnant water at the edge, attempt to sample .
10. Record the appearance of the water body, i.e. colour, turbidity, odour, surface crusts, films or floating material, algae, water velocity, etc. In addition, record the weather conditions at the time of sampling and note any other relevant observations, e.g. dead or distressed flora/fauna, surface rubbish, spills, etc.
11. All measurements and field notes should be documented on the field sheet **(Attachment A)**

5.0 ANALYTICAL/SAMPLE CONTAINER REQUIREMENTS

5.1	1. The analytical suite includes the following: a. pH, EC, TDS, Turbidity b. Ions: Magnesium, Calcium, Sodium, Sulphate, Chloride, Ammonia, Nitrate, Fluoride (total). c. Metals, Aluminium, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Zinc, Boron, Cobalt, Manganese, Molybdenum, Selenium, Silver, Uranium, Vanadium. d. Organics: BTEX, PAH, TPH 2. Each Sample Requires the following containers: a. 60ml Plastic Bottle for metals (with red and green striped label border) (tick 'Total Metals') b. 500ml Plastic Bottle for anions/cations (with green label border) c. 250ml Amber Glass Bottle (with purple label border) d. One pair of BTEX vials (40 mL glass cylindrical containers with purple label border).
	Notes: • The selection of sample containers depends on the laboratories being used. The above list is based on ALS requirements only. When ultra trace analysis is being requested, additional sample volume may be required. Always check with the laboratory prior to submitting samples to the laboratory. • When filling the vials it is important that they are filled to the top with no air space remaining. • Use new sample gloves between sample locations.
5.2	1. Place samples immediately in a chilled ice chest 2. Complete sample request form and include in sealed bag in the cooler 3. Courier samples to the receiving laboratory.

12	Surface Water Sampling						Form
Site				Sampling Method:			
Job Number				Local Air Temperature:			
Date:	Time:			Wind Force:			
Weather:		Cloudiness %		Direction of Wind:			

Location	Sample No.	Water Flow (l/s)	Field Readings				Depth (m)	Comments: including turbidity (plankton and/or sediment), colour, water plants, weather conditions, etc
			pH	Conductivity	Temperature	Dissolved Oxygen		

Comments concerning treatment of samples, especially preservation:

Name: Signed: Project Manager:

adapted from AS 5667.4

Analytes

Quality characteristic	
pH	Ammonia
EC	Nitrate
Turbidity	Fluoride (total)
Magnesium	BTEX
Calcium	PAH
Sodium	TPH
Sulphate	
Chloride	
Aluminium	
Arsenic	
Cadmium	
Chromium	
Copper	
Iron	
Lead	
Mercury	
Nickel	
Zinc	
Boron	
Cobalt	
Manganese	
Molybdenum	
Selenium	
Silver	
Uranium	
Vanadium	

Graham Cordingley

From: [redacted]
Sent: Friday, 24 December 2010 7:40 AM
To: Ben McMahon
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Draft TEP MGP 23 December 2010

Morning Ben

In line with my query yesterday would you please confirm if the release is continuing this morning?

I note from the BOM site that no rain of note has fallen at Moranbah since Monday 20 December.

The DERM website shows the Isaac River flowing at 1208ML at 10pm on 23 December and dropping.

What is the current flow rate? The river appears to be dropping still, so assuming it is still over 1000ML this morning, at what point do Arrow expect it to drop below 1000ML and cease the discharge?

Also please let me know first thing this morning how much has been discharged and confirm whether there have been any unexpected in situ monitoring results in the dam, at the release and downstream of the release.

At what point will Arrow have additionally monitoring results?

Regards

[redacted]

From: [redacted]
Sent: Thursday, 23 December 2010 1:38 PM
To: Ben McMahon
Subject: RE: Draft TEP MGP 23 December 2010

Receipt of TEP acknowledged.

I am having Officers look at it currently with a view to getting back to you with comments if required asap.

From: Ben McMahon [redacted]
Sent: Thursday, 23 December 2010 1:00 PM
To: [redacted]
Subject: Draft TEP MGP 23 December 2010

[redacted]

As discussed earlier today please find attached a draft TEP in relation to PL191/196.

Please do not hesitate to contact me with any comments or concerns.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

Ben McMahon

From: [redacted]
Sent: Friday, 24 December 2010 9:07 AM
To: Ben McMahon
Cc: [redacted]
Subject: RE: Isaac river dischager data.xlsx

Categories: Red Category

Ben

I will raise the gauging station with others – thanks for the advice.

Re you concerns with ALS I strongly recommend Arrow pursue other options. ALS is not the only NATA certified lab available. The fact they are flagging delays should indicate an alternative should be sourced.

Any TEP that is approved will have a condition attached to stiputlating turn around timeframes for sample analysis – likely around 10BD.

Please let me know should the discharge recommence if the river rises again.

Cheers

From: Ben McMahon [redacted]
Sent: Friday, 24 December 2010 8:52 AM
To: [redacted]
Subject: Isaac river dischager data.xlsx

Hi [redacted]

We stopped discharge last night based on the falling flow rates in the Isaac river.

Attached is our working summary of our recent discharge volumes and insitu measurements. Obviously we would work this data into a more suitable format for reporting under the TEP.

Christmas is posing some logistical issues with respect to sample transport and storage which we are working though. ALS are still forecasting significant delays with respect to sample result turnaround which continues to be frustrating.

We are concerned that the Goonyella river monitoring station is down at the moment – the last data was posted 11 pm last night. In relation to this situation the guys have marked the current river level and will consider the minimum level but it will to difficult for us to manage this discharge without the Goonyella flow data.

Best regards

Ben McMahon
Manager Compliance & Reporting

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+----------+

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

+----------+

Ben McMahon

From: Ben McMahon
Sent: Friday, 24 December 2010 10:48 AM
To: [redacted]
Cc: [redacted] Tim Dean
Subject: RE: Draft TEP MGP 23 December 2010 word 2003 version

Categories: Red Category

Thanks [redacted]

I will get our team onto this now.

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
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T: [redacted]
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www.arrowenergy.com.au

From: [redacted]
Sent: Friday, 24 December 2010 10:45 AM
To: Ben McMahon
Cc: [redacted]
Subject: RE: Draft TEP MGP 23 December 2010 word 2003 version

Ben – comments below.

Given the TEP was only submitted yesterday this is not a complete set of DERMs comments. Further comments may be forthcoming.

- Our modelling has shown that given other discharges Arrows discharge should not commence until a Min flow of 1090ML/day is reached.
- Table 1 – the footnotes b and c are not used in the table?.
- ALS sample results show Dam 3 at 25 900 ec, D1 (what is this?) at 25 800ec and D2 (again what is this?) at 26 100ec. My question is will water from these dams be pumped to where they will be discharged?? If so how will Arrow ensure that EC levels are appropriate at discharge point? How will the 'shandy' mix be made to ensure EC limits are met given dams are linked.? Is this where the EC of 13000 as release limit came from?
- Page 4 para 1 states '1000m3/day', then table 8 refers to '11.5m3/sec' which is stated as equal to '1000ML/day' in the table footnote – please use consistent terminology through out for flow
- What is DSA for older and less accessible dams? Only dams 1,2 and 10 are listed in TEP. Are you also using water from other dams for release??
- Include an Objective re discharge linked to table 1 (volume to discharge) and/or table 2 discharge scenarios – note the volumes are different. Which volume is be sought for discharge under TEP?? Only from 1,2 or 10 as shown in table 1 or from all dams as alluded by Table 2 – if all dams my point about water quality changes is important. Table 2 indicates total volume is 69ML plus 7ML (pond 2 extra) so I assume total approval is sought for 76ML discharge under TEP???
- Number all objectives for ease of reference
- Objective re monitoring and monitoring submissions – link to your table and commit to timeframes for getting results to DERM – 10BD should be achievable
- Objective for final report submission – should be a reasonable timeframe

- Objective re Final discharge date or prediction?
- Objective re reporting back on samples in 10bd – ALS delays is not a reasonable excuse to not meet this .
- Objectives re dam 11 not needed under TEP and should be removed. Approval already exists to construct dam 11. The unapproved clearing cannot be authorised long term under a TEP. DERM has determined that the veg type was such that if Arrow had of applied at the time, approval would have been granted to clear this veg. I recommend dam 11 be included in background to TEP but not in objectives/conditions. Arrow can apply for amendment in 2011 to authorise use of cleared area. PIN may still result for original technical breach of the clearing though. Arrows recent response will be considered.
- Table 5 – include easting and northings in table
- Table 6 – these should be listed also BTEX list at no detect levels or drinking water guideline value. Other contaminants may need to be included here such as fluoride, sodium – further advice is coming from Office of water supply/Q Health on this
- Table 7 and list of anlytes to be consistent. This list should be broader rather than narrower. If you test for it there should be a link to a trigger.
- Table 7 – isn't MP1 end of pipe? If so how will triggers be met?? Should MP1 be delted?
- Table 8 – flow rate needs to be consistent. Given column heading no need for => reference
- Condition 5b – rather than background sites, just list the points as referred to in table 5 for clarity
- Condition 5b (ii) point 2 – report to be submitted 20bd after final release.
- Condition 6 – there is no 5a(ii) (2). Do you mean 5b??
- Condition 7 – use consistent flow rate as stated above.
- Condition 9 – uses 0.25% but elsewhere you use 400 to one. For consistency please use either ratio or percentage not both
- Condition 11 states daily max flow is 7.5ML. Please amend to include total release modelled – i.e. my point above **about 69ML plus 7ML (pond 2 extra) what is max volume sought??**
- Condition 12 and 13 – notification should be via our 1300 number. Emails should also be sent to me.
- Condition 14 – 28 days is too long for these details be submitted in writing. You should be able to arrange for a lab to turn around samples in 10BD, so this should be able to be submitted to DERM in 15bd.
- Condition 16 – should be 10bd as if there is monitoring and it shows the exceedence then you already have and don't need to wait for samples
- Condition 21 – consistent flow term pls
- Condition 27 – change to BD is you change other day refs to BD.

Office of water supply/Q Health are getting further points to me, which I will get back to you about asap.

Regards

From: Ben McMahon [redacted]
Sent: Thursday, 23 December 2010 4:49 PM
To: [redacted]
Subject: Draft TEP MGP 23 December 2010 word 2003 version

Here you go [redacted]

B

[redacted]

From: Ben McMahon
Sent: Friday, 24 December 2010 12:21 PM
To: [redacted]
Subject: Wet weather contingency planning
Attachments: ENV10-314.pdf

Importance: High

[redacted]

Please find attached Arrow's response to DERM query regarding wet weather contingency for our coal seam gas activities.

As always please do not hesitate to contact us with any further queries.

Have a safe Christmas

Ben McMahon
Manager Compliance & Reporting

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24 December 2010

arrow energy
go further

Ref: ENV10-314

[redacted]

General Manager, Energy Resources

Department of Environment & Resource Management

(sent via email 24 December 2010)

RE: MGP Discharge

Dear [redacted]

In response to your letter regarding wet weather contingency plans for coal seam gas activities dated 14 December 2010 Arrow has prepared the following information.

Arrow Energy currently manages operations out of the Bowen and Surat Basins, both with numerous multi-functioning water storage facilities. These containments can be described by:

- **Evaporation** – large surfaced impoundments designed to store and evaporate coal seam water;
- **Aggregation** – utilised as a storage or transfer facility generally before treatment or disposal;
- **Process** – a storage structure designed to store waste from compressor facilities;
- **Utility** – a dam designed to store residual CIP chemical from reverse osmosis (RO) plants;
- **Brine** – a dam designed to received and store high salinity RO concentrate; and
- **Treated Water** – A dam designed to store RO permeate.

Attachment A is a table that lists the current major dam assets in conjunction with the related physical data requested with respect to dam levels and locations. In many instances other minor transfer dams are connected to these dams.

Attachment B exhibits an example dam operating plan which is employed for all Arrow managed dams. This document incorporates the situational operating guidelines and hierarchical notifications that are associated with increasing dam levels.

As DERM would be aware our Northern operations on PL191/196 have experienced unusually high rainfall and have submitted a Transitional Environmental Program to DERM and continue to work closely with DERM to in relation to dams and water management.

At present the southern dams have sufficient capacity to endure a large quantity of rainfall as a precaution we have organised sampling to be completed across major dams with the potential to release water to the environment in the event of extended duration high rainfall events.

Sny further queries please do not hesitate to contact us.

Regards,

[redacted]

Ben McMahon
Manager Compliance and Reporting

Attachment A – Major dam assets and physical data details

Asset Base	Site	CLASS	SUB_CLASS	Hazard Category	Description	Lot_plan	ET_X	ET_Y	Crest Level	Crest Volume	Hydraulic Height (Spillway level)	Hydraulic Height Capacity	DSA	MRL	CURRENT LEVEL (mm below MRL)	Catchment Area	Structural Height	Crest width	Recieving Environment
	PL								m (AHD)	ML	m (AHD)	ML	m (AHD)	m (AHD)	22/12/2010	ha	m	m	
Sourthern	198	Dam	Evaporation	Significant	Tipton West Evaporation Pond 1	27SP194537	151.11305	-27.404	353.50		352.25	1396	351.45	351.95	700.00	34.13	5.50	5.00	Lake Broadwater
Sourthern	198	Dam	Evaporation	Significant	Tipton West Evaporation Pond 2	27SP194537	151.10981	-27.41887	361.00		360.75	2042	359.95	360.45	1200.00	44.60	6.00	5.00	Lake Broadwater
Sourthern	230	Dam	Brine Storage	High	Daandine Brine Storage Dam	2SP200461	150.96051	-27.10037	333.00	1867.00	331.90		330.45	331.60	2270.00	38.10	6.50	5.00	Wilkey Creek
Sourthern	230	Dam	Treated Water		Daandine Treated Water Dam	125SP194554	150.95538	-27.09328	337.00	308.90	336.00		335.25	335.60	400.00	7.80	4.80	5.00	Wilkey Creek
Sourthern	230	Dam	Aggregation	Significant	Daandine Utility Dam	125SP194554	150.9517	-27.10026	338.00	50.50	337.00		336.35	336.50	3500.00	1.60	2.90	5.00	Wilkey Creek
Northern	191	Dam	Evaporation	Significant	Moranbah Evaporation Water Dam 1	61SP195395	148.01841	-21.96706	227.40	119.66	227.40	119	226.55	227.05	80.00	30.98	2.50	3.50	Isaac River
Northern	191	Dam	Evaporation	Significant	Moranbah Evaporation Water Dam 2	1SP192459	148.03644	-21.96991	225.40	92.64	225.40	92	224.55	225.05	405.00	25.41	3.50	3.50	Isaac River
Northern	191	Dam	Evaporation	Significant	Moranbah Evaporation Water Dam 10	61SP195395	148.02002	-21.96853	227.50	203.70	226.75	163	225.90	226.40	106.00*	45.93	3.34	4.00	Isaac River

**Red indicates dam over MRL. Northern dams on PL191 are the subject of a Transitional Environmental Program with DERM at present.*

Tipton Dam Operating Plan

REV	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
A	31/03/2010	DRAFT			
B	23/07/2010	ISSUED FOR REVIEW			
0	27/07/10	ISSUED FOR USE			

TABLE OF CONTENTS

RESPONSIBILITY AND CONTACT DETAILS

PRODUCTION SUPERVISOR	
Name:	[redacted]
Contact Ph:	
Mobile:	

SNR ENVIRONMENTAL COORDINATOR	
Name:	[redacted]
Contact Ph:	
Mobile:	

DAM DESIGNER	
Name:	Ross Stafford, Stafford Adamson & Associates
Contact Ph:	[redacted]
Mobile:	

DALBY PRODUCTION MANAGER	
Name:	[redacted]
Contact Ph:	
Mobile:	

EMERGENCY RESPONSE CONTACTS	
ORGANISATION	Contact No :
Emergency	000 or 112 (if 000 fails on mobile phone)
ALWAYS CALL 000 FIRST IN AN EMERGENCY	
Fire	000
Ambulance	000
Police	000 or (07) 4669 9222
SES	132 500 or (07) 4662 1600

For further information and detailed procedures please refer to the Emergency Response Manual (99-H-MN-0007)

1.0 INTRODUCTION

The following plan outlines all information relevant to dam operations, inspections and monitoring guidelines.

1.1 Purpose

The aim of this dam operations plan is to ensure that the relevant storage facilities are operated in accordance with the following objectives:

- Maintaining sufficient storage capacity in alignment with water forecasts to ensure gas production is not hindered
- Minimising the potential for any release to the surrounding environment
- Compliance with DERM reporting requirements
- Compliance with DSA levels annually at November 1
- Maintaining accurate and sufficient records over the relevant timeframe
- Ensuring the relevant dam integrity inspections are conducted, communicated and maintained on record

1.2 Alignment with Overall Strategy

This plan has been developed in alignment with Arrow Energy's overarching water management strategy. Refer to Coal Seam Water Management Strategy (DRAFT). This plan can be linked to the strategy through the CSG Water Management Plan - South (99-W-PL-0001).

2.0 DAM INFORMATION

The relevant storage dams are situated within the Tipton West Coal Seam gas field. The site includes the following four (4) water storage dams:

OPERATIONAL DAMS	
Dam Name	Service
Tipton West Evap Pond 1 (00-DA-01)	CSG associated water
Tipton West Evap Pond 2 (00-DA-012)	CSG associated water
Tipton West Oily Water Dam 1 (00-WW-03)	Oily waste water from the Tipton CGPF
Tipton West Oily Water Dam 2 (00-WW-04)	Oily waste water from the Tipton CGPF

2.1 Location

PROPERTY LOCATION	
Property name:	DUNTROON
Property owner:	ARROW ENERGY LIMITED
Real property description:	Lot 27 DY21
Dam location:	27°24'S, 151°06'E
Nearest town:	DALBY

2.2 Site Layout

A site plan showing the location of all water storage dams is attached in APPENDIX A.

2.3 Design Drawings

Design drawings for all the water storage dams have been attached in APPENDIX A.

2.4 Dam Fill Curves

Fill curves have been constructed to provide more accurate level reading based on pond geometry. Fill curves for all the water storage dams have been attached in APPENDIX B.

2.5 Relevant Dam Level Definitions

The following section details the various design levels within the water storage dams.

DAM DESIGN LEVELS	
Level	Description
Crest Level	Level at the top of the dam wall.
Freeboard	The height between the crest level and the spillway. The freeboard allows for the depth of flood surcharge to pass through the spillway, wave action, and additional allowance for unevenness of the bank crest.
Spillway Sill Level	Designed to discharge a specified flood surcharge
Mandatory Reporting Level (MRL)	The level that allows sufficient freeboard below the spillway sill level to prevent discharge due to wave action under the influence of the 100-year AEP storm.
Design Storage Allowance (DSA)	The excess storage required at November 1 each year that will be filled by the process inputs and runoff from the critical wet period, should it occur. This is based on the 4 month rainfall data for Dalby.

2.6 Off-take Licensing and Water Agreements

The following tables outline the terms and conditions for commercial use of the produced associated water under the relevant environmental licences:

COMMERCIAL WATER AGREEMENTS				
Parties Bound by Agreement		Execution Date	Expiry Date	Maximum Rate*
Arrow (Daandine) Pty Ltd	Tipalea Partners Rural Pty Ltd	16 AUG 2007	16 AUG 2022	3.2 ML/d

WATER LICENCE						
Reference	Licensee	Description	Execution Date	Expiry Date	Authorised Purpose	Nominal Entitlement
405018	Arrow Energy NL	CSG Walloon CM to supply Grassdale Feedlot	24 JAN 2008	28 FEB 2012	Stock Intensive	1095ML p.a.

2.7 Datasheets

DAM DATASHEETS					
Component	Unit	Tipton West Evap Pond 1	Tipton West Evap Pond 2	Titpon West Oily Water Dam 1	Titpon West Oily Water Dam 2
Crest Level	m (AHD)	353.5	361.0	348.6	Proposed
Crest Volume	ML	-	-	3.3	
Storage Capacity at TWL	ML	1396	2042	2.5	
Hazard Category		Significant	Significant	Significant	
Freeboard	m	1.0	1.0	1.0	
Spillway Level	m (AHD)	352.25	360.75		
Spillway Width	m	12	9		
Spillway Capacity	m^3/s				
Mandatory Reporting Level (MRL)	m (AHD)				
MRL Volume					
Level below Spillway	m	0.3	0.3		
Design storage Level (DSL)	m (AHD)				
DSA Volume	ML				
Level Below Spillway	m	0.8	0.8		
Catchment area	m^2 ha	341,300 34.13	446,000 44.6	25,00 2.5	
Structural height (max.)	m	5.5	6.0	0.8	
Hydraulic height	m	5.5	6.0	2	
Footprint area	m^2 ha			25,000 0.25	
Internal batter slope	1 in z	5	5	5	
External batter slope	1 in z	4	4	4	
Crest width	m	5	5	5	
Liner type		CCL-450mm		1.5mm HDPE	

3.0 OPERATIONAL GUIDELINES

3.1 Tipton West Evap Pond 1 (00-DA-01)

An operational guideline flowchart is attached in APPENDIX C.

3.2 Tipton West Evap Pond 2 (00-DA-02)

An operational guideline flowchart is attached in APPENDIX C.

3.3 Tipton West Oily Water Dam 1 (00-DW-03)

An operational guideline flowchart is attached in APPENDIX C.

3.4 Tipton West Oily Water Dam 2 (00-DW-04)

An operational guideline flowchart is attached in APPENDIX C.

4.0 OPERATIONAL INSPECTIONS AND MONITORING

Four levels of inspection intensity are required. The inspection schedules for the four levels are as follows:

INSPECTION SCHEDULES		
Type	Frequency	Inspection By
Level & visual inspections	Weekly	Competent operator
Inspection & water sampling	Monthly	Trained and competent operator
Full monitoring program	Quarterly	Suitably qualified and experienced person
DSA assessment	Annual (October)	Site Supervisor
Integrity Inspection	Annual	Suitably qualified and experienced person

Inspection schedules will be initiated by MEX and actions raised should be flagged and updated within the system.

4.1 Weekly Dam Inspection Checklist

The Weekly Dam Inspection checklist is attached in APPENDIX D. Records should be maintained in alignment with section 6.3. This checklist should be conducted on a weekly basis and will incorporate the following:

- A level reading and check against Mandatory Reporting Level
- If the dam reaches the Mandatory Reporting Level, DERM are to be notified immediately (through the Environment Coordinator – Operations). Action will be initiated, as outlined in APPENDIX C, to reduce the dam level and minimise actual or potential environmental harm.
- A visual inspection for early detection of integrity or containment issues and to ensure ongoing compliance with environment, regulation and Arrow Energy OH&S. Any observations concerning odour, water foaming, surface slicks or fauna interaction should be noted.

4.2 Monthly Dam Inspection Checklist

The Monthly Dam Inspection checklist is attached in APPENDIX D. Records should be maintained in alignment with section 6.3. This checklist should be conducted on a monthly basis and will incorporate the following:

- Identification of any changes to the dam service/contents

  (If the service of the dam changes, an assessment of hazard category must be conducted by a suitably qualified and experienced person)

- A maintenance inspection by a trained and competent person, to identify issues affecting dam integrity and ensure ongoing compliance with environment, regulation and Arrow Energy OH&S. This inspection will focus on the following areas:

MAINTENANCE INSPECTION	
Inspection	Description
EMBANKMENT BATTER	Visual Inspection of full embankment perimeter
SPILLWAY	Visual inspection of joins and surface condition of synthetic liner
STILLING BASIN	Visual inspection of rock armour protection (rip rap), and side batters; and remove any obstructions
HDPE LINER INSPECTION	Inspect liner condition with emphasis on damage from fauna
CREST	Survey embankment levels against original design
SECURITY FENCE & GATE INSPECTION	Inspect full perimeter of security fence

- The monthly inspection will also include a dam and groundwater monitoring program to enable identification of any detrimental effects on the underground aquifers attributable to operations or a loss of containment from a dam. A baseline should be established to set trigger levels for monitoring. The following parameters will be included in the monthly monitoring:

MONTHLY MONITORING PROGRAM		
Parameter	Units	Contaminant Trigger Level
Standing Water Level (SWL)	[m]	Variation from initial level (variation should be defined as SWL will have seasonal variation)
Temperature	[°C]	TBA
Electrical Conductivity	[mS/cm]	TBA
pH		TBA
Salinity	[ppm]	10% above initial background level.

If at any time (throughout the operating life of the dams) the groundwater contamination monitoring results indicates a variation from established baseline conditions, immediate investigations will be conducted and a report will be compiled on the findings. Should the investigation indicate contamination has occurred; an action plan will be written and submitted (through the Environment Coordinator – Operations) to the administering authority within ten (10) business days from completion of the investigation. The action plan must include a further monitoring program and risk assessment to be undertaken by suitably qualified and experienced person.

4.3 Periodic Dam & Groundwater Sampling Program

A scope of works required for the Periodic Dam & Groundwater Sampling Program is attached in APPENDIX D. All records should be maintained in alignment with section 6.3.

A more intensive dam and groundwater contaminant monitoring program is to be developed and implemented by a person possessing appropriate qualifications and experience in water sampling design[1]. The sampling will be undertaken in accordance with the monitoring program and performed by

a suitably experienced person. Initially (i.e. at least for the first year after the sampling program is implemented) the contaminant monitoring program shall be undertaken on a quarterly basis until a set of baseline conditions are established and trigger levels can be identified. At anytime after this initial period is complete, a review of the results and sampling frequency[2] may be undertaken by a suitably qualified and experienced person and the program amended (i.e. sampling period and/or parameters to be measured) to ensure risks are captured.

As a minimum, the following parameters will be measured for water in all major dams and groundwater bores:

PARAMETERS	ALS CODE	UNITS
Parameters	ALS Code	Units
pH	EA005	pH units
Conductivity	EA010P	µS/cm
Salinity (or Total Dissolved Solids)	EA015	mg/L
Suspended Solids	EA025	mg/L
Turbidity*	EA045	mg/L
Fluoride	EK040	mg/L
Major Anions Dissolved (Sulphate as SO4; Chloride, Alkalinity)	**NT-2** (ED041, ED045, ED037)	mg/L
Major Cations Dissolved (Calcium, Magnesium, Sodium, Potassium)	ED040	mg/L
Metals Dissolved – NEPM (As, Ba, Be, Cd, Cr, Co, Cu, Mn, Ni, Pb, V, Zn, Hg) plus	**W-3** + EG020 (Al, B, Fe, Se, Sr)	mg/L
Metals Total – NEPM (As, Ba, Be, Cd, Cr, Co, Cu, Mn, Ni, Pb, V, Zn, Hg) plus	**W-3T** + EG020T (Al, B, Fe, Se, Sr)	mg/L
Cyanide Free	EK025	mg/L
Cyanide Total	EK026	mg/L
Plus for Oily Water Dams		
TPH & BETX	**W-4** (EP071, EP080)	µg/L

* Not required for groundwater

If at any time (throughout the operating life of the dams) the groundwater contamination monitoring results indicates a variation from established baseline conditions, immediate investigations will be conducted and a report will be compiled on the findings. Should the investigation indicate groundwater contamination has occurred; an action plan will be written and submitted (through the Environment Coordinator – Operations) to the administering authority within ten (10) business days from completion of the investigation. The action plan must include a further monitoring program and risk assessment to be undertaken by suitably qualified and experienced person.

NOTES:
1. For groundwater program the person should have experience in hydrogeology and groundwater sampling design.
2. The sampling program cannot be less frequent than biannually (every six months).

4.4 Groundwater Monitoring Bore Locations

TIPTON WEST EVAP POND 1 (00-AW-01)		
Monitoring Bore ID	Latitude	Longitude
Monitoring Bore 01	-27'24'00.437"	151'06'40.281"
Monitoring Bore 02	-27'24'07.636"	151'07'00.403"
Monitoring Bore 03	-27'24'17.892"	151'06'59.001"
Monitoring Bore 04	-27'24'22.964"	151'06'43.077"
Monitoring Bore 05	-27'24'09.031"	151'06'35.530"
TIPTON WEST EVAP POND 2 (00-AW-02)		
Monitoring Bore ID	Latitude	Longitude
Monitoring Bore 01	-27'24'58.051"	151'06'51.017"
Monitoring Bore 02	-27'25'19.977"	151'06'47.391"
Monitoring Bore 03	-27'25'16.511"	151'06'20.759"
Monitoring Bore 04	-27'25'01.363"	151'06'21.219"
Monitoring Bore 05	-27'24'55.167"	151'06'35.957"

4.5 Annual DSA Assessment

The Design Storage Allowance (DSA) checklist is attached in APPENDIX D. Records should be maintained in alignment with section 6.3. This assessment should be conducted on an annual basis (mid October).

The Production Supervisor is required to perform, or oversee, an assessment of the available storage capacity remaining in each regulated dam at November 1st each year. The estimate made, must be equal to, or less than the DSA level at this date.

Where the assessment indicates that the DSA will be exceeded, or at any other time has been or will be exceeded, the administering authority (DERM) will be immediately notified (through the Environment Coordinator – Operations) and action will be taken (in alignment with operational guidelines, see APPENDIX C) to prevent, or if unable to prevent, to minimise any actual or potential environmental harm.

4.6 Annual Integrity Inspection

A scope of works for the Annual Integrity Inspection is attached in APPENDIX D. Records should be maintained in alignment with section 6.3. This annual inspection is to be carried out in accordance with any requirements of the relevant Environmental Authority against the "Manual for assessing Hazard Categories and Hydraulic Performance of Dams".

The inspection is required on all regulated dams and will be carried out by a suitably qualified and experienced person.

A copy of the annual inspection should be forwarded to the Asset Integrity Engineer upon receipt.

A summary of any recommendations or actions proposed to maintain/return the dam to its intended function and required level of safety and integrity will be submitted (through the Environment Coordinator – Operations) to the administering authority (DERM) within forty (40) days from receipt of the report.

This annual inspection report may be carried out in alignment with the Annual DSA Assessment.

5.0 DAM SAFETY EMERGENCY PLAN

A Dam Safety Emergency Plan is to be developed by the Arrow Energy Ltd and communicated as required.

6.0 PROCESS ADMINISTRTAION

6.1 Accountabilities

ACCOUNTABILITIES	
Title	Responsibilities
System Owner (Asset General Manager)	▪ Implementing or significantly changing a system.
System Custodian (Production Supervisor)	▪ Ensuring that the system is applied as intended.
Production Engineer	▪ System Improvements based on significant events or improvements identified through operation.
Field Operator	▪ Managing the water infrastructure as per this plan. ▪ Ensuring reporting and notification obligations are met through the correct processes. ▪ Advising on improvements through operational experience.
Environment Coordinator	▪ Interface with DERM
Asset Integrity Engineer	▪ Structural integrity and maintenance of the assets

6.2 Audit Schedule

This dam operating plan will be reviewed annually or earlier based on significant events or improvements identified through operation.

6.3 Record Keeping

Records will need to be kept for a minimum of 5 years as required under our EA conditions.

Inspection checklists should be completed, signed, scanned and stored in the following location:

F:\Production Data\MEX-maintenance mgmt\DAMS

Relevant data should be transferred into the TBD database, and will be the responsibility of TBD to maintain.

6.4 Related Documentation

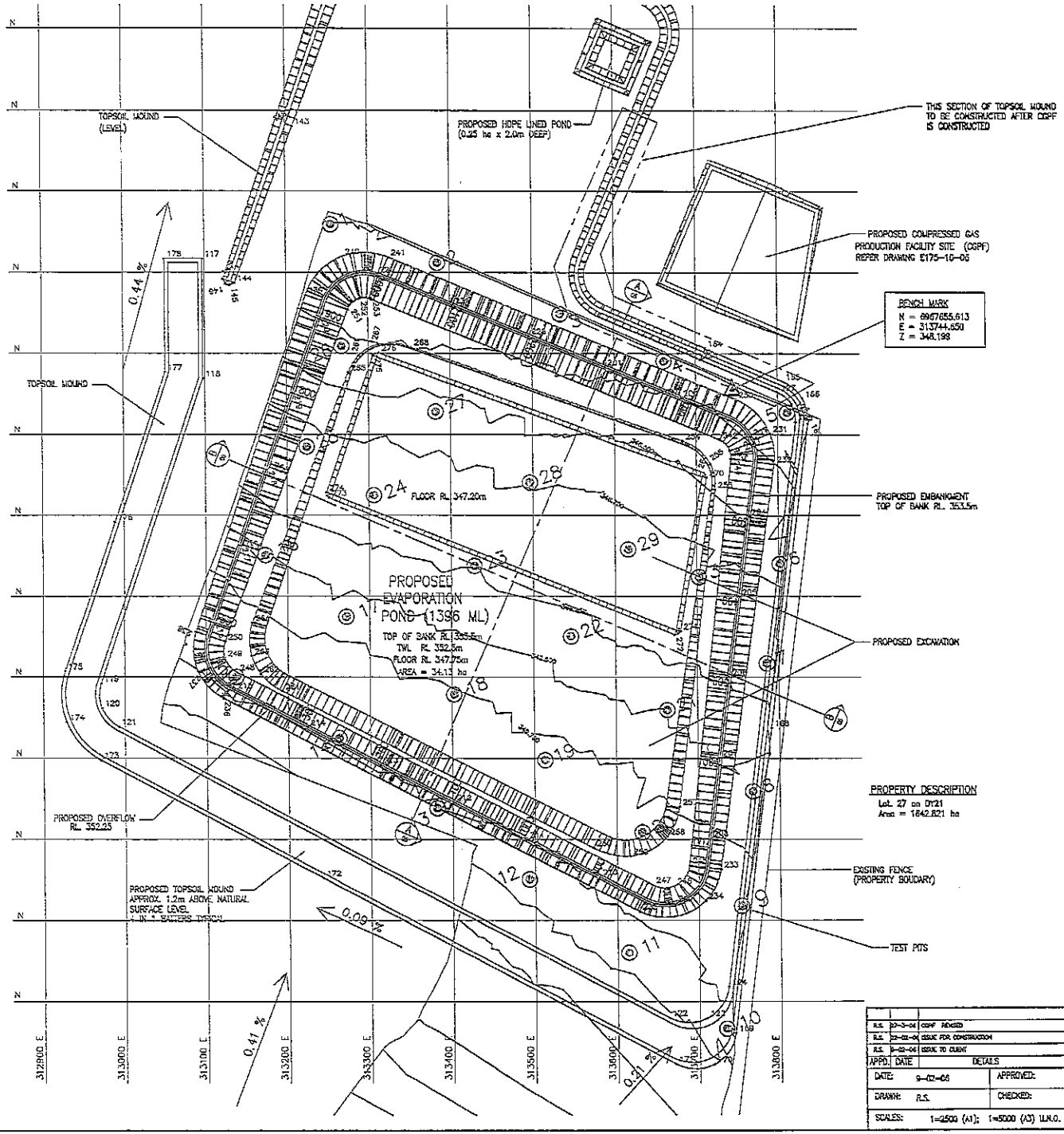
- 99-H-MN-0007 Emergency Response Manual
- DRAFT CSG Water Management Strategy
- 99-W-PL-0001 CSG Water Management Plan – South
- DRAFT Ground Water Management Program
- Golders Groundwater Impact Study 2009
- Golders Groundwater Bore Inventory Report
- (DRAFT) Arrow Energy Dalby Expansion Project" Environmental Authority PEN100449509

APPENDIX A – DESIGN DRAWINGS

APPENDIX B – DAM FILL CURVES

APPENDIX C – OPERATIONAL GUIDLINE FLOW CHART

APPENDIX D – INSPECTION CHECKLISTS



CONSTRUCTION NOTES:

1. TOP 300mm FROM EXISTING SURFACE OVER PROPOSED EVAPORATION POND TO BE STRIPPED & STOCKPILED ON SITE AS SHOWN.
2. SUBGRADE SURFACE BELOW EMBANKMENT WALL TO BE RIPPED TO DEPTH OF 150mm, MOISTURE ADDED AS REQUIRED & COMPACTED TO 98% RDD (STANDARD COMPACTION) WITHIN +2% -0% OF OPTIMUM MOISTURE CONTENT (OMC)
3. EMBANKMENT TO BE CONSTRUCTED FROM EXISTING MATERIAL EXCAVATED FROM WITHIN THE POND AREA.
   MATERIAL FROM BELOW 300mm OF NATURAL SURFACE IS SUITABLE (i.e. BROWN-ORANGE SANDY CLAY - "CI" CLASSIFICATION).
   EMBANKMENT TO BE COMPACTED TO 98% RDD (STANDARD COMPACTION) WITHIN +2% -0% OF OMC.
4. FLOOR OF POND TO BE RIPPED TO DEPTH OF 450mm, MOISTURE ADDED AS REQUIRED & COMPACTED TO 98% RDD (STANDARD COMPACTION) +2% -0% OF OMC.
5. 100mm TOPSOIL TO BE SPREAD OVER OUTER BATTER & TOP OF EMBANKMENT UPON COMPLETION OF BULK EARTHWORKS.
6. 100mm MULCH TO BE SPREAD OVER OUTER BATTER & TOP OF EMBANKMENT

Legend:

◎22 TEST PITS

241 SETOUT POINTS

FOR CONSTRUCTION

APPD.	DATE	DETAILS	ISS.
R.S.	20-3-06	CGPF REVISED	C
R.S.	22-02-06	ISSUE FOR CONSTRUCTION	B
R.S.	9-02-06	ISSUE TO CLIENT	A

DATE: 9-02-06 APPROVED:
DRAWN: R.S. CHECKED:
SCALES: 1=2500 (A1); 1=5000 (A3) U.N.O.

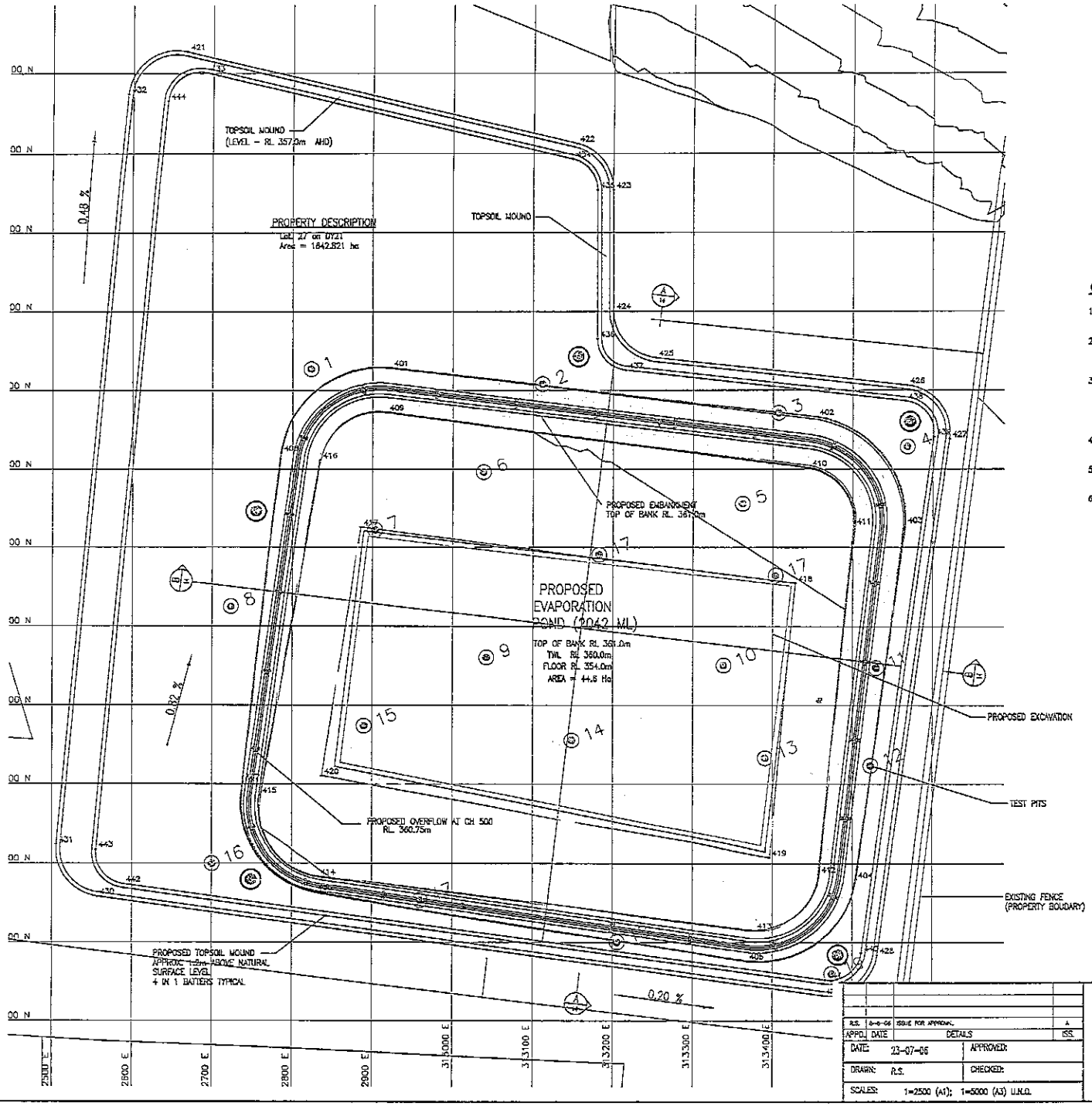
STAFFORD ADAMSON
PROJECT MANAGERS & CONSULTING ENGINEERS
PO BOX 7120
TOOWOOMBA MAIL CENTRE
QLD 4352
Phone: (07) 4639 6600 Fax: (07) 4639 6300
Email: staffadam@staffadam.com.au

PROJECT: PROPOSED COAL SEAM GAS FIELD - TIPTON WEST

TITLE: EVAPORATION POND LAYOUT PLAN EVAPORATION POND

DRAWING No. E175-10-03

REVISION C



N
W E
S

CONSTRUCTION NOTES:

1. TOP 300mm FROM EXISTING SURFACE OVER PROPOSED EVAPORATION POND TO BE STRIPPED & STOCKPILED ON SITE AS SHOWN.
2. SUBGRADE SURFACE BELOW EMBANKMENT WALL TO BE RIPPED TO DEPTH OF 150mm, MOISTURE ADDED AS REQUIRED & COMPACTED TO 98% RDD (STANDARD COMPACTION) WITHIN +2% –0% OF OPTIMUM MOISTURE CONTENT (OMC)
3. EMBANKMENT TO BE CONSTRUCTED FROM EXISTING MATERIAL EXCAVATED FROM WITHIN THE POND AREA.
   MATERIAL FROM BELOW 300mm OF NATURAL SURFACE IS SUITABLE (i.e. BROWN–ORANGE SANDY CLAY – 'CI' CLASSIFICATION).
   EMBANKMENT TO BE COMPACTED TO 98% RDD (STANDARD COMPACTION) WITHIN +2% –0% OF OMC.
4. FLOOR OF POND TO BE RIPPED TO DEPTH OF 450mm, MOISTURE ADDED AS REQUIRED & COMPACTED TO 98% RDD (STANDARD COMPACTION) +2% –0% OF OMC.
5. 100mm TOPSOIL TO BE SPREAD OVER OUTER BATTER & TOP OF EMBANKMENT UPON COMPLETION OF BULK EARTHWORKS.
6. 100mm MULCH TO BE SPREAD OVER OUTER BATTER & TOP OF EMBANKMENT

Legend:

- 22 — TEST PITS
- 241 — SETOUT POINTS
- GROUND WATER MONITORING LOCATIONS
- 0.20 % — NATURAL GROUND SLOPE (%)
- 313400 E — GRID CO–ORDINATE TO – GDA 94 ZONE 56

ENERGY n.L.
Arrow

R.S.	6-6-06	ISSUE FOR APPROVAL	A
APPD.	DATE	DETAILS	ISS.
DATE:	23-07-06	APPROVED:	
DRAWN:	R.S.	CHECKED:	
SCALES:	1=2500 (A1); 1=5000 (A3) U.N.O.		

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QLD 4352
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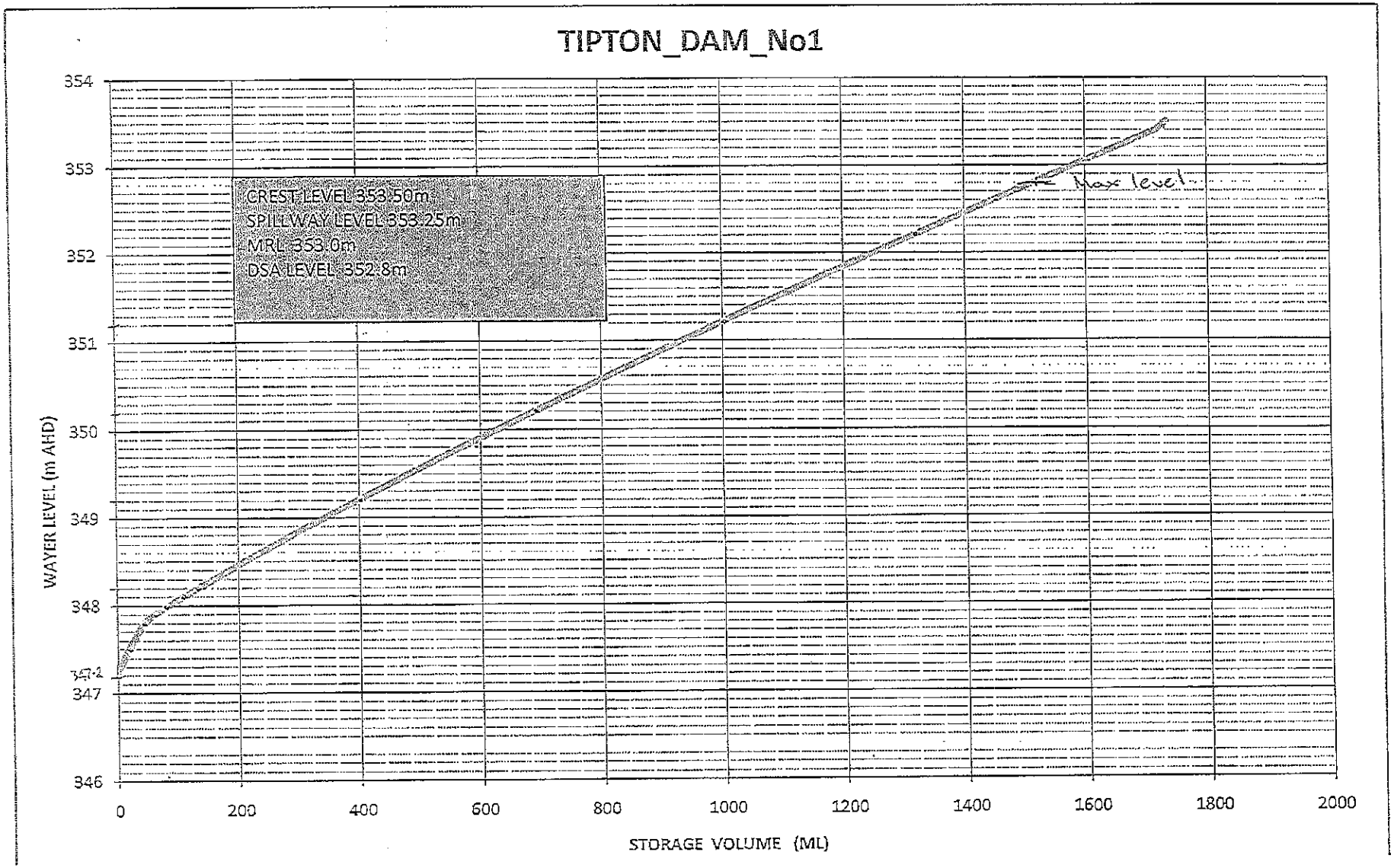
Email: staffadam@staffadam.com.au

PROJECT: TIPTON WEST COAL SEAM GAS FIELD

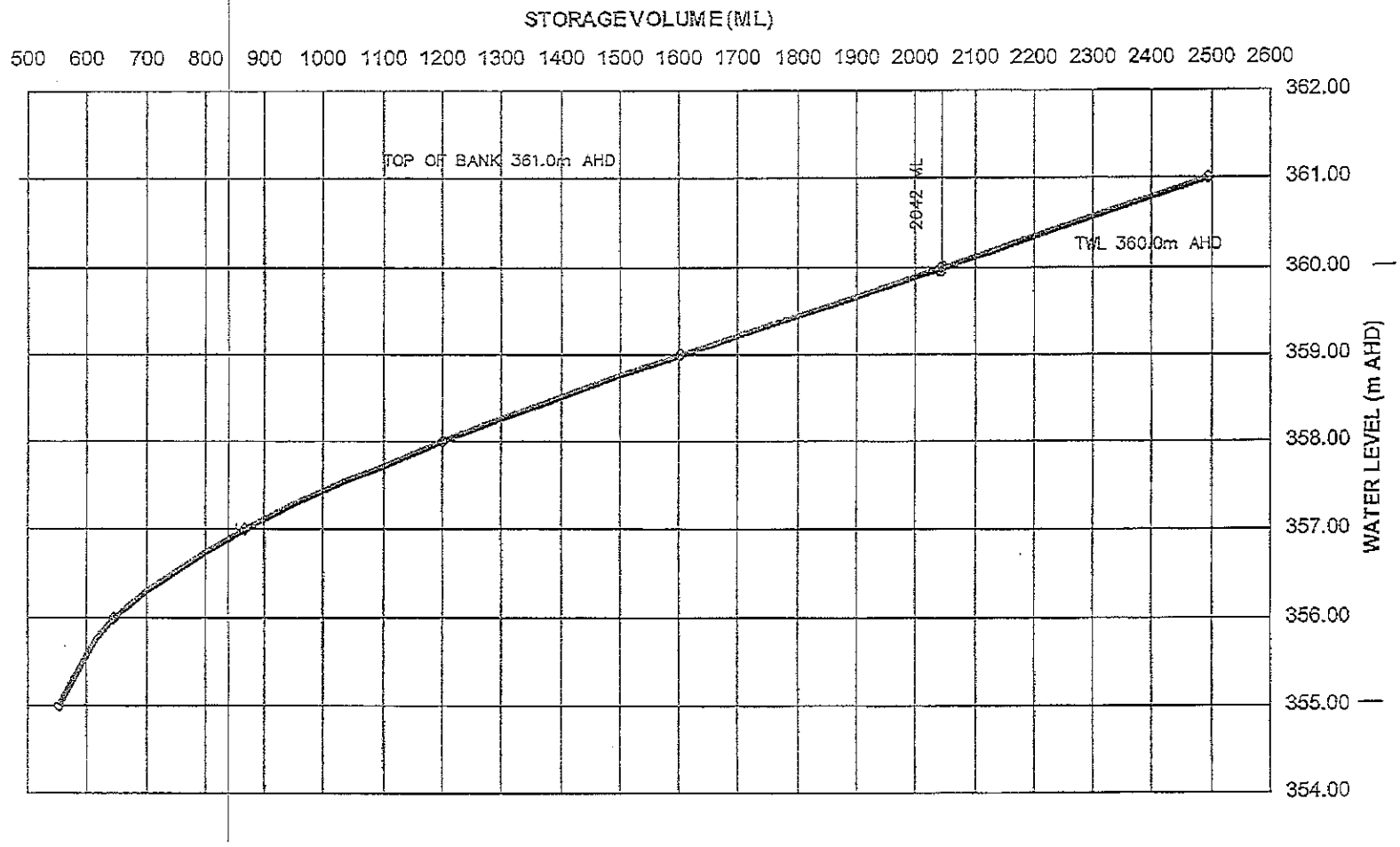
TITLE: EVAPORATION DAM – SITE No. 2
LAYOUT PLAN

DRAWING No. E175–20–01

REVISION A


TIPTON_DAM_No1
CREST LEVEL 353.50m
SPILLWAY LEVEL 353.25m
MRL 353.0m
DSA LEVEL 352.8m
Max level
WAYER LEVEL (m AHD)
354
353
352
351
350
349
348
347
346
0
200
400
600
800
1000
1200
1400
1600
1800
2000
STORAGE VOLUME (ML)

STORAGE CURVE FOR EVAPORATION DAM No 2 TIPTON WEST



FOR CONSTRUCTION

XX	26.11.08	ISSUE FOR CONSTRUCTION	B
XX	9-4-08	ISSUE FOR APPROVAL	A
APPD	DATE	DETAILS	ISS.
DATE:	27-03-08	APPROVED:	
DRAWN:	B.S.	CHECKED:	
SCALES:	N.T.S.		

STAFFORD ROBINSON
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Email: staffadam@staffadam.com.au

PROJECT: TIPTON WEST COAL SEAM GAS FIELD

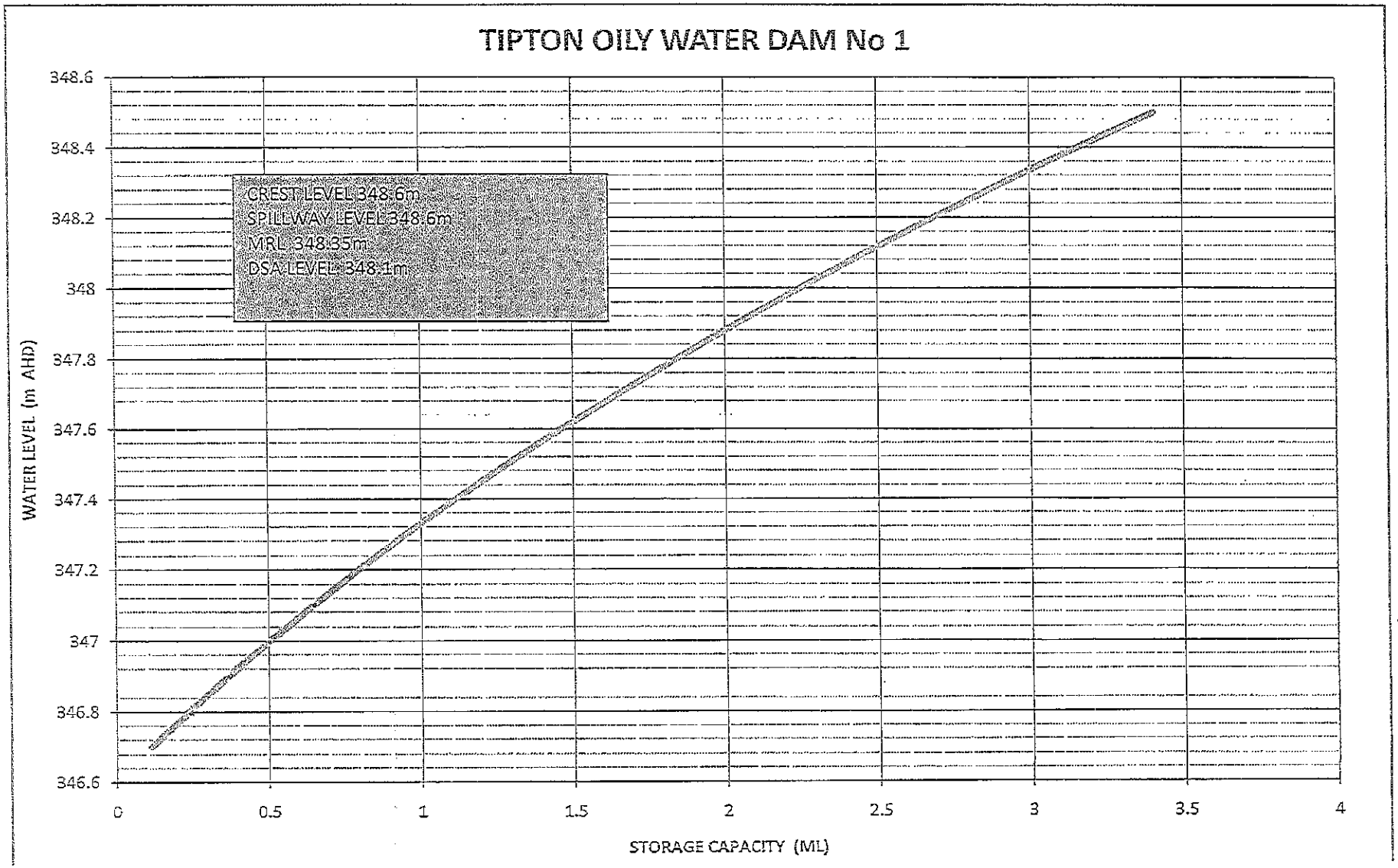
TITLE: EVAPORATION DAM – SITE No. 2 STORAGE CURVE

DRAWING No. E175-20-13

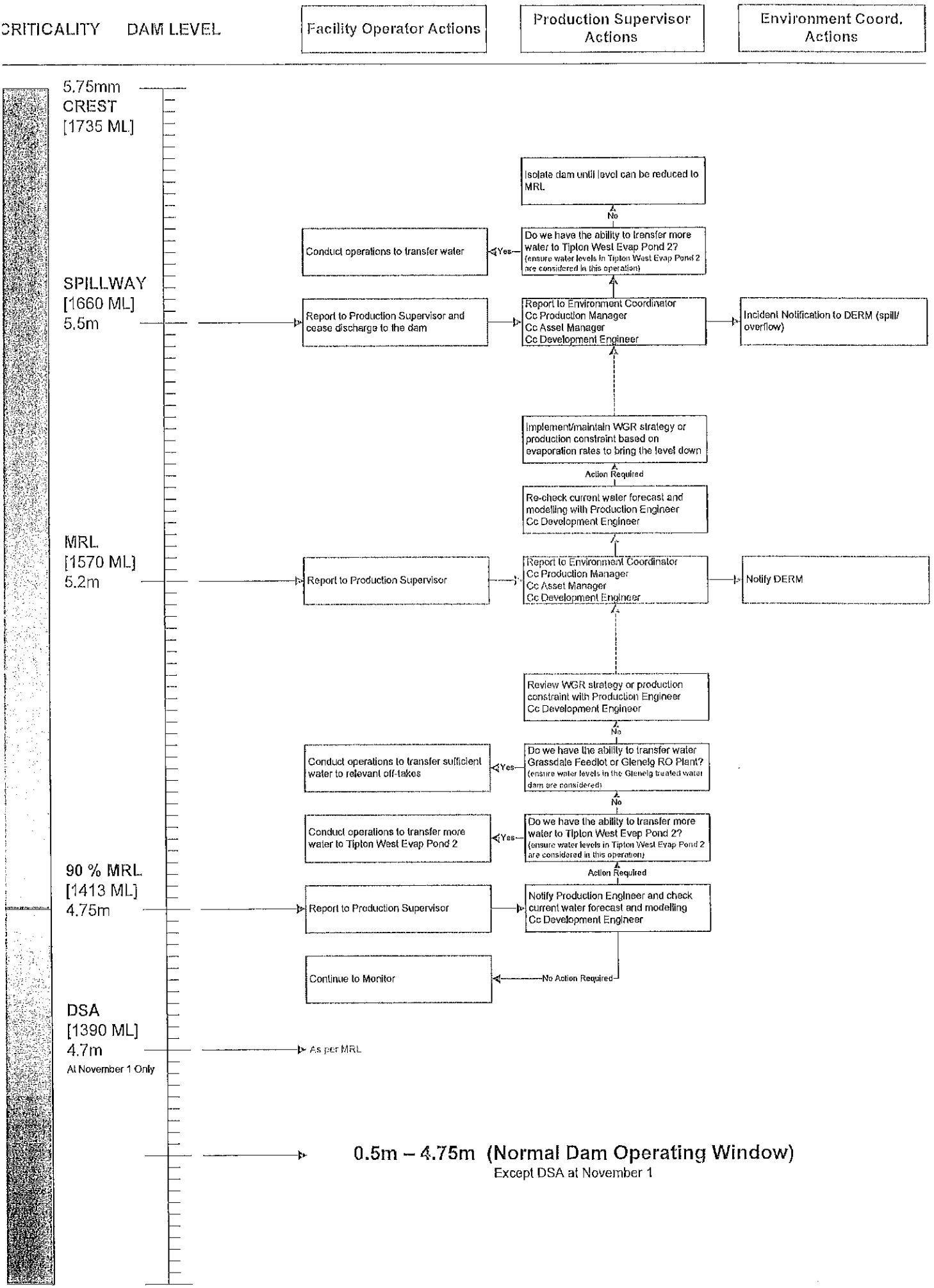
REVISION B

ENERGY P.L. Arrow

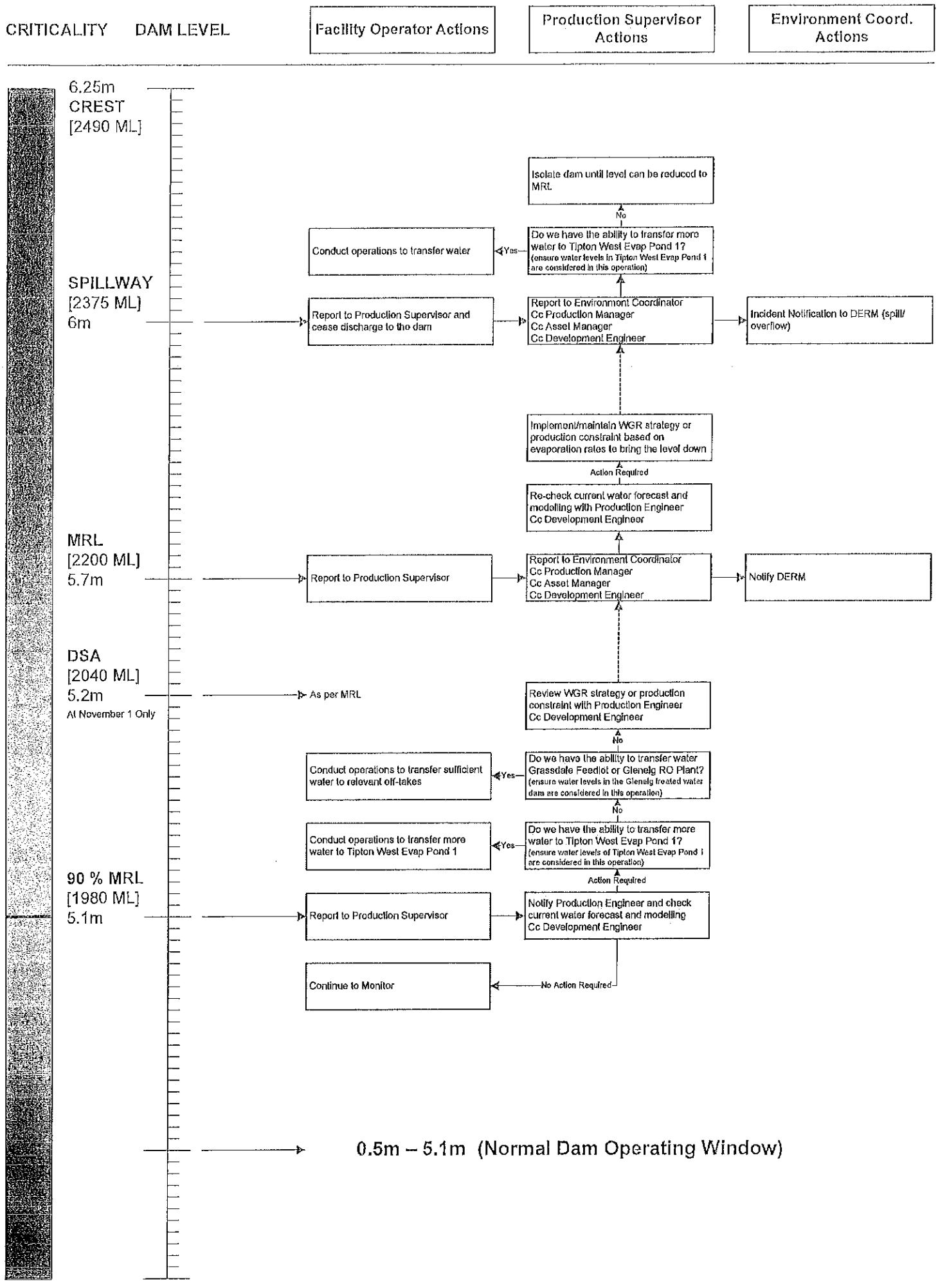
TIPTON OILY WATER DAM No 1



TIPTON WEST EVAP POND 1 (00-DA-01) OPERATING GUIDELINES



TIPTON WEST EVAP POND 2 (00-DA-02) OPERATING GUIDELINES



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WEEKLY DAM INSPECTION CHECKLIST

Review Date: JULY 2011

DOC OWNER: ASSET GM

INSPECTION DETAILS

Dam Name						
Dam Service (Circle One)	Associated Water	Brine	Chemical Waste Water	Oily Waste Water	Treated Water	SAR Adjusted Irrigation Water
Week Ending	/ /					

LEVEL READING

Level	Reading
Level Indicator [m]	
Mandatory Reporting Level [m]	*(see MRL table on reverse side)*
Is the level below MRL?	YES ☐ NO ☐
Vertical height remaining to MRL [m]	

If 'No', has this been reported to the Supervisor?	YES ☐

A visual inspection should be carried weekly for early detection of integrity or containment issues and to ensure compliance with environment, regulation and Arrow Energy OH&S. Note any odour, water foaming or surface slick.

VISUAL INSPECTION / COMMENTS

Did the dam area receive rainfall during this inspection period?	.....mm

INSPECTION VERIFICATION

Name:		Position:	
Signature:		Date:	

DAM INFORMATION						
Dam Name	Unit ID	MRL. Volume [ML]	Surface Area [Ha]	DSA Level [m]	MRL Level [m]	Spillway Level [m]
Kogan North Evap Pond	02-DA-01	408	12	1200mm	700mm	400mm
Daandine Feed Dam	02-DT-02	408	11.5	5.2	5.7	6
Daandine Treated Water Dam	02-DT-04	211	7.8	4.4	4.9	5.2
Daandine Brine Storage Dam	02-DB-03	1371	38.1	5.05	6.2	6.5
Daandine Chemical Waste Dam	02-DW-05	33	1.6	4.35	4.5	5
Daandine CGPF Oily Water Dam	02-DW-06	TBA	TBA	TBA	TBA	TBA
Tipton West Evap Pond 1	00-DA-01	1396	34.13	4.7	5.2	5.5
Tipton West Evap Pond 2	00-DA-02	2042	44.6	5.2	5.7	6
Tipton West Oily Water Dam 1	00-DW-03	2.5	0.25	TBA	TBA	TBA
Tipton West Oily Water Dam 2	02-DW-04	2.5	0.25	TBA	TBA	TBA

DAM INFORMATION						
Dam Name	Unit ID	Max Op. Volume [ML]	Surface Area [Ha]	DSA Level [m] AHD	MRL Level [m] AHD	Spillway Level [m] AHD
Moranbah Dam 1	03 – DB – 001					
Moranbah Dam 2	03 – DB – 002					
Moranbah Dam 3	03 – DB – 003					
Moranbah Dam 4	03 – DB – 004					
Moranbah Dam 5	03 – DB – 005					
Moranbah Dam 6	03 – DB – 006					
Moranbah Dam 7	03 – DB – 007					
Moranbah Dam 8	03 – DB – 008					
Moranbah Dam 9	03 – DB – 009					
Moranbah Dam 10	03 – DB – 010					
Moranbah Dam 11	03 – DB - 011	387	8.6	237.4	237.8	238.2
Moranbah Dam 12						
Moranbah Dam 13						
Moranbah Dam 14						

arrow energy

MONTHLY DAM INSPECTION CHECKLIST

CHECKLIST: [illegible]

REV: [illegible]

STATUS: IFU

Review Date: JULY 2011

DOC OWNER: ASSET GM

INSPECTION DETAILS	
Dam Name	
Dam Service (Circle One)	Associated Water / Brine / Chemical Waste Water / Oily Waste Water / Treated Water / SAR Adjusted Irrigation Water
Service Change	Has the purpose/contents changed during the period? YES ☐ NO ☐
Week Ending	/ /

EMBANKMENT BATTER INSPECTION - Visual Inspection of full embankment perimeter

Inspection	Checklist	Comment
Rill erosion or channelling	YES ☐ NO ☐	
Tunnelling	YES ☐ NO ☐	
Topsoil still in place at specified thickness	YES ☐ NO ☐	
Vegetation & grass coverage	YES ☐ NO ☐	
Cracking in embankment	YES ☐ NO ☐	
Instability in embankment	YES ☐ NO ☐	
Depression in embankment	YES ☐ NO ☐	
Seepage on outer batter	YES ☐ NO ☐	

SPILLWAY INSPECTION - Visual inspection of joins and surface condition of synthetic liner

Inspection	Checklist	Comment
No sign of lifting at joints	YES ☐ NO ☐	
No rippling, stretching or bagging if liner	YES ☐ NO ☐	
No wear or abrasion marks on surface of liner	YES ☐ NO ☐	
No debris in chute, sill or basin	YES ☐ NO ☐	

STILLING BASIN INSPECTION - Visual inspection of rock armour protection (rip rap), and side batters; and remove any obstructions

Inspection	Checklist	Comment
Rock armour is still in position ± 100 mm	YES ☐ NO ☐	
Depth of rock is maintained	YES ☐ NO ☐	
Side batters have not been breached and topsoil present to riprap, edge, no evidence of undermining	YES ☐ NO ☐	
No obstructions or debris in basin	YES ☐ NO ☐	

HDPE LINER INSPECTION - Inspect liner condition with emphasis on damage from fauna and wild animals		
Inspection	Checklist	Comment
Unexpected change in moisture levels in the liner bedding material	YES ☐ NO ☐	
No lifting of joints	YES ☐ NO ☐	
Leak detection sump level check conducted	YES ☐ NO ☐	
No damage adjacent to level markings of lapping joints	YES ☐ NO ☐	
No abrasion or damage from stock, wildlife, machinery or personnel	YES ☐ NO ☐	
Zero joint failure	YES ☐ NO ☐	
No UV damage, fading, cracking or discolouration	YES ☐ NO ☐	

CREST INSPECTION - Survey embankment levels before and ongoing		
Inspection	Checklist	Comment
Settlement less than 150mm, 6months after construction	YES ☐ NO ☐	
Settlement less than 300mm ultimate	YES ☐ NO ☐	

SECURITY FENCE & GATE INSPECTION - Inspect full perimeter of security fence		
Inspection	Checklist	Comment
No damage by wildlife allowing access to facility	YES ☐ NO ☐	
Gates are lockable	YES ☐ NO ☐	
No signs of forced entry	YES ☐ NO ☐	

WATER MONITORING						
Inspection	MB01	MB02	MB03	MB04	MB05	DAM
Bore Location or Name						
Standing Water Level (SWL) [m]						
Temperature [°C]						
Electrical Conductivity [mS/cm]						
pH						
Salinity [ppm]						

INSPECTION VERIFICATION			
Name:		Position:	
Signature:		Date:	

PURPOSE

A more intensive dam and groundwater contaminant monitoring program is to be conducted to initially determine a set of baseline conditions upon which future monitoring can be compared to identify potential variations due to operational practices or loss of containment.

SCOPE

As a minimum, the following parameters will be measured against pre-determined baseline conditions for water in all regulated dams and associated groundwater bores:

PARAMETERS	ALS CODE	UNITS
Parameters	ALS Code	Units
pH	EA005	pH units
Conductivity	EA010P	µS/cm
Salinity (or Total Dissolved Solids)	EA015	mg/L
Suspended Solids	EA025	mg/L
Turbidity	EA045	mg/L
Fluoride	EK040	mg/L
Major Anions Dissolved (Sulphate as SO4; Chloride, Alkalinity)	**NT-2** (ED041, ED045, ED037)	mg/L
Major Cations Dissolved (Calcium, Magnesium, Sodium, Potassium)	ED040	mg/L
Metals Dissolved – NEPM (As, Ba, Be, Cd, Cr, Co, Cu, Mn, Ni, Pb, V, Zn, Hg) plus	**W-3** + EG020 (Al, B, Fe, Se, Sr)	mg/L
Metals Total – NEPM (As, Ba, Be, Cd, Cr, Co, Cu, Mn, Ni, Pb, V, Zn, Hg) plus	**W-3T** + EG020T (Al, B, Fe, Se, Sr)	mg/L
Cyanide Free	EK025	mg/L
Cyanide Total	EK026	mg/L
Plus for Oily Water Dams		
TPH & BETX	**W-4** (EP071, EP080)	µg/L

INSPECTION DETAILS

Dam Name						
Dam Service (Circle One)	Associated Water	Brine	Chemical Waste Water	Oily Waste Water	Treated Water	SAR Adjusted Irrigation Water
Week Ending	/ /					

The following excerpts from the Environmental Authority are conditions relevant to the assessment of the Design Storage Allowance level just prior to 1st of November of each year.

(C1) An assessment of the adequacy of the available storage in each Regulated Dam is to be made, based on an actual dam level observed in the month of October in each year, and the resultant estimate of the level in that dam as at 1 November in each year must be equal or less than the design storage allowance for the dam.

(C2) Where the assessment required in Condition C1 indicates that the design storage allowance will be exceeded, or at any other time the holder of this environmental authority becomes aware that the design storage allowance has been or will be exceeded, the holder of this environmental authority must immediately notify the administering authority, and immediately act to prevent or, if unable to prevent, to minimise any actual or potential environmental harm.

LEVEL READING

Level	Reading
Level Indicator [m]	
Design Storage Allowance Level [m]	*(see DSA table on reverse side)*
Does this assessment indicate the level will be below DSA on 1st Nov.?	YES ☐ NO ☐

If 'No', do operations have the ability to lower the level below DSA in alignment with the Dam Operations Plan?	YES ☐ NO ☐
If 'Yes' for ability, has this plan been communicated and implemented?	YES ☐ NO ☐
If 'No' for ability, has this been reported to the Manager and Environment Coordinator – Ops?	YES ☐ NO ☐

INSPECTION VERIFICATION

Name:		Position:	
Signature:		Date:	

DAM INFORMATION						
Dam Name	Unit ID	MRL Volume [ML]	Surface Area [Ha]	DSA Level [m]	MRL Level [m]	Spillway Level [m]
Kogan North Evap Pond	02-DA-01	408	12	1200mm	700mm	400mm
Daandine Feed Dam	02-DT-02	408	11.5	5.2	5.7	6
Daandine Treated Water Dam	02-DT-04	211	7.8	4.4	4.9	5.2
Daandine Brine Storage Dam	02-DB-03	1371	38.1	5.05	6.2	6.5
Daandine Chemical Waste Dam	02-DW-05	33	1.6	4.35	4.5	5
Daandine CGPF Oily Water Dam	02-DW-06	TBA	TBA	TBA	TBA	TBA
Tipton West Evap Pond 1	00-DA-01	1396	34.13	4.7	5.2	5.5
Tipton West Evap Pond 2	00-DA-02	2042	44.6	5.2	5.7	6
Tipton West Oily Water Dam 1	00-DW-03	2.5	0.25	TBA	TBA	TBA
Tipton West Oily Water Dam 2	02-DW-04	2.5	0.25	TBA	TBA	TBA

DAM INFORMATION						
Dam Name	Unit ID	Max Op. Volume [ML]	Surface Area [Ha]	DSA Level [m] AHD	MRL Level [m] AHD	Spillway Level [m] AHD
Moranbah Dam 1	03 – DB – 001					
Moranbah Dam 2	03 – DB – 002					
Moranbah Dam 3	03 – DB – 003					
Moranbah Dam 4	03 – DB – 004					
Moranbah Dam 5	03 – DB – 005					
Moranbah Dam 6	03 – DB – 006					
Moranbah Dam 7	03 – DB – 007					
Moranbah Dam 8	03 – DB – 008					
Moranbah Dam 9	03 – DB – 009					
Moranbah Dam 10	03 – DB – 010					
Moranbah Dam 11	03 – DB - 011	387	8.6	237.4	237.8	238.2
Moranbah Dam 12						
Moranbah Dam 13						
Moranbah Dam 14						

EACH REGULATED DAM must be inspected annually by a suitably qualified and experienced person.

DAM DESIGNER	
Name:	[redacted] (Stafford Adamson & Associates)
Address	23 Clifford St PO Box 7120 Toowoomba Mail Centre QLD 4352
Contact Phone:	[redacted]
Mobile Phone:	

PURPOSE

This annual inspection is to be carried out in accordance with any requirements of the relevant Environmental Authority against the "Manual for assessing Hazard Categories and Hydraulic Performance of Dams". The inspection will assess both the hazard category of the dam and the structural, geotechnical and hydraulic performance.

SCOPE

A report will be compiled by the person conducting the Annual Integrity Inspection and must include the following at a minimum:

- ☐ An assessment on the condition of each Regulated Dam
- ☐ An assessment of each Regulated Dam for dam safety
- ☐ An assessment against the structural, geotechnical and hydraulic performance criteria contained in the certified design plan
- ☐ An assessment of the hazard category
- ☐ Recommendations for findings on any of the above

Upon receipt of the report, it should be distributed to the following personnel:

- ☐ Asset Integrity Engineer
- ☐ Environment Coordinator – Operations
- ☐ The Environment Coordinator – Operations must, upon receipt of the annual inspection report and, within 40 business days, notify the administering authority in writing of the recommendations of the inspection report and the actions taken to ensure the integrity of each regulated dam.

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Attachment A – Major dam asse

Asset Base	Site	CLASS	SUB_CLASS	Hazard Category	Descriptio	ent	Structural Height	Crest width	Recieving Environment
	PL						m	m	
Sourthern	198	Dam	Evaporation	Significant	Tipton We	4.13	5.50	5.00	Lake Broadwater
Sourthern	198	Dam	Evaporation	Significant	Tipton We	4.60	6.00	5.00	Lake Broadwater
Sourthern	230	Dam	Brine Storage	High	Daandine	8.10	6.50	5.00	Wilkey Creek
Sourthern	230	Dam	Treated Water		Daandine	7.80	4.80	5.00	Wilkey Creek
Sourthern	230	Dam	Aggregation	Significant	Daandine	1.60	2.90	5.00	Wilkey Creek
Northern	191	Dam	Evaporation	Significant	Moranbah	0.98	2.50	3.50	Isaac River
Northern	191	Dam	Evaporation	Significant	Moranbah	6.41	3.50	3.50	Isaac River
Northern	191	Dam	Evaporation	Significant	Moranbah	5.93	3.34	4.00	Isaac River

**Red Indicates dam over MRL. Northern dams on PL191 are the su*

Ben McMahon

From: Ben McMahon
Sent: Friday, 24 December 2010 12:38 PM
To: [redacted]
Subject: URS dam inspection report
Attachments: URS Dam Inspection v1

Categories: Red Category

Hi [redacted]

Please find attached the URS dam inspection report that we just received in relation to Dam 2

Best regards

Ben McMahon

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T:
F:
M: [redacted]
www.arrowenergy.com.au

URS

24 December 2010
Project No. TBD

Arrow Energy Limited
Level 19, AM60
42 - 60 Albert Street
Brisbane Queensland 4000

Attention: [redacted]
Water and Salt Coordinator

Dear [redacted]

Subject: Moranbah Gas Facility Pond 2 Site Visit by URS

URS Australia Pty Ltd (URS) is pleased to submit this letter of findings for Pond 2 located at the Moranbah Gas Facility. This letter provides a description of the project, scope of work completed by URS, identification of risks associated with the current condition of Pond 2 and recommendations to mitigate these risks in short-term and long-term.

1 Introduction

1.1 Background

The Moranbah Gas Facility (MGF) is located in the Bowen Basin, approximately 170km west of Mackay and approximately 10 kilometres north of Moranbah, Queensland. Pond 2 is one of several ponds used for storing saline water produced from coal seam gas (CSG) extraction and is believed to have been in operation for approximately five years. Arrow Energy Limited (AEL) retained URS to inspect Pond 2 for seepage and stability concerns. Based on the information provided by AEL[1] it is our understanding that Pond 2, along with all other AEL dams nearby, are running close to capacity due to recent heavy rainfall. Due to dam safety concerns, a decision was made to pump water from the dam into the Isaac River. Arrow Energy does not hold a licence to discharge and was subsequently instructed by DERM (Department of Environment Resource Management) to cease discharge. It is also understood that Pond 2 does not have a spillway and no outlet works.

1.2 Site Visit

A site visit was performed by a URS Geotechnical Engineer (Shaun Vemuri) on 22 December, 2010 to evaluate the current condition of Pond 2. Upon reaching the site, the URS Geotechnical Engineer met with AEL employees (Dane Donnelly and Cameron Barrett) to discuss the scope of work and subsequently underwent a visitor's induction. The URS Engineer was onsite from 8:45AM to 2:45PM on 22 December, 2010.

[1] Memo from [redacted] (with AEL) to [redacted] (URS) dated 17 December, 2010

URS Australia Pty Ltd (ABN 46 000 691 690)
Level 16, 240 Queen Street
Brisbane, QLD 4000
GPO Box 302, QLD 4001
Australia
T: 61 7 3243 2111
F: 61 7 3243 2199

2 Scope of Work

The objective of the site visit was to evaluate various components of the dam including (i) the upstream slopes, (ii) the crest and shoulders, and (iii) the downstream slopes to identify potential deficiencies. The focus was on noting deficiencies related to seepage, cracking, instability, depressions and maintenance concerns. In addition, the objective of the site visit was to characterise the foundation materials underlying the dam using test pits. However, due to insufficient time for clearance of underground utilities and not having access to an excavator, it was decided by AEL personnel to withhold excavation of the test pits. Hence, the URS Engineer was unable to evaluate the foundation materials underlying Pond 2.

3 Observations

3.1 Dam Orientation

Pond 2 is oriented in a northeast to southwest direction (see Figure 1). The pond is bordered by a railway track on the north and open land on the other sides. The pond crest can be accessed using a ramp located at the northeast corner.

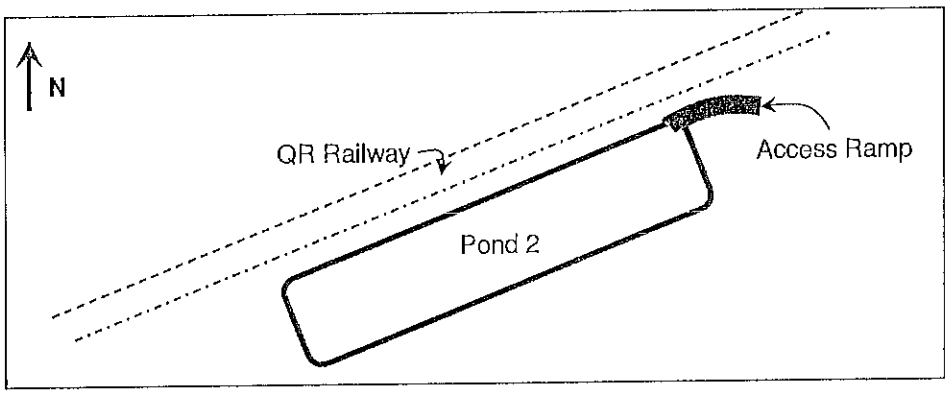
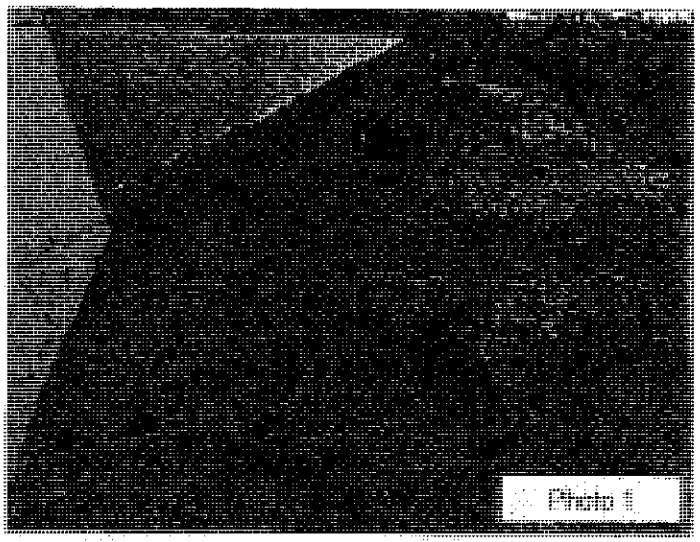


Figure 1: Sketch of Pond 2 in relation to surroundings

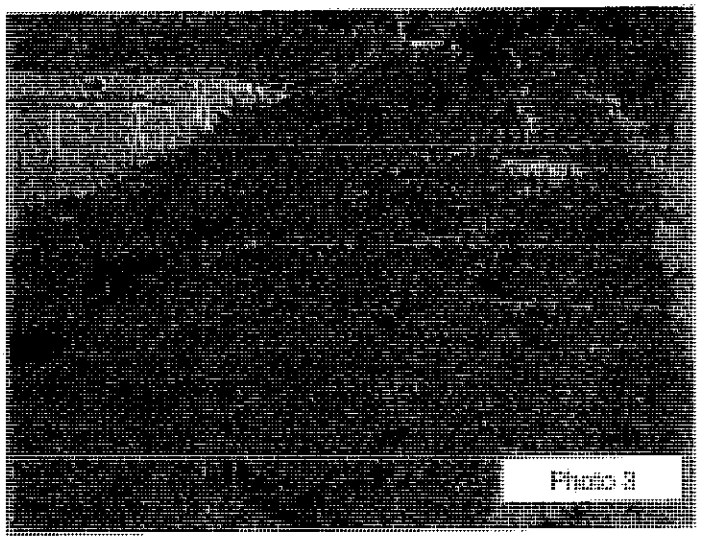
3.2 Upstream Slopes

3.2.1. **Wave Action Erosion**: The action of waves on the upstream slope has resulted in wave action erosion (beaching) and degradation of the slopes (see Photos 1 and 2). The wave action has eroded the embankment material significantly in several locations. Portions of the upstream slopes have been eroded due to wave action reducing the overall width of the crest.



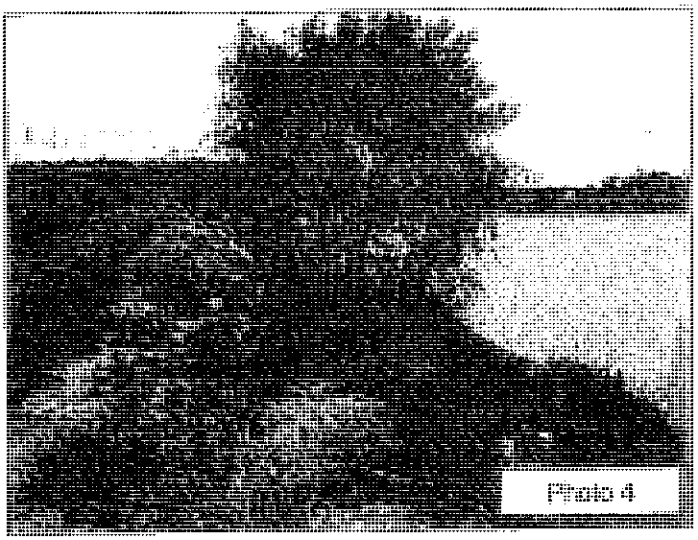
3.2.2. **Degradation:** Degradation of the upstream slopes appears to have been accelerated due to recent heavy rainfalls. Increased wave action from strong winds may also have caused the upstream slopes to erode into the crest, especially along the east side crest.

3.2.3. **Gullies:** Surface run-off has caused formation of gullies in several areas effectively reducing the cross-sectional area of the dam (see Photo 3). It is possible that the recent heavy rainfall has exacerbated the formation of gullies.



3.3 Crest and Shoulders

3.3.1. **Vegetative Growth**: Excessive vegetative growth was noted along the crest with deep-rooted vegetation (trees) in two locations (See Photos 4 and 5). Two trees approximately 200 millimetres in diameter were noted along the crest.



3.3.2. **Desiccation Cracking**: Honeycomb pattern (desiccation) cracking was noted at several locations along the crest. Surface runoff is collecting in desiccation cracks reducing the strength of the underlying embankment material.

3.3.3. **Transverse Cracking:** No clearly visible signs of transverse cracking (cracking perpendicular to the dam axis) were noted with Pond 2 crest. However, three (3) areas were noted along the crest where the crest surface was lower than surrounding areas (localised depressions) (See Figure 2). Specifically, one area was located north of the access ramp, one immediately south of the access ramp and one along the north side crest. The widest depression was approximately 10 meters in width and located approximately 1/3rd of the distance along the north side crest from north east corner (See Photo 6).

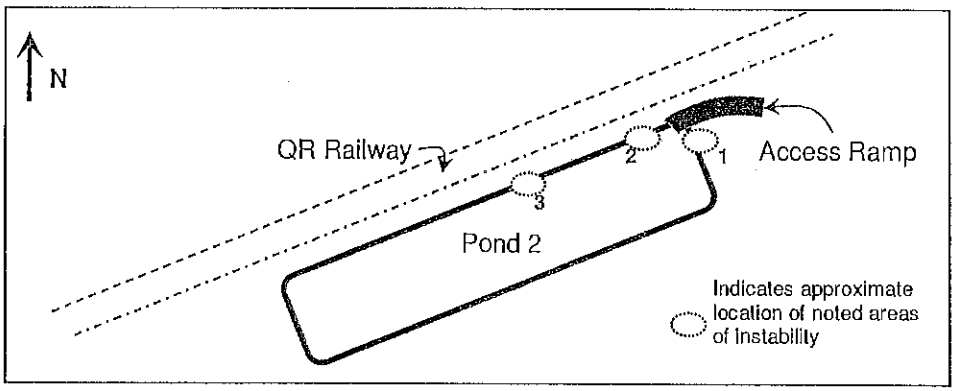
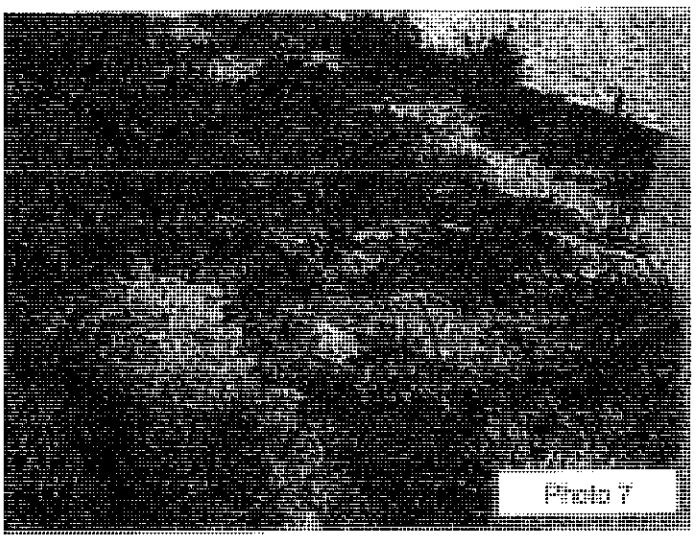


Figure 2: Noted areas of instability

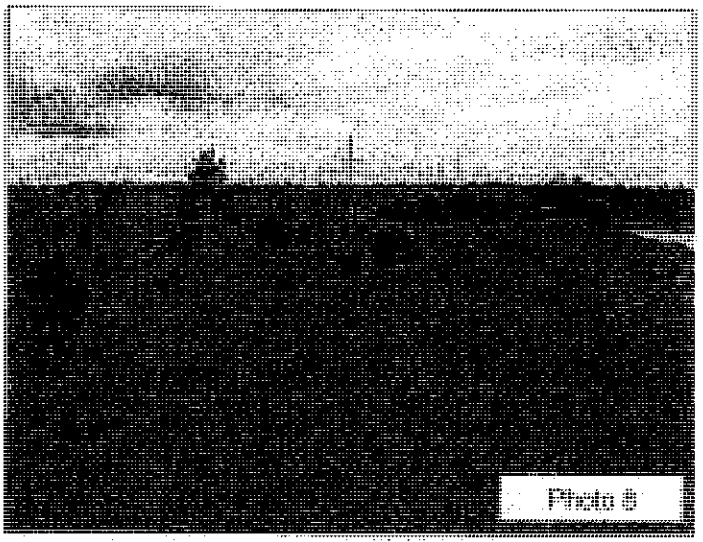
3.3.4. **Longitudinal Cracking:** Signs of longitudinal cracking (parallel to the dam axis) were noted in the same three areas as mentioned in article 3.2.3. Longitudinal cracking in these areas appear to be the beginning scarps of unstable slopes downstream (See Photo 6).

3.3.5. **Depressions:** Localised settlement in the crest surface was noted at several areas along the crest and this may be due to poor compaction and/or surface erosion. (See Photo 7).

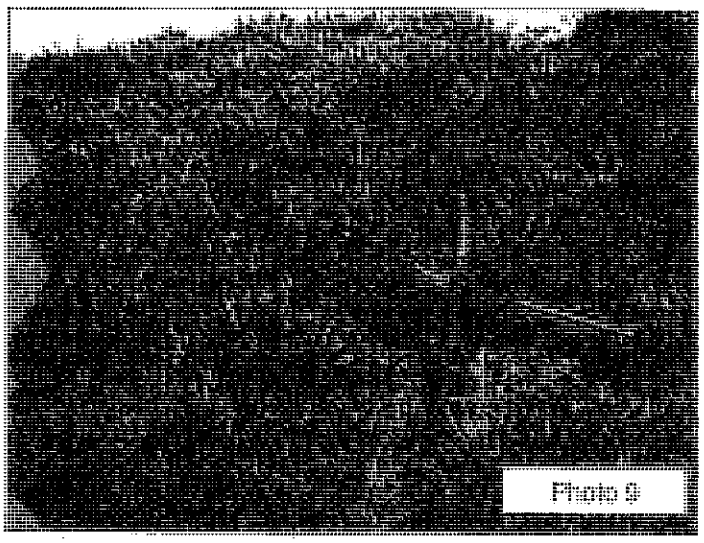


3.4 Downstream Slopes

3.4.1. **Thick Vegetation:** Thick vegetation significantly hindered the visual inspection of the downstream slopes (see Photo 8). It is possible that several signs of instability such as bulges, cracks and slides were obscured by vegetation and thus limiting the scope of inspection.



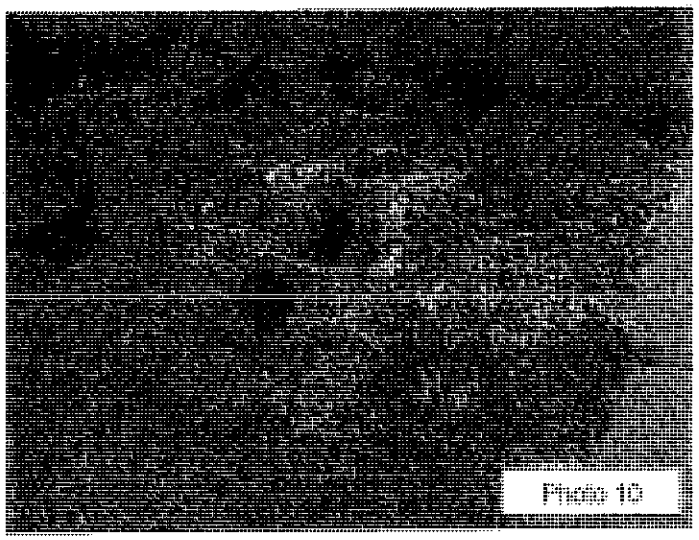
3.4.2. **Slope Instability:** Slope instability was noted in three (3) areas shown in Figure 2. The scarps in these areas have extended to the downstream crest reducing the effective width of the crest. The slides near Area 1 and Area 2 appear to be fairly deep seated and significantly deep cracks (see Photo 9).



3.4.3. **Poor Compaction:** Downstream slopes appear to have significantly higher number of erosion rills, gullies and uneven surface than normally expected for such dams. Due to thick vegetation, the underlying surface was mostly obscured. However, the unevenness noted while walking the slopes, indicates that the slopes are rarely uniform. It is possible that inadequate compaction of embankment material has resulted in erosion and surficial sloughing. No records of construction were available for URS review at the time of this writing.

3.4.4. **Internal Erosion:** Internal erosion can occur when seepage flows along established pathways such as poorly compacted layer interfaces and cracks. Given that the dam is showing

signs of poorly compacted material, it is possible that internal erosion is occurring to some level along the downstream slopes. However, internal erosion cannot be confirmed until the slopes are cleared of vegetation. A visible sign of internal erosion was noted at the southwest corner of the dam (see Photo 10).



3.4.5. **Piping:** Piping is a significant risk to Pond 2. Piping occurs when the reservoir water moves through the pores of the dam with enough tractive force to remove soil particles at the exit point. Good indicators of piping are sand boils. While no sand boils were noted during the visual inspection, it is highly possible that the signs of seepage were obscured by thick vegetation.

3.4.6. **Sampling:** URS obtained soil samples from Area 2 for laboratory tests including soil classification and particle size analysis. Information from laboratory tests will be used for designing emergency response measures such as a reverse graded filter.

4 Conclusions and Recommendations

The following preliminary conclusions and recommendations are provided based on the observations made during the site visit. These conclusions and recommendations will need to be reviewed as further information is obtained regarding the nature of the embankment and based on further discussions with AEL.

4.1. **Dam Safety:** Given that there are three areas of potential instability on the downstream face of the embankment and the observed reduction in the effective crest width due to erosion, Pond 2 is considered to have an unacceptably high risk of embankment failure. Measures need to be implemented as a matter of priority to mitigate the risk of embankment failure.

4.2. **Short Term:** It is recommended that the water in Pond 2 be lowered to below the level of the observed instability on the downstream slopes. While no survey has been undertaken across the embankments, it is estimated that the water level will need to be lowered a minimum of four (4) meters below the Design Storage Allowance (DSA). Lowering the water level will reduce the short

term seepage risk until further action is taken regarding the future use of the dam. It is important that the water level be lowered immediately in preparation for the ongoing wet season.

4.3. **Daily Surveillance**: URS recommends daily surveillance of the embankment in the short term. AEL personnel inspecting the embankment must take photos on a daily basis for comparison and complete a record of each inspection noting the condition of the embankment and any observed changes.

4.3 **Slope instability:** URS has observed three (3) marginally stable areas that need further evaluation. It is recommended that vegetation be removed in these areas immediately to facilitate a second site visit during which the initially planned geotechnical investigations could be undertaken. If Pond 2 is completely dewatered in the short-term, further evaluation of these areas can be postponed until future use of the dam is determined.

4.4. **Spillway**: It is to be noted that Pond 2 does not have a spillway. This increases the risk of overtopping in the event of heavy rainfall. It is recommended that AEL maintain the water elevation in Pond 2 at least four (4) meters below the DSA (Design Storage Allowance) in short term. At the time of URS site visit, the pond water level was 405 mm below MRL (Mandatory Reporting Level).

4.5. **Downstream Slopes**: The URS Engineer could not fully inspect the downstream slopes of the embankment due to thick vegetation. It is recommended that AEL personnel mow the downstream slopes and shoulders as soon as possible to facilitate further inspection. If AEL decides to completely dewater the pond in short-term, mowing is not necessary until the future use of the dam is determined.

4.6. **Long Term Options**: Based on the information presented here, the following long term options need to be discussed with AEL to improve the safety of Pond 2.

- Option 1 would be to decommission the pond.
- Option 2 would be to lower the water level in the dam and maintain it at least four (4) meters below DSA until remedial measures are under taken. Remedial measures could include a range of measures to stabilise the embankments. However the scope of these works must also consider other key design issues such as provision of a spillway and the environmental impacts related to seepage from the dam.
- Option 3 would be to rebuild the dam completely.

5 Limitations

URS Australia Pty Ltd (URS) has prepared this memo in accordance with the usual care and thoroughness of the consulting profession for the use of Arrow Energy Limited and only those third parties who have been authorised in writing by URS to rely on the memo. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this memo.

The methodology adopted and sources of information used by URS are outlined in this memo. URS has made no independent verification of this information beyond the agreed scope of work and URS assumes no responsibility for any inaccuracies or omissions. No indications were found that information contained in this memo as provided to URS was false.

This memo was prepared based on the information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time. This memo should be read in full. No responsibility is accepted for use of any part of this memo in any other context or for any other purpose or by third parties. This memo does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this memo, URS must be notified of any such findings and be provided with an opportunity to review the recommendations of this memo. The contractor must recognise that the memo or drawings do not purport to show completely the existing conditions, nor does URS warrant the correctness of the designations given in the memos, or the correctness of any interpretation, deduction or conclusion shown in the memos or on the drawings.

Whilst to the best of our knowledge information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time. Therefore this document and the information contained herein should only be regarded as valid at the time of the evaluation unless otherwise explicitly stated in this report.

Yours faithfully
URS Australia Pty Ltd

[redacted]
Senior Geotechnical Engineer

[redacted]
Senior Principal

[redacted]

From: Ben McMahon
Sent: Friday, 24 December 2010 6:57 PM
To: [redacted]
Subject: Release notification
Attachments: Notification PL191 release to isaac.pdf

[redacted]

Please find attached a notification in relation to PL191/196 of our intention to continue discharge whislt the draft TEP is finalised between DERM and Arrow.

Best regards and a merry and safe christmas

Ben

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24 December 2010

[redacted]
Director, Gas and Petroleum Unit
Department of Environment & Resource Management
(sent via email 24 December 2010)

Attention: [redacted]

Dear [redacted]

RE: **Contravention of Environmental Authority PEN100015907**
Notice of Intended Discharge of CSG Water due to Unavoidable Circumstances

Arrow is continuing to work with DERM in relation to water levels within dam on Petroleum Lease 191. Arrow has recently submitted a draft Transitional Environmental Program to DERM for review (dated 23 December 2010). We are currently working to address the comments received from DERM in relation to this TEP but note that further comments are expected as DERM continues to evaluate the draft TEP submitted by Arrow.

The current situation on site is that we are concerned that there is a continued risk to the integrity of dam 2 and that sustained rain event could result in the water levels in Dam 10 reaching the spillway and overflowing into the local environment.

In our opinion based on risk to the local environment as a result of a release of water to land, against the risk to the broader environment in the region, we will continue this discharge water from dams 1, 2 and 10 within the parameters described in recent draft transitional environmental programs submitted to the department subject to the recent advice received from DERM in relation to draft TEP. We will of course stop immediately if directed to do so by DERM.

Please be assured that we continue to closely monitor the situation on a daily basis and are continuing to do everything we can to minimise any negative environmental harm arising out of the extremely high levels of rain experienced in the Moranbah region.

Regards,
[redacted]

Ben McMahon
Manager Compliance & Reporting

Graham Cordingley

From: [redacted]
Sent: Thursday, 6 January 2011 1:57 PM
To: Ben McMahon
Cc: [redacted]
Subject: RE: Release notification

Ben

As discussed yesterday please provide an update on the current unauthorised discharge including -

- volumes discharged each day since 20 December
- the results available for in situ samples and lab samples taken so far,
- details of the dams that water has been discharged from,
- the dilution rates achieved etc.

Regards

[redacted]

-----Original Message-----
From: Ben McMahon [redacted]
Sent: Friday, 24 December 2010 6:57 PM
To: [redacted]
Subject: Release notification

[redacted]

Please find attached a notification in relation to PL191/196 of our intention to continue discharge whislt the draft TEP is finalised between DERM and Arrow.

Best regards and a merry and safe christmas

Ben

Ben McMahon

From: Ben McMahon
Sent: Thursday, 6 January 2011 2:44 PM
To: [redacted]
Subject: RE: Release notification

Categories: Red Category

Hi [redacted]

Please find attached a summary of the current insitu monitoring results. The water has come from Dams 1, 2 and 10 it is moved to dam 5 for discharge. We are still awaiting ALS results the flooding has caused a massive backlog of work for all of the labs that we have dealt with recently. We applying as much pressure as possible to short cut the process.

	Riverflow ML/day			Volume discharged L/day				Electrical conducti	
Date	8am	8pm	Total	Pond 5 direct	Pond 5	Total	Approximate Dilution	Isaac River #1	Discharge point
21/12/2010	4134	6778	5456	1036800	3888000	4924800	1108	674	9510
22/12/2010	2594	3442	3018	1663200	1036800	2700000	1118	746	10480
23/12/2010	1559	2132	1845.5	2170800	684000	2854800	646	392	8810
24/12/2010			5156.5	772200	257400	1029600	5008	185.7	10360
25/12/2010	7035	9900	8467.5	2851200	950400	3801600	2227	247.1	10280
26/12/2010	19583	10385	14984	907200	864000	1771200	8460	198.9	10250
27/12/2010	5572	8988	7280	891000	907200	1798200	4048	344	10580
28/12/2010	40190	9388	24789	0	864000	864000	28691	160.4	8770
29/12/2010	7164	14679	10921.5	259200	950400	1209600	9029	191.1	10350
30/12/2010	6271	5026	6680	2142000	820800	2962800	2255	187.3	9970
31/12/2010	4372	7243	4272	2554200	864000	3418200	1250	252.1	8770
1/01/2011	2772	3360	2650		820800	820800	3229	258.7	9600
2/01/2011	1753	2311	2119	819000	649800	1468800	1443	195.4	10620
3/01/2011	5586	4260	3551	1562400	348480	1910880	1858	464	9900
4/01/2011	2494	1948	2526	831600	777600	1609200	1570	321	8710
5/01/2011	2000	2200	4953	267300	550800	818100	6054	734	8780

TOTAL to date 34.0 ML

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

From: [redacted]
Sent: Thursday, 6 January 2011 1:57 PM
To: Ben McMahon
Cc: [redacted]
Subject: RE: Release notification

Ben

As discussed yesterday please provide an update on the current unauthorised discharge including -

- volumes discharged each day since 20 December
- the results available for in situ samples and lab samples taken so far,
- details of the dams that water has been discharged from,
- the dilution rates achieved etc.

Regards

[redacted]

-----Original Message-----
From: Ben McMahon [redacted]
Sent: Friday, 24 December 2010 6:57 PM
To: [redacted]
Subject: Release notification

[redacted]

Please find attached a notification in relation to PL191/196 of our intention to continue discharge whislt the draft TEP is finalised between DERM and Arrow.

Best regards and a merry and safe christmas

Ben

Ben McMahon

From: Ben McMahon
Sent: Thursday, 6 January 2011 5:18 PM
To: [redacted]
Subject: RE: Release notification

Categories: Red Category

No problems [redacted] will get a response concerning the interconnection between dams for you tomorrow.

I look forward to getting TEP comments

Cheers

Ben McMahon
Manager Compliance & Reporting

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GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
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From: [redacted]
Sent: Thursday, 6 January 2011 5:13 PM
To: Ben McMahon
Cc: [redacted]
Subject: RE: Release notification

Hi Ben

Thanks for this advice.

I note that no water has been discharged from ponds other than 1, 2, 5 and 10.

Can you please advise what is the current situation with water levels in all other storages at the site? Does Arrow have any concerns about other storages? If a physical need to discharge was to occur with other storages does Arrow have water quality data for them? If not when is water quality data expected?

I expect to get TEP comments back to you tomorrow, hopefully in the morning.

Regards

From: Ben McMahon [redacted]
Sent: Thursday, 6 January 2011 2:44 PM
To: [redacted]
Subject: RE: Release notification

Hi [redacted]

Please find attached a summary of the current insitu monitoring results. The water has come from Dams 1, 2 and 10 it is moved to dam 5 for discharge. We are still awaiting ALS results the flooding has caused a massive backlog of work for all of the labs that we have dealt with recently. We applying as much pressure as possible to short cut the process.

	Riverflow ML/day			Volume discharged L/day				Electrical conduc	
Date	8am	8pm	Total	Pond 5 direct	Pond 5	Total	Approximate Dilution	Isaac River #1	Discharge point
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5/01/2011	2000	2200	4953	267300	550800	818100	6054	734	878C

TOTAL to date 34.0 ML

Best regards

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[redacted]

From: Ben McMahon
Sent: Friday, 7 January 2011 3:43 PM
To: [redacted]
Cc:
Subject: Moranbah TEP

[redacted]

I appreciate that things must be very busy with DERM at present.

I would like to resolve this outstanding TEP with DERM. It has been my understanding that we would receive comments from DERM this week with sufficient time to respond and update the document. I believe that we address the first round of comments sufficiently and the document is line with the requirements discussed prior to Christmas. In preparing this TEP we have followed the template provided by DERM.

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Ben McMahon

From: [redacted]
Sent: Friday, 7 January 2011 4:23 PM
To: Ben McMahon
Cc: [redacted]
Subject: RE: Moranbah TEP
Attachments: RE Draft TEP MGP 23 December 2010 word 2003 version.htm

Categories: Red Category

Ben

I do apologise that it has taken longer than indicated previously to respond, as I would also like to resolve this issue.

As I pointed out in the attached email, the comments sent through on 24 December were not a complete set of comments and were compiled quickly to allow Arrow the chance to continue working on the issue. I also advised that further comments maybe forthcoming.

I also previously advised the TEP template was drafted for coal mines and as such DERM may have other requirements for CSG operations.

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I note that no sampling information has been provided by Arrow in regards to sodium. QLD Health has indicated that data for sodium and chloride are required.

The draft TEP as submitted on 31 December still contained some inconsistencies as advised on 24 December. On review other errors have also been uncovered.

[redacted] and I are currently working on getting the comments out this afternoon or early Monday morning.

I will make time available to discuss this on Monday.

Regards

[redacted]

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T: [redacted]
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www.arrowenergy.com.au

From: [redacted]
Sent: Friday, 24 December 2010 10:45 AM
To: Ben McMahon
Cc: [redacted]
Subject: RE: Draft TEP MGP 23 December 2010 word 2003 version

Ben – comments below.

Given the TEP was only submitted yesterday this is not a complete set of DERMs comments. Further comments may be forthcoming.

- Our modelling has shown that given other discharges Arrows discharge should not commence until a Min flow of 1090ML/day is reached.
- Table 1 – the footnotes b and c are not used in the table?.
- ALS sample results show Dam 3 at 25 900 ec, D1 (what is this?) at 25 800ec and D2 (again what is this?) at 26 100ec. My question is will water from these dams be pumped to where they will be discharged?? If so how will Arrow ensure that EC levels are appropriate at discharge point? How will the 'shandy' mix be made to ensure EC limits are met given dams are linked.? Is this where the EC of 13000 as release limit came from?
- Page 4 para 1 states '1000m3/day', then table 8 refers to '11.5m3/sec' which is stated as equal to '1000ML/day' in the table footnote – please use consistent terminology through out for flow
- What is DSA for older and less accessible dams? Only dams 1,2 and 10 are listed in TEP. Are you also using water from other dams for release??
- Include an Objective re discharge linked to table 1 (volume to discharge) and/or table 2 discharge scenarios – note the volumes are different. Which volume is be sought for discharge under TEP?? Only from 1,2 or 10 as shown in table 1 or from all dams as alluded by Table 2 – if all dams my point about water quality changes is important. Table 2 indicates total volume is 69ML plus 7ML (pond 2 extra) so I assume total approval is sought for 76ML discharge under TEP???
- Number all objectives for ease of reference
- Objective re monitoring and monitoring submissions – link to your table and commit to timeframes for getting results to DERM – 10BD should be achievable
- Objective for final report submission – should be a reasonable timeframe
- Objective re Final discharge date or prediction?
- Objective re reporting back on samples in 10bd – ALS delays is not a reasonable excuse to not meet this .
- Objectives re dam 11 not needed under TEP and should be removed. Approval already exists to construct dam 11. The unapproved clearing cannot be authorised long term under a TEP. DERM has determined that the veg type was such that if Arrow had of applied at the time, approval would have been granted to clear this veg. I recommend dam 11 be included in background to TEP but not in objectives/conditions. Arrow can apply for amendment in 2011 to authorise use of cleared area. PIN may still result for original technical breach of the clearing though. Arrows recent response will be considered.
- Table 5 – include easting and northings in table
- Table 6 – these should be listed also BTEX list at no detect levels or drinking water guideline value. Other contaminants may need to be included here such as fluoride, sodium – further advice is coming from Office of water supply/Q Health on this
- Table 7 and list of anlytes to be consistent. This list should be broader rather than narrower. If you test for it there should be a link to a trigger.
- Table 7 – isn't MP1 end of pipe? If so how will triggers be met?? Should MP1 be delted?
- Table 8 – flow rate needs to be consistent. Given column heading no need for => reference
- Condition 5b – rather than background sites, just list the points as referred to in table 5 for clarity
- Condition 5b (ii) point 2 – report to be submitted 20bd after final release.
- Condition 6 – there is no 5a(ii) (2). Do you mean 5b??
- Condition 7 – use consistent flow rate as stated above.
- Condition 9 – uses 0.25% but elsewhere you use 400 to one. For consistency please use either ratio or percentage not both
- Condition 11 states daily max flow is 7.5ML. Please amend to include total release modelled – i.e. my point above **about 69ML plus 7ML (pond 2 extra) what is max volume sought**??

- Condition 12 and 13 – notification should be via our 1300 number. Emails should also be sent to me.
- Condition 14 – 28 days is too long for these details be submitted in writing. You should be able to arrange for a lab to turn around samples in 10BD, so this should be able to be submitted to DERM in 15bd.
- Condition 16 – should be 10bd as if there is monitoring and it shows the exceedence then you already have and don't need to wait for samples
- Condition 21 – consistent flow term pls
- Condition 27 – change to BD is you change other day refs to BD.

Office of water supply/Q Health are getting further points to me, which I will get back to you about asap.

Regards

From: Ben McMahon [redacted]
Sent: Thursday, 23 December 2010 4:49 PM
To: [redacted]
Subject: Draft TEP MGP 23 December 2010 word 2003 version

Here you go [redacted]

B

Ben McMahon

From: [redacted]
Sent: Friday, 7 January 2011 5:18 PM
To: [redacted] Ben McMahon
Cc: [redacted]
Subject: RE: Moranbah TEP
Attachments: 2011-01-07 Draft TEP dot points (2).doc

Categories: Red Category

Hi Ben,

Please find attached a document containing DERM's comments with regard to MGP TEP.

As per the email bellow, DERM will be happy to discuss any quires you may have on Monday.

Enjoy your weekend,

[redacted]
Environmental Officer, Petroleum and Gas Unit
Telephone: [redacted]
www.derm.qld.gov.au

Department of Environment and Resource Management
400 George Street, Brisbane QLD 4000
GPO Box 2454, Brisbane QLD 4001

From: [redacted]
Sent: Friday, 7 January 2011 4:23 PM
To: Ben McMahon
Cc: [redacted]
Subject: RE: Moranbah TEP

Ben

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[redacted] and I are currently working on getting the comments out this afternoon or early Monday morning.

I will make time available to discuss this on Monday.

Regards

[redacted]

From: Ben McMahon [redacted]
Sent: Friday, 7 January 2011 3:43 PM
To: Kent Rod
Cc: [redacted]
Subject: Moranbah TEP

[redacted]

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Best regards

Ben McMahon
Manager Compliance & Reporting

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Draft TEP PL 191/196 Dot Points

Flow and discharge rates:

1. Paragraph 1 page 4 sates 1090 m^3/day- DERM requires consistency of units, and advises a change to 1090 ML/day
2. Condition 22 of the TEP states 11.5 m^3/s as the minimum prior cessation of discharge-DERM requires consistency of units, and advises a change to 1090 ML/day for consistency.

Water Quality:

3. No water quality data provided for Sodium and Chloride. DERM has received advice from QLD Health that water quality data for Total Dissolved Ions (there is no data for Sodium and Chloride) is required from all dam's requiring discharge. A release limit for Total Dissolved Ions should be proposed based on the worst water quality proposed to be discharged.
4. Table 6, row 5, states "Below Drinking water guideline value" yet no reference to a guideline is given. DERM requires: Release Limit, Monitoring Frequency, Sample type and Monitoring Point for all elements of BTEX as per ADWG to be listed in Table 6.

5. DERM will only approve a discharge from dams that water quality has been provided for. DERM has not seen any water quality information for dams 6, 7, 8 and 9. All reference to these dams should be removed, unless water quality can be provided. For example text on page 2 clearly states that water will be pumped from dams 6, 7, 8 and 9 to dams 1 and 10. Without water quality data for these dams they cannot be included in any approved TEP.

6. In email 6 Dec Arrow indicated that only water from dams 1, 2, 10 and 5 was to be discharged.

Monitoring Points

7. Page 7, table 5, bottom row, states "dams 1,2,5 or 10" If the discharge is occurring from all and only these dams, and through dam 5; DERM requires Arrow to present MP's for dams 1, 2 and 10 as TEP MP 1 is presented for dam 5.
8. RP1/MP1 is referred to in Table 4 and Table 5 and table 8. Easting and northing details are not consistent within the tables. Additionally table 8 appears to refer to RP1 as being the Goonyella gauging station. Suggest you remove reference to RP1 and ensure easting/northing is correct for gauging station.
9. MP2 in table 5 and 9 – Easting and northing details are not consistent. Please make consistent.
10. Table 9, column 2, states "...downstream of RP 1 1"-DERM requires this error to be corrected to RP1 to be consistent with table 4.

Objectives

11. Objective 1 – no dams are stated. Please state the dams covered by the objective and only include dams for which monitoring data has been submitted (e.g. 1,2,3,4,5,10).
12. Objective 1 action – reference should be made to discharge Point RP1 (i.e. Manage via RP1 discharge to Isaac River)
13. Objective 2- requires rephrasing 'Discharge Monitoring' should be reworded to Monitor Discharge
14. Objective 2 action – needs to be reworded. Suggest to 'monitor discharge in accordance with table 5, for the contaminants listed in table 6 and table 7
15. Objective 3-Rewording required. DERM recommends Arrow reword Objective to reflect implementation of conclusion and recommendation of section four of the URS inspection report.

Conditions

16. Condition 5- to be worded consistently:
    i.e. Instead of using; downstream results, receiving waters in table 9 and downstream site, use: downstream (MP2) or, as specified in Table-X
17. Condition 6-DERM requires a notification from Arrow within 24hours of identifying an exceedance in accordance with condition 5(b)(ii)
18. Condition 8-Can not be accepted with current presentation of table 8 & 4. DERM can only accept this condition on the basis Table 8 & 4 is amended as for comment 8.
19. Condition 24 contradicts the presented monitoring frequency in Table 7. DERM requires confirmation through a new submission of which monitoring frequency Arrow intends to undertake.

General

20. DERM requires Arrow to provide integrity/structural information (i.e. DSA, MRL, etc.) for dam 5.
21. DERM advises Arrow to investigate installing more monitoring points downstream.

Ben McMahon

From: [redacted]
Sent: Thursday, 20 January 2011 4:49 PM
To: Ben McMahon
Cc: [redacted]
Subject: RE: Moranbah TEP

Categories: Red Category

Hi Ben

Just you letting know that I will not be in tomorrow, so if you do send through any information in regards to the MGP draft TEP please ensure that you copy in both [redacted]

[redacted] is a new Principal Officer who has recently joined the team and will be working on Arrow's projects. [redacted] has extensive experience in with environmental regulation having worked with DERM/EPA for over 10yrs in a variety of roles.

Regards

[redacted]

From: [redacted]
Sent: Friday, 7 January 2011 5:18 PM
To: [redacted] 'Ben McMahon'
Cc: [redacted]
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Graham Cordingley

From: Ben McMahon
Sent: Friday, 28 January 2011 10:14 AM
To: Graham Cordingley
Subject: FW: Release notification

Summarised discharge and river flow rates

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
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TOTAL to date 34.0 ML

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Subject: Release notification

[redacted]

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Best regards and a merry and safe christmas

Ben

+----------+

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

+----------+

Ben McMahon

From: Ben McMahon
Sent: Friday, 28 January 2011 10:49 AM
To: [redacted]
Cc: Tim Dean; [redacted]
Subject: Arrow MGP TEP
Attachments: Revised MGP TEP MGP 27 Jan 2011.doc

Categories: Red Category

Hi [redacted]

Attached is the amended version of the Moranbah TEP. Below I have responded to each of the comments we received from DERM.
I would be happy to meet with you next week to discuss any remaining points of concern. We are currently working though the monitoring results we have available to us and expect to issue a these to DERM for review today.

I appreciate your patience throughout what has been a difficult period.

Best regards

Ben

Reference		DERM comment	Arro
Flow and discharge rates:	1	Paragraph 1 page 4 sates 1090 m3/day- DERM requires consistency of units, and advises a change to 1090 ML/day	Correc
Flow and discharge rates:	2	Condition 22 of the TEP states 11.5 m3/s as the minimum prior cessation of discharge-DERM requires consistency of units, and advises a change to 1090 ML/day for consistency.	Correc
Water Quality:	3.	No water quality data provided for Sodium and Chloride. DERM has received advice from QLD Health that water quality data for Total Dissolved Ions (there is no data for Sodium and Chloride) is required from all dam's requiring discharge. A release limit for Total Dissolved Ions should be proposed based on the worst water quality proposed to be discharged	Electri measu (majo progra
Water Quality:	4.	Table 6, row 5, states "Below Drinking water guideline value" yet no reference to a guideline is given. DERM requires: Release Limit, Monitoring Frequency, Sample type and Monitoring Point for all elements of BTEX as per ADWG to be listed in Table 6.	Guidel guidel
Water Quality:	5.	DERM will only approve a discharge from dams that water quality has been provided for. DERM has not seen any water quality information for dams 6, 7, 8 and 9. All reference to these dams should be removed, unless water quality can be provided. For example text on page 2 clearly states that water will be pumped from dams 6, 7, 8 and 9 to dams 1 and 10. Without water quality data for these dams they cannot be included in any approved TEP.	These water in the access elevat storag that e contai any w Water via dai

Water Quality:	6.	In email 6 Dec Arrow indicated that only water from dams 1, 2, 10 and 5 was to be discharged.	Only v discha of a ne and ra 9). Th DERM
Monitoring Points	7.	Page 7, table 5, bottom row, states "dams 1,2,5 or 10" If the discharge is occurring from all and only these dams, and through dam 5; DERM requires Arrow to present MP's for dams 1, 2 and 10 as TEP MP 1 is presented for dam 5.	The da
Monitoring Points	8.	RP1/MP1 is referred to in Table 4 and Table 5 and table 8. Easting and northing details are not consistent within the tables. Additionally table 8 appears to refer to RP1 as being the Goonyella gauging station. Suggest you remove reference to RP1 and ensure easting/northing is correct for gauging station.	This h
Monitoring Points	9.	MP2 in table 5 and 9 – Easting and northing details are not consistent. Please make consistent.	Correc
Monitoring Points	10	Table 9, column 2, states "...downstream of RP 1 1"-DERM requires this error to be corrected to RP1 to be consistent with table 4.	
Objectives	11	Objective 1 – no dams are stated. Please state the dams covered by the objective and only include dams for which monitoring data has been submitted (e.g. 1,2,3,4,5,10).	Correc
Objectives	12	Objective 1 action – reference should be made to discharge Point RP1 (i.e. Manage via RP1 discharge to Isaac River)	Correc
Objectives	13	Objective 2- requires rephrasing 'Discharge Monitoring' should be reworded to Monitor Discharge	Correc
Objectives	14	Objective 2 action – needs to be reworded. Suggest to 'monitor discharge in accordance with table 5, for the contaminants listed in table 6 and table 7	Correc
Objectives	15	Objective 3-Rewording required. DERM recommends Arrow reword Objective to reflect implementation of conclusion and recommendation of section four of the URS inspection report.	At this level c by URS relatic conte standa maybe
Conditions	16	Condition 5- to be worded consistently:i.e. Instead of using; downstream results, receiving waters in table 9 and downstream site, use: downstream (MP2) or, as specified in Table-X	Correc
Conditions	17	Condition 6-DERM requires a notification from Arrow within 24hours of identifying an exceedance in accordance with condition 5(b)(ii)	Correc
Conditions	18	Condition 8-Can not be accepted with current presentation of table 8 & 4. DERM can only accept this condition on the basis Table 8 & 4 is amended as for comment 8.	Comm
Conditions	19	Condition 24 contradicts the presented monitoring frequency in Table 7. DERM requires confirmation through a new submission of which monitoring frequency Arrow intends to undertake.	Correc
General	20	DERM requires Arrow to provide integrity/structural information (i.e. DSA, MRL, etc.) for dam 5.	Includ
General	21	DERM advises Arrow to investigate installing more monitoring points downstream.	Arrow point i

Ben McMahon
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DRAFT TRANSITIONAL ENVIRONMENTAL PROGRAM UNDER SECTION 333 OF THE *ENVIRONMENTAL PROTECTION ACT 1994*

Principal Holder:	CH4 Pty Ltd AM-60 Level 19 42 Albert Street Brisbane QLD 4000
EA Number:	PEN100015907
Title:	Coal Seam Water Management Moranbah Gas Project
Date:	10 January 2011
Finish Date:	31 May 2011

Introduction

The Moranbah Gas Project lacks sufficient water storage capacity as previously indicated in correspondence to DERM (dated 25 October 2010) and subsequent responses to information requests and the program notice documentation submitted by Arrow (dated 3 December 2010). This has been caused by an early start to the wet season contributing to existing dam levels and causing construction delays. This has prevented Arrow from making additional storage available via the completion of dam 11. The synthetic lining for the dam cannot be installed during periods of rainfall; the civil engineering also requires careful control of the moisture content of the construction materials to achieve the required specifications.

Dam 11 has been designed and is being constructed in line with the most current dam standards stipulated by DERM and contained in the previously submitted and assessed dam design report. It is a large lined dam – intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, develop beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies.

The continued rain has delayed the completion of dam 11. This has put Arrow in a position where it cannot comply with the current EA conditions. Arrow intends to employ this transitional environmental program (TEP) as defined in Chapter 7, Part 4 of the *Environmental Protection Act 1994 to bring our operation back into compliance with its current Environmental Authority.* In initiating this process Arrow intends to work with DERM to minimise the potential for environmental harm.

Background

Arrow currently employs a network of 10 dams across PL191 and PL196. Dams 1 through to 7 are shown in the attached drawing (Appendix C). Dams 8 and 9 in the network are SW of the main area depicted in the provided drawing. Approximately 90% of the total storage capacity for coal seam water is held in Arrow's major storage dams 1, 2 and 10. The other dams are employed to move water between groups of remote wells and the major storage dams. Dam 3 is employed to store more concentrated brine. An important feature of the petroleum lease is the Isaac River which divides the lease along a NW to SE axis and its tributary Teviot Brook. Isaac River is an ephemeral river; during periods of high flow it limits access to infrastructure on the north eastern side of the petroleum lease via river crossings.

Situation

Our strategy is to maintain low levels in the older and less accessible dams (particularly dams 6,7, 8 and 9) by moving water to dams 1 and 10. Dam 10 is our most recently constructed dam and has an engineered spillway, dam 1 is in reasonable condition and adjacent to dam 10 which allows water to be transferred readily between dams.

Our risk assessment process and an independent third party geotechnical evaluation by URS has identified particular concerns with the integrity of dam 2 (refer to Appendix E). Arrow has concerns regarding the condition of dam 2 – it is scheduled to be brought out of service on the completion of Dam 11. Based on geotechnical evaluation we intend to lower the level of water in Dam 2 to 4m below DSA. The goal of this strategy is to maintain pond integrity and minimise discharge to the environment when a suitable plan to restore the operational integrity of dam 2 is developed or the dam is retired from operational duty.

Arrow believes that a controlled discharge during high flow conditions in the Isaac River via the existing infrastructure would result in the least environmental impact whilst preserving the integrity of the existing dams. This option prevents the overland flow of untreated coal seam water reaching the Isaac River and minimises the risk of damaging older dams which are built prior to the new standards and lacking engineered spillways. When the facility was originally developed the water management scheme was significantly different to now and included a wet weather discharge. At present our existing infrastructure is not sufficient to comply with the conditions of the current Environmental Authority particularly during extended wet periods.

Our system of dams has an area of 125,100 m^2, this equates to a gain of 0.125ML per mm of rainfall. The system is designed to transfer water to the major storage dams 1, 2 and 10 this contribute to the catchments of these structures, each 1 mm of rainfall will cause an increase in dam height of 1.6 mm in dams 1, 2 and 10. When all the input rainfall is directed to dam 10 each 1 mm of rainfall causes an increase in dam height of 2.7 mm in dam 10.

Table 1 Key Dam Variables Dams 1, 2, 5 and 10

Dam		1	2	5	10
Volume at Spill level	ML	119.66	92.64	7.64	203.70
Spillway		No	No	No	Yes
Liner type		CCL	CCL	0.5mm HDPE	1.5mm HDPE
Hydraulic height	m	5.60	5.50	3.5	4.75
MRL	m	5.25	5.15	3.15	4.40
DSA	m	4.75	4.65	2.65	3.90
Target dam fill height[b]	m	4.75	0.65	2.65	3.90
Current level (below MRL)[a]	mm	100	870	Varies[c]	40
Remaining rainfall *(to spill)*[d]	mm	281	762	>800	244

[a] Levels 27 December 2010, negative denotes level above MRL

[b] Target dam fill height is DSA for dams 1 and 10, 4m below DSA for dam 2. Current target height for dam 2 is based on 3rd party civil engineering assessment completed by URS.

[c] This dam is much smaller than the major storage dams its level can change rapidly during operations

[d] Rainfall based on approximate catchment ratio of 1.6 (based on total catchment area including transfer dams)

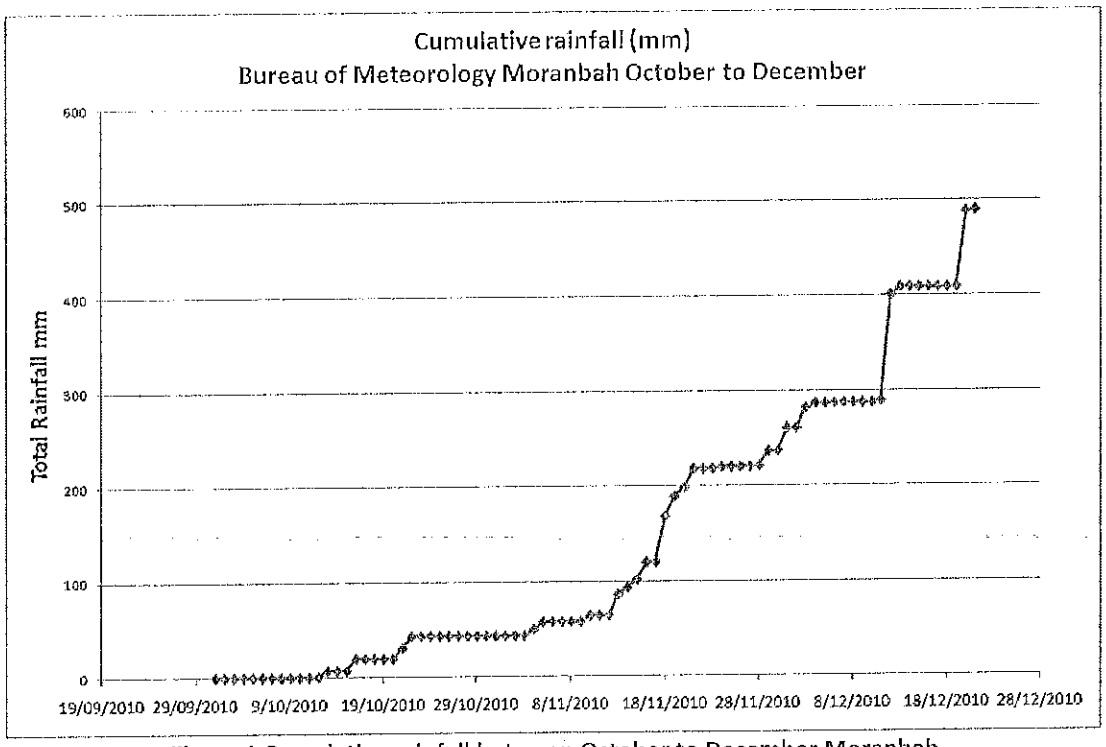


Figure 1 Cumulative rainfall between October to December Moranbah

Future water levels will be a product of the rainfall, coal seam water production and evaporation. Our goal is to maintain dams 1 and 10 at DSA levels by employing a discharge to the Isaac River. Dam 2 will be lowered to a level determined by independent third party engineering risk assessment.

Arrow has evaluated 2 scenarios for water requiring discharge from the storage system:

- Scenario 1 – Mean rainfall until end of wet season
- Scenario 2 – 95th percentile rainfall until end of wet season

Rainfall to date is very close to the 95th percentile rainfalls on average from October through to December. We have had a cumulative total of 490mm from the 1st of October to date (Figure 1), 95th percentile cumulative rainfall for the period from the start of October to the end of December totals 522mm. At present with one week remaining in December the cumulative total is 30mm short of the 95th percentile. Given the current progress of the wet season Arrow believes that the next few months will produce above average rainfall. Long range forecasts from the Bureau of Meteorology give a 55% chance of rainfall at or above the 95% percentile values. In determining the water balance for the facility has evaluated 2 scenarios – mean and 95th Percentile rainfall (refer to Table 2).

Table 2 Discharge scenarios

Scenario	Volume to reach DSA (ML)	Additional removal from Dam 2 (ML) [b]	Expected Net [a] Water to Storage (ML)	Total (ML)
Mean Rainfall	69	75	54.5	198.5
95th Percentile	69	75	130	274

[a] *Net water to storage is produced water, less evaporation plus expected rainfall.*
[b] *This is based on a dam 2 target of 4000mm below DSA.*

Arrow proposes a discharge of up to 7.5ML/day to commence when the Isaac River is at least 1090 ML/day measured upstream at the Goonyella river gauge (operated by DERM). Discharge will be maintained at a 400:1 dilution ratio on the basis of maintaining Australian drinking water guidelines (NHMRC,2004) downstream of the discharge. Based on a predicted salinity impact as detailed in Appendix B. This discharge rate and the dilution factor will be reviewed thoughout the TEP in consultation with DERM and informed on the basis of the upstream/downstream river monitoring in line with the proposed conditions detailed within this document.

Sampling will be conducted in line with the conditions detailed in this TEP under the procedure attached as Appendix D. Appendix A contains detailed results of the sampling completed to date to characterise the coal seam water to be discharged.

Supporting Information

Consideration of the management hierarchy for the management of coal seam water at the MGP

Evaluation as per the management hierarchy of preferred procedures from Environmental Protection (Water) Policy 2009:

Step 1—evaluate water conservation measures to reduce the use of water and the production of waste water or contaminants;
Water is not employed in the coal seam gas production process but must be removed from the coal seam to allow the gas to be extracted. Water conservation measures will not reduce the amount of coal seam water associated with the gas extracted.

Step 2—evaluate waste prevention options and implement appropriate waste prevention measures;
The key waste prevention measure employed is maximisation of the coal seam gas to water ratio. The coal seams targeted by MGP have relatively low ratios of water to gas in comparison to other fields. In an effort to manage our recent water storage constraints Arrow has shut in a large number of wells, targeting the wells with high water to gas ratios to minimise the production of coal seam water associated with our operations.

Whilst this has reduced our coal seam water production, shutting in further wells will yield limited benefits in terms of water reduction but will cause significant reduction in gas output.

Use of dam 11 in its current uncompleted, unlined state has been investigated. The pipe work and major civil infrastructure is complete but the floor of the dam is incomplete – as discussed (in our meeting on the 1st of December) it lacks its intended second liner, more importantly the clay liner has not been sufficiently compacted to allow its use. Key elements of the pipework connecting dam 11 to the rest of the network remain incomplete. Employing dam 11 would require its use for an extended period to allow subsequent emptying and upgrade of the existing dam infrastructure.

Step 3—if waste prevention does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate treatment and recycling options and implement appropriate treatment and recycling;
The construction of Dam 11 is the first component of our coal seam water management strategy. It is a large lined dam, intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies. Rainfall is delaying the construction of dam 11 and contributing to the current water storage problems.

Installation of water treatment (such as a mobile RO plant) is limited by the logistics (such as civil engineering, chemical storage and power supply), cost and the challenges posed during current wet conditions. Another option considered was employing water entitlements to dilute the untreated coal seam water to the current environmental authority specification. This option was ruled out since a large quantity of good quality water would be required to dilute and dispose of a limited amount of coal seam water from our dams.

Step 4—if treatment and recycling does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate the following options
for waste water or contaminants, in the order in which they are listed—
(i) appropriate treatment and release to a waste facility or sewer;
(ii) appropriate treatment and release to land;
(iii) appropriate treatment and release to surface waters or ground waters.

I) We cannot practically truck water from the dams given the large quantities and the lack of disposal options. Wet weather is likely to complicate trucking of water by limiting access to some points within the MGP. Infrastructure does not exist to process this water via sewer or other industrial water treatment options. Our landholders have expressed concern of minimising truck movements during the wet season.

II) Until our water treatment management strategy is implemented we cannot treat the water to a standard that is suitable for use on land.

III) We consider the water in its current state is suitable for discharge into the Isaac – this was the water management strategy employed by the facility until earlier EA conditions were amended, we are seeking permission from DERM to allow this discharge as previously authorised until we can implement our water management strategy for the MGP. We consider a temporary discharge to the Isaac river during high flow conditions to be compliant with section 51 of the Environmental Protection Regulation 2008.

Objectives

To achieve compliance with the Environmental Authority with respect to coal seam water management and dam standards by April 2011.

This will be achieved in the short term by the release of water to the Isaac River. This measure will protect the integrity of our storage infrastructure and is consistent with the operational philosophy that our existing infrastructure was designed to accommodate.

In the medium term compliance with the new EA will be achieved by the completion of Dam 11. Completion of dam 11 will require Arrow energy to utilise the cleared area north of dam 11.

In the long term, compliance with our EA will be achieved by completion of water treatment facilities that allow beneficial use and disposal within Arrows Environmental Authority conditions. Arrow is to provide DERM with a detailed plan concerning future water management for approval.

Table 3 – Achieving TEP objectives

OBJECTIVE	ACTION	RESPONSIBILITY	TIME FRAME	PERFORMANCE INDICATOR
1. Lower dam levels for (dams 1, 2, 5, 10)	Manage via discharge (RP1) to Isaac river	Arrow site personnel	Immediate	Manage dams within appropriate levels as detailed in Tables 1 and 2. Discharge is to be subject to monitoring and reporting requirements
2. Monitor Discharge	Monitor discharge in accordance with Table 5, for the contaminants listed in Table 6 and Table 7	Arrow site personnel	During discharge	Lab results to be reported to DERM within 10 business days of collection.
3. Pond 2	Develop management plan to restore dam integrity or remove from service	Arrow	15 March 2010	Submission of management plan to DERM
4. Cease discharge	Cease discharge to Isaac river under TEP	Arrow	31 March 2011	Cease discharge to Isaac river
5. TEP report submission	Provide DERM with final TEP report detailing how the objectives of this TEP have been met	Arrow	31 May 2011	Submission of TEP report to DERM

Monitoring

Table 4 Contaminant release points, sources and receiving waters

Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point	Receiving waters
TEP RP 1	148° 2' 35"	-21° 57' 41"	untreated CSG water from PL191/196	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
				Upstream from discharge – Isaac River Crossing	
				Downstream from discharge – Blair Athol Bridge	

Table 5 Contaminant release monitoring points

Monitoring point (TEP MP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point location	Receiving waters
TEP MP 1	148° 2' 35"	-21° 57' 41"	Untreated CSG water from PL191	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
TEP MP 2	148° 2' 46"	-21° 57' 55"	Downstream from discharge – Blair Athol Bridge	Blair Athol Railway Bridge	na
TEP MP 3	148° 2' 20"	-21° 57' 41"	Upstream from discharge	Isaac River Crossing	
TEP MP 4	148° 1' 10"	-21° 58' 00"	Untreated CSG water dam 1	Dam 1	
TEP MP 5	148° 2' 8"	-21° 58' 01"	Untreated CSG water dam 2	Dam 2	
TEP MP 6	148° 2' 32"	-21° 57' 44"	Untreated CSG water dam 5	Dam 5	
TEP MP 7	148° 1' 14"	-21° 58' 4"	Untreated CSG water dam 10	Dam 10	

Table 6 Contaminant release limits

Quality characteristic	Release Limit	Monitoring Frequency	Sample Type	Monitoring Point
Electrical conductivity (uS/cm)	13000	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1
			Samples require laboratory analysis[2]	TEP MP 1
pH (pH Unit)	6.5 (minimum) 9.5 (maximum)	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1
				TEP MP 2
				TEP MP 3
			Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 2
				TEP MP 3
Turbidity (NTU)	500	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 2
				TEP MP 3
BTEX Benzene, Ethylbenzene, Toluene and Xylene (mg/L)	Benzene 0.001 Ethylbenzene 0.3 Toluene 0.8 Xylene 0.02	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 2
				TEP MP 3

[1] *In situ samples can be taken using electronic sampling equipment.*
[2] *Samples are required to be analysed at a NATA accredited facility in accordance with this Transitional Environmental Program.*

Table 7 Downstream contaminant trigger investigation levels

Quality characteristic	Trigger levels (µg/L)	Monitoring frequency	Monitoring Point
Aluminium	55	Commencement of release and thereafter weekly during release	TEP MP 2 TEP MP 3
Arsenic	13		
Cadmium	0.2		
Chromium	1.0		
Copper	2.0		
Iron	300		
Lead	10		
Mercury	0.2		
Nickel	11		
Zinc	8.0		
Boron	370		
Cobalt	90		
Manganese	1900		
Molybdenum	34		
Selenium	10		
Silver	1.0		
Uranium	1.0		
Vanadium	10		
Ammonia	900		
Nitrate	1100		
Petroleum hydrocarbons (C6-C9)	20		
Petroleum hydrocarbons (C10-C36)	100		
Fluoride (total)	2000		

Table 8 Contaminant release during flow events

Receiving waters	Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Minimum flow in receiving water required for a release event	Flow recording frequency
Isaac River	TEP RP1	-148° 2' 0"	21° 51' 20"	1090ML/day	Daily from Goonyella Gauging station

Table 9 Receiving water downstream monitoring points

Monitoring points (TEP MP)	Receiving waters location description	Easting (GDA94)	Northing (GDA94)
TEP MP 2	Blair Athol Bridge 500 metres downstream of RP1	148° 2' 46"	-21° 57' 55"

Conditions

In carrying out this Transitional Environmental Program, CH4 Ltd (Arrow Energy) will undertake all activities in accordance with the following conditions.

Undertaking the release of untreated coal seam methane water

1 Contaminants that will, or have the potential to cause environmental harm must not be released directly or indirectly released to any waters except as permitted under this Transitional Environmental Approval.

2 The release of contaminants to waters must only occur from the release points specified in Table 4 and depicted in Appendix C attached to this Transitional Environmental Program.

3 The release of contaminants to waters must not exceed the release limits stated in Table 6 at the monitoring points specified in Table 5 and Table 6 of this Transitional Environmental Program.

4 The release of contaminants to waters from the release points must be monitored at the locations specified in Table 5 and Table 9 for each quality characteristic and at the frequency specified in Table 7 and Table 8 of this Transitional Environmental Program.

5 If quality characteristics of the release exceed any of the trigger levels specified in Table 7 during a release event, the Transitional Environmental Program holder must compare MP2 to the trigger values specified in Table 7 and:

a) where the trigger values are not exceeded then no action is to be taken

b) where the downstream results exceed the trigger values specified Table 7 for any quality characteristic, compare the results of the downstream site to the data from the upstream monitoring sites (MP3)

i) if the result is less than that recorded at Monitoring Point 3 (MP3), then no action is to be taken or

ii) if the result is greater than the background monitoring site data, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology, into the potential for environmental harm and provide a written report 20 business days after receiving results, outlining

- details of the investigations carried out
- actions taken to prevent environmental harm.

6 If an exceedance in accordance with condition 5(b)(ii) is identified, the holder of the Transitional Environmental Program must notify the administering authority within 24 hours of receiving the result. The notification must include written verification of the exceedance forwarded to the administering authority.

Contaminant Release Events

7 The release of coal seam water will not occur until flow in the Isaac River flow reaches 1090 ML/day (at Goonyella Gauging Station).

8 Notwithstanding any other condition of this Transitional Environmental Program, the release of contaminants to waters must only take place during periods of natural flow events specified as minimum flow in Table 8 for the contaminant release point(s) specified in Table 4.

9 Contaminant release flow rate must not exceed 1:400 (0.25%) of receiving water flow rate.

10 The daily quantity of contaminants released from each release point must be measured and recorded at the monitoring points in Table 4

11 The daily quantity of contaminants is not to exceed 7.5ML/day in total.

12 Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build up of sediment in such waters.

Notification of Release Events

13 The Transitional Environmental Program holder must notify the administering authority within 24hours of having commenced releasing coal seam water to the receiving environment. Notification must include the submission of written verification to the administering authority of the following information:

a) release commencement date/time
b) expected release cessation date/time
c) release point/s
d) release volume (estimated)

e) receiving water/s including the natural flow rate
f) any details (including available data) regarding likely impacts on the receiving water(s).

14 The Transitional Environmental Program holder must provide the administering authority daily during the release of coal seam water, the following information:
a) all in situ monitoring data for that day
b) the receiving water flow rate
c) the release flow rate.

15 The Transitional Environmental Program holder must notify the administering authority as soon as practicable, (no later than within 24 hours after cessation of a release) of the cessation of a release notified under condition 12 and within 15 business days provide the following information in writing:
a) release cessation date/time
b) natural flow volume in receiving water
c) volume of water released
d) details regarding the compliance of the release with the conditions of this Transitional Environmental Program (i.e. contamination limits, natural flow, discharge volume)
e) all in-situ water quality monitoring results
f) any other matters pertinent to the water release event.

Notification of release event exceedence

16 If the release limits defined in Table 6 are exceeded, the holder of the Transitional Environmental Program must notify the administering authority within 2 business days of receiving the results.

17 The Transitional Environmental Program holder must, within 28 days of a release that exceeds the conditions of this Transitional Environmental Program, provide a report to the administering authority detailing:
a) the reason for the release
b) the location of the release
c) all water quality monitoring results
d) any general observations
e) all calculations

f) any other matters pertinent to the water release event.

Requirements to cease the release of coal seam water

18 The coal seam water discharge must cease immediately if any water quality limit as specified in Table 6 is exceeded.

19 The Department of Environment and Resource Management may require CH4 Pty to cease discharge if the department's water monitoring stations detect any water quality limit exceedance.

20 The release of coals seam water must cease immediately if identified that the release of coal seam waters is causing erosion of the bed and banks of the receiving waters, or is causing a material build up of sediment in such waters.

21 The release of coal seam water must cease immediately if holder of this Transitional Environmental Program is directed to do so by the administering authority.

22 The release of coal seam water will cease immediately if Isaac River flow decreases below 1090ML/day (at Goonyella Gauging Station).

Monitoring Requirements

23 Where monitoring is a requirement of this Transitional Environmental Program, ensure that a competent person(s) conducts all monitoring.

24 Monitoring will occur at the frequencies identified in Table 6 and Table 7.

25 All monitoring undertaken as a requirement of this Transitional Environmental Program must be undertaken in accordance with the administering authority's Water Sampling Manual.

Notification of emergencies, incidents and exceptions

26 As soon as practicable after becoming aware of any 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 Transitional Environmental Program, the administering authority must be notified of the release by telephone, facsimile or email.

27 The notification of emergencies or incidents must include but not be limited to the following:

a) the holder of the Transitional Environmental Program
b) the location of the emergency or incident
c) the number of the Transitional Environmental Program
d) the name and telephone number of the designated contact person
e) the time of the release
f) the time the holder of the Transitional Environmental Program became aware of the release
g) the suspected cause of the release
h) the environmental harm caused, threatened, or suspected to be caused by the release, and
i) actions taken to prevent any further release and mitigate any environmental harm caused by the release.

29 Not more than 10 business days following the initial notification of an emergency or incident, written advice must be provided of the information supplied to the administering authority in relation to:

a) proposed actions to prevent a recurrence of the emergency or incident, and

b) outcomes of actions taken at the time to prevent or minimise environmental harm.

Appendix A
ALS & Qld Health water sampling results

Client Reference	Collected Date	Received Date	Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmiun	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	3.8	< 0.0001	0.0011	0.076	< 0.0001	0.05	< 0.0001	0.0027	0.0011	0.003	1.7	0.0013	0.056	< 0.0001	0.0007
Discharge_Point	14-Dec-10	17-Dec-10	0.18	< 0.0001	0.0012	4.5	< 0.0001	1.1	< 0.0001	0.0003	0.0002	0.002	0.08	0.0004	0.0046	< 0.0001	0.0019
Pond_2a	16-Dec-10	17-Dec-10	0.1	< 0.0001	0.0015	6.1	< 0.0001	1	< 0.0001	0.0002	0.0003	0.001	0.066	< 0.0001	0.007	< 0.0001	0.0013
Pond_2	16-Dec-10	17-Dec-10	0.09	< 0.0001	0.0014	6	< 0.0001	1	< 0.0001	0.0002	0.0003	< 0.001	0.044	< 0.0001	0.0065	< 0.0001	0.0012
POND1_1	17-Dec-10	20-Dec-10	0.37	< 0.0001	0.0021	5.8	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.18	< 0.0001	0.0057	< 0.0001	0.0028
POND1_2	17-Dec-10	20-Dec-10	0.43	< 0.0001	0.0023	6	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.2	0.0002	0.0065	< 0.0001	0.0031
POND10_1	17-Dec-10	20-Dec-10	0.2	< 0.0001	0.0018	7.7	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.069	< 0.0001	0.0039	< 0.0001	0.0031
POND10_2	17-Dec-10	20-Dec-10	0.18	< 0.0001	0.0019	7.6	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.067	< 0.0001	0.0041	< 0.0001	0.0034

Client Reference	Collected Date	Received Date	Nickel	Selenium	Silver	Stroniu m	Thallium	Titani um	Uranium	Vanadium	Zinc	Benzen e	Toluene	Ethylbenzon e	Meta&Para-Xylenes	Ortho-Xylene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	0.0031	< 0.0010	< 0.001	0.2	< 0.0001	0.14	0.0002	0.012	0.003	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Discharge_Point	14-Dec-10	17-Dec-10	0.0008	< 0.0010	< 0.001	7.3	< 0.0001	0.006	0.0003	0.0029	0.013	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2a	16-Dec-10	17-Dec-10	0.0012	< 0.0010	< 0.001	9.6	< 0.0001	0.003	0.0003	0.0051	0.006	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2	16-Dec-10	17-Dec-10	0.0011	< 0.0010	< 0.001	9.4	< 0.0001	0.002	0.0003	0.005	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_1	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	10	< 0.0001	0.017	0.0009	0.0059	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_2	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	11	< 0.0001	0.015	0.0009	0.0062	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_1	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.026	0.0008	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_2	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.01	0.0007	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

ALS	21/12/2010	Sample	ID 1	DAM 1	DAM 10	DAM 4	DAM 3	D1	D2	DAM 5	DAM2	TRIP BLANK
			ID 2									
ES1025292	Results		Date Sampled	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010
Analyte	CAS #	Units	LOR	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
EA005: pH												
pH Value		pH Unit	0.01	9.17	9.28	9.34	9.38	9.4	9.42	9.27	9.15	-
EA010P: Conductivity by PC Titrator												
Electrical Conductivity @ 25°C		µS/cm	1	12600	14000	16400	25900	25800	26100	10700	10600	-
EG020T: Total Metals by ICP-MS												
Arsenic	7440-38-2	mg/L	0.001	0.003	0.003	0.002	<0.001	0.004	0.004	<0.001	0.002	-
Barium	7440-39-3	mg/L	0.001	6.54	8.33	4.35	1.93	1.92	1.98	6.4	9.31	-
Beryllium	7440-41-7	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cadmium	7440-43-9	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Cobalt	7440-48-4	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	-
Chromium	7440-47-3	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	-
Copper	7440-50-8	mg/L	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004	-
Manganese	7439-96-5	mg/L	0.001	0.008	0.003	0.002	0.001	0.001	0.003	0.002	0.038	-
Nickel	7440-02-0	mg/L	0.001	0.001	<0.001	0.001	0.002	0.002	0.002	<0.001	0.003	-
Lead	7439-92-1	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Vanadium	7440-62-2	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Zinc	7440-66-6	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	-
EG035T: Total Recoverable Mercury by FIMS												
Mercury	7439-97-6	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
EK055G: Ammonia as N by Discrete Analyser												
Ammonia as N	7664-41-7	mg/L	0.01	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
EK057G: Nitrite as N by Discrete Analyser												
Nitrite as N		mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EK058G: Nitrate as N by Discrete Analyser												
Nitrate as N	14797-55-8	mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser												
Nitrite + Nitrate as N		mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser												
Total Kjeldahl Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser												
Total Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK067G: Total Phosphorus as P by Discrete Analyser												
Total Phosphorus as P		mg/L	0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EP080: BTEX												
Benzene	71-43-2	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	108-88-3	µg/L	2	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	100-41-4	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
EP080S: TPH(V)/BTEX Surrogates												
1,2-Dichloroethane-D4	17060-07-0	%	surrogate	113	111	103	112	105	110	110	106	106
Toluene-D8	2037-26-5	%	surrogate	110	106	103	109	105	106	107	103	102
4-Bromofluorobenzene	460-00-4	%	surrogate	106	99.7	97.9	104	97.1	98.6	101	97	101

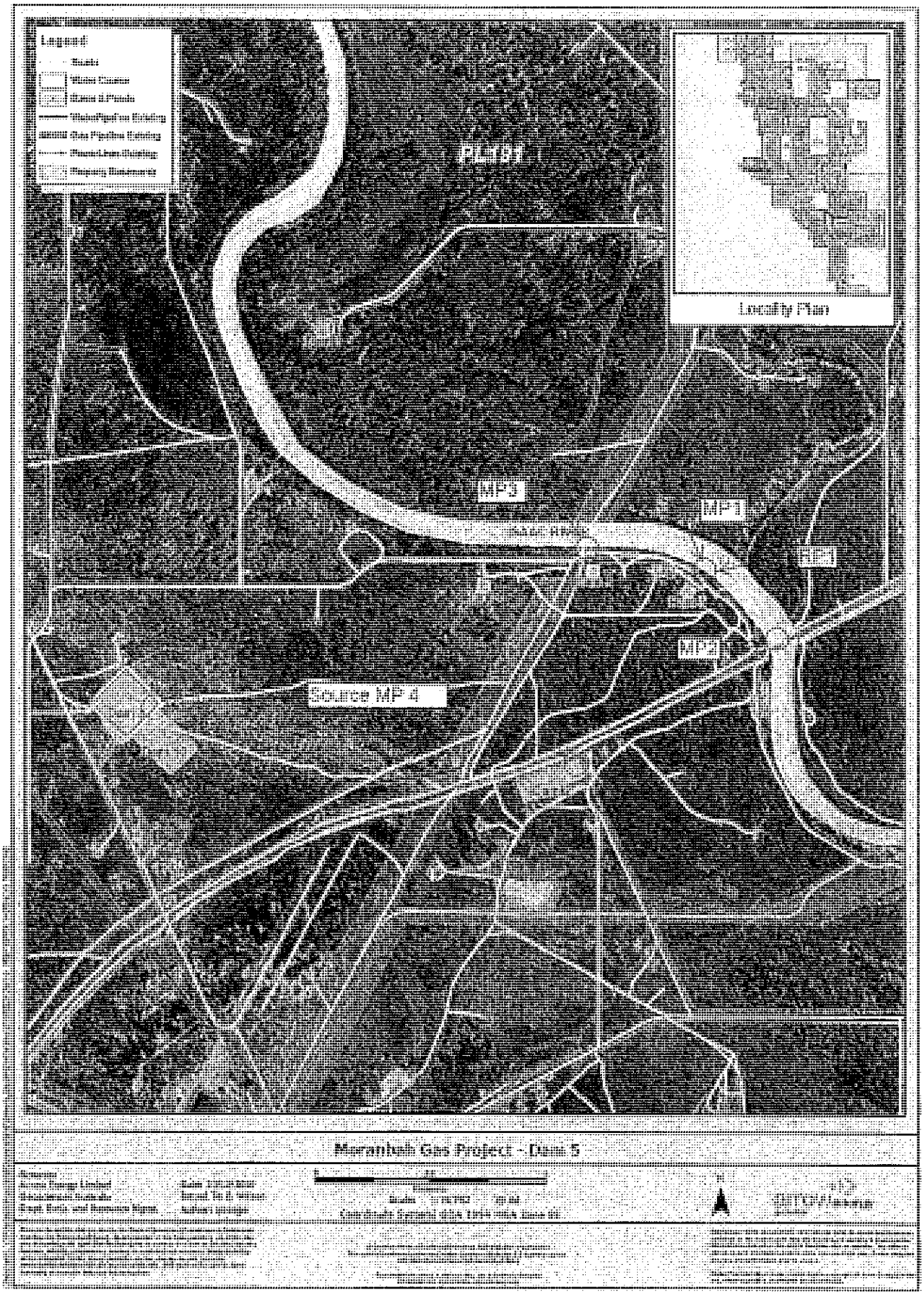
Table 10 Dilution calculation at 400:1 release

Parameter	Unit	Surface Water Concentration	Concentration of Discharge	Dilution X:1	Surface Concentration after dilution	Guideline[1]
EC	µs/cm	250	10600	400	276.5	746
Sodium	mg/L	65	2970	400	72.4	180
Chloride	mg/L	80	4280	400	90.7	250

[1] *Australian drinking water guidelines (NHMRC,2004)*
Sodium and Chloride based on EC, common soil quality (run off) and historical data from upstream

Appendix C
Mapping showing PL191 and location of key Dams

ARROW ENERGY - BOWEN BASIN GAS PROJECT



NOT FOR CONSTRUCTION

Appendix D
Sampling Procedure

SUMMARY

1.1	This procedure outlines general sampling protocols and work practices to be followed during the sampling of surface water, during the discharge of untreated CSG well water to the Isaac River. This procedure includes details on: ▪ Sampling equipment requirements; ▪ Surface water sampling techniques; ▪ Quality control requirements. ▪ Sample locations (Figure 1) ▪ Analytical requirements

EQUIPMENT

2.1	▪ Documentation o Sampling and analysis plan. o Health and safety plan o Personal protective equipment (PPE) as identified in the HSP, inc. Life Jacket and other specialised PPE, as per the HSP. ▪ Water sampling equipment o sample collection device, (Swing Arm Sampler/extension sampler) o decontamination solution (e.g. Decon 90™) or use new sample collection container in the swing arm sampler at each location. o Calibrated water quality meter (ensure parameter ranges are suitable for the water being tested), o laboratory supplied sample containers, o Chilled ice chest. o Field sample Record Sheet o Chain of Custody Form (Attached).

3.0 REFERENCES & PROFORMA

3.1	▪ AS NZS 5667.1-1998 *Water quality - Sampling - Guidance on the design of sampling programs sampling techniques* ▪ AS NZS 5667.4-1998 *Water quality - Sampling - Guidance on sampling from lakes natural and man-made* ▪ AS NZS 5667.6-1998 *Water quality - Sampling - Guidance on sampling of rivers and streams* ▪ Monitoring and Sampling Manual 2009 Environmental Protection (Water) Policy 2009, *Monitoring and Sampling Manual 2009*, Version 2 September 2010

4.0 PROCEDURE

4.1	**Safety**

	Unless specifically required, the following general safety requirements should be noted: 1. Appropriate personal protective equipment should be worn as specified in the Health and Safety Plan (HSP). When working in or around water bodies, a life jacket is required to be worn and a minimum of two persons to be present should be assessed. 2. Assess hidden hazards (eg. trip hazards, snakes, leeches, etc.). 3. Assess risks from slippery or unstable banks. 4. Assess whether the water body / drain may constitute a confined space. 5. Assess the likelihood that surface conditions within and around the water body may change rapidly in the event of heavy rainfall or tidal change.

4.2	Sampling
	1. The sampling frequency during and following discharge to the Isaac River shall be as follows: • daily during discharge; and • daily for two days following discharge stopping. 2. The sampling sequence should commence where the lowest likely contaminant concentrations are expected (e.g. downstream and work upstream), to reduce the risk of cross contamination between samples. On this basis, the samples shall be collected at the following locations (in order): (See Figure 1 for sampling locations) I. River crossing (upstream), (One primary sample (S1), plus one duplicate sample (QC1)) II. Blair Athol Bridge (downstream), One primary sample (S2), plus one duplicate sample (QC2)) III. At the Discharge Point, One primary sample (S3), plus one duplicate sample (QC3)) IV. At the Source (Dam) One primary sample (S4), plus one duplicate sample (QC4)) V. QC samples – Field/Trip Blank (QC5) and rinsate blank (QC6) (If required) 3. At each location, a water sample should be collected for standard field parameters using a calibrated water quality meter. The following parameters should be recorded: a. pH, b. conductivity, c. dissolved oxygen, d. redox potential, e. temperature and f. turbidity. Notes: • Follow the manufacturer's instructions for use and calibration of instruments to measure water parameters. A calibration record must be kept. • When recording dissolved oxygen readings, it is important to note whether the results are reported as % saturation or ppm. • With conductivity, record whether units are mS or µS.

4. Based on the nature of the sampling locations, heterogeneous distribution of potential contaminants in the water samples is considered likely. Therefore, the following Quality Control Samples should be collected and analysed for this program:
    a. One duplicate sample per sample location for TPH, BTEX and 8 Metals analysis (**QC1 – QC4**).
    b. One Blank Sample per esky (laboratory prepared DI Water for TPH (C6 – C9) and BTEX analysis) (**QC5**).
5. One rinsate sample per day (unless using new sample collection medium between sample locations i.e. a new container in the swing arm sampler) for TPH (C6 – C9) and BTEX analysis) (**QC6**).
6. At each location sample bottles should be filled based on a decreasing order of potential volatility (i.e. VOCs, BTEX and TPH first, followed by metals and other inorganic samples).
7. Note: **DO NOT** field filter samples for total metals. Perform field filtering for dissolved metals samples only.
8. When sampling shallow waters, contamination from bottom sediments should be avoided. Samples should be collected by submerging a clean sample collection container (up-side down) into the water and to approximately 100mm below the surface, rotate the container to allow it to fill.
9. The sampling location should be as representative as possible of the event being monitored. i.e. do not sample stagnant water at the edge, attempt to sample .
10. Record the appearance of the water body, i.e. colour, turbidity, odour, surface crusts, films or floating material, algae, water velocity, etc. In addition, record the weather conditions at the time of sampling and note any other relevant observations, e.g. dead or distressed flora/fauna, surface rubbish, spills, etc.
11. All measurements and field notes should be documented on the field sheet (**Attachment A**)

5.0 ANALYTICAL/SAMPLE CONTAINER REQUIREMENTS

5.1	1. The analytical suite includes the following: a. pH, EC, TDS, Turbidity b. Ions: Magnesium, Calcium, Sodium, Sulphate, Chloride, Ammonia, Nitrate, Fluoride (total). c. Metals, Aluminium, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Zinc, Boron, Cobalt, Manganese, Molybdenum, Selenium, Silver, Uranium, Vanadium. d. Organics: BTEX, PAH, TPH 2. Each Sample Requires the following containers: a. 60ml Plastic Bottle for metals (with red and green striped label border) (tick 'Total Metals') b. 500ml Plastic Bottle for anions/cations (with green label border) c. 250ml Amber Glass Bottle (with purple label border) d. One pair of BTEX vials (40 mL glass cylindrical containers with purple label border).
	Notes: • The selection of sample containers depends on the laboratories being used. The above list is based on ALS requirements only. When ultra trace analysis is being requested, additional sample volume may be required. Always check with the laboratory prior to submitting samples to the laboratory. • When filling the vials it is important that they are filled to the top with no air space remaining. • Use new sample gloves between sample locations.
5.2	1. Place samples immediately in a chilled ice chest 2. Complete sample request form and include in sealed bag in the cooler 3. Courier samples to the receiving laboratory.

12			Surface Water Sampling					Form
Site				Sampling Method:				
Job Number				Local Air Temperature:				
Date:		Time:		Wind Force:				
Weather:			Cloudiness %	Direction of Wind:				
Location	Sample No.	Water Flow (l/s)	Field Readings				Depth (m)	Comments: including turbidity (plankton and/or sediment), colour, water plants, weather conditions, etc
			pH	Conductivity	Temperature	Dissolved Oxygen		
Comments concerning treatment of samples, especially preservation:								
Name:		Signed:		Project Manager:				adapted from AS 5667.4

Analytes

Quality characteristic	
pH	
EC	Ammonia
Turbidity	Nitrate
Magnesium	Fluoride (total)
Calcium	BTEX
Sodium	PAH
Sulphate	TPH
Chloride	
Aluminium	
Arsenic	
Cadmium	
Chromium	
Copper	
Iron	
Lead	
Mercury	
Nickel	
Zinc	
Boron	
Cobalt	
Manganese	
Molybdenum	
Selenium	
Silver	
Uranium	
Vanadium	

Appendix E
URS Dam 2 Assessment

Ben McMahon

From: [redacted]
Sent: Friday, 28 January 2011 10:57 AM
To: Ben McMahon
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Arrow MGP TEP
Categories: Red Category

Hi Ben

Confirming receipt of the resubmitted draft TEP for assessment.

We will commence review of the responses and the importantly the data you intend to submit later today, with a view to getting back to Arrow early next week.

Regards

[redacted]

From: Ben McMahon [redacted]
Sent: Friday, 28 January 2011 10:49 AM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: Arrow MGP TEP

Hi [redacted]

Attached is the amended version of the Moranbah TEP. Below I have responded to each of the comments we received from DERM.
I would be happy to meet with you next week to discuss any remaining points of concern. We are currently working though the monitoring results we have available to us and expect to issue a these to DERM for review today.

I appreciate your patience throughout what has been a difficult period.

Best regards

Ben

Reference		DERM comment	Arrc
Flow and discharge rates:	1	Paragraph 1 page 4 sates 1090 m3/day- DERM requires consistency of units, and advises a change to 1090 ML/day	Corre
Flow and discharge rates:	2	Condition 22 of the TEP states 11.5 m3/s as the minimum prior cessation of discharge-DERM requires consistency of units, and advises a change to 1090 ML/day for consistency.	Corre
Water Quality:	3.	No water quality data provided for Sodium and Chloride. DERM has received advice from QLD Health that water quality data for Total Dissolved Ions (there is no data for Sodium and Chloride) is required from all dam's requiring discharge. A release limit for Total Dissolved Ions should be proposed based on the worst water quality proposed to be discharged	Elect meas (majc progi

Water Quality:	4.	Table 6, row 5, states "Below Drinking water guideline value" yet no reference to a guideline is given. DERM requires: Release Limit, Monitoring Frequency, Sample type and Monitoring Point for all elements of BTEX as per ADWG to be listed in Table 6.	Guid guide
Water Quality:	5.	DERM will only approve a discharge from dams that water quality has been provided for. DERM has not seen any water quality information for dams 6, 7, 8 and 9. All reference to these dams should be removed, unless water quality can be provided. For example text on page 2 clearly states that water will be pumped from dams 6, 7, 8 and 9 to dams 1 and 10. Without water quality data for these dams they cannot be included in any approved TEP.	Thes wate in th acce eleva stora that conta any v Wate via d
Water Quality:	6.	In email 6 Dec Arrow indicated that only water from dams 1, 2, 10 and 5 was to be discharged.	Only disch of a r and r 9). T DERM
Monitoring Points	7.	Page 7, table 5, bottom row, states "dams 1,2,5 or 10" If the discharge is occurring from all and only these dams, and through dam 5; DERM requires Arrow to present MP's for dams 1, 2 and 10 as TEP MP 1 is presented for dam 5.	The c
Monitoring Points	8.	RP1/MP1 is referred to in Table 4 and Table 5 and table 8. Easting and northing details are not consistent within the tables. Additionally table 8 appears to refer to RP1 as being the Goonyella gauging station. Suggest you remove reference to RP1 and ensure easting/northing is correct for gauging station.	This
Monitoring Points	9.	MP2 in table 5 and 9 – Easting and northing details are not consistent. Please make consistent.	Corre
Monitoring Points	10	Table 9, column 2, states "...downstream of RP 1 1"-DERM requires this error to be corrected to RP1 to be consistent with table 4.	
Objectives	11	Objective 1 – no dams are stated. Please state the dams covered by the objective and only include dams for which monitoring data has been submitted (e.g. 1,2,3,4,5,10).	Corre
Objectives	12	Objective 1 action – reference should be made to discharge Point RP1 (i.e. Manage via RP1 discharge to Isaac River)	Corre
Objectives	13	Objective 2- requires rephrasing 'Discharge Monitoring' should be reworded to Monitor Discharge	Corre
Objectives	14	Objective 2 action – needs to be reworded. Suggest to 'monitor discharge in accordance with table 5, for the contaminants listed in table 6 and table 7	Corre
Objectives	15	Objective 3-Rewording required. DERM recommends Arrow reword Objective to reflect implementation of conclusion and recommendation of section four of the URS inspection report.	At th level by UI relati conte stanc mayk

Conditions	16	Condition 5- to be worded consistently:i.e. Instead of using; downstream results, receiving waters in table 9 and downstream site, use: downstream (MP2) or, as specified in Table-X	Corre
Conditions	17	Condition 6-DERM requires a notification from Arrow within 24hours of identifying an exceedance in accordance with condition 5(b)(ii)	Corre
Conditions	18	Condition 8-Can not be accepted with current presentation of table 8 & 4. DERM can only accept this condition on the basis Table 8 & 4 is amended as for comment 8.	Comi
Conditions	19	Condition 24 contradicts the presented monitoring frequency in Table 7. DERM requires confirmation through a new submission of which monitoring frequency Arrow intends to undertake.	Corre
General	20	DERM requires Arrow to provide integrity/structural information (i.e. DSA, MRL, etc.) for dam 5.	Inclu
General	21	DERM advises Arrow to investigate installing more monitoring points downstream.	Arro\ point

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

Ben McMahon

From: Ben McMahon
Sent: Friday, 28 January 2011 11:55 AM
To: [redacted]
Subject: RE: Arrow MGP TEP

Categories: Red Category

Thanks [redacted]

Arrow expects to be back into AM60 next week. I am currently planning to be out west until Wednesday.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
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Monitoring Points	10	Table 9, column 2, states "...downstream of RP 1 1"-DERM requires this error to be corrected to RP1 to be consistent with table 4.	Corre
Objectives	11	Objective 1 – no dams are stated. Please state the dams covered by the objective and only include dams for which monitoring data has been submitted (e.g. 1,2,3,4,5,10).	
Objectives	12	Objective 1 action – reference should be made to discharge Point RP1 (i.e. Manage via RP1 discharge to Isaac River)	Corre
Objectives	13	Objective 2- requires rephrasing 'Discharge Monitoring' should be reworded to Monitor Discharge	Corre
Objectives	14	Objective 2 action – needs to be reworded. Suggest to 'monitor discharge in accordance with table 5, for the contaminants listed in table 6 and table 7	Corre
Objectives	15	Objective 3-Rewording required. DERM recommends Arrow reword Objective to reflect implementation of conclusion and recommendation of section four of the URS inspection report.	Corre At th level by UI relati conte stanc mayt
Conditions	16	Condition 5- to be worded consistently:i.e. Instead of using; downstream results, receiving waters in table 9 and downstream site, use: downstream (MP2) or, as specified in Table-X	
Conditions	17	Condition 6-DERM requires a notification from Arrow within 24hours of identifying an exceedance in accordance with condition 5(b)(ii)	Corre Corre
Conditions	18	Condition 8-Can not be accepted with current presentation of table 8 & 4. DERM can only accept this condition on the basis Table 8 & 4 is amended as for comment 8.	
Conditions	19	Condition 24 contradicts the presented monitoring frequency in Table 7. DERM requires confirmation through a new submission of which monitoring frequency Arrow intends to undertake.	Comi
General	20	DERM requires Arrow to provide integrity/structural information (i.e. DSA, MRL, etc.) for dam 5.	Corre Inclu
General	21	DERM advises Arrow to investigate installing more monitoring points downstream.	Arrow point

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
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M:
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+----------+

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

+----------+

Ben McMahon

From: [redacted]
Sent: Friday, 28 January 2011 11:56 AM
To: Ben McMahon
Subject: RE: Arrow MGP TEP

Categories: Red Category

Whats AM60?

From: Ben McMahon [redacted]
Sent: Friday, 28 January 2011 11:55 AM
To: [redacted]
Subject: RE: Arrow MGP TEP

Thanks Rod

Arrow expects to be back into AM60 next week. I am currently planning to be out west until Wednesday.

Best regards

Ben McMahon
Manager Compliance & Reporting

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From: [redacted]
Sent: Friday, 28 January 2011 10:57 AM
To: Ben McMahon
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Arrow MGP TEP

Hi Ben

Confirming receipt of the resubmitted draft TEP for assessment.

We will commence review of the responses and the importantly the data you intend to submit later today, with a view to getting back to Arrow early next week.

Regards

[redacted]

From: Ben McMahon [redacted]
Sent: Friday, 28 January 2011 10:49 AM
To [redacted]

Cc: [redacted] Tim Dean; [redacted]
Subject: Arrow MGP TEP

Hi [redacted]

Attached is the amended version of the Moranbah TEP. Below I have responded to each of the comments we received from DERM.
I would be happy to meet with you next week to discuss any remaining points of concern. We are currently working though the monitoring results we have available to us and expect to issue a these to DERM for review today.

I appreciate your patience throughout what has been a difficult period.

Best regards

Ben

Reference		DERM comment	Arrc
Flow and discharge rates:	1	Paragraph 1 page 4 sates 1090 m3/day- DERM requires consistency of units, and advises a change to 1090 ML/day	Corre
Flow and discharge rates:	2	Condition 22 of the TEP states 11.5 m3/s as the minimum prior cessation of discharge-DERM requires consistency of units, and advises a change to 1090 ML/day for consistency.	Corre
Water Quality:	3.	No water quality data provided for Sodium and Chloride. DERM has received advice from QLD Health that water quality data for Total Dissolved Ions (there is no data for Sodium and Chloride) is required from all dam's requiring discharge. A release limit for Total Dissolved Ions should be proposed based on the worst water quality proposed to be discharged	Elect meas (majc progı
Water Quality:	4.	Table 6, row 5, states "Below Drinking water guideline value" yet no reference to a guideline is given. DERM requires: Release Limit, Monitoring Frequency, Sample type and Monitoring Point for all elements of BTEX as per ADWG to be listed in Table 6.	Guidc guide
Water Quality:	5.	DERM will only approve a discharge from dams that water quality has been provided for. DERM has not seen any water quality information for dams 6, 7, 8 and 9. All reference to these dams should be removed, unless water quality can be provided. For example text on page 2 clearly states that water will be pumped from dams 6, 7, 8 and 9 to dams 1 and 10. Without water quality data for these dams they cannot be included in any approved TEP.	Thesc wate in the acces eleva stora that (conta any v Wate via di
Water Quality:	6.	In email 6 Dec Arrow indicated that only water from dams 1, 2, 10 and 5 was to be discharged.	Only disch of a r and r 9). T DERM

Monitoring Points	7.	Page 7, table 5, bottom row, states "dams 1,2,5 or 10" If the discharge is occurring from all and only these dams, and through dam 5; DERM requires Arrow to present MP's for dams 1, 2 and 10 as TEP MP 1 is presented for dam 5.	
Monitoring Points	8.	RP1/MP1 is referred to in Table 4 and Table 5 and table 8. Easting and northing details are not consistent within the tables. Additionally table 8 appears to refer to RP1 as being the Goonyella gauging station. Suggest you remove reference to RP1 and ensure easting/northing is correct for gauging station.	The c
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Conditions	19	Condition 24 contradicts the presented monitoring frequency in Table 7. DERM requires confirmation through a new submission of which monitoring frequency Arrow intends to undertake.	Comi
General	20	DERM requires Arrow to provide integrity/structural information (i.e. DSA, MRL, etc.) for dam 5.	Corre
General	21	DERM advises Arrow to investigate installing more monitoring points downstream.	Inclu Arro point

Ben McMahon
Manager Compliance & Reporting

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Graham Cordingley

From: Ben McMahon
Sent: Friday, 28 January 2011 4:39 PM
To: [redacted]
Cc: [redacted] Tim Dean
Subject: Water quality results
Attachments: Moranbah TEP Letter Report.doc; Available water quality results.xls; Table 1 Discharge Volumes.xlsx

[redacted]

Please find attached a brief report and all of our water quality results to date. It would be good to catch up at some point next week and discuss these results in detail.

It is clear from our analysis that the background water quality is well in exceedence of the trigger values for many compounds detailed in the current draft TEP.

Best regards

Ben McMahon
Manager Compliance & Reporting

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arrowenergy
go further

28 January 2011

Att: [redacted]
Department of Environment and Resource Management (DERM)

Via Email: [redacted]

Ref:

Dear [redacted]

Draft TEP for PEN100015907: Water Quality Monitoring Update

This letter report presents all available data from the assessments carried out in response to discharges to the Isaac River in attempt to preserve the integrity of the existing dams. The recorded discharge dates and volumes are presented in Table 1 (Attachment A).

Water quality samples have been collected during the discharge period and submitted to a NATA accredited laboratory for analysis. The available data is presented in Table 2 (Attachment B). Based on review of the data, the draft trigger levels are observed as being triggered for a number of parameters including aluminium, copper, chromium, iron, nickel, zinc and vanadium. Further review was undertaken to assess the concentrations with respect to background levels reported in the Isaac River. Based on this review, the reported concentrations in the discharge waters do not appear to significantly vary from the concentrations reported in the Isaac River. Based on the forgoing, no further assessment of potential contaminants is considered warranted for the purpose of this interim report.

Discharge volumes were maintained below the draft allowable limit of 7.5 ML/day for the duration of pumping, with an average of 2.13 ML released per day. Based on review of the available field sampling data, the pH of the discharge water and electrical conductivity were reported within the draft discharge limits of 6.5 – 9.5 (i.e. pH) and 13,000 (i.e. EC).

Regards,

Graham Cordingley
Senior Environmental Operations Coordinator

Attachments:

Attachment A: Table 1 Daily record of water discharge.
Attachment B: Table 1 Available water quality results

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ALS		EB1100019	Analyte	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
		Results	CAS #					
Sample			Units	µg/L	µg/L	µg/L	µg/L	µg/L
ID 1	ID 2	Date Sampled	LOR	20	50	100	50	50
DISCHARGE POINT		21/12/2010	WATER	<20				
ISAAC 1		21/12/2010	WATER	<20				
ISAAC 2		21/12/2010	WATER	<20				
DISCHARGE POINT		21/12/2010	WATER	-	-	-	-	-
ISAAC 1		21/12/2010	WATER	-	-	-	-	-
ISSAC 2		21/12/2010	WATER	<20				
DISCHARGE POINT		23/12/2010	WATER	<20	<50	<100	<50	<50
Downstrea m		23/12/2010	WATER	<20	<50	<100	<50	<50
ISAAC 2		23/12/2010	WATER	<20	<50	<100	<50	<50
ISAAC 1-S1		24/12/2010	WATER	<20	<50	<100	<50	60
ISAAC 1-QC1		24/12/2010	WATER	<20	<50	<100	<50	<50
ISAAC 2- S2		24/12/2010	WATER	<20	<50	<100	<50	<50
ISAAC 2-QC2		24/12/2010	WATER	<20	<50	<100	50	<50
DISCHARGE S3		24/12/2010	WATER	<20	<50	<100	<50	<50
DISCHARGE QC3		24/12/2010	WATER	<20	<50	<100	<50	<50
QC 5		24/12/2010	WATER	20	-	-	-	-
ISAAC 1-S1		25/12/2010	WATER	-	-	-	-	-
ISAAC 1-QC1		25/12/2010	WATER	-	-	-	-	-
ISAAC 2- S2		25/12/2010	WATER	-	-	-	-	-
ISAAC 2-QC2		25/12/2010	WATER	-	-	-	-	-
DISCHARGE S3		25/12/2010	WATER	-	-	-	-	-
DISCHARGE QC3		25/12/2010	WATER	-	-	-	-	-
S5		25/12/2010	WATER	<20	-	-	-	-
QC 5		25/12/2010	WATER	-	-	-	-	-
ISAAC 1-S1		27/12/2010	WATER	-	-	-	-	-

ISAAC 1-QC1		27/12/2010	WATER	-	-	-	-	-
ISAAC 2- S2		27/12/2010	WATER	-	-	-	-	-
ISAAC 2-QC2		27/12/2010	WATER	-	-	-	-	-
DISCHARGE-S3		27/12/2010	WATER	-	-	-	-	-
DISCHARGE-QC3		27/12/2010	WATER	-	-	-	-	-
TRIP-S5		29/12/2010	WATER	30	-	-	-	-
ISAAC1-S1		29/12/2010	WATER	<20	<50	<100	<50	<50
ISAAC1-QC1		29/12/2010	WATER	<20	<50	<100	<S0	<50
ISAAC2-S2		29/12/2010	WATER	<20	<50	<100	<50	<50
ISAAC2-QC2		29/12/2010	WATER	<20	<50	<100	<50	<50
DISCHARGE-S3		29/12/2010	WATER	<20	<50	<100	<50	<50
DISCHARGE-QC3		29/12/2010	WATER	<20	<50	<100	<50	<50
TRIP-QC5		29/12/2010	WATER	<20	-	-	-	-
DISCHARGE POINT		31/12/2010	WATER	<20	<50	<100	<50	<50
ISAAC 1		31/12/2010	WATER	<20	<50	<100	<50	<50
ISAAC 2		31/12/2010	WATER	<20	<50	<100	<50	<50
TRIP 1 2		31/12/2010	WATER	<20	-	-	-	-

	EP075(SIM)B: Polynuclear Aromatic Hydrocarbons	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene
		91-20-3	208-96-8	83-32-9	86-73-7	85-01-8	120-12-7	206-44-0
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		1	1	1	1	1	1	1
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
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		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
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		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
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		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
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Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1.2.3.cd)pyrene	Dibenz(a.h)anthracene	Benzo(g.h.i)perylene
129-00-0	56-55-3	218-01-9	205-99-2	207-08-9	50-32-8	193-39-5	53-70-3	191-24-2
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
1	1	1	1	1	0.5	1	1	1
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EP075(SIM) S: Phenolic Compound Surrogates	Phenol-d6	2-Chlorophenol-D4	2.4.6-Tribromophenol	EP075(SIM) T: PAH Surrogates	2-Fluorobiphenyl	Anthracene-d10	4-Terphenyl-d14	EP080/071: Total Petroleum Hydrocarbons
	13127-88-3	93951-73-6	118-79-6		321-60-8	1719-06-8	1718-51-0	
	%	%	%		%	%	%	
	surrogate	surrogate	surrogate		surrogate	surrogate	surrogate	
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
	30.6	67.5	99.3		31.3	76.2	106	
	12	27.5	72.1		24.5	52.2	78.5	
	17	37.2	79.6		16.8	60.3	84.4	
	28.4	57.4	68.6		58	74.5	84.7	
	28.1	52.6	78.6		47.5	72.4	78.3	
	32.7	61.6	77.7		57.2	59.9	80	
	30.9	63.9	74.1		62.7	49.7	54.7	
	33.1	57.1	68.9		65.7	63.9	56.4	
	28.6	59.8	67.8		54.9	58.7	56	
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	26.5	65.5	59.1		62.2	72.3	55.3	
	28.9	67.8	70.5		70	80.4	58.9	
	29.5	71	66.5		65.1	73.3	54.3	
	25.9	63.9	56.7		60.1	66.2	47.2	
	29	60.2	60.4		68.8	78.7	56.6	
	29.9	62.2	60.8		67.2	77.3	56.3	
	-	-	-		-	-	-	
	37.8	67.4	67.2		74.5	80.7	60.2	
	44.1	86.6	76.3		78.6	86.8	66.1	
	47.8	88.9	77		80.5	90	67.2	
	-	-	-		-	-	-	

EP080: BTEX	Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene	EP080S: TPH(V)/BTEX Surrogates	1.2-Dichloroethane-D4	Toluene-D8
	71-43-2	108-88-3	100-41-4	108-38-3 106-42-3	95-47-6		17060-07-0	2037-26-5
	µg/L	µg/L	µg/L	µg/L	µg/L		%	%
	1	2	2	2	2		surrogate	surrogate
	<1	<2	<2	<2	<2		103	98.2
	<1	<2	<2	<2	<2		102	96.8
	<1	<2	<2	<2	<2		94.7	96.8
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
	<1	<2	<2	<2	<2		101	103
	<1	<2	<2	<2	<2		99.6	95.2
	<1	<2	<2	<2	<2		105	92.3
	<1	<2	<2	<2	<2		109	92
	<1	<2	<2	<2	<2		106	99.3
	<1	<2	<2	<2	<2		99.4	98.8
	<1	<2	<2	<2	<2		99.6	97.8
	<1	<2	<2	<2	<2		100	98.7
	<1	<2	<2	<2	<2		102	101
	<1	<2	<2	<2	<2		102	102
	<1	<2	<2	<2	<2		116	105
	-	-	-	-	-		-	-
	-	-	-	-	-		-	-
	-	-	-	-	-		-	-
	-	-	-	-	-		-	-
	-	-	-	-	-		-	-
	-	-	-	-	-		-	-
	<1	<2	<2	<2	<2		131	108
	-	-	-	-	-		-	-
	-	-	-	-	-		-	-

	-	-	-	-	-		-	-
	-	-	-	-	-		-	-
	-	-	-	-	-		-	-
	-	-	-	-	-		-	-
	-	-	-	-	-		-	-
	<1	<2	<2	<2	<2		101	98.1
	<1	<5	<2	<2	<2		102	122
	<1	<5	<2	<2	<2		122	123
	<1	<5	<2	<2	<2		110	102
	<1	<5	<2	<2	<2		118	110
	<1	<5	<2	<2	<2		118	110
	<1	<5	<2	<2	<2		93.3	94.2
	<1	<5	<2	<2	<2		125	116
	<1	<5	<2	<2	<2		95.8	86.4
	<1	<5	<2	<2	<2		104	91
	<1	<5	<2	<2	<2		106	93.1
	<1	<5	<2	<2	<2		105	87.7

4-Bromofluorobenzene
460-00-4
%
surrogate
98.8
92
91
-
-
96.4
101
103
106
100
96.6
97.9
97.5
97.7
95.2
102
-
-
-
-
-
-
112
-
-

-
-
-
-
-
92.6
110
109
99.9
106
103
85.7
114
91.7
87.4
90.2
84.4

Date	Riverflow ML/day			Volume discharged ML/day			Approximate Dilution	Electrical conductivity			pH			Notes
	8am	8pm	Total	Pond 5 direct	Pond 5	Total		Isaac River #1	Discharge point	Isaac River #2	Isaac River #1	Discharge point	Isaac River # 2	
21/12/2010	4134	6778	5456	1.037	3.888	4.925	1108	674	9510	426	9.14	9.12	9.28	Release commenced 9pm
22/12/2010	2594	3442	3018	1.663	1.037	2.700	1118	746	10480	336	8.47	9.09	8.35	
23/12/2010	1559	2132	1845.5	2.171	0.684	2.855	646	392	8810	382	8.14	8.95	8.53	Release stopped 4pm
24/12/2010			5156.5	0.772	0.257	1.030	5008	185.7	10360	179.1	8.02	7.96	9.09	Release commenced 10:30am
25/12/2010	7035	9900	8467.5	2.851	0.950	3.802	2227	247.1	10280	190.5	7.88	9.09	7.88	
26/12/2010	19583	10385	14984	0.907	0.864	1.771	8460	198.9	10250	178.8	8.57	9.12	8.52	
27/12/2010	5572	8988	7280	0.891	0.907	1.798	4048	344	10580	188.7	8.22	9.12	8.6	
28/12/2010	40190	9388	24789		0.864	0.864	28691	160.4	8770	137.9	8.13	9	8.33	
29/12/2010	7164	14679	10921.5	0.259	0.950	1.210	9029	191.1	10350	198.2	7.8	9.01	8.8	
30/12/2010	6271	5026	6680	2.142	0.821	2.963	2255	187.3	9970	194.3	8.01	9.08	8.48	
31/12/2010	4372	7243	4272	2.554	0.864	3.418	1250	252.1	8770	213.9	8.03	9.01	7.78	
1/01/2011	2772	3360	2650		0.821	0.821	3229	258.7	9600	202.4	7.9	8.9	8.7	
2/01/2011	1753	2311	2119	0.819	0.650	1.469	1443	195.4	10620	189.4	8.2	9.05	8.2	Release stopped 5pm
3/01/2011	5586	4260	3551	1.562	0.348	1.911	1858	464	9900	288	8.07	8.9	8.6	Release started 7am
4/01/2011	2494	1948	2526	0.832	0.778	1.609	1570	321	8710	336	7.52	8.8	7.07	
5/01/2011	2000	2200	4953	0.267	0.551	0.818	6054	734	8780	423	8.62	9.03	8.78	Release stopped 5pm

1000000

[redacted]

From: [redacted]
Sent: Monday, 31 January 2011 12:18 PM
To: [redacted]
Cc: Ben McMahon; Tim Dean; [redacted]
Subject: FW: Water quality results
Attachments: Moranbah TEP Letter Report.doc; Available water quality results.xls; Table 1 Discharge Volumes.xlsx

Importance: High

Hi [redacted]

As discussed on the phone, and further to Ben's email on Friday, I would like to update you on the status of dams in Moranbah.

1. 40mm rain fell overnight over the dams
2. Dam 10 is currently 60mm below MRL
3. Dam 2 is currently 910mm below MRL – the target level is to be <910mm to ensure integrity
4. Dam 1 is 130mm below MRL
5. Dam 5 is 1770mm below MRL
6. Isaac River is running in excess of the agreed trigger of 1090ML/hr
7. Daily sampling has recommenced at both upstream and downstream monitoring points.
8. Weekly sampling is continuing of the dam.
9. Due to the forecast of cyclone Yasi and potential rain to be dumped on the Moranbah site:
    a. Arrow is in the process of implementing crisis management plans for field staff working in the Moranbah area
    b. Access to the field is now limited - currently the Isaac Crossings are closed and due to the recent rain, field conditions are unstable.
10. Based on the above triggers, at 10:50am Arrow recommenced discharge into Isaac River based on the above triggers.
11. The discharge is being conducted in accordance with the same management measures as the previous discharge

As discussed, I would appreciate your confirmation of the status of the TEP application in relation to the MGP this afternoon. We view the situation in Moranbah as critical with the threat of cyclone Yasi adding significantly to rainfall in the region.

Ben is currently in the field, so in his absence could you please correspond with me until his return on Wednesday.

Regards

[redacted]
Environment Manager

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T:
F:
M:
www.arrowenergy.com.au

From: Ben McMahon
Sent: Friday, 28 January 2011 4:39 PM
To:
Cc: Tim Dean
Subject: Water quality results

Please find attached a brief report and all of our water quality results to date. It would be good to catch up at some point next week and discuss these results in detail.

It is clear from our analysis that the background water quality is well in exceedence of the trigger values for many compounds detailed in the current draft TEP.

Best regards

Ben McMahon
Manager Compliance & Reporting

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arrow energy
go further

28 January 2011

Att: [redacted]
Department of Environment and Resource Management (DERM)

Via Email: [redacted]

Ref:

Dear [redacted]

Draft TEP for PEN100015907: Water Quality Monitoring Update

This letter report presents all available data from the assessments carried out in response to discharges to the Isaac River in attempt to preserve the integrity of the existing dams. The recorded discharge dates and volumes are presented in Table 1 (Attachment A).

Water quality samples have been collected during the discharge period and submitted to a NATA accredited laboratory for analysis. The available data is presented in Table 2 (Attachment B). Based on review of the data, the draft trigger levels are observed as being triggered for a number of parameters including aluminium, copper, chromium, iron, nickel, zinc and vanadium. Further review was undertaken to assess the concentrations with respect to background levels reported in the Isaac River. Based on this review, the reported concentrations in the discharge waters do not appear to significantly vary from the concentrations reported in the Isaac River. Based on the forgoing, no further assessment of potential contaminants is considered warranted for the purpose of this interim report.

Discharge volumes were maintained below the draft allowable limit of 7.5 ML/day for the duration of pumping, with an average of 2.13 ML released per day. Based on review of the available field sampling data, the pH of the discharge water and electrical conductivity were reported within the draft discharge limits of 6.5 – 9.5 (i.e. pH) and 13,000 (i.e. EC).

Regards,

Graham Cordingley
Senior Environmental Operations Coordinator

Attachments:

Attachment A: Table 1 Daily record of water discharge.
Attachment B: Table 1 Available water quality results

T +61 7 3012 4000 ARROW ENERGY PTY LTD LEVEL 19, AM-60, 42-60 ALBERT STREET GPO BOX 5262 BRISBANE QLD 4001 info@arrowenergy.com.au
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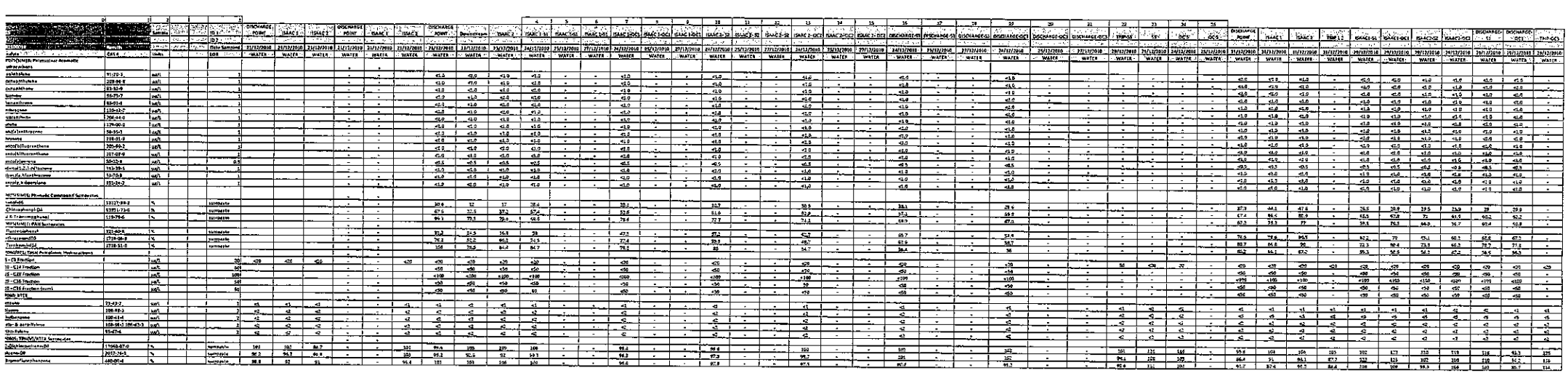
	Analyte	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Nickel	Zinc	Boron	Cobalt	Manganese	Molybdenum	Selenium	Silver	Uranium	Vanadium	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	Nitrite as N
Sample ID	Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L
	Date Sampled/LOR	0.01	0.01-0.001	0.005 - 0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.0001	0.01-0.001	0.01-0.005	0.1-0.05	0.01-0.001	0.01-0.001	0.01-0.001	0.01	0.001	0.001	0.01	20	50	100	50	50	0.01
Draft TEP Trigger Investigation Level		0.055	0.013	0.0002	0.001	0.002	0.3	0.01	0.0002	0.011	0.008	0.37	0.09	1.9	0.034	0.01	0.001	0.001	0.01	20		100		100	1.1
DISCHARGE POINT	21/12/2010	15.6	<0.01	<0.005	0.04	0.02	23.5	0.01	<0.0001	0.03	0.04	<0.1	0.01	0.39	<0.01	<0.01		<0.001	0.06	<20					<0.01
ISAAC 1	21/12/2010	13.3	<0.01	<0.005	0.04	0.02	29	0.01	<0.0001	0.03	0.03	<0.1	0.01	0.48	<0.01	<0.01		<0.001	0.06	<20					<0.01
ISAAC 2	21/12/2010	18.1	0.02	<0.005	0.03	0.02	28.1	<0.01	<0.0001	0.03	0.05	<0.1	0.01	0.5	<0.01	<0.01		<0.001	0.05	<20					<0.01
ISSAC 2	21/12/2010	12.8	<0.01	<0.005	0.02	0.02	20.1	<0.01	<0.0001	0.02	0.03	<0.1	<0.01	0.39	<0.01	<0.01		<0.001	0.04	<20					<0.01
DISCHARGE POINT	23/12/2010	-	0.001	<0.0001	0.012	0.009	-	0.006	<0.0001	0.014	0.022	-	-	-	-		-	-		<20	<50	<100	<50	<50	-
Downstream	23/12/2010	-	0.002	<0.0001	0.013	0.009	-	0.006	<0.0001	0.015	0.018	-	-	-	-		-	-		<20	<50	<100	<50	<50	-
ISAAC 2	23/12/2010	-	0.001	<0.0001	0.013	0.01	-	0.006	<0.0001	0.015	0.019	-	-	-	-		-	-		<20	<50	<100	<50	<50	-
ISAAC 1-S1	24/12/2010	15.2	<0.001	<0.0001	0.012	0.015	10.7	0.006	<0.0001	0.013	0.016	<0.05	0.01	0.252	<0.001	<0.01	<0.001	-	0.02	<20	<50	<100	<50	60	-
ISAAC 1-QC1	24/12/2010	9.18	0.001	<0.0001	0.012	0.009	10.9	0.006	<0.0001	0.013	0.02	<0.05	0.006	0.244	<0.001	<0.01	<0.001	-	0.02	<20	<50	<100	<50	<50	-
ISAAC 2- S2	24/12/2010	16.4	0.002	<0.0001	0.017	0.012	19.7	0.009	<0.0001	0.02	0.034	<0.05	0.007	0.289	<0.001	<0.01	<0.001	-	0.03	<20	<50	<100	<50	<50	-
ISAAC 2- QC2	24/12/2010	11.1	0.002	<0.0001	0.017	0.013	15.6	0.007	<0.0001	0.016	0.026	<0.05	0.009	0.383	<0.001	<0.01	<0.001	-	0.03	<20	<50	<100	50	<50	-
DISCHARGE-S3	24/12/2010	10.9	0.001	<0.0001	0.021	0.011	13.4	0.007	<0.0001	0.016	0.021	<0.05	0.007	0.399	<0.001	<0.01	<0.001	-	0.03	<20	<50	<100	<50	<50	-
DISCHARGE-QC3	24/12/2010	11	0.002	<0.0001	0.023	0.016	12.8	0.007	<0.0001	0.016	0.019	<0.05	0.01	0.424	<0.001	<0.01	<0.001	-	0.02	<20	<50	<100	<50	<50	-
ISAAC1-S1	29/12/2010	-	<0.001	<0.0001	0.009	0.008	-	0.004	<0.0001	0.011	0.015	-	0.006	0.235	-	-	-	-	0.02	<20	<50	<100	<50	<50	-
ISAAC1-QC1	29/12/2010	-	<0.001	0.0002	0.008	0.008	-	0.004	<0.0001	0.01	0.014	-	0.006	0.242	-	-	-	-	0.02	<20	<50	<100	<50	<50	-
ISAAC2-S2	29/12/2010	-	<0.001	0.0001	0.01	0.009	-	0.005	<0.0001	0.012	0.017	-	0.006	0.264	-	-	-	-	0.02	<20	<50	<100	<50	<50	-
ISAAC2-QC2	29/12/2010	-	<0.001	<0.0001	0.008	0.008	-	0.004	<0.0001	0.01	0.013	-	0.006	0.24	-	-	-	-	0.02	<20	<50	<100	<50	<50	-
DISCHARGE-S3	29/12/2010	-	0.003	<0.0001	<0.001	0.002	-	<0.001	<0.0001	0.001	<0.005	-	<0.001	0.008	-	-	-	-	<0.01	<20	<50	<100	<50	<50	-
DISCHARGE-QC3	29/12/2010	-	0.002	<0.0001	<0.001	0.002	-	<0.001	<0.0001	0.001	<0.005	-	<0.001	0.008	-	-	-	-	<0.01	<20	<50	<100	<50	<50	-
DISCHARGE POINT	31/12/2010	-	<0.001	<0.0001	<0.001	0.002	-	<0.001	<0.0001	0.002	0.007	-	<0.001	0.019	-	-	-	-	<0.01	<20	<50	<100	<50	<50	-
ISAAC 1	31/12/2010	-	<0.001	<0.0001	0.008	0.006	-	0.004	<0.0001	0.009	0.014	-	0.005	0.201	-	-	-	-	0.01	<20	<50	<100	<50	<50	-
ISAAC 2	31/12/2010	-	0.001	<0.0001	0.009	0.007	-	0.004	<0.0001	0.011	0.016	-	0.005	0.184	-	-	-	-	0.02	<20	<50	<100	<50	<50	-



	Analyte	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N	Sulfate as SO4 2-	Chloride	Calcium	Magnesium	Sodium	Potassium	Volatile Acids as Acetic Acid
	Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	LOR	0.01	0.01	0.01	1	1	1	1	1	1	5
Sample ID	Date Sampled										
DISCHARGE POINT	21/12/2010	<0.01	0.08	0.06	8	53	10	5	45	4	14
ISAAC 1	21/12/2010	<0.01	0.06	0.06	8	47	8	5	27	4	10
ISAAC 2	21/12/2010	<0.01	0.06	0.06	8	21	8	4	23	3	7
DISCHARGE POINT	21/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 1	21/12/2010	-	-	-	-	-	-	-	-	-	-
ISSAC 2	21/12/2010	<0.01	0.09	0.09	11	38	10	5	35	3	10
DISCHARGE POINT	23/12/2010	-	-	-	-	-	-	-	-	-	-
Downstream	23/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 2	23/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 1-S1	24/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 1-QC1	24/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 2- S2	24/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 2- QC2	24/12/2010	-	-	-	-	-	-	-	-	-	-
DISCHARGE-S3	24/12/2010	-	-	-	-	-	-	-	-	-	-
DISCHARGE-QC3	24/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 1-S1	25/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 1-QC1	25/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 2- S2	25/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 2- QC2	25/12/2010	-	-	-	-	-	-	-	-	-	-
DISCHARGE-S3	25/12/2010	-	-	-	-	-	-	-	-	-	-
DISCHARGE-QC3	25/12/2010	-	-	-	-	-	-	-	-	-	-
S5	25/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 1-S1	27/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 1-QC1	27/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 2- S2	27/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 2- QC2	27/12/2010	-	-	-	-	-	-	-	-	-	-
DISCHARGE-S3	27/12/2010	-	-	-	-	-	-	-	-	-	-
DISCHARGE-QC3	27/12/2010	-	-	-	-	-	-	-	-	-	-

TRIP-S5	29/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC1-S1	29/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC1-QC1	29/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC2-S2	29/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC2-QC2	29/12/2010	-	-	-	-	-	-	-	-	-	-
DISCHARGE-S3	29/12/2010	-	-	-	-	-	-	-	-	-	-
DISCHARGE-QC3	29/12/2010	-	-	-	-	-	-	-	-	-	-
TRIP-QC5	29/12/2010	-	-	-	-	-	-	-	-	-	-
DISCHARGE POINT	31/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 1	31/12/2010	-	-	-	-	-	-	-	-	-	-
ISAAC 2	31/12/2010	-	-	-	-	-	-	-	-	-	-
TRIP 1 2	31/12/2010	-	-	-	-	-	-	-	-	-	-

ALS	[redacted]	[redacted]	Analyte	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)		EP075(SIM)B: Polynuclear Aromatic Hydrocarbons	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[a]pyrene	Indeno[1,2,3-cd]pyrene	Dibenz[a,h]anthracene	Benzo[g,h,i]perylene		EP075(SIM)S: Phenolic Compound Surrogates	Phenol-d6	2-Chlorophenol-D4	2,4,6-Tribromophenol	EP075(SIM)T: PAH Surrogates	2-Fluorobiphenyl	Anthracene-d10	4-Terphenyl-d14	EP080/071: Total Petroleum Hydrocarbons	EP068: BTEX	Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene	EP0405: TPH(V)/BTEX Surrogates	1,2-Dichloroethane-D4	Toluene-D8	4-Bromofluorobenzene
	[redacted]		CAS Number								91-20-3	208-96-8	83-32-9	86-73-7	85-01-8	120-12-7	206-44-0	129-00-0	56-55-3	218-01-9	205-99-2	207-08-9	50-32-8	193-39-5	53-70-3	191-24-2			13127-88-3	95951-73-6	118-79-6		321-60-8	1719-06-8	1718-51-0			71-43-2	108-88-3	100-41-4	106-38-3 / 106-42-3	95-47-6		17060-07-0	2037-26-5	460-00-4
Sample No.			Units	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L			%	%	%		%	%	%			µg/L	µg/L	µg/L	µg/L	µg/L		%	%	%
[redacted]																																														
[redacted]																																														
ID 1	ID 2	Date Sampled	LOR	20	50	100	50	50			1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1			surrogate	surrogate	surrogate		surrogate	surrogate	surrogate			1	2	2	2	2		surrogate	surrogate	surrogate
DISCHARGE POINT		[redacted]	WATER	<20																																									
ISAAC 1		[redacted]	WATER	<20																																									
ISAAC 2		[redacted]	WATER	<20																																									
DISCHARGE POINT		[redacted]	WATER	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-		-	-	-	-	-		-	-	-
ISAAC 3		[redacted]	WATER	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-		-	-	-	-	-		-	-	-
ISSAC 2		[redacted]	WATER	<20																																									
DISCHARGE "E POINT"		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			30.6	67.5	99.3		91.3	76.2	106			<1	<2	<2	<2	<2		101	103	96.4
Downstream		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			32	27.5	72.1		24.5	52.2	73.5			<1	<2	<2	<2	<2		105	92.3	103
ISAAC 3		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			27	37.2	79.6		16.8	69.3	93.4			<1	<2	<2	<2	<2		109	92	106
ISAAC 1-S1		[redacted]	WATER	<20	<50	<100	<50	50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			28.4	57.4	83.8		58	74.5	84.7			<1	<2	<2	<2	<2		106	99.3	100
ISAAC 1-OC1		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			28.1	52.6	73.6		47.5	72.1	78.3			<1	<2	<2	<2	<2		99.4	98.8	96.6
ISAAC 2-S2		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			32.7	61.6	77.7		57.2	89.9	90			<1	<2	<2	<2	<2		96.6	97.5	97.9
ISAAC 2-OC2		[redacted]	WATER	<20	<50	<100	50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			30.9	63.8	74.1		62.7	89.7	94.7			<1	<2	<2	<2	<2		100	99.7	97.5
DISCHARGE E-S3		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			33.1	57.1	68.9		65.7	83.9	96.4			<1	<2	<2	<2	<2		102	101	97.7
DISCHARGE E-OC3		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			28.6	59.8	87.8		54.9	89.7	96			<1	<2	<2	<2	<2		103	102	98.2
QC 3		[redacted]	WATER	20	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			<1	<2	<2	<2	<2		116	105	102
ISAAC 1-S1		[redacted]	WATER	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			-	-	-	-	-		-	-	-
ISAAC 1-OC1		[redacted]	WATER	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			-	-	-	-	-		-	-	-
ISAAC 2-S2		[redacted]	WATER	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			-	-	-	-	-		-	-	-
ISAAC 2-OC2		[redacted]	WATER	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			-	-	-	-	-		-	-	-
DISCHARGE E-S3		[redacted]	WATER	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			-	-	-	-	-		-	-	-
DISCHARGE E-OC3		[redacted]	WATER	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			-	-	-	-	-		-	-	-
QC 3		[redacted]	WATER	<20	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			<1	<2	<2	<2	<2		131	108	112
ISAAC 1-S1		[redacted]	WATER	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			-	-	-	-	-		-	-	-
ISAAC 1-OC1		[redacted]	WATER	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			-	-	-	-	-		-	-	-
ISAAC 2-S2		[redacted]	WATER	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			-	-	-	-	-		-	-	-
ISAAC 2-OC2		[redacted]	WATER	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			-	-	-	-	-		-	-	-
DISCHARGE E-S3		[redacted]	WATER	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			-	-	-	-	-		-	-	-
DISCHARGE E-OC3		[redacted]	WATER	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			-	-	-	-	-		-	-	-
TRIP QS 1		[redacted]	WATER	30	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			<1	<2	<2	<2	<2		101	98.1	92.6
ISAAC1-S2		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			26.5	69.5	98.1		61.2	72.3	93.3			<1	<5	<2	<2	<2		102	122	119
ISAAC1-OC1		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			28.9	67.5	70.5		70	93.4	98.9			<1	<5	<2	<2	<2		122	123	109
ISAAC2-S2		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			29.5	71	86.5		63.1	73.3	94.3			<1	<5	<2	<2	<2		110	102	99.9
ISAAC2-OC2		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			35.9	63.9	96.7		60.1	88.2	97.2			<1	<5	<2	<2	<2		118	110	106
DISCHARGE E-S3		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			29	60.2	80.4		68.9	78.7	96.6			<1	<5	<2	<2	<2		116	110	103
DISCHARGE E-OC3		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			29.9	62.2	80.8		67.2	77.3	96.3			<1	<5	<2	<2	<2		111.3	94.2	85.7
TRIP QC3		[redacted]	WATER	<20	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			<1	<5	<2	<2	<2		125	116	114
DISCHARGE "E POINT"		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			37.8	67.4	67.2		74.5	80.7	89.2			<1	<5	<2	<2	<2		95.5	99.4	91.7
ISAAC 1		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			44.1	86.9	75.3		78.6	86.8	66.1			<1	<5	<2	<2	<2		104	91	87.4
ISAAC 2		[redacted]	WATER	<20	<50	<100	<50	<50			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0			47.5	83.9	77		90.5	90	67.2			<1	<5	<2	<2	<2		106	93.1	93.2
TRIP 1 2		[redacted]	WATER	<20	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-		-	-	-			<1	<5	<2	<2	<2		105	87.7	94.4

[redacted]

From: [redacted]
Sent: Monday, 31 January 2011 12:38 PM
To: [redacted]
Cc: [redacted] Ben McMahon; [redacted]
Subject: Fw: Moranbah Pond Levels

[redacted]

I have just received the updated dam level readings from the site. Please refer to email below. I trust this will provide the supporting information to enable assessment of the TEP based on curret levels and risk.

Regards

[redacted]

Arrow Energy Ltd

From: [redacted]
To: [redacted]
Sent: Mon Jan 31 11:44:13 2011
Subject: Moranbah Pond Levels

Hi [redacted]

Just had updated pond levels from morning readings.

Pond 1 = 50mm below MRL
Pond 2 = 850mm below MRL
Pond 5 = 1600mm below MRL
Pond 10 = 10mm below MRL

If you require any further information regarding pond levels and river sampling please contact me.

Regards,

[redacted]

Wellfield Coordinator

Arrow Energy Limited
Lot 9 Thorpe Street, Moranbah QLD 4744
PO Box 335, Moranbah QLD 4744, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

[redacted]

From: [redacted]
Sent: Monday, 31 January 2011 5:26 PM
To: [redacted]
Subject: TEP - PDF Version
Attachments: Revised MGP TEP MGP 27 Jan 2011

DRAFT TRANSITIONAL ENVIRONMENTAL PROGRAM UNDER SECTION 333 OF THE *ENVIRONMENTAL PROTECTION ACT 1994*

Principal Holder:	CH4 Pty Ltd **AM-60** Level 19 42 Albert Street Brisbane QLD 4000
EA Number:	PEN100015907
Title:	Coal Seam Water Management Moranbah Gas Project
Date:	10 January 2011
Finish Date:	31 May 2011

Introduction

The Moranbah Gas Project lacks sufficient water storage capacity as previously indicated in correspondence to DERM (dated 25 October 2010) and subsequent responses to information requests and the program notice documentation submitted by Arrow (dated 3 December 2010). This has been caused by an early start to the wet season contributing to existing dam levels and causing construction delays. This has prevented Arrow from making additional storage available via the completion of dam 11. The synthetic lining for the dam cannot be installed during periods of rainfall; the civil engineering also requires careful control of the moisture content of the construction materials to achieve the required specifications.

Dam 11 has been designed and is being constructed in line with the most current dam standards stipulated by DERM and contained in the previously submitted and assessed dam design report. It is a large lined dam – intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, develop beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies.

The continued rain has delayed the completion of dam 11. This has put Arrow in a position where it cannot comply with the current EA conditions. Arrow intends to employ this transitional environmental program (TEP) as defined in Chapter 7, Part 4 of the *Environmental Protection Act 1994 to bring our operation back into compliance with its current Environmental Authority*. In initiating this process Arrow intends to work with DERM to minimise the potential for environmental harm.

Background

Arrow currently employs a network of 10 dams across PL191 and PL196. Dams 1 through to 7 are shown in the attached drawing (Appendix C). Dams 8 and 9 in the network are SW of the main area depicted in the provided drawing. Approximately 90% of the total storage capacity for coal seam water is held in Arrow's major storage dams 1, 2 and 10. The other dams are employed to move water between groups of remote wells and the major storage dams. Dam 3 is employed to store more concentrated brine. An important feature of the petroleum lease is the Isaac River which divides the lease along a NW to SE axis and its tributary Teviot Brook. Isaac River is an ephemeral river; during periods of high flow it limits access to infrastructure on the north eastern side of the petroleum lease via river crossings.

Situation

Our strategy is to maintain low levels in the older and less accessible dams (particularly dams 6,7, 8 and 9) by moving water to dams 1 and 10. Dam 10 is our most recently constructed dam and has an engineered spillway, dam 1 is in reasonable condition and adjacent to dam 10 which allows water to be transferred readily between dams.

Our risk assessment process and an independent third party geotechnical evaluation by URS has identified particular concerns with the integrity of dam 2 (refer to Appendix E). Arrow has concerns regarding the condition of dam 2 – it is scheduled to be brought out of service on the completion of Dam 11. Based on geotechnical evaluation we intend to lower the level of water in Dam 2 to 4m below DSA. The goal of this strategy is to maintain pond integrity and minimise discharge to the environment when a suitable plan to restore the operational integrity of dam 2 is developed or the dam is retired from operational duty.

Arrow believes that a controlled discharge during high flow conditions in the Isaac River via the existing infrastructure would result in the least environmental impact whilst preserving the integrity of the existing dams. This option prevents the overland flow of untreated coal seam water reaching the Isaac River and minimises the risk of damaging older dams which are built prior to the new standards and lacking engineered spillways. When the facility was originally developed the water management scheme was significantly different to now and included a wet weather discharge. At present our existing infrastructure is not sufficient to comply with the conditions of the current Environmental Authority particularly during extended wet periods.

Our system of dams has an area of 125,100 m^2, this equates to a gain of 0.125ML per mm of rainfall. The system is designed to transfer water to the major storage dams 1, 2 and 10 this contribute to the catchments of these structures, each 1 mm of rainfall will cause an increase in dam height of 1.6 mm in dams 1, 2 and 10. When all the input rainfall is directed to dam 10 each 1 mm of rainfall causes an increase in dam height of 2.7 mm in dam 10.

Table 1 Key Dam Variables Dams 1, 2, 5 and 10

Dam		1	2	5	10
Volume at Spill level	ML	119.66	92.64	7.64	203.70
Spillway		No	No	No	Yes
Liner type		CCL	CCL	0.5mm HDPE	1.5mm HDPE
Hydraulic height	m	5.60	5.50	3.5	4.75
MRL	m	5.25	5.15	3.15	4.40
DSA	m	4.75	4.65	2.65	3.90
Target dam fill height[b]	m	4.75	0.65	2.65	3.90
Current level (below MRL)[a]	mm	100	870	Varies[c]	40
Remaining rainfall *(to spill)*[d]	mm	281	762	>800	244

[a] Levels 27 December 2010, negative denotes level above MRL
[b] Target dam fill height is DSA for dams 1 and 10, 4m below DSA for dam 2. Current target height for dam 2 is based on 3rd party civil engineering assessment completed by URS.
[c] This dam is much smaller than the major storage dams its level can change rapidly during operations
[d] Rainfall based on approximate catchment ratio of 1.6 (based on total catchment area including transfer dams)

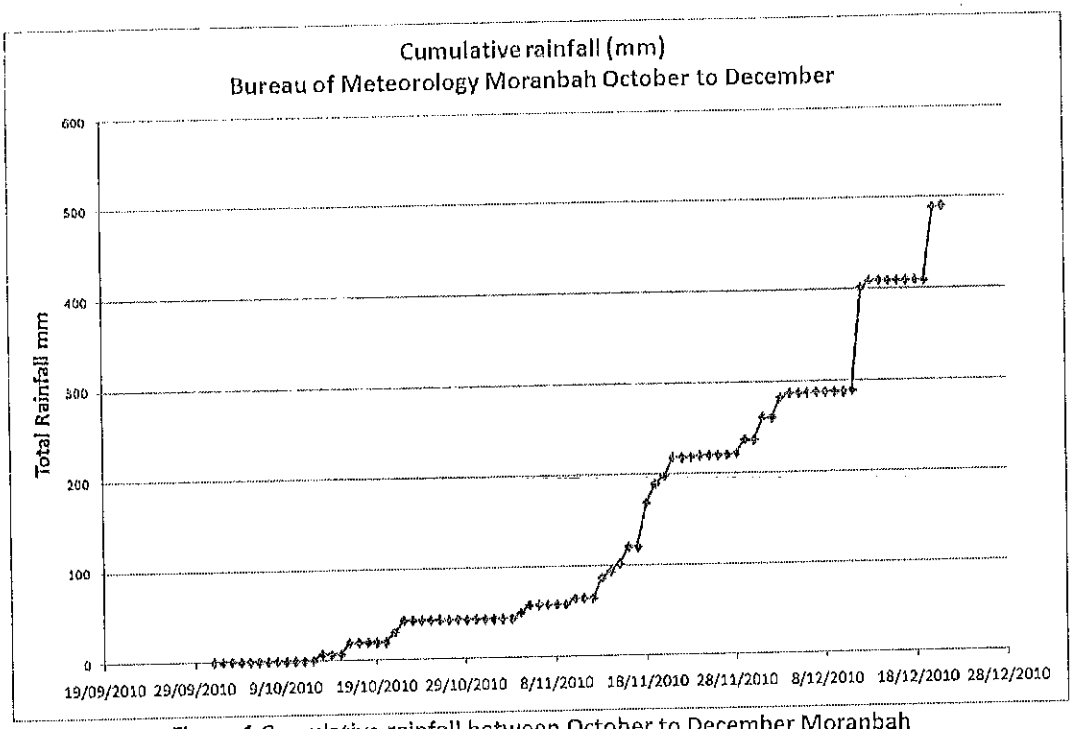


Figure 1 Cumulative rainfall between October to December Moranbah

Future water levels will be a product of the rainfall, coal seam water production and evaporation. Our goal is to maintain dams 1 and 10 at DSA levels by employing a discharge to the Isaac River. Dam 2 will be lowered to a level determined by independent third party engineering risk assessment.

Arrow has evaluated 2 scenarios for water requiring discharge from the storage system:

- Scenario 1 – Mean rainfall until end of wet season
- Scenario 2 – 95th percentile rainfall until end of wet season

Rainfall to date is very close to the 95th percentile rainfalls on average from October through to December. We have had a cumulative total of 490mm from the 1st of October to date (Figure 1), 95th percentile cumulative rainfall for the period from the start of October to the end of December totals 522mm. At present with one week remaining in December the cumulative total is 30mm short of the 95th percentile. Given the current progress of the wet season Arrow believes that the next few months will produce above average rainfall. Long range forecasts from the Bureau of Meteorology give a 55% chance of rainfall at or above the 95% percentile values. In determining the water balance for the facility has evaluated 2 scenarios – mean and 95th Percentile rainfall (refer to Table 2).

Table 2 Discharge scenarios

Scenario	Volume to reach DSA (ML)	Additional removal from Dam 2 (ML) [b]	Expected Net [a] Water to Storage (ML)	Total (ML)
Mean Rainfall	69	75	54.5	198.5
95th Percentile	69	75	130	274

[a] *Net water to storage is produced water, less evaporation plus expected rainfall.*
[b] *This is based on a dam 2 torget of 4000mm below DSA.*

Arrow proposes a discharge of up to 7.5ML/day to commence when the Isaac River is at least 1090 ML/day measured upstream at the Goonyella river gauge (operated by DERM). Discharge will be maintained at a 400:1 dilution ratio on the basis of maintaining Australian drinking water guidelines (NHMRC,2004) downstream of the discharge. Based on a predicted salinity impact as detailed in Appendix B. This discharge rate and the dilution factor will be reviewed thoughout the TEP in consultation with DERM and informed on the basis of the upstream/downstream river monitoring in line with the proposed conditions detailed within this document.

Sampling will be conducted in line with the conditions detailed in this TEP under the procedure attached as Appendix D. Appendix A contains detailed results of the sampling completed to date to characterise the coal seam water to be discharged.

Supporting Information

Consideration of the management hierarchy for the management of coal seam water at the MGP

Evaluation as per the management hierarchy of preferred procedures from Environmental Protection (Water) Policy 2009:

Step 1—evaluate water conservation measures to reduce the use of water and the production of waste water or contaminants;
Water is not employed in the coal seam gas production process but must be removed from the coal seam to allow the gas to be extracted. Water conservation measures will not reduce the amount of coal seam water associated with the gas extracted.

Step 2—evaluate waste prevention options and implement appropriate waste prevention measures;
The key waste prevention measure employed is maximisation of the coal seam gas to water ratio. The coal seams targeted by MGP have relatively low ratios of water to gas in comparison to other fields. In an effort to manage our recent water storage constraints Arrow has shut in a large number of wells, targeting the wells with high water to gas ratios to minimise the production of coal seam water associated with our operations.

Whilst this has reduced our coal seam water production, shutting in further wells will yield limited benefits in terms of water reduction but will cause significant reduction in gas output.

Use of dam 11 in its current uncompleted, unlined state has been investigated. The pipe work and major civil infrastructure is complete but the floor of the dam is incomplete – as discussed (in our meeting on the 1st of December) it lacks its intended second liner, more importantly the clay liner has not been sufficiently compacted to allow its use. Key elements of the pipework connecting dam 11 to the rest of the network remain incomplete. Employing dam 11 would require its use for an extended period to allow subsequent emptying and upgrade of the existing dam infrastructure.

Step 3—if waste prevention does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate treatment and recycling options and implement appropriate treatment and recycling;
The construction of Dam 11 is the first component of our coal seam water management strategy. It is a large lined dam, intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies. Rainfall is delaying the construction of dam 11 and contributing to the current water storage problems.

Installation of water treatment (such as a mobile RO plant) is limited by the logistics (such as civil engineering, chemical storage and power supply), cost and the challenges posed during current wet conditions. Another option considered was employing water entitlements to dilute the untreated coal seam water to the current environmental authority specification. This option was ruled out since a large quantity of good quality water would be required to dilute and dispose of a limited amount of coal seam water from our dams.

Step 4—if treatment and recycling does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate the following options
for waste water or contaminants, in the order in which they are listed—
(i) appropriate treatment and release to a waste facility or sewer;
(ii) appropriate treatment and release to land;
(iii) appropriate treatment and release to surface waters or ground waters.

I) We cannot practically truck water from the dams given the large quantities and the lack of disposal options. Wet weather is likely to complicate trucking of water by limiting access to some points within the MGP. Infrastructure does not exist to process this water via sewer or other industrial water treatment options. Our landholders have expressed concern of minimising truck movements during the wet season.

II) Until our water treatment management strategy is implemented we cannot treat the water to a standard that is suitable for use on land.

III) We consider the water in its current state is suitable for discharge into the Isaac – this was the water management strategy employed by the facility until earlier EA conditions were amended, we are seeking permission from DERM to allow this discharge as previously authorised until we can implement our water management strategy for the MGP. We consider a temporary discharge to the Isaac river during high flow conditions to be compliant with section 51 of the Environmental Protection Regulation 2008.

Objectives

To achieve compliance with the Environmental Authority with respect to coal seam water management and dam standards by April 2011.

This will be achieved in the short term by the release of water to the Isaac River. This measure will protect the integrity of our storage infrastructure and is consistent with the operational philosophy that our existing infrastructure was designed to accommodate.

In the medium term compliance with the new EA will be achieved by the completion of Dam 11. Completion of dam 11 will require Arrow energy to utilise the cleared area north of dam 11.

In the long term, compliance with our EA will be achieved by completion of water treatment facilities that allow beneficial use and disposal within Arrows Environmental Authority conditions. Arrow is to provide DERM with a detailed plan concerning future water management for approval.

Table 3 – Achieving TEP objectives

OBJECTIVE	ACTION	RESPONSIBILITY	TIME FRAME	PERFORMANCE INDICATOR
1. Lower dam levels for (dams 1, 2, 5, 10)	Manage via discharge (RP1) to Isaac river	Arrow site personnel	Immediate	Manage dams within appropriate levels as detailed in Tables 1 and 2. Discharge is to be subject to monitoring and reporting requirements
2. Monitor Discharge	Monitor discharge in accordance with Table 5, for the contaminants listed in Table 6 and Table 7	Arrow site personnel	During discharge	Lab results to be reported to DERM within 10 business days of collection.
3. Pond 2	Develop management plan to restore dam integrity or remove from service	Arrow	15 March 2010	Submission of management plan to DERM
4. Cease discharge	Cease discharge to Isaac river under TEP	Arrow	31 March 2011	Cease discharge to Isaac river
5. TEP report submission	Provide DERM with final TEP report detailing how the objectives of this TEP have been met	Arrow	31 May 2011	Submission of TEP report to DERM

Monitoring

Table 4 Contaminant release points, sources and receiving waters

Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point	Receiving waters
TEP RP 1	148° 2' 35"	-21° 57' 41"	untreated CSG water from PL191/196	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
				Upstream from discharge – Isaac River Crossing	
				Downstream from discharge – Blair Athol Bridge	

Table 5 Contaminant release monitoring points

Monitoring point (TEP MP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point location	Receiving waters
TEP MP 1	148° 2' 35"	-21° 57' 41"	Untreated CSG water from PL191	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
TEP MP 2	148° 2' 46"	-21° 57' 55"	Downstream from discharge – Blair Athol Bridge	Blair Athol Railway Bridge	na
TEP MP 3	148° 2' 20"	-21° 57' 41"	Upstream from discharge	Isaac River Crossing	
TEP MP 4	148° 1' 10"	-21° 58' 00"	Untreated CSG water dam 1	Dam 1	
TEP MP 5	148° 2' 8"	-21° 58' 01"	Untreated CSG water dam 2	Dam 2	
TEP MP 6	148° 2' 32"	-21° 57' 44"	Untreated CSG water dam 5	Dam 5	
TEP MP 7	148° 1' 14"	-21° 58' 4"	Untreated CSG water dam 10	Dam 10	

Table 6 Contaminant release limits

Quality characteristic	Release Limit	Monitoring Frequency	Sample Type	Monitoring Point
Electrical conductivity (uS/cm)	13000	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1
			Samples require laboratory analysis[2]	TEP MP 1
pH (pH Unit)	6.5 (minimum) 9.5 (maximum)	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1
				TEP MP 2
				TEP MP 3
			Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 2
				TEP MP 3
Turbidity (NTU)	500	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 2
				TEP MP 3
BTEX Benzene, Ethylbenzene, Toluene and Xylene (mg/L)	Benzene 0.001 Ethylbenzene 0.3 Toluene 0.8 Xylene 0.02	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 2
				TEP MP 3

[1] *In situ samples can be taken using electronic sampling equipment.*
[2] *Samples are required to be analysed at a NATA accredited facility in accordance with this Transitional Environmental Program.*

Table 7 Downstream contaminant trigger investigation levels

Quality characteristic	Trigger levels (µg/L)	Monitoring frequency	Monitoring Point
Aluminium	55	Commencement of release and thereafter weekly during release	TEP MP 2 TEP MP 3
Arsenic	13		
Cadmium	0.2		
Chromium	1.0		
Copper	2.0		
Iron	300		
Lead	10		
Mercury	0.2		
Nickel	11		
Zinc	8.0		
Boron	370		
Cobalt	90		
Manganese	1900		
Molybdenum	34		
Selenium	10		
Silver	1.0		
Uranium	1.0		
Vanadium	10		
Ammonia	900		
Nitrate	1100		
Petroleum hydrocarbons (C6-C9)	20		
Petroleum hydrocarbons (C10-C36)	100		
Fluoride (total)	2000		

Table 8 Contaminant release during flow events

Receiving waters	Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Minimum flow in receiving water required for a release event	Flow recording frequency
Isaac River	TEP RP1	-148° 2' 0"	21° 51' 20"	1090ML/day	Daily from Goonyella Gauging station

Table 9 Receiving water downstream monitoring points

Monitoring points (TEP MP)	Receiving waters location description	Easting (GDA94)	Northing (GDA94)
TEP MP 2	Blair Athol Bridge 500 metres downstream of RP1	148° 2' 46"	-21° 57' 55"

Conditions

In carrying out this Transitional Environmental Program, CH4 Ltd (Arrow Energy) will undertake all activities in accordance with the following conditions.

Undertaking the release of untreated coal seam methane water

1 Contaminants that will, or have the potential to cause environmental harm must not be released directly or indirectly released to any waters except as permitted under this Transitional Environmental Approval.

2 The release of contaminants to waters must only occur from the release points specified in Table 4 and depicted in Appendix C attached to this Transitional Environmental Program.

3 The release of contaminants to waters must not exceed the release limits stated in Table 6 at the monitoring points specified in Table 5 and Table 6 of this Transitional Environmental Program.

4 The release of contaminants to waters from the release points must be monitored at the locations specified in Table 5 and Table 9 for each quality characteristic and at the frequency specified in Table 7 and Table 8 of this Transitional Environmental Program.

5 If quality characteristics of the release exceed any of the trigger levels specified in Table 7 during a release event, the Transitional Environmental Program holder must compare MP2 to the trigger values specified in Table 7 and:

a) where the trigger values are not exceeded then no action is to be taken

b) where the downstream results exceed the trigger values specified Table 7 for any quality characteristic, compare the results of the downstream site to the data from the upstream monitoring sites (MP3)

i) if the result is less than that recorded at Monitoring Point 3 (MP3), then no action is to be taken or

ii) if the result is greater than the background monitoring site data, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology, into the potential for environmental harm and provide a written report 20 business days after receiving results, outlining

- details of the investigations carried out
- actions taken to prevent environmental harm.

6 If an exceedance in accordance with condition 5(b)(ii) is identified, the holder of the Transitional Environmental Program must notify the administering authority within 24 hours of receiving the result. The notification must include written verification of the exceedance forwarded to the administering authority.

Contaminant Release Events

7 The release of coal seam water will not occur until flow in the Isaac River flow reaches 1090 ML/day (at Goonyella Gauging Station).

8 Notwithstanding any other condition of this Transitional Environmental Program, the release of contaminants to waters must only take place during periods of natural flow events specified as minimum flow in Table 8 for the contaminant release point(s) specified in Table 4.

9 Contaminant release flow rate must not exceed 1:400 (0.25%) of receiving water flow rate.

10 The daily quantity of contaminants released from each release point must be measured and recorded at the monitoring points in Table 4

11 The daily quantity of contaminants is not to exceed 7.5ML/day in total.

12 Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build up of sediment in such waters.

Notification of Release Events

13 The Transitional Environmental Program holder must notify the administering authority within 24hours of having commenced releasing coal seam water to the receiving environment. Notification must include the submission of written verification to the administering authority of the following information:

a) release commencement date/time
b) expected release cessation date/time
c) release point/s
d) release volume (estimated)

e) receiving water/s including the natural flow rate
f) any details (including available data) regarding likely impacts on the receiving water(s).

14 The Transitional Environmental Program holder must provide the administering authority daily during the release of coal seam water, the following information:
a) all in situ monitoring data for that day
b) the receiving water flow rate
c) the release flow rate.

15 The Transitional Environmental Program holder must notify the administering authority as soon as practicable, (no later than within 24 hours after cessation of a release) of the cessation of a release notified under condition 12 and within 15 business days provide the following information in writing:
a) release cessation date/time
b) natural flow volume in receiving water
c) volume of water released
d) details regarding the compliance of the release with the conditions of this Transitional Environmental Program (i.e. contamination limits, natural flow, discharge volume)
e) all in-situ water quality monitoring results
f) any other matters pertinent to the water release event.

Notification of release event exceedence

16 If the release limits defined in Table 6 are exceeded, the holder of the Transitional Environmental Program must notify the administering authority within 2 business days of receiving the results.

17 The Transitional Environmental Program holder must, within 28 days of a release that exceeds the conditions of this Transitional Environmental Program, provide a report to the administering authority detailing:
a) the reason for the release
b) the location of the release
c) all water quality monitoring results
d) any general observations
e) all calculations

f) any other matters pertinent to the water release event.

Requirements to cease the release of coal seam water

18 The coal seam water discharge must cease immediately if any water quality limit as specified in Table 6 is exceeded.

19 The Department of Environment and Resource Management may require CH4 Pty to cease discharge if the department's water monitoring stations detect any water quality limit exceedance.

20 The release of coals seam water must cease immediately if identified that the release of coal seam waters is causing erosion of the bed and banks of the receiving waters, or is causing a material build up of sediment in such waters.

21 The release of coal seam water must cease immediately if holder of this Transitional Environmental Program is directed to do so by the administering authority.

22 The release of coal seam water will cease immediately if Isaac River flow decreases below 1090ML/day (at Goonyella Gauging Station).

Monitoring Requirements

23 Where monitoring is a requirement of this Transitional Environmental Program, ensure that a competent person(s) conducts all monitoring.

24 Monitoring will occur at the frequencies identified in Table 6 and Table 7.

25 All monitoring undertaken as a requirement of this Transitional Environmental Program must be undertaken in accordance with the administering authority's Water Sampling Manual.

Notification of emergencies, incidents and exceptions

26 As soon as practicable after becoming aware of any 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 Transitional Environmental Program, the administering authority must be notified of the release by telephone, facsimile or email.

27 The notification of emergencies or incidents must include but not be limited to the following:

a) the holder of the Transitional Environmental Program
b) the location of the emergency or incident
c) the number of the Transitional Environmental Program
d) the name and telephone number of the designated contact person
e) the time of the release
f) the time the holder of the Transitional Environmental Program became aware of the release
g) the suspected cause of the release
h) the environmental harm caused, threatened, or suspected to be caused by the release, and
i) actions taken to prevent any further release and mitigate any environmental harm caused by the release.

29 Not more than 10 business days following the initial notification of an emergency or incident, written advice must be provided of the information supplied to the administering authority in relation to:

a) proposed actions to prevent a recurrence of the emergency or incident, and

b) outcomes of actions taken at the time to prevent or minimise environmental harm.

Appendix A
ALS & Qld Health water sampling results

ALS	21/12/2010	Sample ID 1	DAM 1	DAM 10	DAM 4	DAM 3	D1	D2	DAM 5	DAM2	TRIP BLANK
		ID 2									
ES1025292	Results	Date Sampled	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010
Analyte	CAS #	Units	LOR	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
EA005: pH											
pH Value		pH Unit	0.01	9.17	9.28	9.34	9.38	9.4	9.42	9.27	9.15	-
EA010P: Conductivity by PC Titrator											
Electrical Conductivity @ 25°C		µS/cm	1	12600	14000	16400	25900	25800	26100	10700	10600	-
EG020T: Total Metals by ICP-MS											
Arsenic	7440-38-2	mg/L	0.001	0.003	0.003	0.002	<0.001	0.004	0.004	<0.001	0.002	-
Barium	7440-39-3	mg/L	0.001	6.54	8.33	4.35	1.93	1.92	1.98	6.4	9.31	-
Beryllium	7440-41-7	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cadmium	7440-43-9	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Cobalt	7440-48-4	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	-
Chromium	7440-47-3	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	-
Copper	7440-50-8	mg/L	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004	-
Manganese	7439-96-5	mg/L	0.001	0.008	0.003	0.002	0.001	0.001	0.003	0.002	0.038	-
Nickel	7440-02-0	mg/L	0.001	0.001	<0.001	0.001	0.002	0.002	0.002	<0.001	0.003	-
Lead	7439-92-1	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Vanadium	7440-62-2	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Zinc	7440-66-6	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	-
EG035T: Total Recoverable Mercury by FIMS											
Mercury	7439-97-6	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
EK055G: Ammonia as N by Discrete Analyser											
Ammonia as N	7664-41-7	mg/L	0.01	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
EK057G: Nitrite as N by Discrete Analyser											
Nitrite as N		mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EK058G: Nitrate as N by Discrete Analyser											
Nitrate as N	14797-55-8	mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser											
Nitrite + Nitrate as N		mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser											
Total Kjeldahl Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser											
Total Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK067G: Total Phosphorus as P by Discrete Analyser											
Total Phosphorus as P		mg/L	0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EP080: BTEX											
Benzene	71-43-2	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	108-88-3	µg/L	2	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	100-41-4	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
EP080S: TPH(V)/BTEX Surrogates											
1,2-Dichloroethane-D4	17060-07-0	%	surrogate	113	111	103	112	105	110	110	106	106
Toluene-D8	2037-26-5	%	surrogate	110	106	103	109	105	106	107	103	102
4-Bromofluorobenzene	460-00-4	%	surrogate	106	99.7	97.9	104	97.1	98.6	101	97	101

Appendix B
Dilution calculation basis

Table 10 Dilution calculation at 400:1 release

Parameter	Unit	Surface Water Concentration	Concentration of Discharge	Dilution X:1	Surface Concentration after dilution	Guideline[1]
EC	µs/cm	250	10600	400	276.5	746
Sodium	mg/L	65	2970	400	72.4	180
Chloride	mg/L	80	4280	400	90.7	250

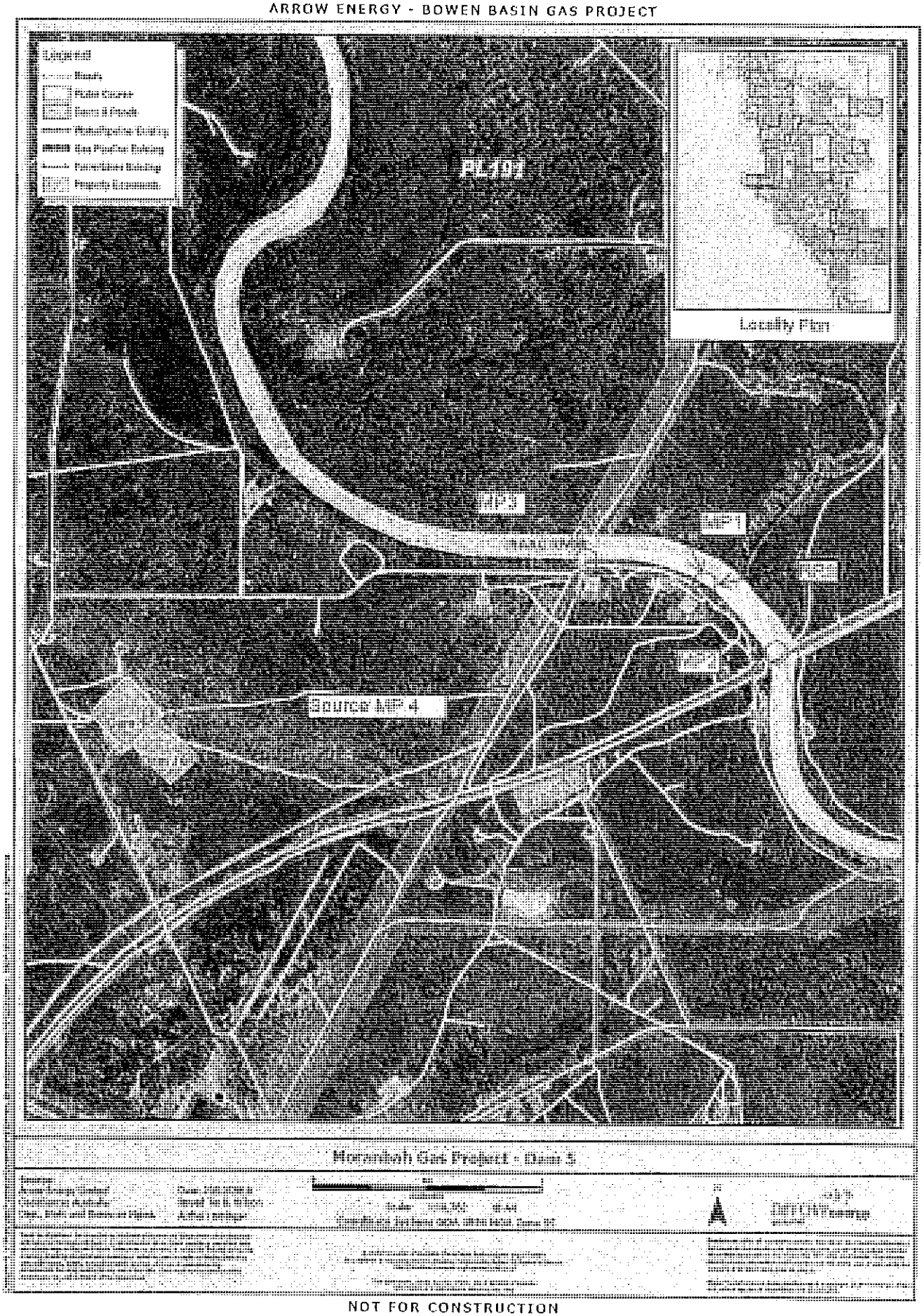
[1] *Australian drinking water guidelines (NHMRC,2004)*
Sodium and Chloride based on EC, common soil quality (run off) and historical data from upstream

Appendix C
Mapping showing PL191 and location of key Dams

Client Reference	Collected Date	Received Date	Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmiun	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	3.8	< 0.0001	0.0011	0.076	< 0.0001	0.05	< 0.0001	0.0027	0.0011	0.003	1.7	0.0013	0.056	< 0.0001	0.0007
Discharge_Point	14-Dec-10	17-Dec-10	0.18	< 0.0001	0.0012	4.5	< 0.0001	1.1	< 0.0001	0.0003	0.0002	0.002	0.08	0.0004	0.0046	< 0.0001	0.0019
Pond_2a	16-Dec-10	17-Dec-10	0.1	< 0.0001	0.0015	6.1	< 0.0001	1	< 0.0001	0.0002	0.0003	0.001	0.066	< 0.0001	0.007	< 0.0001	0.0013
Pond_2	16-Dec-10	17-Dec-10	0.09	< 0.0001	0.0014	6	< 0.0001	1	< 0.0001	0.0002	0.0003	< 0.001	0.044	< 0.0001	0.0065	< 0.0001	0.0012
POND1_1	17-Dec-10	20-Dec-10	0.37	< 0.0001	0.0021	5.8	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.18	< 0.0001	0.0057	< 0.0001	0.0028
POND1_2	17-Dec-10	20-Dec-10	0.43	< 0.0001	0.0023	6	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.2	0.0002	0.0065	< 0.0001	0.0031
POND10_1	17-Dec-10	20-Dec-10	0.2	< 0.0001	0.0018	7.7	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.069	< 0.0001	0.0039	< 0.0001	0.0031
POND10_2	17-Dec-10	20-Dec-10	0.18	< 0.0001	0.0019	7.6	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.067	< 0.0001	0.0041	< 0.0001	0.0034

Client Reference	Collected Date	Received Date	Nickel	Selenium	Silver	Stronium	Thallium	Titanium	Uranium	Vanadium	Zinc	Benzene	Toluene	Ethylbenzone	Meta&Para-Xylenes	Ortho-Xylene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	0.0031	< 0.0010	< 0.001	0.2	< 0.0001	0.14	0.0002	0.012	0.003	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Discharge_Point	14-Dec-10	17-Dec-10	0.0008	< 0.0010	< 0.001	7.3	< 0.0001	0.006	0.0003	0.0029	0.013	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2a	16-Dec-10	17-Dec-10	0.0012	< 0.0010	< 0.001	9.6	< 0.0001	0.003	0.0003	0.0051	0.006	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2	16-Dec-10	17-Dec-10	0.0011	< 0.0010	< 0.001	9.4	< 0.0001	0.002	0.0003	0.005	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_1	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	10	< 0.0001	0.017	0.0009	0.0059	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_2	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	11	< 0.0001	0.015	0.0009	0.0062	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_1	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.026	0.0008	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_2	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.01	0.0007	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

ARROW ENERGY - BOWEN BASIN GAS PROJECT



NOT FOR CONSTRUCTION

Appendix D
Sampling Procedure

SUMMARY

1.1	This procedure outlines general sampling protocols and work practices to be followed during the sampling of surface water, during the discharge of untreated CSG well water to the Isaac River. This procedure includes details on: ▪ Sampling equipment requirements; ▪ Surface water sampling techniques; ▪ Quality control requirements. ▪ Sample locations (Figure 1) ▪ Analytical requirements

EQUIPMENT

2.1	▪ Documentation o Sampling and analysis plan. o Health and safety plan o Personal protective equipment (PPE) as identified in the HSP, inc. Life Jacket and other specialised PPE, as per the HSP. ▪ Water sampling equipment o sample collection device, (Swing Arm Sampler/extension sampler) o decontamination solution (e.g. Decon 90™) or use new sample collection container in the swing arm sampler at each location. o Calibrated water quality meter (ensure parameter ranges are suitable for the water being tested), o laboratory supplied sample containers, o Chilled ice chest. o Field sample Record Sheet o Chain of Custody Form (Attached).

3.0 REFERENCES & PROFORMA

3.1	▪ AS NZS 5667.1-1998 *Water quality - Sampling - Guidance on the design of sampling programs sampling techniques* ▪ AS NZS 5667.4-1998 *Water quality - Sampling - Guidance on sampling from lakes natural and man-made* ▪ AS NZS 5667.6-1998 *Water quality - Sampling - Guidance on sampling of rivers and streams* ▪ Monitoring and Sampling Manual 2009 Environmental Protection (Water) Policy 2009, *Monitoring and Sampling Manual 2009*, Version 2 September 2010

4.0 PROCEDURE

4.1	**Safety**

	Unless specifically required, the following general safety requirements should be noted: 1. Appropriate personal protective equipment should be worn as specified in the Health and Safety Plan (HSP). When working in or around water bodies, a life jacket is required to be worn and a minimum of two persons to be present should be assessed. 2. Assess hidden hazards (eg. trip hazards, snakes, leeches, etc.). 3. Assess risks from slippery or unstable banks. 4. Assess whether the water body / drain may constitute a confined space. 5. Assess the likelihood that surface conditions within and around the water body may change rapidly in the event of heavy rainfall or tidal change.

4.2	Sampling
	1. The sampling frequency during and following discharge to the Isaac River shall be as follows: • daily during discharge; and • daily for two days following discharge stopping. 2. The sampling sequence should commence where the lowest likely contaminant concentrations are expected (e.g. downstream and work upstream), to reduce the risk of cross contamination between samples. On this basis, the samples shall be collected at the following locations (in order): (See **Figure 1** for sampling locations) I. **River crossing** (upstream), (One **primary sample (S1)**, plus **one duplicate sample (QC1)**) II. **Blair Athol Bridge** (downstream), One **primary sample (S2)**, plus **one duplicate sample (QC2)**) III. At the **Discharge Point**, One **primary sample (S3)**, plus **one duplicate sample (QC3)**) IV. At the **Source (Dam)** One **primary sample (S4)**, plus **one duplicate sample (QC4)**) V. QC samples – Field/Trip Blank (QC5) and rinsate blank (QC6) (if required) 3. At each location, a water sample should be collected for standard field parameters using a calibrated water quality meter. The following parameters should be recorded: a. pH, b. conductivity, c. dissolved oxygen, d. redox potential, e. temperature and f. turbidity. Notes: • Follow the manufacturer's instructions for use and calibration of instruments to measure water parameters. A calibration record must be kept. • When recording dissolved oxygen readings, it is important to note whether the results are reported as % saturation or ppm. • With conductivity, record whether units are mS or µS.

4. Based on the nature of the sampling locations, heterogeneous distribution of potential contaminants in the water samples is considered likely. Therefore, the following Quality Control Samples should be collected and analysed for this program:
    a. One duplicate sample per sample location for TPH, BTEX and 8 Metals analysis (**QC1 – QC4**).
    b. One Blank Sample per esky (laboratory prepared DI Water for TPH (C6 – C9) and BTEX analysis) (**QC5**).
5. One rinsate sample per day (unless using new sample collection medium between sample locations i.e. a new container in the swing arm sampler) for TPH (C6 – C9) and BTEX analysis) (**QC6**).
6. At each location sample bottles should be filled based on a decreasing order of potential volatility (i.e. VOCs, BTEX and TPH first, followed by metals and other inorganic samples).
7. Note: **DO NOT** field filter samples for total metals. Perform field filtering for dissolved metals samples only.
8. When sampling shallow waters, contamination from bottom sediments should be avoided. Samples should be collected by submerging a clean sample collection container (up-side down) into the water and to approximately 100mm below the surface, rotate the container to allow it to fill.
9. The sampling location should be as representative as possible of the event being monitored. i.e. do not sample stagnant water at the edge, attempt to sample .
10. Record the appearance of the water body, i.e. colour, turbidity, odour, surface crusts, films or floating material, algae, water velocity, etc. In addition, record the weather conditions at the time of sampling and note any other relevant observations, e.g. dead or distressed flora/fauna, surface rubbish, spills, etc.
11. All measurements and field notes should be documented on the field sheet (**Attachment A**)

5.0 ANALYTICAL/SAMPLE CONTAINER REQUIREMENTS

5.1	1. The analytical suite includes the following: a. pH, EC, TDS, Turbidity b. Ions: Magnesium, Calcium, Sodium, Sulphate, Chloride, Ammonia, Nitrate, Fluoride (total). c. Metals, Aluminium, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Zinc, Boron, Cobalt, Manganese, Molybdenum, Selenium, Silver, Uranium, Vanadium. d. Organics: BTEX, PAH, TPH 2. Each Sample Requires the following containers: a. 60ml Plastic Bottle for metals (with red and green striped label border) (tick 'Total Metals') b. 500ml Plastic Bottle for anions/cations (with green label border) c. 250ml Amber Glass Bottle (with purple label border) d. One pair of BTEX vials (40 mL glass cylindrical containers with purple label border).
	Notes: • The selection of sample containers depends on the laboratories being used. The above list is based on ALS requirements only. When ultra trace analysis is being requested, additional sample volume may be required. Always check with the laboratory prior to submitting samples to the laboratory. • When filling the vials it is important that they are filled to the top with no air space remaining. • Use new sample gloves between sample locations.
5.2	1. Place samples immediately in a chilled ice chest 2. Complete sample request form and include in sealed bag in the cooler 3. Courier samples to the receiving laboratory.

12			**Surface Water Sampling**					**Form**
Site					Sampling Method:			
Job Number					Local Air Temperature:			
Date:		Time:			Wind Force:			
Weather:			Cloudiness %		Direction of Wind:			
Location	**Sample No.**	**Water Flow (l/s)**	**Field Readings**				**Depth (m)**	**Comments: including turbidity (plankton and/or sediment), colour, water plants, weather conditions, etc**
			pH	**Conductivity**	**Temperature**	**Dissolved Oxygen**		
Comments concerning treatment of samples, especially preservation:								
Name:			**Signed:**			**Project Manager:**		adapted from AS 5667.4

Analytes

Quality characteristic	
pH	
EC	Ammonia
Turbidity	Nitrate
Magnesium	Fluoride (total)
Calcium	BTEX
Sodium	PAH
Sulphate	TPH
Chloride	
Aluminium	
Arsenic	
Cadmium	
Chromium	
Copper	
Iron	
Lead	
Mercury	
Nickel	
Zinc	
Boron	
Cobalt	
Manganese	
Molybdenum	
Selenium	
Silver	
Uranium	
Vanadium	

Appendix E
URS Dam 2 Assessment

Ben McMahon

From: [redacted]
Sent: Monday, 31 January 2011 1:01 PM
To: [redacted]
Cc: [redacted] Ben McMahon; [redacted]
Subject: RE: Moranbah Pond Levels

Categories: Red Category

Hi [redacted]

Do you have a PDF version of the TEP?

There is an IT issue our computers have with the word version you use. Text appears fine but tables to do not show on screen correctly or print.

If you could please PDF the version submitted on Friday that would be appreciated.

Regards

[redacted]

From: [redacted]
Sent: Monday, 31 January 2011 12:38 PM
To: [redacted]
Cc: [redacted] Ben McMahon; [redacted]
Subject: Fw: Moranbah Pond Levels

[redacted]

I have just received the updated dam level readings from the site. Please refer to email below. I trust this will provide the supporting information to enable assessment of the TEP based on curret levels and risk.

Regards

[redacted]

Arrow Energy Ltd

From: [redacted]
To: [redacted]
Sent: Mon Jan 31 11:44:13 2011
Subject: Moranbah Pond Levels

Hi [redacted]

Just had updated pond levels from morning readings.

Pond 1 = 50mm below MRL
Pond 2 = 850mm below MRL
Pond 5 = 1600mm below MRL
Pond 10 = 10mm below MRL

If you require any further information regarding pond levels and river sampling please contact me.

Regards,

[redacted]
Wellfield Coordinator

Arrow Energy Limited
Lot 9 Thorpe Street, Moranbah QLD 4744
PO Box 335, Moranbah QLD 4744, Australia
T: [redacted]
F: [redacted]
M: [redacted]
www.arrowenergy.com.au

Graham Cordingley

From: [redacted]
Sent: Monday, 31 January 2011 1:29 PM
To: [redacted]
Cc:
Subject: RE: Water Quality Results

Cheers [redacted]

Is a copy of the draft TEP document also on its way?

Thanks

From: [redacted]
Sent: Monday, 31 January 2011 1:24 PM
To: [redacted]
Cc: [redacted]
Subject: Water Quality Results

Hi [redacted]

Please find attached the PDF versions of the above document. Hope they are helpful.

Regards,

[redacted]
Environment Officer

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M
www.arrowenergy.com.au

Graham Cordingley

From: [redacted]
Sent: Monday, 31 January 2011 5:01 PM
To: [redacted]
Cc:
Subject: RE: Arrow MGP TEP

[redacted]

Is there a PDF version of this? The tables do not display properly in the word version.

Thanks

From: [redacted]
Sent: Monday, 31 January 2011 2:01 PM
To: [redacted]
Subject: FW: Arrow MGP TEP

Hi [redacted]

Please refer to the email below.

Regards,

[redacted]
Environment Officer

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T [redacted]
F
M
www.arrowenergy.com.au

From: [redacted]
Sent: Monday, 31 January 2011 1:52 PM
To: [redacted]
Subject: FW: Arrow MGP TEP

[redacted]
Environment Manager

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T:
F: [redacted]

M: [redacted]
www.arrowenergy.com.au

From: Ben McMahon
Sent: Friday, 28 January 2011 10:49 AM
To: [redacted] Tim Dean; [redacted]
Cc:
Subject: Arrow MGP TEP

Hi [redacted]

Attached is the amended version of the Moranbah TEP. Below I have responded to each of the comments we received from DERM.
I would be happy to meet with you next week to discuss any remaining points of concern. We are currently working though the monitoring results we have available to us and expect to issue a these to DERM for review today.

I appreciate your patience throughout what has been a difficult period.

Best regards

Ben

Reference		DERM comment	Arro
Flow and discharge rates:	1	Paragraph 1 page 4 sates 1090 m3/day- DERM requires consistency of units, and advises a change to 1090 ML/day	Correc
Flow and discharge rates:	2	Condition 22 of the TEP states 11.5 m3/s as the minimum prior cessation of discharge-DERM requires consistency of units, and advises a change to 1090 ML/day for consistency.	Correc
Water Quality:	3.	No water quality data provided for Sodium and Chloride. DERM has received advice from QLD Health that water quality data for Total Dissolved Ions (there is no data for Sodium and Chloride) is required from all dam's requiring discharge. A release limit for Total Dissolved Ions should be proposed based on the worst water quality proposed to be discharged	Electri measu ajor progra
Water Quality:	4.	Table 6, row 5, states "Below Drinking water guideline value" yet no reference to a guideline is given. DERM requires: Release Limit, Monitoring Frequency, Sample type and Monitoring Point for all elements of BTEX as per ADWG to be listed in Table 6.	Guidel guideli

Water Quality:	5.	DERM will only approve a discharge from dams that water quality has been provided for. DERM has not seen any water quality information for dams 6, 7, 8 and 9. All reference to these dams should be removed, unless water quality can be provided. For example text on page 2 clearly states that water will be pumped from dams 6, 7, 8 and 9 to dams 1 and 10. Without water quality data for these dams they cannot be included in any approved TEP.	These water in the acces eleva stora that e conta any w Wate via da
Water Quality:	6.	In email 6 Dec Arrow indicated that only water from dams 1, 2, 10 and 5 was to be discharged.	Only disch of a n and r 9). Tl DERM
Monitoring Points	7.	Page 7, table 5, bottom row, states "dams 1,2,5 or 10" If the discharge is occurring from all and only these dams, and through dam 5; DERM requires Arrow to present MP's for dams 1, 2 and 10 as TEP MP 1 is presented for dam 5.	
Monitoring Points	8.	RP1/MP1 is referred to in Table 4 and Table 5 and table 8. Easting and northing details are not consistent within the tables. Additionally table 8 appears to refer to RP1 as being the Goonyella gauging station. Suggest you remove reference to RP1 and ensure easting/northing is correct for gauging station.	The d
Monitoring Points	9.	MP2 in table 5 and 9 – Easting and northing details are not consistent. Please make consistent.	This h
Monitoring Points	10	Table 9, column 2, states "...downstream of RP 1 1"-DERM requires this error to be corrected to RP1 to be consistent with table 4.	Corre
Objectives	11	Objective 1 – no dams are stated. Please state the dams covered by the objective and only include dams for which monitoring data has been submitted (e.g. 1,2,3,4,5,10).	
Objectives	12	Objective 1 action – reference should be made to discharge Point RP1 (i.e. Manage via RP1 discharge to Isaac River)	Corre
Objectives	13	Objective 2- requires rephrasing 'Discharge Monitoring' should be reworded to Monitor Discharge	Corre
Objectives	14	Objective 2 action – needs to be reworded. Suggest to 'monitor discharge in accordance with table 5, for the contaminants listed in table 6 and table 7	Corre
Objectives	15	Objective 3-Rewording required. DERM recommends Arrow reword Objective to reflect implementation of conclusion and recommendation of section four of the URS inspection report.	Corre At this level by UR relatic conte: standi mayb

Conditions	16	Condition 5- to be worded consistently:i.e. Instead of using; downstream results, receiving waters in table 9 and downstream site, use: downstream (MP2) or, as specified in Table-X	Correc
Conditions	17	Condition 6-DERM requires a notification from Arrow within 24hours of identifying an exceedance in accordance with condition 5(b)(ii)	Correc
Conditions	18	Condition 8-Can not be accepted with current presentation of table 8 & 4. DERM can only accept this condition on the basis Table 8 & 4 is amended as for comment 8.	Comm
Conditions	19	Condition 24 contradicts the presented monitoring frequency in Table 7. DERM requires confirmation through a new submission of which monitoring frequency Arrow intends to undertake.	Correc
General	20	DERM requires Arrow to provide integrity/structural information (i.e. DSA, MRL, etc.) for dam 5.	Include
General	21	DERM advises Arrow to investigate installing more monitoring points downstream.	Arrow point i

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
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T:
F:
M:
www.arrowenergy.com.au

[redacted]

From: Ben McMahon
Sent: Tuesday, 1 February 2011 7:44 AM
To: [redacted]
Cc:
Subject: FW: Moranbah Pond Levels
Attachments: Revised MGP TEP MGP 27 Jan 2011.pdf

Hi [redacted]

I am currently operating from Dalby today.

Attached is the pdf version of the MGP TEP submitted last Friday. I will be in and out of mobile range today with Toowoomba DERM officers having a look at the recent flood impacts on our southern infrastructure.

I will be working from Brisbane tomorrow and would be happy to meet with DERM to discuss any remaining issues with the MGP TEP.

Cheers

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

From [redacted]
Sent: Monday, 31 January 2011 1:01 PM
To: [redacted]
Cc: [redacted] Ben McMahon; [redacted]
Subject: RE: Moranbah Pond Levels

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Regards

[redacted]

From: [redacted]
Sent: Monday, 31 January 2011 12:38 PM
To: [redacted]
Cc: [redacted] Ben McMahon; [redacted]
Subject: Fw: Moranbah Pond Levels

[redacted]
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Regards

[redacted]
Arrow Energy Ltd

From: [redacted]
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Pond 10 = 10mm below MRL

If you require any further information regarding pond levels and river sampling please contact me.

Regards,

[redacted]
Wellfield Coordinator

Arrow Energy Limited
Lot 9 Thorpe Street, Moranbah QLD 4744
PO Box 335, Moranbah QLD 4744, Australia
T: [redacted]
F: [redacted]
M: [redacted]
www.arrowenergy.com.au

DRAFT TRANSITIONAL ENVIRONMENTAL PROGRAM UNDER SECTION 333 OF THE *ENVIRONMENTAL PROTECTION ACT 1994*

Principal Holder:	CH4 Pty Ltd **AM-60** Level 19 42 Albert Street Brisbane QLD 4000
EA Number:	PEN100015907
Title:	**Coal Seam Water Management Moranbah Gas Project**
Date:	10 January 2011
Finish Date:	31 May 2011

Introduction

The Moranbah Gas Project lacks sufficient water storage capacity as previously indicated in correspondence to DERM (dated 25 October 2010) and subsequent responses to information requests and the program notice documentation submitted by Arrow (dated 3 December 2010). This has been caused by an early start to the wet season contributing to existing dam levels and causing construction delays. This has prevented Arrow from making additional storage available via the completion of dam 11. The synthetic lining for the dam cannot be installed during periods of rainfall; the civil engineering also requires careful control of the moisture content of the construction materials to achieve the required specifications.

Dam 11 has been designed and is being constructed in line with the most current dam standards stipulated by DERM and contained in the previously submitted and assessed dam design report. It is a large lined dam – intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, develop beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies.

The continued rain has delayed the completion of dam 11. This has put Arrow in a position where it cannot comply with the current EA conditions. Arrow intends to employ this transitional environmental program (TEP) as defined in Chapter 7, Part 4 of the *Environmental Protection Act 1994 to bring our operation back into compliance with its current Environmental Authority.* In initiating this process Arrow intends to work with DERM to minimise the potential for environmental harm.

Background

Arrow currently employs a network of 10 dams across PL191 and PL196. Dams 1 through to 7 are shown in the attached drawing (Appendix C). Dams 8 and 9 in the network are SW of the main area depicted in the provided drawing. Approximately 90% of the total storage capacity for coal seam water is held in Arrow's major storage dams 1, 2 and 10. The other dams are employed to move water between groups of remote wells and the major storage dams. Dam 3 is employed to store more concentrated brine. An important feature of the petroleum lease is the Isaac River which divides the lease along a NW to SE axis and its tributary Teviot Brook. Isaac River is an ephemeral river; during periods of high flow it limits access to infrastructure on the north eastern side of the petroleum lease via river crossings.

Situation

Our strategy is to maintain low levels in the older and less accessible dams (particularly dams 6,7, 8 and 9) by moving water to dams 1 and 10. Dam 10 is our most recently constructed dam and has an engineered spillway, dam 1 is in reasonable condition and adjacent to dam 10 which allows water to be transferred readily between dams.

Our risk assessment process and an independent third party geotechnical evaluation by URS has identified particular concerns with the integrity of dam 2 (refer to Appendix E). Arrow has concerns regarding the condition of dam 2 – it is scheduled to be brought out of service on the completion of Dam 11. Based on geotechnical evaluation we intend to lower the level of water in Dam 2 to 4m below DSA. The goal of this strategy is to maintain pond integrity and minimise discharge to the environment when a suitable plan to restore the operational integrity of dam 2 is developed or the dam is retired from operational duty.

Arrow believes that a controlled discharge during high flow conditions in the Isaac River via the existing infrastructure would result in the least environmental impact whilst preserving the integrity of the existing dams. This option prevents the overland flow of untreated coal seam water reaching the Isaac River and minimises the risk of damaging older dams which are built prior to the new standards and lacking engineered spillways. When the facility was originally developed the water management scheme was significantly different to now and included a wet weather discharge. At present our existing infrastructure is not sufficient to comply with the conditions of the current Environmental Authority particularly during extended wet periods.

Our system of dams has an area of 125,100 m^2, this equates to a gain of 0.125ML per mm of rainfall. The system is designed to transfer water to the major storage dams 1, 2 and 10 this contribute to the catchments of these structures, each 1 mm of rainfall will cause an increase in dam height of 1.6 mm in dams 1, 2 and 10. When all the input rainfall is directed to dam 10 each 1 mm of rainfall causes an increase in dam height of 2.7 mm in dam 10.

Table 1 Key Dam Variables Dams 1, 2, 5 and 10

Dam		1	2	5	10
Volume at Spill level	ML	119.66	92.64	7.64	203.70
Spillway		No	No	No	Yes
Liner type		CCL	CCL	0.5mm HDPE	1.5mm HDPE
Hydraulic height	m	5.60	5.50	3.5	4.75
MRL	m	5.25	5.15	3.15	4.40
DSA	m	4.75	4.65	2.65	3.90
Target dam fill height[b]	m	4.75	0.65	2.65	3.90
Current level (below MRL)[a]	mm	100	870	Varies[c]	40
Remaining rainfall *(to spill)*[d]	mm	281	762	>800	244

[a] Levels 27 December 2010, negative denotes level above MRL

[b] Target dam fill height is DSA for dams 1 and 10, 4m below DSA for dam 2. Current target height for dam 2 is based on 3rd party civil engineering assessment completed by URS.

[c] This dam is much smaller than the major storage dams its level can change rapidly during operations

[d] Rainfall based on approximate catchment ratio of 1.6 (based on total catchment area including transfer dams)

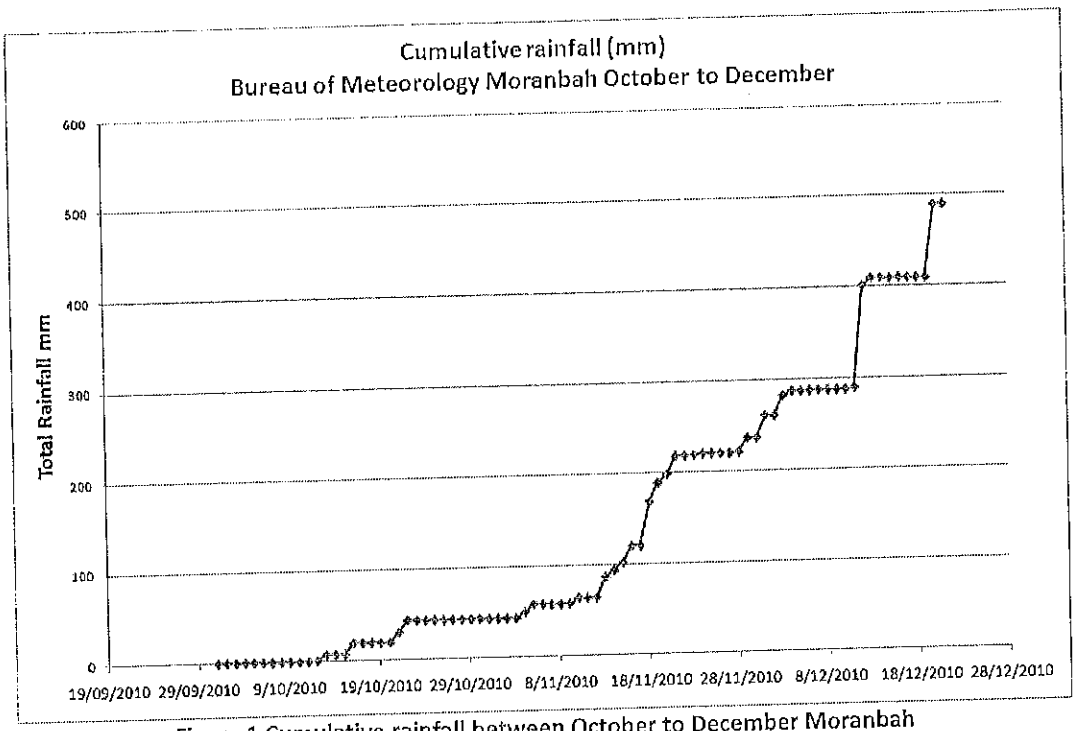


Figure 1 Cumulative rainfall between October to December Moranbah

Future water levels will be a product of the rainfall, coal seam water production and evaporation. Our goal is to maintain dams 1 and 10 at DSA levels by employing a discharge to the Isaac River. Dam 2 will be lowered to a level determined by independent third party engineering risk assessment.

Arrow has evaluated 2 scenarios for water requiring discharge from the storage system:

- Scenario 1 – Mean rainfall until end of wet season
- Scenario 2 – 95th percentile rainfall until end of wet season

Rainfall to date is very close to the 95th percentile rainfalls on average from October through to December. We have had a cumulative total of 490mm from the 1st of October to date (Figure 1), 95th percentile cumulative rainfall for the period from the start of October to the end of December totals 522mm. At present with one week remaining in December the cumulative total is 30mm short of the 95th percentile. Given the current progress of the wet season Arrow believes that the next few months will produce above average rainfall. Long range forecasts from the Bureau of Meteorology give a 55% chance of rainfall at or above the 95% percentile values. In determining the water balance for the facility has evaluated 2 scenarios – mean and 95th Percentile rainfall (refer to Table 2).

Table 2 Discharge scenarios

Scenario	Volume to reach DSA (ML)	Additional removal from Dam 2 (ML) [b]	Expected Net [a] Water to Storage (ML)	Total (ML)
Mean Rainfall	69	75	54.5	198.5
95th Percentile	69	75	130	274

[a] *Net water to storage is produced water, less evaporation plus expected rainfall.*
[b] *This is based on a dam 2 target of 4000mm below DSA.*

Arrow proposes a discharge of up to 7.5ML/day to commence when the Isaac River is at least 1090 ML/day measured upstream at the Goonyella river gauge (operated by DERM). Discharge will be maintained at a 400:1 dilution ratio on the basis of maintaining Australian drinking water guidelines (NHMRC,2004) downstream of the discharge. Based on a predicted salinity impact as detailed in Appendix B. This discharge rate and the dilution factor will be reviewed thoughout the TEP in consultation with DERM and informed on the basis of the upstream/downstream river monitoring in line with the proposed conditions detailed within this document.

Sampling will be conducted in line with the conditions detailed in this TEP under the procedure attached as Appendix D. Appendix A contains detailed results of the sampling completed to date to characterise the coal seam water to be discharged.

Supporting Information

Consideration of the management hierarchy for the management of coal seam water at the MGP

Evaluation as per the management hierarchy of preferred procedures from Environmental Protection (Water) Policy 2009:

Step 1—evaluate water conservation measures to reduce the use of water and the production of waste water or contaminants;
Water is not employed in the coal seam gas production process but must be removed from the coal seam to allow the gas to be extracted. Water conservation measures will not reduce the amount of coal seam water associated with the gas extracted.

Step 2—evaluate waste prevention options and implement appropriate waste prevention measures;
The key waste prevention measure employed is maximisation of the coal seam gas to water ratio. The coal seams targeted by MGP have relatively low ratios of water to gas in comparison to other fields. In an effort to manage our recent water storage constraints Arrow has shut in a large number of wells, targeting the wells with high water to gas ratios to minimise the production of coal seam water associated with our operations.

Whilst this has reduced our coal seam water production, shutting in further wells will yield limited benefits in terms of water reduction but will cause significant reduction in gas output.

Use of dam 11 in its current uncompleted, unlined state has been investigated. The pipe work and major civil infrastructure is complete but the floor of the dam is incomplete – as discussed (in our meeting on the 1st of December) it lacks its intended second liner, more importantly the clay liner has not been sufficiently compacted to allow its use. Key elements of the pipework connecting dam 11 to the rest of the network remain incomplete. Employing dam 11 would require its use for an extended period to allow subsequent emptying and upgrade of the existing dam infrastructure.

Step 3—if waste prevention does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate treatment and recycling options and implement appropriate treatment and recycling;
The construction of Dam 11 is the first component of our coal seam water management strategy. It is a large lined dam, intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies. Rainfall is delaying the construction of dam 11 and contributing to the current water storage problems.

Installation of water treatment (such as a mobile RO plant) is limited by the logistics (such as civil engineering, chemical storage and power supply), cost and the challenges posed during current wet conditions. Another option considered was employing water entitlements to dilute the untreated coal seam water to the current environmental authority specification. This option was ruled out since a large quantity of good quality water would be required to dilute and dispose of a limited amount of coal seam water from our dams.

Step 4—if treatment and recycling does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate the following options
for waste water or contaminants, in the order in which they are listed—
(i) appropriate treatment and release to a waste facility or sewer;
(ii) appropriate treatment and release to land;
(iii) appropriate treatment and release to surface waters or ground waters.

I) We cannot practically truck water from the dams given the large quantities and the lack of disposal options. Wet weather is likely to complicate trucking of water by limiting access to some points within the MGP. Infrastructure does not exist to process this water via sewer or other industrial water treatment options. Our landholders have expressed concern of minimising truck movements during the wet season.

II) Until our water treatment management strategy is implemented we cannot treat the water to a standard that is suitable for use on land.

III) We consider the water in its current state is suitable for discharge into the Isaac – this was the water management strategy employed by the facility until earlier EA conditions were amended, we are seeking permission from DERM to allow this discharge as previously authorised until we can implement our water management strategy for the MGP. We consider a temporary discharge to the Isaac river during high flow conditions to be compliant with section 51 of the Environmental Protection Regulation 2008.

Objectives

To achieve compliance with the Environmental Authority with respect to coal seam water management and dam standards by April 2011.

This will be achieved in the short term by the release of water to the Isaac River. This measure will protect the integrity of our storage infrastructure and is consistent with the operational philosophy that our existing infrastructure was designed to accommodate.

In the medium term compliance with the new EA will be achieved by the completion of Dam 11. Completion of dam 11 will require Arrow energy to utilise the cleared area north of dam 11.

In the long term, compliance with our EA will be achieved by completion of water treatment facilities that allow beneficial use and disposal within Arrows Environmental Authority conditions. Arrow is to provide DERM with a detailed plan concerning future water management for approval.

Table 3 – Achieving TEP objectives

OBJECTIVE	ACTION	RESPONSIBILITY	TIME FRAME	PERFORMANCE INDICATOR
1. Lower dam levels for (dams 1, 2, 5, 10)	Manage via discharge (RP1) to Isaac river	Arrow site personnel	Immediate	Manage dams within appropriate levels as detailed in Tables 1 and 2. Discharge is to be subject to monitoring and reporting requirements
2. Monitor Discharge	Monitor discharge in accordance with Table 5, for the contaminants listed in Table 6 and Table 7	Arrow site personnel	During discharge	Lab results to be reported to DERM within 10 business days of collection.
3. Pond 2	Develop management plan to restore dam integrity or remove from service	Arrow	15 March 2010	Submission of management plan to DERM
4. Cease discharge	Cease discharge to Isaac river under TEP	Arrow	31 March 2011	Cease discharge to Isaac river
5. TEP report submission	Provide DERM with final TEP report detailing how the objectives of this TEP have been met	Arrow	31 May 2011	Submission of TEP report to DERM

Monitoring

Table 4 Contaminant release points, sources and receiving waters

Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point	Receiving waters
TEP RP 1	148° 2' 35"	-21° 57' 41"	untreated CSG water from PL191/196	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
				Upstream from discharge – Isaac River Crossing	
				Downstream from discharge – Blair Athol Bridge	

Table 5 Contaminant release monitoring points

Monitoring point (TEP MP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point location	Receiving waters
TEP MP 1	148° 2' 35"	-21° 57' 41"	Untreated CSG water from PL191	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
TEP MP 2	148° 2' 46"	-21° 57' 55"	Downstream from discharge – Blair Athol Bridge	Blair Athol Railway Bridge	na
TEP MP 3	148° 2' 20"	-21° 57' 41"	Upstream from discharge	Isaac River Crossing	
TEP MP 4	148° 1' 10"	-21° 58' 00"	Untreated CSG water dam 1	Dam 1	
TEP MP 5	148° 2' 8"	-21° 58' 01"	Untreated CSG water dam 2	Dam 2	
TEP MP 6	148° 2' 32"	-21° 57' 44"	Untreated CSG water dam 5	Dam 5	
TEP MP 7	148° 1' 14"	-21° 58' 4"	Untreated CSG water dam 10	Dam 10	

Table 6 Contaminant release limits

Quality characteristic	Release Limit	Monitoring Frequency	Sample Type	Monitoring Point
Electrical conductivity (uS/cm)	13000	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1
			Samples require laboratory analysis[2]	TEP MP 1
pH (pH Unit)	6.5 (minimum) 9.5 (maximum)	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1
				TEP MP 2
				TEP MP 3
			Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 2
				TEP MP 3
Turbidity (NTU)	500	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 2
				TEP MP 3
BTEX Benzene, Ethylbenzene, Toluene and Xylene (mg/L)	Benzene 0.001 Ethylbenzene 0.3 Toluene 0.8 Xylene 0.02	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1
				TEP MP 2
				TEP MP 3

[1] *In situ samples can be taken using electronic sampling equipment.*
[2] *Samples are required to be analysed at a NATA accredited facility in accordance with this Transitional Environmental Program.*

Table 7 Downstream contaminant trigger investigation levels

Quality characteristic	Trigger levels (µg/L)	Monitoring frequency	Monitoring Point
Aluminium	55	Commencement of release and thereafter weekly during release	TEP MP 2 TEP MP 3
Arsenic	13		
Cadmium	0.2		
Chromium	1.0		
Copper	2.0		
Iron	300		
Lead	10		
Mercury	0.2		
Nickel	11		
Zinc	8.0		
Boron	370		
Cobalt	90		
Manganese	1900		
Molybdenum	34		
Selenium	10		
Silver	1.0		
Uranium	1.0		
Vanadium	10		
Ammonia	900		
Nitrate	1100		
Petroleum hydrocarbons (C6-C9)	20		
Petroleum hydrocarbons (C10-C36)	100		
Fluoride (total)	2000		

Table 8 Contaminant release during flow events

Receiving waters	Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Minimum flow in receiving water required for a release event	Flow recording frequency
Isaac River	TEP RP1	-148° 2' 0"	21° 51' 20"	1090ML/day	Daily from Goonyella Gauging station

Table 9 Receiving water downstream monitoring points

Monitoring points (TEP MP)	Receiving waters location description	Easting (GDA94)	Northing (GDA94)
TEP MP 2	Blair Athol Bridge 500 metres downstream of RP1	148° 2' 46"	-21° 57' 55"

Conditions

In carrying out this Transitional Environmental Program, CH4 Ltd (Arrow Energy) will undertake all activities in accordance with the following conditions.

Undertaking the release of untreated coal seam methane water

1 Contaminants that will, or have the potential to cause environmental harm must not be released directly or indirectly released to any waters except as permitted under this Transitional Environmental Approval.

2 The release of contaminants to waters must only occur from the release points specified in Table 4 and depicted in Appendix C attached to this Transitional Environmental Program.

3 The release of contaminants to waters must not exceed the release limits stated in Table 6 at the monitoring points specified in Table 5 and Table 6 of this Transitional Environmental Program.

4 The release of contaminants to waters from the release points must be monitored at the locations specified in Table 5 and Table 9 for each quality characteristic and at the frequency specified in Table 7 and Table 8 of this Transitional Environmental Program.

5 If quality characteristics of the release exceed any of the trigger levels specified in Table 7 during a release event, the Transitional Environmental Program holder must compare MP2 to the trigger values specified in Table 7 and:

a) where the trigger values are not exceeded then no action is to be taken

b) where the downstream results exceed the trigger values specified Table 7 for any quality characteristic, compare the results of the downstream site to the data from the upstream monitoring sites (MP3)

i) if the result is less than that recorded at Monitoring Point 3 (MP3), then no action is to be taken or

ii) if the result is greater than the background monitoring site data, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology, into the potential for environmental harm and provide a written report 20 business days after receiving results, outlining

- details of the investigations carried out
- actions taken to prevent environmental harm.

6 If an exceedance in accordance with condition 5(b)(ii) is identified, the holder of the Transitional Environmental Program must notify the administering authority within 24 hours of receiving the result. The notification must include written verification of the exceedance forwarded to the administering authority.

Contaminant Release Events

7 The release of coal seam water will not occur until flow in the Isaac River flow reaches 1090 ML/day (at Goonyella Gauging Station).

8 Notwithstanding any other condition of this Transitional Environmental Program, the release of contaminants to waters must only take place during periods of natural flow events specified as minimum flow in Table 8 for the contaminant release point(s) specified in Table 4.

9 Contaminant release flow rate must not exceed 1:400 (0.25%) of receiving water flow rate.

10 The daily quantity of contaminants released from each release point must be measured and recorded at the monitoring points in Table 4

11 The daily quantity of contaminants is not to exceed 7.5ML/day in total.

12 Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build up of sediment in such waters.

Notification of Release Events

13 The Transitional Environmental Program holder must notify the administering authority within 24hours of having commenced releasing coal seam water to the receiving environment. Notification must include the submission of written verification to the administering authority of the following information:

a) release commencement date/time
b) expected release cessation date/time
c) release point/s
d) release volume (estimated)

e) receiving water/s including the natural flow rate
f) any details (including available data) regarding likely impacts on the receiving water(s).

14 The Transitional Environmental Program holder must provide the administering authority daily during the release of coal seam water, the following information:
a) all in situ monitoring data for that day
b) the receiving water flow rate
c) the release flow rate.

15 The Transitional Environmental Program holder must notify the administering authority as soon as practicable, (no later than within 24 hours after cessation of a release) of the cessation of a release notified under condition 12 and within 15 business days provide the following information in writing:
a) release cessation date/time
b) natural flow volume in receiving water
c) volume of water released
d) details regarding the compliance of the release with the conditions of this Transitional Environmental Program (i.e. contamination limits, natural flow, discharge volume)
e) all in-situ water quality monitoring results
f) any other matters pertinent to the water release event.

Notification of release event exceedence

16 If the release limits defined in Table 6 are exceeded, the holder of the Transitional Environmental Program must notify the administering authority within 2 business days of receiving the results.

17 The Transitional Environmental Program holder must, within 28 days of a release that exceeds the conditions of this Transitional Environmental Program, provide a report to the administering authority detailing:
a) the reason for the release
b) the location of the release
c) all water quality monitoring results
d) any general observations
e) all calculations

f) any other matters pertinent to the water release event.

Requirements to cease the release of coal seam water

18 The coal seam water discharge must cease immediately if any water quality limit as specified in Table 6 is exceeded.

19 The Department of Environment and Resource Management may require CH4 Pty to cease discharge if the department's water monitoring stations detect any water quality limit exceedance.

20 The release of coals seam water must cease immediately if identified that the release of coal seam waters is causing erosion of the bed and banks of the receiving waters, or is causing a material build up of sediment in such waters.

21 The release of coal seam water must cease immediately if holder of this Transitional Environmental Program is directed to do so by the administering authority.

22 The release of coal seam water will cease immediately if Isaac River flow decreases below 1090ML/day (at Goonyella Gauging Station).

Monitoring Requirements

23 Where monitoring is a requirement of this Transitional Environmental Program, ensure that a competent person(s) conducts all monitoring.

24 Monitoring will occur at the frequencies identified in Table 6 and Table 7.

25 All monitoring undertaken as a requirement of this Transitional Environmental Program must be undertaken in accordance with the administering authority's Water Sampling Manual.

Notification of emergencies, incidents and exceptions

26 As soon as practicable after becoming aware of any 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 Transitional Environmental Program, the administering authority must be notified of the release by telephone, facsimile or email.

27 The notification of emergencies or incidents must include but not be limited to the following:

a) the holder of the Transitional Environmental Program
b) the location of the emergency or incident
c) the number of the Transitional Environmental Program
d) the name and telephone number of the designated contact person
e) the time of the release
f) the time the holder of the Transitional Environmental Program became aware of the release
g) the suspected cause of the release
h) the environmental harm caused, threatened, or suspected to be caused by the release, and
i) actions taken to prevent any further release and mitigate any environmental harm caused by the release.

29 Not more than 10 business days following the initial notification of an emergency or incident, written advice must be provided of the information supplied to the administering authority in relation to:

a) proposed actions to prevent a recurrence of the emergency or incident, and

b) outcomes of actions taken at the time to prevent or minimise environmental harm.

Appendix A
ALS & Qld Health water sampling results

Client Reference	Collected Date	Received Date	Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmiun	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	3.8	< 0.0001	0.0011	0.076	< 0.0001	0.05	< 0.0001	0.0027	0.0011	0.003	1.7	0.0013	0.056	< 0.0001	0.0007
Discharge_Point	14-Dec-10	17-Dec-10	0.18	< 0.0001	0.0012	4.5	< 0.0001	1.1	< 0.0001	0.0003	0.0002	0.002	0.08	0.0004	0.0046	< 0.0001	0.0019
Pond_2a	16-Dec-10	17-Dec-10	0.1	< 0.0001	0.0015	6.1	< 0.0001	1	< 0.0001	0.0002	0.0003	0.001	0.066	< 0.0001	0.007	< 0.0001	0.0013
Pond_2	16-Dec-10	17-Dec-10	0.09	< 0.0001	0.0014	6	< 0.0001	1	< 0.0001	0.0002	0.0003	< 0.001	0.044	< 0.0001	0.0065	< 0.0001	0.0012
POND1_1	17-Dec-10	20-Dec-10	0.37	< 0.0001	0.0021	5.8	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.18	< 0.0001	0.0057	< 0.0001	0.0028
POND1_2	17-Dec-10	20-Dec-10	0.43	< 0.0001	0.0023	6	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.2	0.0002	0.0065	< 0.0001	0.0031
POND10_1	17-Dec-10	20-Dec-10	0.2	< 0.0001	0.0018	7.7	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.069	< 0.0001	0.0039	< 0.0001	0.0031
POND10_2	17-Dec-10	20-Dec-10	0.18	< 0.0001	0.0019	7.6	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.067	< 0.0001	0.0041	< 0.0001	0.0034

Client Reference	Collected Date	Received Date	Nickel	Selenium	Silver	Stroniu m	Thallium	Titani um	Uranium	Vanadium	Zinc	Benzen e	Toluene	Ethylbenzon e	Meta&Para-Xylenes	Ortho-Xylene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	0.0031	< 0.0010	< 0.001	0.2	< 0.0001	0.14	0.0002	0.012	0.003	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Discharge_Point	14-Dec-10	17-Dec-10	0.0008	< 0.0010	< 0.001	7.3	< 0.0001	0.006	0.0003	0.0029	0.013	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2a	16-Dec-10	17-Dec-10	0.0012	< 0.0010	< 0.001	9.6	< 0.0001	0.003	0.0003	0.0051	0.006	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2	16-Dec-10	17-Dec-10	0.0011	< 0.0010	< 0.001	9.4	< 0.0001	0.002	0.0003	0.005	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_1	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	10	< 0.0001	0.017	0.0009	0.0059	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_2	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	11	< 0.0001	0.015	0.0009	0.0062	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_1	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.026	0.0008	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_2	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.01	0.0007	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

ALS	21/12/2010	Sample ID 1	DAM 1	DAM 10	DAM 4	DAM 8	D1	D2	DAM 5	DAM2	TRIP BLANK
		ID 2									
ES1025292	Results	Date Sampled	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010
Analyte	CAS #	Units	LOR	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
EA005: pH											
pH Value		pH Unit	0.01	9.17	9.28	9.34	9.38	9.4	9.42	9.27	9.15	-
EA010P: Conductivity by PC Titrator											
Electrical Conductivity @ 25°C		µS/cm	1	12600	14000	16400	25900	25800	26100	10700	10600	-
EG020T: Total Metals by ICP-MS											
Arsenic	7440-38-2	mg/L	0.001	0.003	0.003	0.002	<0.001	0.004	0.004	<0.001	0.002	-
Barium	7440-39-3	mg/L	0.001	6.54	8.33	4.35	1.93	1.92	1.98	6.4	9.31	-
Beryllium	7440-41-7	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cadmium	7440-43-9	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Cobalt	7440-48-4	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	-
Chromium	7440-47-3	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	-
Copper	7440-50-8	mg/L	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004	-
Manganese	7439-96-5	mg/L	0.001	0.008	0.003	0.002	0.001	0.001	0.003	0.002	0.038	-
Nickel	7440-02-0	mg/L	0.001	0.001	<0.001	0.001	0.002	0.002	0.002	<0.001	0.003	-
Lead	7439-92-1	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Vanadium	7440-62-2	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Zinc	7440-66-6	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	-
EG035T: Total Recoverable Mercury by FIMS											
Mercury	7439-97-6	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
EK055G: Ammonia as N by Discrete Analyser											
Ammonia as N	7664-41-7	mg/L	0.01	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
EK057G: Nitrite as N by Discrete Analyser											
Nitrite as N		mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EK058G: Nitrate as N by Discrete Analyser											
Nitrate as N	14797-55-8	mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser											
Nitrite + Nitrate as N		mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser											
Total Kjeldahl Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser											
Total Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK067G: Total Phosphorus as P by Discrete Analyser											
Total Phosphorus as P		mg/L	0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EP080: BTEX											
Benzene	71-43-2	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	108-88-3	µg/L	2	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	100-41-4	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
EP080S: TPH(V)/BTEX Surrogates											
1.2-Dichloroethane-D4	17060-07-0	%	surrogate	113	111	103	112	105	110	110	106	106
Toluene-D8	2037-26-5	%	surrogate	110	106	103	109	105	106	107	103	102
4-Bromofluorobenzene	460-00-4	%	surrogate	106	99.7	97.9	104	97.1	98.6	101	97	101

Appendix B
Dilution calculation basis

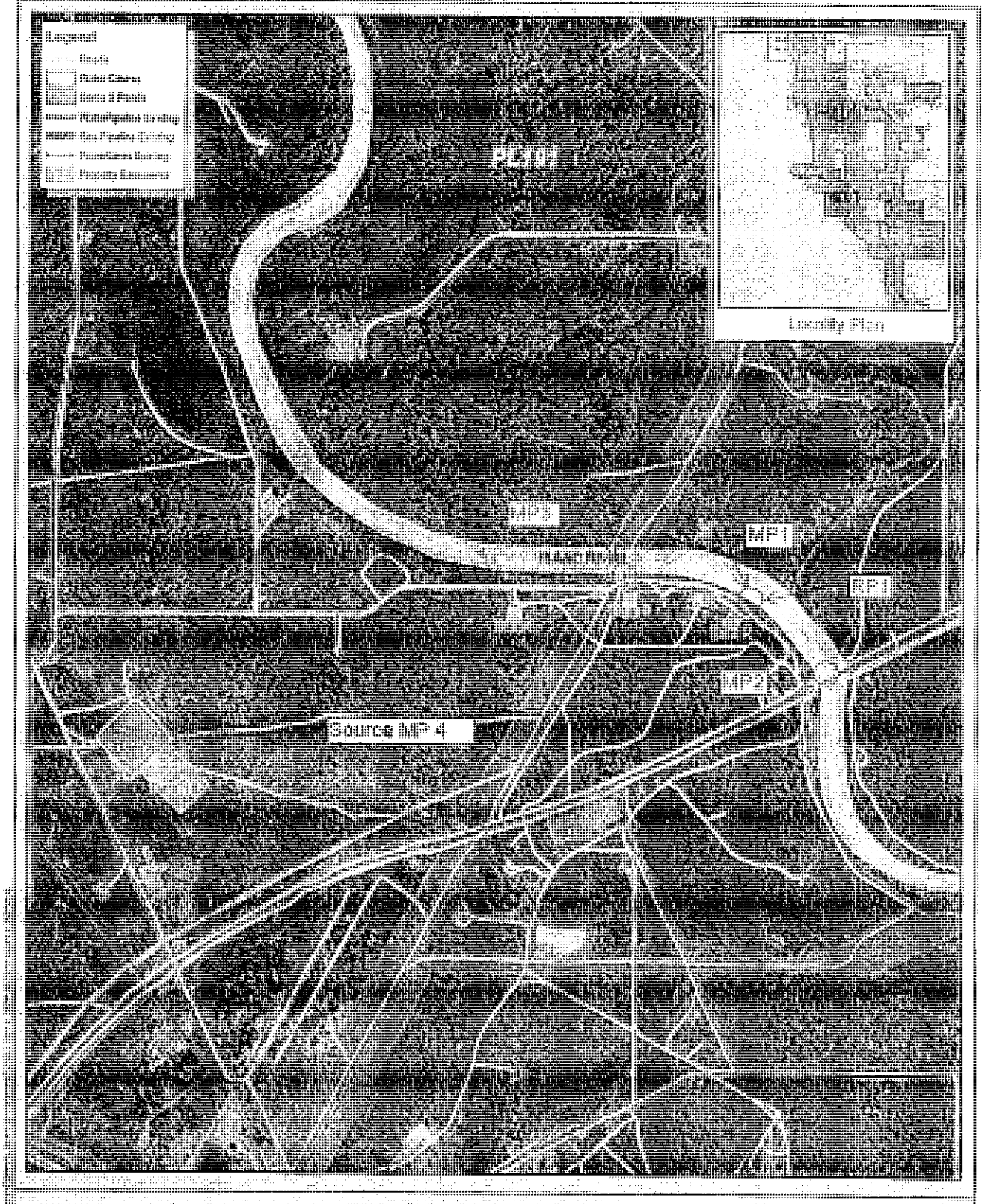
Table 10 Dilution calculation at 400:1 release

Parameter	Unit	Surface Water Concentration	Concentration of Discharge	Dilution X:1	Surface Concentration after dilution	Guideline[1]
EC	µs/cm	250	10600	400	276.5	746
Sodium	mg/L	65	2970	400	72.4	180
Chloride	mg/L	80	4280	400	90.7	250

[1] *Australian drinking water guidelines (NHMRC,2004)*
Sodium and Chloride based on EC, common soil quality (run off) and historical dato from upstream

Appendix C
Mapping showing PL191 and location of key Dams

ARROW ENERGY - BOWEN BASIN GAS PROJECT



Moranbah Gas Project - Dam 5

NOT FOR CONSTRUCTION

Appendix D
Sampling Procedure

SUMMARY

1.1	This procedure outlines general sampling protocols and work practices to be followed during the sampling of surface water, during the discharge of untreated CSG well water to the Isaac River. This procedure includes details on: ▪ Sampling equipment requirements; ▪ Surface water sampling techniques; ▪ Quality control requirements. ▪ Sample locations (Figure 1) ▪ Analytical requirements

EQUIPMENT

2.1	▪ Documentation o Sampling and analysis plan. o Health and safety plan o Personal protective equipment (PPE) as identified in the HSP, inc. Life Jacket and other specialised PPE, as per the HSP. ▪ Water sampling equipment o sample collection device, (Swing Arm Sampler/extension sampler) o decontamination solution (e.g. Decon 90™) or use new sample collection container in the swing arm sampler at each location. o Calibrated water quality meter (ensure parameter ranges are suitable for the water being tested), o laboratory supplied sample containers, o Chilled ice chest. o Field sample Record Sheet o Chain of Custody Form (Attached).

3.0 REFERENCES & PROFORMA

3.1	▪ AS NZS 5667.1-1998 *Water quality - Sampling - Guidance on the design of sampling programs sampling techniques* ▪ AS NZS 5667.4-1998 *Water quality - Sampling - Guidance on sampling from lakes natural and man-made* ▪ AS NZS 5667.6-1998 *Water quality - Sampling - Guidance on sampling of rivers and streams* ▪ Monitoring and Sampling Manual 2009 Environmental Protection (Water) Policy 2009, *Monitoring and Sampling Manual 2009*, Version 2 September 2010

4.0 PROCEDURE

4.1	**Safety**

	Unless specifically required, the following general safety requirements should be noted: 1. Appropriate personal protective equipment should be worn as specified in the Health and Safety Plan (HSP). When working in or around water bodies, a life jacket is required to be worn and a minimum of two persons to be present should be assessed. 2. Assess hidden hazards (eg. trip hazards, snakes, leeches, etc.). 3. Assess risks from slippery or unstable banks. 4. Assess whether the water body / drain may constitute a confined space. 5. Assess the likelihood that surface conditions within and around the water body may change rapidly in the event of heavy rainfall or tidal change.

4.2	Sampling
	1. The sampling frequency during and following discharge to the Isaac River shall be as follows: • daily during discharge; and • daily for two days following discharge stopping. 2. The sampling sequence should commence where the lowest likely contaminant concentrations are expected (e.g. downstream and work upstream), to reduce the risk of cross contamination between samples. On this basis, the samples shall be collected at the following locations (in order): (See Figure 1 for sampling locations) I. River crossing (upstream), (One primary sample (S1), plus one duplicate sample (QC1)) II. Blair Athol Bridge (downstream), One primary sample (S2), plus one duplicate sample (QC2)) III. At the Discharge Point, One primary sample (S3), plus one duplicate sample (QC3)) IV. At the Source (Dam) One primary sample (S4), plus one duplicate sample (QC4)) V. QC samples – Field/Trip Blank (QC5) and rinsate blank (QC6) (if required) 3. At each location, a water sample should be collected for standard field parameters using a calibrated water quality meter. The following parameters should be recorded: a. pH, b. conductivity, c. dissolved oxygen, d. redox potential, e. temperature and f. turbidity. Notes: • Follow the manufacturer's instructions for use and calibration of instruments to measure water parameters. A calibration record must be kept. • When recording dissolved oxygen readings, it is important to note whether the results are reported as % saturation or ppm. • With conductivity, record whether units are mS or µS.

4. Based on the nature of the sampling locations, heterogeneous distribution of potential contaminants in the water samples is considered likely. Therefore, the following Quality Control Samples should be collected and analysed for this program:
    a. One duplicate sample per sample location for TPH, BTEX and 8 Metals analysis **(QC1 – QC4)**.
    b. One Blank Sample per esky (laboratory prepared DI Water for TPH (C6 – C9) and BTEX analysis) **(QC5)**.
5. One rinsate sample per day (unless using new sample collection medium between sample locations i.e. a new container in the swing arm sampler) for TPH (C6 – C9) and BTEX analysis) **(QC6)**.
6. At each location sample bottles should be filled based on a decreasing order of potential volatility (i.e. VOCs, BTEX and TPH first, followed by metals and other inorganic samples).
7. Note: **DO NOT** field filter samples for total metals. Perform field filtering for dissolved metals samples only.
8. When sampling shallow waters, contamination from bottom sediments should be avoided. Samples should be collected by submerging a clean sample collection container (up-side down) into the water and to approximately 100mm below the surface, rotate the container to allow it to fill.
9. The sampling location should be as representative as possible of the event being monitored. i.e. do not sample stagnant water at the edge, attempt to sample .
10. Record the appearance of the water body, i.e. colour, turbidity, odour, surface crusts, films or floating material, algae, water velocity, etc. In addition, record the weather conditions at the time of sampling and note any other relevant observations, e.g. dead or distressed flora/fauna, surface rubbish, spills, etc.
11. All measurements and field notes should be documented on the field sheet (**Attachment A**)

5.0 ANALYTICAL/SAMPLE CONTAINER REQUIREMENTS

5.1	1. The analytical suite includes the following: a. pH, EC, TDS, Turbidity b. Ions: Magnesium, Calcium, Sodium, Sulphate, Chloride, Ammonia, Nitrate, Fluoride (total). c. Metals, Aluminium, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Zinc, Boron, Cobalt, Manganese, Molybdenum, Selenium, Silver, Uranium, Vanadium. d. Organics: BTEX, PAH, TPH 2. Each Sample Requires the following containers: a. 60ml Plastic Bottle for metals (with red and green striped label border) (tick 'Total Metals') b. 500ml Plastic Bottle for anions/cations (with green label border) c. 250ml Amber Glass Bottle (with purple label border) d. One pair of BTEX vials (40 mL glass cylindrical containers with purple label border).
	Notes: • The selection of sample containers depends on the laboratories being used. The above list is based on ALS requirements only. When ultra trace analysis is being requested, additional sample volume may be required. Always check with the laboratory prior to submitting samples to the laboratory. • When filling the vials it is important that they are filled to the top with no air space remaining. • Use new sample gloves between sample locations.
5.2	1. Place samples immediately in a chilled ice chest 2. Complete sample request form and include in sealed bag in the cooler 3. Courier samples to the receiving laboratory.

12	Surface Water Sampling							Form
Site					Sampling Method:			
Job Number					Local Air Temperature:			
Date:	Time:				Wind Force:			
Weather:		Cloudiness %			Direction of Wind:			
Location	Sample No.	Water Flow (l/s)	Field Readings				Depth (m)	Comments: including turbidity (plankton and/or sediment), colour, water plants, weather conditions, etc
			pH	Conductivity	Temperature	Dissolved Oxygen		
Comments concerning treatment of samples, especially preservation:								
Name:		Signed:			Project Manager:			adapted from AS 5667.4

Analytes

Quality characteristic	
pH	
EC	Ammonia
Turbidity	Nitrate
Magnesium	Fluoride (total)
Calcium	BTEX
Sodium	PAH
Sulphate	TPH
Chloride	
Aluminium	
Arsenic	
Cadmium	
Chromium	
Copper	
Iron	
Lead	
Mercury	
Nickel	
Zinc	
Boron	
Cobalt	
Manganese	
Molybdenum	
Selenium	
Silver	
Uranium	
Vanadium	

Appendix E
URS Dam 2 Assessment

Graham Cordingley

From: [redacted]
Sent: Tuesday, 1 February 2011 1:06 PM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Water quality results

[redacted]

As this afternoon's general meeting is cancelled, [redacted] and I will spend that time focussed on putting assessment the draft TEP and compiling any comments from QLD Health or other internal areas.

Monitoring Results
In regards to the draft TEP and the monitoring results please have the results from ALS marked so they can be related to the monitoring points in the draft TEP. The description of monitoring points on the results and the TEP are different which makes it difficult to work out which results relate directly to the points specified in the TEP.

For example is Isaacs 1 referred to in monitoring results the same as TEPMP3 or TEPMP2 or TEPMP1?? I assume from the EC results for Isaacs 1 that it is downstream of Isaacs 2, however this site is not described in the TEP nor shown on the any plan.

At this stage it appears that some monitoring was not conducted in accordance with the draft TEP and in one case it appears that mixing zone levels were exceeded, however given the different naming used for the samples and TEP points it is not possible to tell. At this stage it appears that monitoring has not been conducted in accordance with the draft TEP.

Current Dam levels and volumes
The information below is helpful, however it should be reflected in the draft TEP version submitted for assessment and not just in email – please update accordingly, including dam volumes and proposed volumes for discharge, factoring in how this has been impacted by the releases of the 34ML between 20/12/10 to 5/1/11.

TEP Date
Also the draft TEP I received on 28 Jan is dated 10 Jan on front cover. Please rectify to a date that corresponds with its resubmission.

The draft as submitted has been sent out for comment from QLD Health with a request it be actioned asap.

I will contact QLD Health today and see if they have had an opportunity to provide advice on your information.

Technical Non Compliances

I note your reference to Arrow's commitment to conduct this current unauthorised release in accordance with the draft TEP submitted, which is similar to previous commitments made by Arrow since the release commenced on 20 December 2010.

Whilst I appreciate this statement of intention, it has not translated into reality, as Arrow has not previously met this same commitment to conduct the unauthorised release in accordance with the draft TEP received on 31 Dec 2010 or earlier versions. Had the TEP been approved Arrow would already be in breach of multiple conditions.

I am aware that the flooding in Brisbane impacted Arrows ability to continue operating its business from Tuesday 11 January; however in many cases the failure to comply with commitments to conduct the unauthorised release in accordance with the TEP would not have been impacted by this, as many of these issues relate to dates prior to this flood event.

For example the draft TEP states –

- Objective 2 monitor discharges – submit lab results within 10 bd of collection.

  With the exception of lab results received 28 January, I have not received lab results in accordance with this objective.

- Condition 13 – You rang me yesterday and verbally advised me that the discharge had commenced again at 10.50am. Whilst you have emailed some information, you have not yet provided all of the information required by this condition in regards to the commencement of the release (release volumes, likely cessation date, receiving waters flow rate etc)..

- Condition 14 – At no stage have I ever been provided daily in situ data, volumes etc as required by this condition. I made contact with Arrow on 13 Jan and sought this information. Whilst Arrow had been impacted by floods in Brisbane when I called on 13 Jan, I was advised the release had ceased on 5 January (pre Brisbane floods).

- Condition 15 – The original release ceased on 5 January, however I was not advised until I asked on 13 January. Whilst Arrow have provided release information partially satisfying this condition, the information provided does not identify the 'details regarding compliance with the TEP' required by 15(d) – i.e. it does not identify the conditions above I have highlighted.

Whilst these issues are technical in nature, they still would have been clear non compliances should the TEP have been approved and show that Arrow has not met their stated commitment to comply with the draft TEP.

If the current draft TEP is approved I would expect that all of the objectives and conditions within it would be met. If th were not met, I would expect Arrow to provide advice as to why they had not been met for consideration before any enforcement action was taken.

Regards

[redacted]

From: [redacted]
Sent: Monday, 31 January 2011 12:18 PM
To: [redacted]
Cc: Ben McMahon; Tim Dean; [redacted]
Subject: FW: Water quality results
Importance: High

Hi [redacted]

As discussed on the phone, and further to Ben's email on Friday, I would like to update you on the status of dams in Moranbah.

1. 40mm rain fell overnight over the dams
2. Dam 10 is currently 60mm below MRL
3. Dam 2 is currently 910mm below MRL – the target level is to be <910mm to ensure integrity
4. Dam 1 is 130mm below MRL
5. Dam 5 is 1770mm below MRL
6. Isaac River is running in excess of the agreed trigger of 1090ML/hr
7. Daily sampling has recommenced at both upstream and downstream monitoring points.
8. Weekly sampling is continuing of the dam.
9. Due to the forecast of cyclone Yasi and potential rain to be dumped on the Moranbah site:

a. Arrow is in the process of implementing crisis management plans for field staff working in the Moranbah area
b. Access to the field is now limited - currently the Isaac Crossings are closed and due to the recent rain, field conditions are unstable.

10. Based on the above triggers, at 10:50am Arrow recommenced discharge into Isaac River based on the above triggers.
11. The discharge is being conducted in accordance with the same management measures as the previous discharge

As discussed, I would appreciate your confirmation of the status of the TEP application in relation to the MGP this afternoon. We view the situation in Moranbah as critical with the threat of cyclone Yasi adding significantly to rainfall in the region.

Ben is currently in the field, so in his absence could you please correspond with me until his return on Wednesday.

Regards

[redacted]
Environment Manager

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F: [redacted]
M: [redacted]
www.arrowenergy.com.au

From: Ben McMahon
Sent: Friday, 28 January 2011 4:39 PM
To: [redacted]
Cc: [redacted] Tim Dean
Subject: Water quality results

[redacted]

Please find attached a brief report and all of our water quality results to date. It would be good to catch up at some point next week and discuss these results in detail.

It is clear from our analysis that the background water quality is well in exceedence of the trigger values for many compounds detailed in the current draft TEP.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
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www.arrowenergy.com.au

+----------+

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

+----------+

Ben McMahon

From: Ben McMahon
Sent: Wednesday, 2 February 2011 6:27 PM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted] (Enviro)
Subject: MGP TEP
Attachments: MGP discharge notification 2 Febuary 2011.pdf

Categories: Red Category

Hi [redacted]

Please find a letter detailing the current situation up at the MGP. The site has recently been evacuated in anticipation of the coming wild weather.

Below is an update of our recent insitu monitoring data.

Best regards

Ben

	Riverflow ML/day			Volume discharged L/day				Electrical cond	
Date	8am	8pm	Total	Pond 5 direct	Pond 5	Total	Approximate Dilution	MP3	MP1
21/12/2010	4134	6778	5456	1036800	3888000	4924800	1108	674	95
22/12/2010	2594	3442	3018	1663200	1036800	2700000	1118	746	104
23/12/2010	1559	2132	1845.5	2170800	684000	2854800	646	392	88
24/12/2010			5156.5	772200	257400	1029600	5008	185.7	103
25/12/2010	7035	9900	8467.5	2851200	950400	3801600	2227	247.1	102
26/12/2010	19583	10385	14984	907200	864000	1771200	8460	198.9	102
27/12/2010	5572	8988	7280	891000	907200	1798200	4048	344	105
28/12/2010	40190	9388	24789	0	864000	864000	28691	160.4	87
29/12/2010	7164	14679	10921.5	259200	950400	1209600	9029	191.1	103
30/12/2010	6271	5026	6680	2142000	820800	2962800	2255	187.3	99
31/12/2010	4372	7243	4272	2554200	864000	3418200	1250	252.1	87
1/01/2011	2772	3360	2650		820800	820800	3229	258.7	96
2/01/2011	1753	2311	2119	819000	649800	1468800	1443	195.4	106
3/01/2011	5586	4260	3551	1562400	348480	1910880	1858	464	99
4/01/2011	2494	1948	2526	831600	777600	1609200	1570	321	87
5/01/2011	2000	2200	4953	267300	550800	818100	6054	734	87
31/01/2011	36660	19855	18099	1638000	302400	1940400	9327.458256	734	87
1/02/2011	6300	15751	5867	5616000	907200	6523200	899.4051999	470	113
2/02/2011	2668		2668	1638000	264600	1902600	1402.291601	405	na

Provisional number since daily total is not available

Ben McMahon
Manager Compliance & Reporting

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02 February 2010

Ref: ENV11-05

[redacted]

Department of Environment & Resource Management
(sent via email 02 February 2010)

RE: Discharge notification

Dear [redacted]

Further to [redacted] correspondence with yourself and your team yesterday I am writing on the behalf of Arrow Energy Limited to provide clarification regarding discharge under the draft TEP. As detailed in the correspondence provided by [redacted] yesterday discharge commenced from RP1 at 10:50am, 31 January 2011 discharge was ceased at 6pm 1 February 2011. The site has been evacuated in anticipation of the current extreme weather.

We intend to recommence discharge unless advised otherwise once it is safe to return and operate the site. This letter is our formal notification of intent to discharge under a draft TEP relating to Moranbah PL191/196 (under EA PEN100015907 grated 14th September 2010).

Current Dam levels

Dam 10 is currently 60mm below MRL
Dam 2 is currently 910mm below MRL – the target level is to be <4000mm to ensure integrity
Dam 1 is 130mm below MRL
Dam 5 is 1770mm below MRL
We are expecting significant rainfall associated with cyclone Yasi.

Discharge details

Arrow intends to commence discharge into Isaac River from RP 1 from the 4 February at a discharge rate of upto 7.5ML/day (depending on available dilution) for the duration that sufficient flow is available in the Isaac river (i.e. greater than 1090ML/day as per the draft TEP conditions). As of the 1 February 2011 available river monitoring data from the Isaac River monitoring station at Goonyella recorded daily values of 5867 ML/day.

At present this flow is falling but we expect forecast rainfall associated with Yasi to contribute to daily flow and allow for discharge from the site for at least 7 days (Which implies a total discharge of upto 52.5 ML). Daily sampling has recommenced at both upstream and downstream monitoring points.

Cyclone preparation

Due to cyclone Yasi and potential rain to be dumped on the Moranbah site:

- Arrow is in the process of implementing crisis management plans for field staff working in the Moranbah area this plan includes evacuation of staff particularly since our offices and accommodation comprise temporary 'donga' style accommodation.
- Access to the field is now limited - currently the Isaac Crossings are closed and due to the recent rain, field conditions are unstable.
- The Moranbah airport is currently closed this will restrict our ability to move samples from Moranbah during the cyclone. We will maintain samples that can be analysed following a delay some samples with limited retention times may be impacted.

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- The weather may prevent some samples from being collected due to access and safety requirements. We will monitor conditions and report any ongoing monitoring issues to DERM.

Regards,

[redacted]

Ben McMahon
Manager Compliance & Reporting

Ben McMahon

From: Ben McMahon
Sent: Thursday, 3 February 2011 8:59 AM
To: [redacted]
Subject: FW: Data Tables
Attachments: Available Water quality results 02FEB11.xls

Categories: Red Category

Hi [redacted]

Please find the latest water quality results

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
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M:
www.arrowenergy.com.au

From: Graham Cordingley
Sent: Wednesday, 2 February 2011 3:09 PM
To: Ben McMahon
Subject: Data Tables

Ben,

Please find attached the most recent tables (with corrections to the last tables to meet DERM's comments.

Regards,

Graham Cordingley
Senior Environmental Operations Coordinator

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		Analyte	Aluminium	Arsenic
Sample ID	Location Description	Units	mg/L	mg/L
		Date Sampled/LOR	0.01	0.01-0.001
Draft TEP Trigger Investigation Level			0.055	0.013
DISCHARGE POINT	Discharge Point (MP1)	21/12/2010	15.6	<0.01
ISAAC 1	Up Stream (MP3)	21/12/2010	13.3	<0.01
ISAAC 2	Downstream (MP2)	21/12/2010	18.1	0.02
DISCHARGE POINT		21/12/2010	-	-
ISAAC 1		21/12/2010	-	-
ISSAC 2	Downstream (MP2) QC	21/12/2010	12.8	<0.01
DISCHARGE POINT	Discharge Point (MP1)	23/12/2010	-	0.001
Downstream	Downstream (MP2)	23/12/2010	-	0.002
ISAAC 2	Downstream (MP2) QC	23/12/2010	-	0.001
ISAAC 1-S1	Up Stream (MP3)	24/12/2010	15.2	<0.001
ISAAC 1-QC1	Up Stream (MP3) QC	24/12/2010	9.18	0.001
ISAAC 2- S2	Downstream (MP2)	24/12/2010	16.4	0.002
ISAAC 2- QC2	Downstream (MP2) QC	24/12/2010	11.1	0.002
DISCHARGE-S3	Discharge Point (MP1)	24/12/2010	10.9	0.001
DISCHARGE-QC3	Discharge Point (MP1) QC	24/12/2010	11	0.002
QC 5		24/12/2010		
S5		25/12/2010		
ISAAC1-S1	Up Stream (MP3)	29/12/2010	-	<0.001
ISAAC1-QC1	Up Stream (MP3)QC	29/12/2010	-	<0.001
ISAAC2-S2	Downstream (MP2)	29/12/2010	-	<0.001
ISAAC2-QC2	Downstream (MP2) QC	29/12/2010	-	<0.001
DISCHARGE-S3	Discharge Point (MP1)	29/12/2010	-	0.003
DISCHARGE-QC3	Discharge Point (MP1) QC	29/12/2010	-	0.002
TRIP-QC5		29/12/2010		
TRIP-S5		29/12/2010		
DISCHARGE POINT	Discharge Point (MP1)	31/12/2010	-	<0.001
ISAAC 1	Up Stream (MP3)	31/12/2010	-	<0.001
ISAAC 2		31/12/2010	-	0.001
TRIP 1 2		31/12/2010		
Issac 1 - s1	Up Stream (MP3)	02/01/2011	7.94	0.002
Issac 2 - s2	Downstream (MP2)	02/01/2011	6.96	0.001
Discharge point - s3	Discharge Point (MP1)	02/01/2011	0.14	0.002
Issac 1 - qc1	Up Stream (MP3) QC	02/01/2011	7.25	0.001
Issac 2 - qc2	Downstream (MP2)QC	02/01/2011	6.94	0.001
Discharge point = qc3	Discharge Point (MP1) QC	02/01/2011	0.17	0.002
Trip - QC5		02/01/2011	-	-

Issac 1 - s1	Up Stream (MP3)	03/01/2011	7:07	0.001
Issac 2 - s2	Downstream (MP2)	03/01/2011	8:48	0.001
Discharge point - s3	Discharge Point (MP1)	03/01/2011	0:14	0.002
Issac 1 - qc1	Up Stream (MP3) QC	03/01/2011	8:47	0.001
Issac 2 - qc2	Downstream (MP2)QC	03/01/2011	9:04	0.001
Discharge point - qc3	Discharge Point (MP1) QC	03/01/2011	0:13	0.002
Trip - QC5		03/01/2011	-	-
Isaac 1 - s1	Up Stream (MP3)	04/01/2011	8:18	0.002
Isaac 2 - s2	Downstream (MP2)	04/01/2011	7:1	0.002
Discharge point - s3	Discharge Point (MP1)	04/01/2011	0:08	0.002
Isaac 1 - qc1	Up Stream (MP3) QC	04/01/2011	8:57	0.002
Isaac 2 - qc2	Downstream (MP2)QC	04/01/2011	8:13	0.002
Discharge point - s3	Discharge Point (MP1) QC	04/01/2011	0:09	0.002
Trip - s5		04/01/2011	-	-
Isaac 1 - s1	Up Stream (MP3)	05/01/2011	6:07	0.001
Isaac 2 - s2	Downstream (MP2)	05/01/2011	6:44	0.001
Discharge point - s3	Discharge Point (MP1)	05/01/2011	0:09	0.002
Isaac 1 - qc1	Up Stream (MP3) QC	05/01/2011	6:87	0.002
Isaac 2 - qc2	Downstream (MP2)QC	05/01/2011	6:36	0.001
Discharge point - s3	Discharge Point (MP1) QC	05/01/2011	0:09	0.002
Notes:				
IS = Insufficient Sample				
				1

Cadmium	Chromium	Copper	Iron	Lead	Mercury	Nickel	Zinc	Boron	Cobalt	Manganese	Molybdenum	Selenium
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
0.005 - 0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.0001	0.01-0.001	0.01-0.005	0.1-0.05	0.01-0.001	0.01-0.001	0.01-0.001	0.01
0.0002	0.001	0.002	0.3	0.01	0.0002	0.011	0.008	0.37	0.09	1.9	0.034	0.01
<0.005	0.04	0.02	23.5	0.01	<0.0001	0.03	0.04	<0.1	0.01	0.39	<0.01	<0.01
<0.005	0.04	0.02	29	0.01	<0.0001	0.03	0.03	<0.1	0.01	0.48	<0.01	<0.01
<0.005	0.03	0.02	28.1	<0.01	<0.0001	0.03	0.05	<0.1	0.01	0.5	<0.01	<0.01
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
<0.005	0.02	0.02	20.1	<0.01	<0.0001	0.02	0.03	<0.1	<0.01	0.39	<0.01	<0.01
<0.0001	0.012	0.009	-	0.006	<0.0001	0.014	0.022	-	-	-	-	
<0.0001	0.013	0.009	-	0.006	<0.0001	0.015	0.018	-	-	-	-	
<0.0001	0.013	0.01	-	0.006	<0.0001	0.015	0.019	-	-	-	-	
<0.0001	0.012	0.015	10.7	0.006	<0.0001	0.013	0.016	<0.05	0.01	0.252	<0.001	<0.01
<0.0001	0.012	0.009	10.9	0.006	<0.0001	0.013	0.02	<0.05	0.006	0.244	<0.001	<0.01
<0.0001	0.017	0.012	19.7	0.009	<0.0001	0.02	0.034	<0.05	0.007	0.289	<0.001	<0.01
<0.0001	0.017	0.013	15.6	0.007	<0.0001	0.016	0.026	<0.05	0.009	0.383	<0.001	<0.01
<0.0001	0.021	0.011	13.4	0.007	<0.0001	0.016	0.021	<0.05	0.007	0.399	<0.001	<0.01
<0.0001	0.023	0.016	12.8	0.007	<0.0001	0.016	0.019	<0.05	0.01	0.424	<0.001	<0.01
<0.0001	0.009	0.008	-	0.004	<0.0001	0.011	0.015	-	0.006	0.235	-	-
0.0002	0.008	0.008	-	0.004	<0.0001	0.01	0.014	-	0.006	0.242	-	-
0.0001	0.01	0.009	-	0.005	<0.0001	0.012	0.017	-	0.006	0.264	-	-
<0.0001	0.008	0.008	-	0.004	<0.0001	0.01	0.013	-	0.006	0.24	-	-
<0.0001	<0.001	0.002	-	<0.001	<0.0001	0.001	<0.005	-	<0.001	0.008	-	-
<0.0001	<0.001	0.002	-	<0.001	<0.0001	0.001	<0.005	-	<0.001	0.008	-	-
<0.0001	<0.001	0.002	-	<0.001	<0.0001	0.002	0.007	-	<0.001	0.019	-	-
<0.0001	0.008	0.006	-	0.004	<0.0001	0.009	0.014	-	0.005	0.201	-	-
<0.0001	0.009	0.007	-	0.004	<0.0001	0.011	0.016	-	0.005	0.184	-	-
<0.0001	0.011	0.005	10.2	0.012	<0.0001	0.206	0.02	0.09	0.008	0.005	0.017	<0.001
<0.0001	0.01	0.004	9.2	0.012	<0.0001	0.208	0.02	<0.05	0.014	0.005	0.021	<0.001
<0.0001	0.001	<0.001	0.16	<0.001	<0.0001	0.008	<0.01	1.15	0.002	<0.001	0.01	0.003
<0.0001	0.011	0.004	9.65	0.012	<0.0001	0.199	0.02	0.09	0.008	0.005	0.018	<0.001
<0.0001	0.01	0.005	9.23	0.012	<0.0001	0.209	0.02	<0.05	0.008	0.005	0.016	<0.001
<0.0001	0.001	<0.001	0.19	0.001	<0.0001	0.008	<0.01	1.17	0.002	<0.001	0.011	0.003
-	-	-	-	-	-	-	-	-	-	-	-	-

<0.0001	0.017	0.006	9.96	0.015	<0.0001	0.186	0.02	0.05	0.009	0.004	0.018	<0.001
<0.0001	0.022	0.008	13.7	0.019	<0.0001	0.233	0.03	<0.05	0.011	0.005	0.019	<0.001
<0.0001	<0.001	<0.001	0.14	0.001	<0.0001	0.01	<0.01	1.06	0.002	<0.001	0.006	0.002
<0.0001	0.023	0.008	13.6	0.019	<0.0001	0.226	0.03	0.06	0.011	0.005	0.02	<0.001
<0.0001	0.022	0.008	14.3	0.02	<0.0001	0.237	0.03	<0.05	0.011	0.006	0.02	<0.001
<0.0001	<0.001	<0.001	0.15	0.001	<0.0001	0.01	<0.01	1.12	0.002	<0.001	0.008	0.002
-	-	-	-	-	-	-	-	-	-	-	-	-
<0.0001	0.015	0.008	11.2	0.005	<0.0001	0.014	0.015	0.08	0.005	0.178	<0.001	<0.01
<0.0001	0.013	0.007	9.41	0.004	<0.0001	0.011	0.012	0.06	0.004	0.135	<0.001	<0.01
<0.0001	<0.001	0.002	0.12	<0.001	<0.0001	<0.001	<0.005	1.39	<0.001	0.006	0.003	<0.01
<0.0001	0.016	0.009	11.7	0.005	<0.0001	0.014	0.017	0.08	0.006	0.186	<0.001	<0.01
<0.0001	0.015	0.008	10.3	0.006	<0.0001	0.012	0.014	0.06	0.004	0.135	<0.001	<0.01
<0.0001	<0.001	0.002	0.12	<0.001	<0.0001	<0.001	<0.005	1.33	<0.001	0.006	0.003	<0.01
-	-	-	-	-	-	-	-	-	-	-	-	-
<0.0001	0.009	0.006	7.64	0.004	<0.0001	0.009	0.011	0.05	0.003	0.138	<0.001	<0.01
<0.0001	0.009	0.006	7.91	0.004	<0.0001	0.009	0.012	<0.05	0.004	0.144	<0.001	<0.01
<0.0001	<0.001	0.002	0.12	<0.001	<0.0001	<0.001	0.008	1.33	<0.001	0.008	0.003	<0.01
<0.0001	0.01	0.007	8.51	0.004	<0.0001	0.01	0.012	0.08	0.004	0.148	<0.001	<0.01
<0.0001	0.009	0.007	7.91	0.004	<0.0001	0.01	0.011	0.06	0.004	0.156	<0.001	<0.01
<0.0001	<0.001	0.002	0.13	<0.001	<0.0001	<0.001	0.008	1.39	<0.001	0.008	0.003	<0.01

Silver	Uranium	Vanadium
mg/L	mg/L	mg/L
0.001	0.001	0.01
0.001	0.001	0.01
	<0.001	0.06
	<0.001	0.06
	<0.001	0.05
-	-	-
-	-	-
	<0.001	0.04
-	-	
-	-	
-	-	
<0.001	-	0.02
<0.001	-	0.02
<0.001	-	0.03
<0.001	-	0.03
<0.001	-	0.03
<0.001	-	0.02
-	-	0.02
-	-	0.02
-	-	0.02
-	-	0.02
-	-	<0.01
-	-	<0.01
-	-	<0.01
-	-	0.01
-	-	0.02
<0.01	<0.001	<0.001
<0.01	<0.001	<0.001
<0.01	<0.001	<0.001
<0.01	<0.001	<0.001
<0.01	<0.001	<0.001
<0.01	<0.001	<0.001
-	-	-

<0.01	<0.001	<0.001
<0.01	<0.001	<0.001
<0.01	<0.001	<0.001
<0.01	<0.001	<0.001
<0.01	<0.001	<0.001
<0.01	<0.001	<0.001
-	-	-
<0.001	<0.001	0.02
<0.001	<0.001	0.02
<0.001	<0.001	<0.01
<0.001	<0.001	0.02
<0.001	<0.001	0.02
<0.001	<0.001	<0.01
-	-	-
<0.001	<0.001	0.02
<0.001	<0.001	0.02
<0.001	<0.001	<0.01
<0.001	<0.001	0.02
<0.001	<0.001	0.02
<0.001	<0.001	<0.01

Ben McMahon

From: [redacted]
Sent: Thursday, 3 February 2011 10:24 AM
To: Ben McMahon
Cc: [redacted]
Subject: RE: Data Tables
Attachments: ARROW Water quality results 02FEB11.xls

Categories: Red Category

Hi Ben

We received QLD Health's comments last night and these are being worked into a tracked changed version of the TEP which I will send through prior to lunch.

Once you receive this if you would like to meet today to discuss please contact me.

Now that the monitoring data has been amended to include a link between the sample descriptors and the TEP, this will make assessment much easier.

Is there any reason why several whole days are missing in the data? The days that are missing are also days on which discharges occurred, so in keeping with Arrows commitment to conduct the unauthorised release in accordance with the draft, monitoring should have been undertaken.

One of the questions QLD Health had related to Chloride and Sodium levels – i.e. why on 21 Dec where levels in discharge the same as levels in background water and not consistent with previous levels related to RO feed data?

The new data submitted today shows that chloride and sodium in the discharge were typically around 3200mg/L and 2600mg/L respectively and not the very low levels shown on the 21 dec.

Is there any reason for this anomaly?

And why after testing on 21 Dec did Arrow not test again for Chloride/Sodium until 2 January?

I have provided this new data to QLD Health this morning for their advice.

Also has Arrow any view as to why data on 2 Jan for Annions/cations are all typically much higher upstream then downstream (its double EC upstream of discharge then downstream...)? This does not appear to be replicated for other contaminants (i.e. metals appear to be similar both upstream and downstream on the same date).

I have highlighted the parts of the excel sheet of concern to assist you.

Regards

[redacted]

From: Ben McMahon [redacted]
Sent: Thursday, 3 February 2011 8:59 AM
To: [redacted]
Subject: FW: Data Tables

Hi [redacted]

Please find the latest water quality results

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

From: Graham Cordingley
Sent: Wednesday, 2 February 2011 3:09 PM
To: Ben McMahon
Subject: Data Tables

Ben,

Please find attached the most recent tables (with corrections to the last tables to meet DERM's comments.

Regards,

Graham Cordingley
Senior Environmental Operations Coordinator

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
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		Analyte	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Nickel	Zinc	Boron	Cobalt	Manganese	Molybdenum	Selenium	Silver	Uranium	Vanadium
Sample ID	Location Description	Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
		Date Sampled/LOR	0.01	0.01-0.001	0.005-0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.0001	0.01-0.001	0.01-0.005	0.1-0.05	0.01-0.001	0.01-0.001	0.01-0.001	0.01	0.001	0.001	0.01
Draft TEP Trigger Investigation Level			0.055	0.013	0.0002	0.001	0.002	0.3	0.014	0.0002	0.011	0.008	0.37	0.09	1.9	0.034	0.01	0.001	0.001	0.012
DISCHARGE POINT	Discharge Point (MP1)	21/12/2010	15.6	<0.01	<0.005	0.04	0.02	23.5	0.01	<0.0001	0.033	0.041	<0.1	0.01	0.39	<0.01	<0.01		<0.001	0.061
ISAAC 1	Up Stream (MP3)	21/12/2010	13.3	<0.01	<0.005	0.045	0.02	29	0.01	<0.0001	0.03	0.036	<0.1	0.01	0.48	<0.01	<0.01		<0.001	0.063
ISAAC 2	Downstream (MP2)	21/12/2010	12.1	0.026	<0.005	0.03	0.02	28.1	<0.01	<0.0001	0.03	0.05	<0.1	0.01	0.5	<0.01	<0.01		<0.001	0.05
DISCHARGE POINT		21/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ISAAC 1		21/12/2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ISSAC 2	Downstream (MP2) QC	21/12/2010	12.8	<0.01	<0.005	0.021	0.02	20.1	<0.01	<0.0001	0.027	0.038	<0.1	<0.01	0.39	<0.01	<0.01		<0.001	0.04
DISCHARGE POINT	Discharge Point (MP1)	23/12/2010	-	0.001	<0.0001	0.012	0.009	-	0.006	<0.0001	0.014	0.022	-	-	-	-		-	-	
Downstream	Downstream (MP2)	23/12/2010	-	0.002	<0.0001	0.013	0.009	-	0.006	<0.0001	0.015	0.018	-	-	-	-		-	-	
ISAAC 2	Downstream (MP2) QC	23/12/2010	-	0.001	<0.0001	0.013	0.01	-	0.006	<0.0001	0.015	0.019	-	-	-	-		-	-	
ISAAC 1-S1	Up Stream (MP3)	24/12/2010	15.2	<0.001	<0.0001	0.012	0.015	10.7	0.006	<0.0001	0.013	0.016	<0.05	0.01	0.252	<0.001	<0.01	<0.001	-	0.023
ISAAC 1-QC1	Up Stream (MP3) QC	24/12/2010	9.13	0.001	<0.0001	0.012	0.009	10.9	0.006	<0.0001	0.013	0.02	<0.05	0.006	0.244	<0.001	<0.01	<0.001	-	0.02
ISAAC 2-S2	Downstream (MP2)	24/12/2010	16.4	0.002	<0.0001	0.017	0.012	19.7	0.009	<0.0001	0.02	0.034	<0.05	0.007	0.289	<0.001	<0.01	<0.001	-	0.03
ISAAC 2-QC2	Downstream (MP2) QC	24/12/2010	11.1	0.002	<0.0001	0.017	0.013	15.6	0.007	<0.0001	0.016	0.026	<0.05	0.009	0.383	<0.001	<0.01	<0.001	-	0.03
DISCHARGE-S3	Discharge Point (MP1)	24/12/2010	10.9	0.001	<0.0001	0.021	0.011	13.4	0.007	<0.0001	0.016	0.021	<0.05	0.007	0.399	<0.001	<0.01	<0.001	-	0.03
DISCHARGE-QC3	Discharge Point (MP1) QC	24/12/2010	11	0.002	<0.0001	0.023	0.016	12.8	0.007	<0.0001	0.016	0.019	<0.05	0.01	0.424	<0.001	<0.01	<0.001	-	0.02
QC 5		24/12/2010																		
SS		25/12/2010																		
ISAAC1-S1	Up Stream (MP3)	29/12/2010	-	<0.001	<0.0001	0.009	0.008	-	0.004	<0.0001	0.011	0.015	-	0.006	0.235	-	-	-	-	0.02
ISAAC1-QC1	Up Stream (MP3)QC	29/12/2010	-	<0.001	0.0002	0.008	0.008	-	0.004	<0.0001	0.01	0.014	-	0.006	0.242	-	-	-	-	0.02
ISAAC2-S2	Downstream (MP2)	29/12/2010	-	<0.001	0.0001	0.01	0.009	-	0.005	<0.0001	0.012	0.017	-	0.006	0.264	-	-	-	-	0.02
ISAAC2-QC2	Downstream (MP2) QC	29/12/2010	-	<0.001	<0.0001	0.008	0.008	-	0.004	<0.0001	0.01	0.013	-	0.006	0.24	-	-	-	-	0.02
DISCHARGE-S3	Discharge Point (MP1)	29/12/2010	-	0.003	<0.0001	<0.001	0.002	-	<0.001	<0.0001	0.001	<0.005	-	<0.001	0.008	-	-	-	-	<0.01
DISCHARGE-QC3	Discharge Point (MP1) QC	29/12/2010	-	0.002	<0.0001	<0.001	0.002	-	<0.001	<0.0001	0.001	<0.005	-	<0.001	0.008	-	-	-	-	<0.01
TRIP-QC5		29/12/2010																		
TRIP-SS		29/12/2010																		
DISCHARGE POINT	Discharge Point (MP1)	31/12/2010	-	<0.001	<0.0001	<0.001	0.002	-	<0.001	<0.0001	0.002	0.007	-	<0.001	0.019	-	-	-	-	<0.01
ISAAC 1	Up Stream (MP3)	31/12/2010	-	<0.001	<0.0001	0.008	0.006	-	0.004	<0.0001	0.009	0.014	-	0.005	0.201	-	-	-	-	0.01
ISAAC 2		31/12/2010	-	0.001	<0.0001	0.009	0.007	-	0.004	<0.0001	0.011	0.016	-	0.005	0.184	-	-	-	-	0.02
TRIP 1 2		31/12/2010																		
Issac 1 - s1	Up Stream (MP3)	02/01/2011	7.94	0.002	<0.0001	0.011	0.005	10.2	0.012	<0.0001	0.206	0.02	0.09	0.008	0.005	0.017	<0.001	<0.01	<0.001	<0.001
Issac 2 - s2	Downstream (MP2)	02/01/2011	5.96	0.001	<0.0001	0.01	0.004	9.2	0.012	<0.0001	0.208	0.02	<0.05	0.014	0.005	0.021	<0.001	<0.01	<0.001	<0.001
Discharge point - s3	Discharge Point (MP1)	02/01/2011	0.14	0.002	<0.0001	0.002	<0.001	0.16	<0.001	<0.0001	0.008	<0.01	1.15	0.002	<0.001	0.01	0.003	<0.01	<0.001	<0.001
Issac 1 - qc1	Up Stream (MP3) QC	02/01/2011	7.25	0.001	<0.0001	0.011	0.004	9.65	0.012	<0.0001	0.199	0.02	0.09	0.008	0.005	0.018	<0.001	<0.01	<0.001	<0.001
Issac 2 - qc2	Downstream (MP2)QC	02/01/2011	6.94	0.001	<0.0001	0.01	0.005	9.23	0.012	<0.0001	0.209	0.02	<0.05	0.008	0.005	0.016	<0.001	<0.01	<0.001	<0.001
Discharge point = qc3	Discharge Point (MP1) QC	02/01/2011	0.17	0.002	<0.0001	0.001	<0.001	0.19	0.001	<0.0001	0.008	<0.01	1.17	0.002	<0.001	0.011	0.003	<0.01	<0.001	<0.001
Trip - QC5		02/01/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Issac 1 - s1	Up Stream (MP3)	03/01/2011	7.07	0.001	<0.0001	0.017	0.006	9.96	0.015	<0.0001	0.186	0.02	0.05	0.009	0.004	0.018	<0.001	<0.01	<0.001	<0.001
Issac 2 - s2	Downstream (MP2)	03/01/2011	8.48	0.001	<0.0001	0.022	0.008	12.7	0.019	<0.0001	0.233	0.03	<0.05	0.011	0.005	0.019	<0.001	<0.01	<0.001	<0.001
Discharge point - s3	Discharge Point (MP1)	03/01/2011	0.14	0.002	<0.0001	<0.001	<0.001	0.14	0.001	<0.0001	0.01	<0.01	1.06	0.002	<0.001	0.006	0.002	<0.01	<0.001	<0.001
Issac 1 - qc1	Up Stream (MP3) QC	03/01/2011	8.47	0.001	<0.0001	0.023	0.008	13.6	0.019	<0.0001	0.226	0.03	0.06	0.011	0.005	0.02	<0.001	<0.01	<0.001	<0.001
Issac 2 - qc2	Downstream (MP2)QC	03/01/2011	9.04	0.001	<0.0001	0.022	0.008	14.5	0.02	<0.0001	0.237	0.03	<0.05	0.011	0.006	0.02	<0.001	<0.01	<0.001	<0.001
Discharge point - qc3	Discharge Point (MP1) QC	03/01/2011	0.13	0.002	<0.0001	<0.001	<0.001	0.15	0.001	<0.0001	0.01	<0.01	1.12	0.002	<0.001	0.008	0.002	<0.01	<0.001	<0.001
Trip - QC5		03/01/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Isaac 1 - s1	Up Stream (MP3)	04/01/2011	8.18	0.002	<0.0001	0.015	0.008	11.2	0.005	<0.0001	0.014	0.015	0.08	0.005	0.178	<0.001	<0.01	<0.001	<0.001	0.02
Isaac 2 - s2	Downstream (MP2)	04/01/2011	7.19	0.002	<0.0001	0.013	0.007	9.41	0.004	<0.0001	0.011	0.012	0.06	0.004	0.135	<0.001	<0.01	<0.001	<0.001	0.02
Discharge point - s3	Discharge Point (MP1)	04/01/2011	0.08	0.002	<0.0001	<0.001	0.002	0.12	<0.001	<0.0001	<0.001	<0.005	1.39	<0.001	0.006	0.003	<0.01	<0.001	<0.001	<0.01
Isaac 1 - qc1	Up Stream (MP3) QC	04/01/2011	8.57	0.002	<0.0001	0.016	0.009	11.7	0.005	<0.0001	0.014	0.017	0.08	0.006	0.186	<0.001	<0.01	<0.001	<0.001	0.02
Isaac 2 - qc2	Downstream (MP2)QC	04/01/2011	8.13	0.002	<0.0001	0.015	0.008	10.3	0.006	<0.0001	0.012	0.014	0.06	0.004	0.135	<0.001	<0.01	<0.001	<0.001	0.02
Discharge point - s3	Discharge Point (MP1) QC	04/01/2011	0.09	0.002	<0.0001	<0.001	0.002	0.12	<0.001	<0.0001	<0.001	<0.005	1.39	<0.001	0.006	0.003	<0.01	<0.001	<0.001	<0.01
Trip - s5		04/01/2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Issac 1 - s1	Up Stream (MP3)	05/01/2011	6.07	0.001	<0.0001	0.009	0.006	7.64	0.004	<0.0001	0.009	0.011	0.05	0.003	0.138	<0.001	<0.01	<0.001	<0.001	0.02
Issac 2 - s2	Downstream (MP2)	05/01/2011	6.44	0.001	<0.0001	0.009	0.006	7.91	0.004	<0.0001	0.009	0.012	<0.05	0.004	0.144	<0.001	<0.01	<0.001	<0.001	0.02
Discharge point - s3	Discharge Point (MP1)	05/01/2011	0.09	0.002	<0.0001	<0.001	0.002	0.12	<0.001	<0.0001	<0.001	0.008	1.33	<0.001	0.008	0.003	<0.01	<0.001	<0.001	<0.01
Isaac 1 - qc1	Up Stream (MP3) QC	05/01/2011	6.87	0.001	<0.0001	0.01	0.007	8.51	0.004	<0.0001	0.01	0.012	0.08	0.004	0.148	<0.001	<0.01	<0.001	<0.001	0.02
Isaac 2 - qc2	Downstream (MP2)QC	05/01/2011	6.36	0.001	<0.0001	0.009	0.007	7.91	0.004	<0.0001	0.01	0.011	0.06	0.004	0.156	<0.001	<0.01	<0.001	<0.001	0.02
Discharge point - s3	Discharge Point (MP1) QC	05/01/2011	0.09	0.002	<0.0001	<0.001	0.002	0.13	<0.001	<0.0001	<0.001	0.008	1.39	<0.001	0.008	0.003	<0.01	<0.001	<0.001	<0.01

Notes:
IS = Insufficient Sample

Ben McMahon

From: Ben McMahon
Sent: Thursday, 3 February 2011 1:17 PM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: Intent to discharge 03 Febuary 2011

Categories: Red Category

[redacted]

Moranbah is operational again following the weather events of last night.

Further to the advise provided yesterday afternoon we intent to move forward the discharge as notified yesterday to this afternoon. The details of the discharge otherwise remain as advised yesterday. In particular there is sufficient flow in the Isaac, Arrow intents to discharge while there is flow greater than 1090 ML/day from RP1.

We have commenced sampling and expect that we will be able to move samples from the Mackay airport to the lab for analysis.

We will provide the daily summary of the discharge details as per the current draft TEP later today. Please be advised that this summary may require an update to comply with the revised TEP expected to be issued by DERM this afternoon.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

Ben McMahon

From: [redacted]
Sent: Thursday, 3 February 2011 4:12 PM
To: Ben McMahon; [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: Intent to discharge 03 Febuary 2011

Categories: Red Category

Ben

This notification has been received.

Regards

[redacted]

From: Ben McMahon [redacted]
Sent: Thursday, 3 February 2011 1:17 PM
To: [redacted]
Cc: [redacted]; Tim Dean; [redacted]
Subject: Intent to discharge 03 Febuary 2011

[redacted]

Moranbah is operational again following the weather events of last night.

Further to the advise provided yesterday afternoon we intent to move forward the discharge as notified yesterday to this afternoon. The details of the discharge otherwise remain as advised yesterday. In particular there is sufficient flow in the Isaac, Arrow intents to discharge while there is flow greater than 1090 ML/day from RP1.

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Best regards

Ben McMahon
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+----------+

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

+----------+

[redacted]

From: [redacted]
Sent: Thursday, 3 February 2011 1:42 PM
To: Ben McMahon
Cc: [redacted]
Subject: Arrow TEP comments from DERM/QLD Health
Attachments: Tracked changed arrow tep.doc

Ben

As promised this morning please find attached a tracked changed version of the TEP with changes and comments.

I have taken onboard comments from QLD Health and included them with comments/additions from DERM.

You will note I have added conditions clearly showing that the TEP discharge can only occur and must cease which are linked to 'Target Dam Fill Heights' from Table 1.

Whilst flow levels, max volumes and dilution levels were included before the TEP did not explicitly state at point the discharge was needed to commence or should cease in regards to dam levels. This was no doubt the intent in the text but was not stated clearly in the conditions. If my interpretation is incorrect please advise me, however it is my understanding if dams are at or below the Target Dam Fill Heights there is no need for a discharge.

I will be happy to meet to discuss anytime this afternoon/tomorrow morning.

Regards

[redacted]

<<Tracked changed arrow tep.doc>>

[redacted]

[redacted]

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

DRAFT TRANSITIONAL ENVIRONMENTAL PROGRAM UNDER SECTION 333 OF THE *ENVIRONMENTAL PROTECTION ACT 1994*

Principal Holder:	CH4 Pty Ltd AM-60 Level 19 42 Albert Street Brisbane QLD 4000
EA Number:	PEN100015907
Title:	Coal Seam Water Management Moranbah Gas Project
Date:	3 or 4 February ~~10 January~~ 2011
Finish Date:	31 May 2011

Introduction

The Moranbah Gas Project lacks sufficient water storage capacity as previously indicated in correspondence to DERM (dated 25 October 2010) and subsequent responses to information requests and the program notice documentation submitted by Arrow (dated 3 December 2010). This has been caused by an early start to the wet season contributing to existing dam levels and causing construction delays. This has prevented Arrow from making additional storage available via the completion of dam 11. The synthetic lining for the dam cannot be installed during periods of rainfall; the civil engineering also requires careful control of the moisture content of the construction materials to achieve the required specifications.

Dam 11 has been designed and is being constructed in line with the most current dam standards stipulated by DERM and contained in the previously submitted and assessed dam design report. It is a large lined dam – intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, develop beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies.

The continued rain has delayed the completion of dam 11. This has put Arrow in a position where it cannot comply with the current EA conditions. Arrow intends to employ this transitional environmental program (TEP) as defined in Chapter 7, Part 4 of the *Environmental Protection Act 1994 to bring our operation back into compliance with its current Environmental Authority*. In initiating this process Arrow intends to work with DERM to minimise the potential for environmental harm.

Background

Arrow currently employs a network of 10 dams across PL191 and PL196. Dams 1 through to 7 are shown in the attached drawing (Appendix C). Dams 8 and 9 in the network are SW of the main area depicted in the provided drawing. Approximately 90% of the total storage capacity for coal seam water is held in Arrow's major storage dams 1, 2 and 10. The other dams are employed to move water between groups of remote wells and the major storage dams. Dam 3 is employed to store more concentrated brine. An important feature of the petroleum lease is the Isaac River which divides the lease along a NW to SE axis and its tributary Teviot Brook. Isaac River is an ephemeral river; during periods of high flow it limits access to infrastructure on the north eastern side of the petroleum lease via river crossings.

Situation

Our strategy is to maintain low levels in the older and less accessible dams (particularly dams 6,7, 8 and 9) by moving water to dams 1 and 10. Dam 10 is our most recently constructed dam and has an engineered spillway, dam 1 is in reasonable condition and adjacent to dam 10 which allows water to be transferred readily between dams.

Our risk assessment process and an independent third party geotechnical evaluation by URS has identified particular concerns with the integrity of dam 2 (refer to Appendix E). Arrow has concerns regarding the condition of dam 2 – it is scheduled to be brought out of service on the completion of Dam 11. Based on geotechnical evaluation we intend to lower the level of water in Dam 2 to 4m below DSA. The goal of this strategy is to maintain pond integrity and minimise discharge to the environment when a suitable plan to restore the operational integrity of dam 2 is developed or the dam is retired from operational duty.

Arrow believes that a controlled discharge during high flow conditions in the Isaac River via the existing infrastructure would result in the least environmental impact whilst preserving the integrity of the existing dams. This option prevents the overland flow of untreated coal seam water reaching the Isaac River and minimises the risk of damaging older dams which are built prior to the new standards and lacking engineered spillways. When the facility was originally developed the water management scheme was significantly different to now and included a wet weather discharge. At present our existing infrastructure is not sufficient to comply with the conditions of the current Environmental Authority particularly during extended wet periods.

Our system of dams has an area of 125,100 m^2, this equates to a gain of 0.125ML per mm of rainfall. The system is designed to transfer water to the major storage dams 1, 2 and 10 this contribute to the catchments of these structures, each 1 mm of rainfall will cause an increase in dam height of 1.6 mm in dams 1, 2 and 10. When all the input rainfall is directed to dam 10 each 1 mm of rainfall causes an increase in dam height of 2.7 mm in dam 10.

Table 1 Key Dam Variables Dams 1, 2, 5 and 10

Dam		1	2	5	10
Volume at Spill level	ML	119.66	92.64	7.64	203.70
Spillway		No	No	No	Yes
Liner type		CCL	CCL	0.5mm HDPE	1.5mm HDPE
Hydraulic height	m	5.60	5.50	3.5	4.75
MRL	m	5.25	5.15	3.15	4.40
DSA	m	4.75	4.65	2.65	3.90
Target dam fill height[b]	m	4.75	0.65	2.65	3.90
Current level (below MRL)[a]	mm	100	870	Varies[c]	40
Remaining rainfall *(to spill)*[d]	mm	281	762	>800	244

[a] Levels 27 December 2010, negative denotes level above MRL
[b] Target dam fill height is DSA for dams 1 and 10, 4m below DSA for dam 2. Current target height for dam 2 is based on 3rd party civil engineering assessment completed by URS.
[c] This dam is much smaller than the major storage dams its level can change rapidly during operations
[d] Rainfall based on approximate catchment ratio of 1.6 (based on total catchment area including transfer dams)

Comment [k1]: Data from 27 December is not appropriate. Update table with current details of dam levels – If the TEP is resubmitted on 3 or 4 Feb I would accept data from 31 Jan onwards.

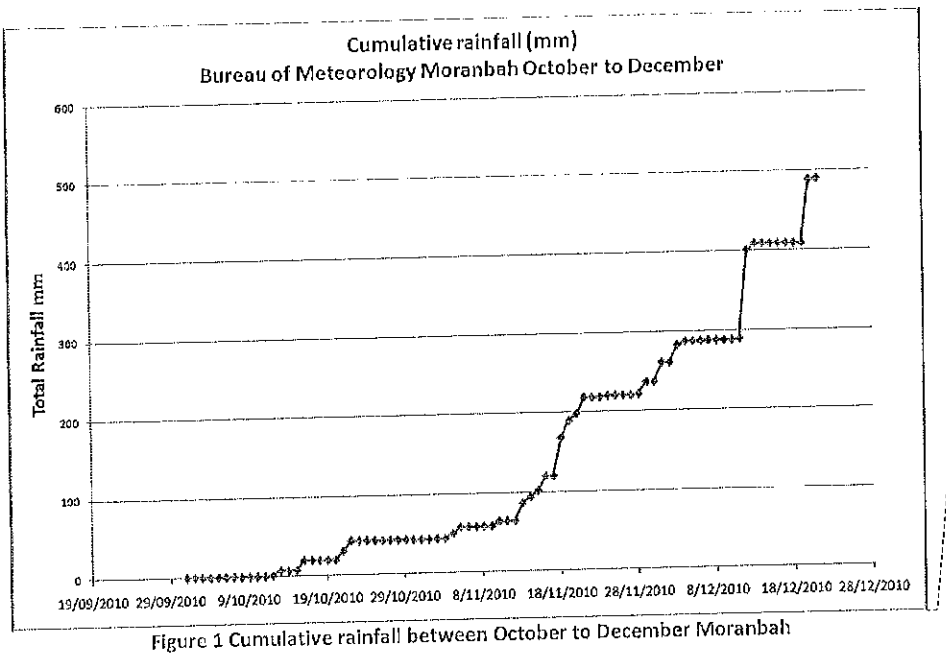

Figure 1 Cumulative rainfall between October to December Moranbah

Comment [a2]: Could this table be updated to include rainfall to 31 January 2011, or a later date?

Future water levels will be a product of the rainfall, coal seam water production and evaporation. Our goal is to maintain dams 1 and 10 at DSA levels by employing a discharge to the Isaac River. Dam 2 will be lowered to a level determined by independent third party engineering risk assessment.

Arrow has evaluated 2 scenarios for water requiring discharge from the storage system:

- Scenario 1 – Mean rainfall until end of wet season
- Scenario 2 – 95th percentile rainfall until end of wet season

Rainfall to date is very close to the 95th percentile rainfalls on average from October through to December. We have had a cumulative total of 490mm from the 1st of October to date (Figure 1~~Figure 1~~~~Figure 1~~~~Figure 1~~), 95th percentile cumulative rainfall for the period from the start of October to the end of December totals 522mm. At present with one week remaining in December the cumulative total is 30mm short of the 95th percentile. Given the current progress of the wet season Arrow believes that the next few months will produce above average rainfall. Long range forecasts from the Bureau of Meteorology give a 55% chance of rainfall at or above the 95% percentile values. In determining the water balance for the facility has evaluated 2 scenarios – mean and 95th Percentile rainfall (refer to Table 2).

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Comment [k3]: Given this was resubmitted on 28 Jan cant this be updated?

Table 2 Discharge scenarios

Scenario	Volume to reach DSA (ML)	Additional removal from Dam 2 (ML) [b]	Expected Net [a] Water to Storage (ML)	Total (ML)
Mean Rainfall	69	75	54.5	198.5
95th Percentile	69	75	130	274

[a] *Net water to storage is produced water, less evaporation plus expected rainfall.*
[b] *This is based on a dam 2 target of 4000mm below DSA.*

Comment [a4]: Could this table be updated to reflect releases/rainfall to date?

Arrow proposes a discharge of up to 7.5ML/day when dams are above the target dam fill height shown in Table 1. The release will commence when the Isaac River is flowing above 12.6m^3/s (at this starting flow only 2.4ML/day could be discharged) ~~to commence when the Isaac River is at least 34.72 m^3/seccond 1090 ML/day~~ measured upstream at the Goonyella river gauge (operated by DERM). Discharge will be maintained at a 400:1 dilution ratio on the basis of maintaining Australian drinking water guidelines (NHMRC,2004) downstream of the discharge. Based on a predicted salinity impact as detailed in Appendix B. This discharge rate and the dilution factor will be reviewed throughout the TEP in consultation with DERM and informed on the basis of the upstream/downstream river monitoring in line with the proposed conditions detailed within this document.

Comment [k5]: How is discharge proposed? Provide info on release point placement please.

Comment [k6]: At 1090ML/day 400:1 would allow 2.4ML to be discharged. Once 3000ML or 35m3/s flow was reached then the max of 7.5ML could be discharged.

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Comment [a7]: 1090ML/day flow in the river is appropriate when discharging up to 2.4 ML/day, however for 7.5ML/day discharge requires 3000ML/day of flow in the river or as proposed; 34.72 m3/second.

Sampling will be conducted in line with the conditions detailed in this TEP under the procedure attached as Appendix D. Appendix A contains detailed results of the sampling completed to date to characterise the coal seam water to be discharged.

Comment [k8]: Please include the newer data emailed separately on 28 jan and in a format that makes it possible to compare against TEP sample locations.

Supporting Information

Consideration of the management hierarchy for the management of coal seam water at the MGP

Evaluation as per the management hierarchy of preferred procedures from Environmental Protection (Water) Policy 2009:

Step 1—evaluate water conservation measures to reduce the use of water and the production of waste water or contaminants;
Water is not employed in the coal seam gas production process but must be removed from the coal seam to allow the gas to be extracted. Water conservation measures will not reduce the amount of coal seam water associated with the gas extracted.

Step 2—evaluate waste prevention options and implement appropriate waste prevention measures;
The key waste prevention measure employed is maximisation of the coal seam gas to water ratio. The coal seams targeted by MGP have relatively low ratios of water to gas in comparison to other fields. In an effort to manage our recent water storage constraints Arrow has shut in a large number of wells, targeting the wells with high water to gas ratios to minimise the production of coal seam water associated with our operations.

Whilst this has reduced our coal seam water production, shutting in further wells will yield limited benefits in terms of water reduction but will cause significant reduction in gas output.

Use of dam 11 in its current uncompleted, unlined state has been investigated. The pipe work and major civil infrastructure is complete but the floor of the dam is incomplete – as discussed (in our meeting on the 1st of December) it lacks its intended second liner, more importantly the clay liner has not been sufficiently compacted to allow its use. Key elements of the pipework connecting dam 11 to the rest of the network remain incomplete. Employing dam 11 would require its use for an extended period to allow subsequent emptying and upgrade of the existing dam infrastructure.

Step 3—If waste prevention does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate treatment and recycling options and implement appropriate treatment and recycling;
The construction of Dam 11 is the first component of our coal seam water management strategy. It is a large lined dam, intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies. Rainfall is delaying the construction of dam 11 and contributing to the current water storage problems.

Installation of water treatment (such as a mobile RO plant) is limited by the logistics (such as civil engineering, chemical storage and power supply), cost and the challenges posed during current wet conditions. Another option considered was employing water entitlements to dilute the untreated coal seam water to the current environmental authority specification. This option was ruled out since a large quantity of good quality water would be required to dilute and dispose of a limited amount of coal seam water from our dams.

Step 4—if treatment and recycling does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate the following options
for waste water or contaminants, in the order in which they are listed—
(i) appropriate treatment and release to a waste facility or sewer;
(ii) appropriate treatment and release to land;
(iii) appropriate treatment and release to surface waters or ground waters.

I) We cannot practically truck water from the dams given the large quantities and the lack of disposal options. Wet weather is likely to complicate trucking of water by limiting access to some points within the MGP. Infrastructure does not exist to process this water via sewer or other industrial water treatment options. Our landholders have expressed concern of minimising truck movements during the wet season.

II) Until our water treatment management strategy is implemented we cannot treat the water to a standard that is suitable for use on land.

III) We consider the water in its current state is suitable for discharge into the Isaac – this was the water management strategy employed by the facility until earlier EA conditions were amended, we are seeking permission from DERM to allow this discharge as previously authorised until we can implement our water management strategy for the MGP. We consider a temporary discharge to the Isaac river during

high flow conditions to be compliant with section 51 of the Environmental Protection Regulation 2008.

Objectives

To achieve compliance with the Environmental Authority with respect to coal seam water management and dam standards by April 2011.

This will be achieved in the short term by the release of water to the Isaac River. This measure will protect the integrity of our storage infrastructure and is consistent with the operational philosophy that our existing infrastructure was designed to accommodate.

In the medium term compliance with the new EA will be achieved by the completion of Dam 11. Completion of dam 11 will require Arrow energy to utilise the cleared area north of dam 11.

In the long term, compliance with our EA will be achieved by completion of water treatment facilities that allow beneficial use and disposal within Arrows Environmental Authority conditions. Arrow is to provide DERM with a detailed plan concerning future water management for approval.

Table 3 – Achieving TEP objectives

OBJECTIVE	ACTION	RESPONSIBILITY	TIME FRAME	PERFORMANCE INDICATOR
1. Lower dam levels for (dams 1, 2, 5, 10) to below the 'Target dam fill height" as shown in Table 1.	Manage via discharge (RP1) to Isaac river	Arrow site personnel	Immediate	Manage dams within appropriate levels as detailed in Tables 1 and 2. Discharge is to be subject to monitoring and reporting requirements
2. Monitor Discharge	Monitor discharge in accordance with Table 5, for the contaminants listed in Table 6 and Table 7	Arrow site personnel	During discharge	Lab results to be reported to DERM within 10 business days of collection.
3. Pond 2	Develop management plan to restore dam integrity or remove from service	Arrow	15 March 2010	Submission of management plan to DERM
4. Cease discharge	Cease discharge to Isaac river under TEP	Arrow	31 March 2011	Cease discharge to Isaac river
5. TEP report submission	Provide DERM with final TEP report detailing how the objectives of this	Arrow	31 May 2011	Submission of TEP report to DERM

	TEP have been met			

Monitoring

Table 4 Contaminant release points, sources and receiving waters

Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point	Receiving waters
TEP RP 1	148° 2' 35"	-21° 57' 41"	untreated CSG water from PL191/196	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
				Upstream from discharge – Isaac River Crossing	
				Downstream from discharge – Blair Athol Bridge	

Table 5 Contaminant release monitoring points

Monitoring point (TEP MP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point location	Receiving waters
TEP MP 1	148° 2' 35"	-21° 57' 41"	Untreated CSG water from PL191	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
TEP MP 2	148° 2' 46"	-21° 57' 55"	Downstream from discharge – Blair Athol Bridge	Blair Athol Railway Bridge	na
TEP MP 3	148° 2' 20"	-21° 57' 41"	Upstream from discharge	Isaac River Crossing	
TEP MP 4	148° 1' 10"	-21° 58' 00"	Untreated CSG water dam 1	Dam 1	
TEP MP 5	148° 2' 8"	-21° 58' 01"	Untreated CSG water dam 2	Dam 2	
TEP MP 6	148° 2' 32"	-21° 57' 44"	Untreated CSG water dam 5	Dam 5	
TEP MP 7	148° 1' 14"	-21° 58' 4"	Untreated CSG water dam 10	Dam 10	

Table 6 Contaminant release limits

Quality characteristic	Release Limit	Monitoring Frequency	Sample Type	Monitoring Point
Electrical conductivity (uS/cm)	13000	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1 TEP MP2 TEPMP3
			Samples require laboratory analysis[2]	TEP MP 1 TEP MP2 TEPMP3
pH (pH Unit)	6.5 (minimum) 9.5 (maximum)	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1 TEP MP 2 TEP MP 3
			Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3
Turbidity (NTU)	500	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3
BTEX Benzene, Ethylbenzene, Toluene and Xylene (mg/L)	Benzene 0.001 Ethylbenzene 0.3 Toluene 0.8 Xylene 0.02	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3

Comment [k9]: EC should be monitored upstream and downstream and not just at discharge point. QLD Health also support this.

[1] *In situ samples can be taken using electronic sampling equipment.*
[2] *Samples are required to be analysed at a NATA accredited facility in accordance with this Transitional Environmental Program.*

Table 7 Downstream contaminant trigger investigation levels

Quality characteristic	Trigger levels (µg/L)	Monitoring frequency	Monitoring Point
Aluminium	55	Commencement of release and thereafter weekly during release	TEP MP 2 TEP MP 3
Arsenic	~~10~~13		
Cadmium	0.2		
Chromium	1.0		
Copper	2.0		
Iron	300		
Lead	10		
Mercury	0.2		
Nickel	11		
Zinc	8.0		
Boron	370		
Cobalt	90		
Manganese	~~1900~~500		
Molybdenum	34		
Selenium	10		
Silver	1.0		
Uranium	1.0		
Vanadium	10		
Ammonia	900		
Nitrate	1100		
Petroleum hydrocarbons (C6-C9)	20		
Petroleum hydrocarbons (C10-C36)	100		
Fluoride (total)	~~2000~~1500		

Comment [k10]: This list should be consistent with the list in Appendix D – Analytes. For example sodium and chloride are listed in that table but not in this table.

QLD Health have advised trigger levels for Chloride should be 250mg/L and sodium 180mg/L

EC should be added with trigger of 350us/cm

Comment [k11]: QLD Health advice this should be ADWG level of 10

Comment [k12]: Q Health advice as above

Comment [k13]: As above

Table 8 Contaminant release during flow events

Receiving waters	Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Minimum flow in receiving water required for a release event	Flow recording frequency
Isaac River	TEP RP1	~~1~~48° 2' 0"	21° 51' 20"	~~1090ML/day~~12.6m^3/s	Daily from Goonyella Gauging station

Comment [k15]: I apologise for this backflip given my earlier advice about ML/day. Given the nature of the hydrograph for the river I have been advised that m3/s is more appropriate.

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Comment [k14]: Table 4 RP1 and this RP1 easting/northing do not match.

Comment [k16]: Recognise that Arrow intend on using DERM data for flow information. Suggest due to the nature of the hydro graph Arrow commit to monitoring levels on at least a twice daily basis.

Table 9 Receiving water downstream monitoring points

Monitoring points (TEP MP)	Receiving waters location description	Easting (GDA94)	Northing (GDA94)
TEP MP 2	Blair Athol Bridge 500 metres downstream of RP1	148° 2' 46"	-21° 57' 55"
TEP MP 4	Spot x X distance (1km??) downstream of Blair Athol Bridge	X	X

Comment [k17]: I note the comment that one downstream monitoring location is in Arrows view enough. QLD Health and DERM water scientist require another one downstream. Please advise if it is physically possible to safely get samples from an accessible downstream location.

Conditions

In carrying out this Transitional Environmental Program, CH4 Ltd (Arrow Energy) will undertake all activities in accordance with the following conditions.

Undertaking the release of untreated coal seam methane water

1 Contaminants that will, or have the potential to cause environmental harm must not be released directly or indirectly released to any waters except as permitted under this Transitional Environmental Approval.

2 The release of contaminants to waters must only occur from the release points specified in Table 4~~Table 4~~ and depicted in Appendix C attached to this Transitional Environmental Program.

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3 The release of contaminants to waters must not exceed the release limits stated in Table 6~~Table 6~~ at the monitoring points specified in Table 5~~Table 5~~ and Table 6~~Table 6~~ of this Transitional Environmental Program.

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4 The release of contaminants to waters from the release points must be monitored at the locations specified in Table 5~~Table 5~~ and Table 9~~Table 9~~ for each quality characteristic and at the frequency specified in Table 7~~Table 7~~ and Table 8~~Table 8~~ of this Transitional Environmental Program.

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5 If quality characteristics of the release exceed any of the trigger levels specified in Table 7~~Table 7~~ during a release event, the Transitional Environmental Program holder must compare MP2 to the trigger values specified in Table 7~~Table 7~~ and:

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a) where the trigger values are not exceeded then no action is to be taken

b) where the downstream results exceed the trigger values specified Table 7~~Table 7~~ for any quality characteristic, compare the results of the downstream site to the data from the upstream monitoring sites (MP3)

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i) if the result is less than that recorded at Monitoring Point 3 (MP3), then no action is to be taken or

ii) if the result is greater than the background monitoring site data, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology, into the potential for environmental harm and provide a written report 20 business days after receiving results, outlining

- details of the investigations carried out
- actions taken to prevent environmental harm.

6 If an exceedance in accordance with condition 5(b)(ii) is identified, the holder of the Transitional Environmental Program must notify the administering authority within 24 hours of receiving the result. The notification must include written verification of the exceedance forwarded to the administering authority.

Contaminant Release Events

7 The release of coal seam water from the release point shown in Table 4 will not occur until :-

a) - flow in the Isaac River flow reaches 12.6m^3/s~~1000 ML/day~~ as shown in Table 8 (at Goonyella Gauging Station); and

b) – At least one dam in Table 1 has exceeded the 'Target Dam Fill Height' shown in Table 1; and

c) – A dilution of at least 400 parts river flow to 1 part discharge can be maintained at all times (0.25% of receiving flow).~~.~~

~~8Notwithstanding any other condition of this Transitional Environmental Program, the release of contaminants to waters must only take place during periods of natural flow events specified as minimum flow in Table 8 for the contaminant release point(s) specified in Table 4.~~

~~9Contaminant release flow rate must not exceed 1:400 (0.25%) of receiving water flow rate.~~

~~10~~8 The daily quantity of contaminants released from each release point must be measured and recorded at the monitoring points in Table 4~~Table 4~~

~~11~~9 The daily quantity of contaminants is not to exceed 7.5ML/day in total.

~~12~~10 Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build up of sediment in such waters.

Notification of Release Events

~~13~~11 The Transitional Environmental Program holder must notify the administering authority within 24hours of having commenced releasing coal

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seam water to the receiving environment. Notification must include the submission of written verification to the administering authority of the following information:

a) release commencement date/time
b) expected release cessation date/time
c) release point/s
d) release volume (estimated)
e) receiving water/s including the natural flow rate
f) any details (including available data) regarding likely impacts on the receiving water(s).

~~11~~12 The Transitional Environmental Program holder must provide the administering authority daily during the release of coal seam water, the following information:

a) all in situ monitoring data for that day
b) the receiving water flow rate
c) the release flow rate.

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~~12~~13 The Transitional Environmental Program holder must notify the administering authority as soon as practicable, (no later than within 24 hours after cessation of a release) of the cessation of a release notified under condition ~~12~~ 113 and within 15 business days provide the following information in writing:

Comment [k18]: This previously referred to a condition that was not relevant

a) release cessation date/time
b) natural flow volume in receiving water
c) volume of water released
d) details regarding the compliance of the release with the conditions of this Transitional Environmental Program (i.e. contamination limits, natural flow, discharge volume)
e) all in-situ water quality monitoring results
f) any other matters pertinent to the water release event.

Notification of release event exceedence

~~13~~14 If the release limits defined in Table 6~~Table 6~~ are exceeded, the holder of the Transitional Environmental Program must notify the administering authority within 2 business days of receiving the results.

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~~17~~15 The Transitional Environmental Program holder must, within 28 days of a release that exceeds the conditions of this Transitional Environmental Program, provide a report to the administering authority detailing:

a) the reason for the release
b) the location of the release
c) all water quality monitoring results
d) any general observations
e) all calculations
f) any other matters pertinent to the water release event.

Requirements to cease the release of coal seam water

~~18~~16 The coal seam water discharge must cease immediately if any water quality limit as specified in Table ~~6~~Table-6 is exceeded or if a dilution of 400 parts river flow to 1 part discharge (0.25% of receiving flow) cannot be achieved.

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~~19~~17 The Department of Environment and Resource Management may require CH4 Pty to cease discharge if the department's water monitoring stations detect any water quality limit exceedance.

~~20~~18 The release of coals seam water must cease immediately if identified that the release of coal seam waters is causing erosion of the bed and banks of the receiving waters, or is causing a material build up of sediment in such waters.

~~21 The release of coal seam water must cease immediately if holder of this Transitional Environmental Program is directed to do so by the administering authority.~~

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~~22~~19 The release of coal seam water will cease immediately if Isaac River flow decreases below 12.6m^3/s~~1090ML/day~~ (at Goonyella Gauging Station).

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20 The release of coal seam water will cease immediately from any dam in Table 1 once the dams level is more than 100mm lower than the 'Target Dam Fill Height' shown in Table 1.

Monitoring Requirements

~~23~~21 Where monitoring is a requirement of this Transitional Environmental Program, ensure that a competent person(s) conducts all monitoring.

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~~24~~22 Monitoring will occur at the frequencies identified in Table 6 and Table 7.

~~25~~23 All monitoring undertaken as a requirement of this Transitional Environmental Program must be undertaken in accordance with the administering authority's Water Sampling Manual.

Notification of emergencies, incidents and exceptions

~~26~~24 As soon as practicable after becoming aware of any 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 Transitional Environmental Program, the administering authority must be notified of the release by telephone, facsimile or email.

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~~27~~25 The notification of emergencies or incidents must include but not be limited to the following:

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a) the holder of the Transitional Environmental Program
b) the location of the emergency or incident
c) the number of the Transitional Environmental Program
d) the name and telephone number of the designated contact person
e) the time of the release
f) the time the holder of the Transitional Environmental Program became aware of the release
g) the suspected cause of the release
h) the environmental harm caused, threatened, or suspected to be caused by the release, and
i) actions taken to prevent any further release and mitigate any environmental harm caused by the release.

29 Not more than 10 business days following the initial notification of an emergency or incident, written advice must be provided of the information supplied to the administering authority in relation to:

a) proposed actions to prevent a recurrence of the emergency or incident, and

b) outcomes of actions taken at the time to prevent or minimise environmental harm.

Appendix A
ALS & Qld Health water sampling results

Client Reference	Collected Date	Received Date	Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmiun	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	3.8	< 0.0001	0.0011	0.076	< 0.0001	0.05	< 0.0001	0.0027	0.0011	0.003	1.7	0.0013	0.056	< 0.0001	0.0007
Discharge_Point	14-Dec-10	17-Dec-10	0.18	< 0.0001	0.0012	4.5	< 0.0001	1.1	< 0.0001	0.0003	0.0002	0.002	0.08	0.0004	0.0046	< 0.0001	0.0019
Pond_2a	16-Dec-10	17-Dec-10	0.1	< 0.0001	0.0015	6.1	< 0.0001	1	< 0.0001	0.0002	0.0003	0.001	0.066	< 0.0001	0.007	< 0.0001	0.0013
Pond_2	16-Dec-10	17-Dec-10	0.09	< 0.0001	0.0014	6	< 0.0001	1	< 0.0001	0.0002	0.0003	< 0.001	0.044	< 0.0001	0.0065	< 0.0001	0.0012
POND1_1	17-Dec-10	20-Dec-10	0.37	< 0.0001	0.0021	5.8	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.18	< 0.0001	0.0057	< 0.0001	0.0028
POND1_2	17-Dec-10	20-Dec-10	0.43	< 0.0001	0.0023	6	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.2	0.0002	0.0065	< 0.0001	0.0031
POND10_1	17-Dec-10	20-Dec-10	0.2	< 0.0001	0.0018	7.7	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.069	< 0.0001	0.0039	< 0.0001	0.0031
POND10_2	17-Dec-10	20-Dec-10	0.18	< 0.0001	0.0019	7.6	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.067	< 0.0001	0.0041	< 0.0001	0.0034

Client Reference	Collected Date	Received Date	Nickel	Selenium	Silver	Stroniu m	Thallium	Titani um	Uranium	Vanadium	Zinc	Benzen e	Toluene	Ethylbenzon e	Meta&Para- Xylenes	Ortho- Xylene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	0.0031	< 0.0010	< 0.001	0.2	< 0.0001	0.14	0.0002	0.012	0.003	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Discharge_Point	14-Dec-10	17-Dec-10	0.0008	< 0.0010	< 0.001	7.3	< 0.0001	0.006	0.0003	0.0029	0.013	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2a	16-Dec-10	17-Dec-10	0.0012	< 0.0010	< 0.001	9.6	< 0.0001	0.003	0.0003	0.0051	0.006	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2	16-Dec-10	17-Dec-10	0.0011	< 0.0010	< 0.001	9.4	< 0.0001	0.002	0.0003	0.005	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_1	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	10	< 0.0001	0.017	0.0009	0.0059	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_2	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	11	< 0.0001	0.015	0.0009	0.0062	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_1	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.026	0.0008	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_2	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.01	0.0007	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

ALS	21/12/2010	Sample	ID 1	DAM 1	DAM 10	DAM 4	DAM 3	D1	D2	DAM 5	DAM2	TRIP BLANK
			ID 2									
ES1025292	Results		Date Sampled	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010
Analyte	CAS #	Units	LOR	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
EA005: pH												
pH Value		pH Unit	0.01	9.17	9.28	9.34	9.38	9.4	9.42	9.27	9.15	-
EA010P: Conductivity by PC Titrator												
Electrical Conductivity @ 25°C		µS/cm	1	12600	14000	16400	25900	25800	26100	10700	10600	-
EG020T: Total Metals by ICP-MS												
Arsenic	7440-38-2	mg/L	0.001	0.003	0.003	0.002	<0.001	0.004	0.004	<0.001	0.002	-
Barium	7440-39-3	mg/L	0.001	6.54	8.33	4.35	1.93	1.92	1.98	6.4	9.31	-
Beryllium	7440-41-7	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cadmium	7440-43-9	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Cobalt	7440-48-4	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	-
Chromium	7440-47-3	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	-
Copper	7440-50-8	mg/L	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004	-
Manganese	7439-96-5	mg/L	0.001	0.008	0.003	0.002	0.001	0.001	0.003	0.002	0.038	-
Nickel	7440-02-0	mg/L	0.001	0.001	<0.001	0.001	0.002	0.002	0.002	<0.001	0.003	-
Lead	7439-92-1	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Vanadium	7440-62-2	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Zinc	7440-66-6	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	-
EG035T: Total Recoverable Mercury by FIMS												
Mercury	7439-97-6	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
EK055G: Ammonia as N by Discrete Analyser												
Ammonia as N	7664-41-7	mg/L	0.01	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
EK057G: Nitrite as N by Discrete Analyser												
Nitrite as N		mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EK058G: Nitrate as N by Discrete Analyser												
Nitrate as N	14797-55-8	mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser												
Nitrite + Nitrate as N		mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser												
Total Kjeldahl Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser												
Total Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK067G: Total Phosphorus as P by Discrete Analyser												
Total Phosphorus as P		mg/L	0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EP080: BTEX												
Benzene	71-43-2	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	108-88-3	µg/L	2	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	100-41-4	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
EP080S: TPH(V)/BTEX Surrogates												
1,2-Dichloroethane-D4	17060-07-0	%	surrogate	113	111	103	112	105	110	110	106	106
Toluene-D8	2037-26-5	%	surrogate	110	106	103	109	105	106	107	103	102
4-Bromofluorobenzene	460-00-4	%	surrogate	106	99.7	97.9	104	97.1	98.6	101	97	101

Appendix B
Dilution calculation basis

Table 10 Dilution calculation at 400:1 release

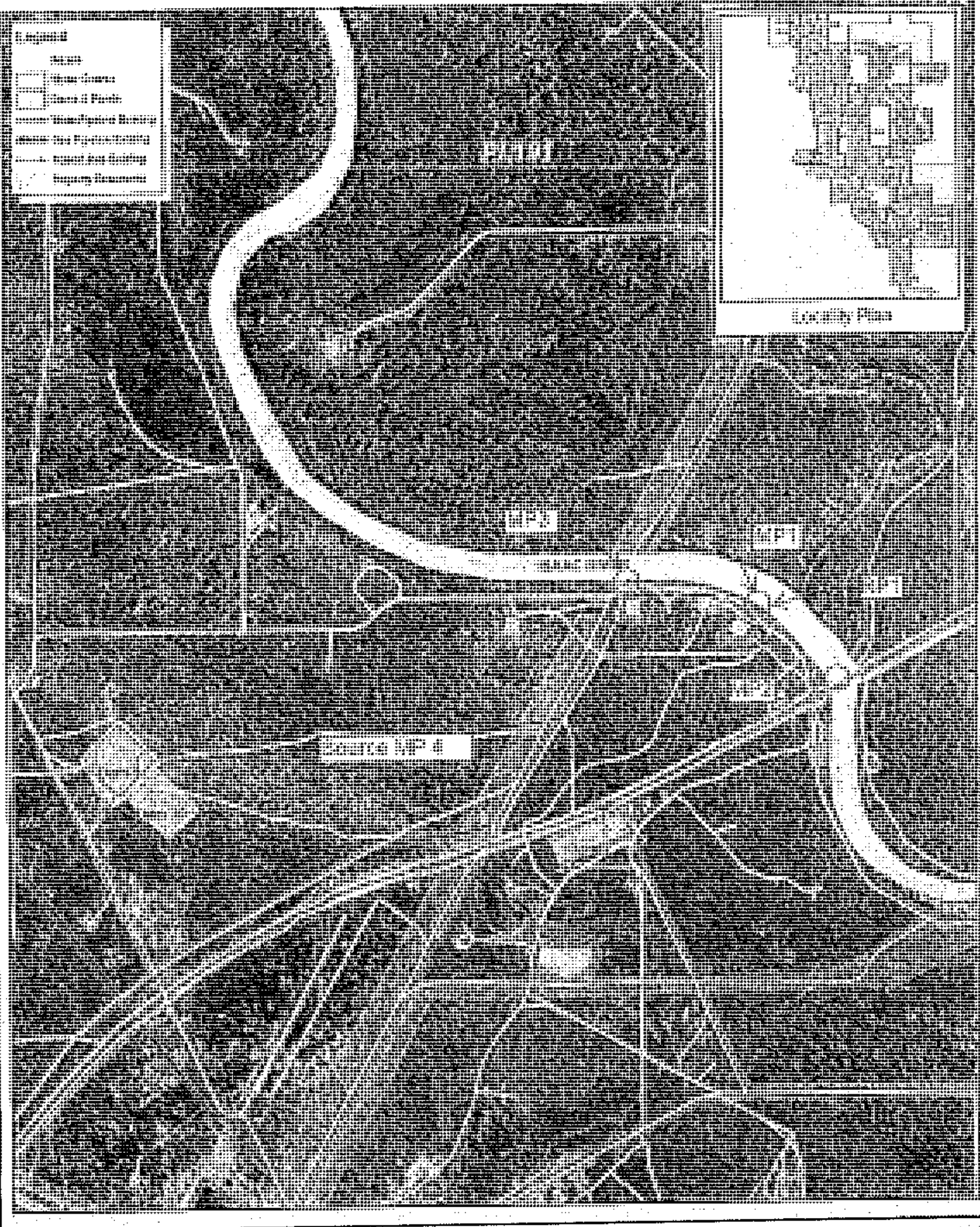
Parameter	Unit	Surface Water Concentration	Concentration of Discharge	Dilution X:1	Surface Concentration after dilution	Guideline[1]
EC	µs/cm	250	~~10600~~13000	400	276.5	746
Sodium	mg/L	65	2970	400	72.4	180
Chloride	mg/L	80	4280	400	90.7	250

Comment [k19]: Given an end of pipe of 13000 EC has been sought this table should reflect that. For example water discharged in early Jan was higher than 10600 coming in at 11200

[1] *Australian drinking water guidelines (NHMRC,2004)*
Sodium and Chloride based on EC, common soil quality (run off) and historical data from upstream

Appendix C
Mapping showing PL191 and location of key Dams

ARROW ENERGY - BOWEN BASIN GAS PROJECT



Moranbah Gas Project - Dam 5

Source:
Arrow Energy Limited
Geosciences Australia
Dept. Envis and Resource Mgmt.

Date: 23/12/2010
Issued To: B. Wilson
Author: tstringer

Scale: 1:19,762 @ A4
Coordinate System: GDA 1994 MGA Zone 55

arrow energy

NOT FOR CONSTRUCTION

Appendix D
Sampling Procedure

SUMMARY

1.1	This procedure outlines general sampling protocols and work practices to be followed during the sampling of surface water, during the discharge of untreated CSG well water to the Isaac River. This procedure includes details on: ▪ Sampling equipment requirements; ▪ Surface water sampling techniques; ▪ Quality control requirements. ▪ Sample locations (Figure 1) ▪ Analytical requirements

EQUIPMENT

2.1	▪ Documentation o Sampling and analysis plan. o Health and safety plan o Personal protective equipment (PPE) as identified in the HSP, inc. Life Jacket and other specialised PPE, as per the HSP. ▪ Water sampling equipment o sample collection device, (Swing Arm Sampler/extension sampler) o decontamination solution (e.g. Decon 90™) or use new sample collection container in the swing arm sampler at each location. o Calibrated water quality meter (ensure parameter ranges are suitable for the water being tested), o laboratory supplied sample containers, o Chilled ice chest. o Field sample Record Sheet o Chain of Custody Form (Attached).

3.0 REFERENCES & PROFORMA

3.1	▪ AS NZS 5667.1-1998 *Water quality - Sampling - Guidance on the design of sampling programs sampling techniques* ▪ AS NZS 5667.4-1998 *Water quality - Sampling - Guidance on sampling from lakes natural and man-made* ▪ AS NZS 5667.6-1998 *Water quality - Sampling - Guidance on sampling of rivers and streams* ▪ Monitoring and Sampling Manual 2009 Environmental Protection (Water) Policy 2009, *Monitoring and Sampling Manual 2009*, Version 2 September 2010

4.0 PROCEDURE

4.1	Safety

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	Unless specifically required, the following general safety requirements should be noted: 1. Appropriate personal protective equipment should be worn as specified in the Health and Safety Plan (HSP). When working in or around water bodies, a life jacket is required to be worn and a minimum of two persons to be present should be assessed. 2. Assess hidden hazards (eg. trip hazards, snakes, leeches, etc.). 3. Assess risks from slippery or unstable banks. 4. Assess whether the water body / drain may constitute a confined space. 5. Assess the likelihood that surface conditions within and around the water body may change rapidly in the event of heavy rainfall or tidal change.

4.2	Sampling
	1. The sampling frequency during and following discharge to the Isaac River shall be as follows: • daily during discharge; and • daily for two days following discharge stopping. 2. The sampling sequence should commence where the lowest likely contaminant concentrations are expected (e.g. downstream and work upstream), to reduce the risk of cross contamination between samples. On this basis, the samples shall be collected at the following locations (in order): (See Figure 1 for sampling locations) I. River crossing (upstream), (One primary sample (S1), plus one duplicate sample (QC1)) II. Blair Athol Bridge (downstream), One primary sample (S2), plus one duplicate sample (QC2)) III. At the Discharge Point, One primary sample (S3), plus one duplicate sample (QC3)) IV. At the Source (Dam) One primary sample (S4), plus one duplicate sample (QC4)) V. QC samples – Field/Trip Blank (QC5) and rinsate blank (QC6) (If required) 3. At each location, a water sample should be collected for standard field parameters using a calibrated water quality meter. The following parameters should be recorded: a. pH, b. conductivity, c. dissolved oxygen, d. redox potential, e. temperature and f. turbidity. Notes: • Follow the manufacturer's instructions for use and calibration of instruments to measure water parameters. A calibration record must be kept. • When recording dissolved oxygen readings, it is important to note whether the results are reported as % saturation or ppm. • With conductivity, record whether units are mS or µS.

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4. Based on the nature of the sampling locations, heterogeneous distribution of potential contaminants in the water samples is considered likely. Therefore, the following Quality Control Samples should be collected and analysed for this program:
    a. One duplicate sample per sample location for TPH, BTEX and 8 Metals analysis (QC1 – QC4).
    b. One Blank Sample per esky (laboratory prepared DI Water for TPH (C6 – C9) and BTEX analysis) (QC5).
5. One rinsate sample per day (unless using new sample collection medium between sample locations i.e. a new container in the swing arm sampler) for TPH (C6 – C9) and BTEX analysis) (QC6).
6. At each location sample bottles should be filled based on a decreasing order of potential volatility (i.e. VOCs, BTEX and TPH first, followed by metals and other inorganic samples).
7. Note: DO NOT field filter samples for total metals. Perform field filtering for dissolved metals samples only.
8. When sampling shallow waters, contamination from bottom sediments should be avoided. Samples should be collected by submerging a clean sample collection container (up-side down) into the water and to approximately 100mm below the surface, rotate the container to allow it to fill.
9. The sampling location should be as representative as possible of the event being monitored. i.e. do not sample stagnant water at the edge, attempt to sample .
10. Record the appearance of the water body, i.e. colour, turbidity, odour, surface crusts, films or floating material, algae, water velocity, etc. In addition, record the weather conditions at the time of sampling and note any other relevant observations, e.g. dead or distressed flora/fauna, surface rubbish, spills, etc.
11. All measurements and field notes should be documented on the field sheet (Attachment A)

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5.0 ANALYTICAL/SAMPLE CONTAINER REQUIREMENTS

5.1	1. The analytical suite includes the following: a. pH, EC, TDS, Turbidity b. Ions: Magnesium, Calcium, Sodium, Sulphate, Chloride, Ammonia, Nitrate, Fluoride (total). c. Metals, Aluminium, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Zinc, Boron, Cobalt, Manganese, Molybdenum, Selenium, Silver, Uranium, Vanadium. d. Organics: BTEX, PAH, TPH 2. Each Sample Requires the following containers: a. 60ml Plastic Bottle for metals (with red and green striped label border) (tick 'Total Metals') b. 500ml Plastic Bottle for anions/cations (with green label border) c. 250ml Amber Glass Bottle (with purple label border) d. One pair of BTEX vials (40 mL glass cylindrical containers with purple label border).
	Notes: • The selection of sample containers depends on the laboratories being used. The above list is based on ALS requirements only. When ultra trace analysis is being requested, additional sample volume may be required. Always check with the laboratory prior to submitting samples to the laboratory. • When filling the vials it is important that they are filled to the top with no air space remaining. • Use new sample gloves between sample locations.
5.2	1. Place samples immediately in a chilled ice chest 2. Complete sample request form and include in sealed bag in the cooler 3. Courier samples to the receiving laboratory.

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12			Surface Water Sampling					Form
Site				Sampling Method:				
Job Number				Local Air Temperature:				
Date:	Time:			Wind Force:				
Weather:		Cloudiness %		Direction of Wind:				
Location	Sample No.	Water Flow (l/s)	Field Readings				Depth (m)	Comments: including turbidity (plankton and/or sediment), colour, water plants, weather conditions, etc
			pH	Conductivity	Temperature	Dissolved Oxygen		
Comments concerning treatment of samples, especially preservation:								
Name:		Signed:		Project Manager:				adapted from AS 5667.4

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Analytes

Quality characteristic	
pH	
EC	Ammonia
Turbidity	Nitrate
Magnesium	Fluoride (total)
Calcium	BTEX
Sodium	PAH
Sulphate	TPH
Chloride	
Aluminium	
Arsenic	
Cadmium	
Chromium	
Copper	
Iron	
Lead	
Mercury	
Nickel	
Zinc	
Boron	
Cobalt	
Manganese	
Molybdenum	
Selenium	
Silver	
Uranium	
Vanadium	

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Appendix E
URS Dam 2 Assessment

[redacted]

From: Ben McMahon
Sent: Friday, 4 February 2011 10:30 AM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: MGP TEP
Attachments: Tracked changed arrow tep.doc

Hi [redacted]

Round 4 (I think)

I have updated the TEP based on the comments received yesterday afternoon. I think we have reached an appropriate point to issue this TEP We would like to focus on meeting the requirements of a granted TEP. This is difficult for us if the requirements keep changing.

Please be advised that we are presently refraining from discharge until we have a granted TEP.

Best regards

Ben

DERM comment	*Arrow Response*
Data from 27 December is not appropriate. Update table with current details of dam levels – If the TEP is resubmitted on 3 or 4 Feb I would accept data from 31 Jan onwards..	This data is in fact from 27th of January. Text has been updated to reflect the correct date
Could this table be updated to include rainfall to 31 January 2011, or a later date?	This has been updated. The rainfall up to the first submission of the TEP is the cause of the TEP - much of this requirement to rework data does not change the circumstances leading to the TEP
Given this was resubmitted on 28 Jan cant this be updated?	
Could this table be updated to reflect releases/rainfall to date?	
How is discharge proposed? Provide info on release point placement please.	This discharge point is pre-existing and within historic and current EA's

At 1090ML/day 400:1 would allow 2.4ML to be discharged. Once 3000ML or 35m3/s flow was reached then the max of 7.5ML could be discharged.	This was our understanding but it seems worthwhile to clarify this point within the EA
1090ML/day flow in the river is appropriate when discharging up to 2.4 ML/day, however for 7.5ML/day discharge requires 3000ML/day of flow in the river or as proposed; 34.72 m3/second.	
Please include the newer data emailed separately on 28 jan and in a format that makes it possible to compare against TEP sample locations.	This data will be reported under the TEP and should not be part of the current revisions. The text has been updated to reflect this better
EC should be monitored upstream and downstream and not just at discharge point. QLD Health also support this.	This is happening in practice we agree with the change
This list should be consistent with the list in Appendix D – Analytes. For example sodium and chloride are listed in that table but not in this table.	Sodium, Chloride and EC have been added.
QLD Health have advised trigger levels for Chloride should be 250mg/L and sodium 180mg/L	Added
EC should be added with trigger of 350us/cm	We have accepted these changes. This is the second round of comments from Q Health we are concerned that they are adding new requirements.
QLD Health advice this should be ADWG level of 10	
Q Health advice as above	
As above	
Table 4 RP1 and this RP1 easting/northing do not match.	
I apologise for this backflip given my earlier advice about ML/day. Given the nature of the hydrograph for the river I have been advised that m3/s is more appropriate.	This is not a material change our understanding is that the DERM monitoring reports daily totals in ML/day we will stick with this units. We base the decision to discharge on the cumulative daily total not on instantaneous flow
Recognise that Arrow intend on using DERM data for flow information. Suggest due to the nature of the hydro graph Arrow commit to monitoring levels on at least a twice daily basis.	We check at 8am and 8pm. The decision to discharge is based on the daily total.

I note the comment that one downstream monitoring location is in Arrows view enough. QLD Health and DERM water scientist require another one downstream. Please advise if it is physically possible to safely get samples from an accessible downstream location.	The current downstream location is consistent with historic EA requirements. Arrow has safety and access concerns in adding additional sites particularly since they require access during periods of wet weather
This previously referred to a condition that was not relevant	Noted
Given an end of pipe of 13000 EC has been sought this table should reflect that. For example water discharged in early Jan was higher than 10600 coming in at 11200	This has been updated to the 13000 value

Ben McMahon
Manager Compliance & Reporting

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DRAFT TRANSITIONAL ENVIRONMENTAL PROGRAM UNDER SECTION 333 OF THE *ENVIRONMENTAL PROTECTION ACT 1994*

Principal Holder:	CH4 Pty Ltd **AM-60** Level 19 42 Albert Street Brisbane QLD 4000
EA Number:	PEN100015907
Title:	**Coal Seam Water Management Moranbah Gas**
Project	**Moranbah Gas Project PL191/196**
Program notice submitted:	3 December 2010
Revision date	Version 4, 4 February 2011
Finish Date:	31 May 2011

Introduction

The Moranbah Gas Project lacks sufficient water storage capacity as previously indicated in correspondence to DERM (dated 25 October 2010) and subsequent responses to information requests and the program notice documentation submitted by Arrow (dated 3 December 2010). This has been caused by an early start to the wet season contributing to existing dam levels and causing construction delays. This has prevented Arrow from making additional storage available via the completion of dam 11. The synthetic lining for the dam cannot be installed during periods of rainfall; the civil engineering also requires careful control of the moisture content of the construction materials to achieve the required specifications.

Dam 11 has been designed and is being constructed in line with the most current dam standards stipulated by DERM and contained in the previously submitted and assessed dam design report. It is a large lined dam – intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, develop beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies.

The continued rain has delayed the completion of dam 11. This has put Arrow in a position where it cannot comply with the current EA conditions. Arrow intends to employ this transitional environmental program (TEP) as defined in Chapter 7, Part 4 of the *Environmental Protection Act 1994 to bring our operation back into compliance with its current Environmental Authority*. In initiating this process Arrow intends to work with DERM to minimise the potential for environmental harm.

Background

Arrow currently employs a network of 10 dams across PL191 and PL196. Dams 1 through to 7 are shown in the attached drawing (Appendix C). Dams 8 and 9 in the network are SW of the main area depicted in the provided drawing. Approximately 90% of the total storage capacity for coal seam water is held in Arrow's major storage dams 1, 2 and 10. The other dams are employed to move water between groups of remote wells and the major storage dams. Dam 3 is employed to store more concentrated brine. An important feature of the petroleum lease is the Isaac River which divides the lease along a NW to SE axis and its tributary Teviot Brook. Isaac River is an ephemeral river; during periods of high flow it limits access to infrastructure on the north eastern side of the petroleum lease via river crossings.

Situation

Our strategy is to maintain low levels in the older and less accessible dams (particularly dams 6,7, 8 and 9) by moving water to dams 1 and 10. Dam 10 is our most recently constructed dam and has an engineered spillway, dam 1 is in reasonable condition and adjacent to dam 10 which allows water to be transferred readily between dams.

Our risk assessment process and an independent third party geotechnical evaluation by URS has identified particular concerns with the integrity of dam 2 (refer to Appendix E). Arrow has concerns regarding the condition of dam 2 – it is scheduled to be brought out of service on the completion of Dam 11. Based on geotechnical evaluation we intend to lower the level of water in Dam 2 to 4m below DSA. The goal of this strategy is to maintain pond integrity and minimise discharge to the environment when a suitable plan to restore the operational integrity of dam 2 is developed or the dam is retired from operational duty.

Arrow believes that a controlled discharge during high flow conditions in the Isaac River via the existing infrastructure would result in the least environmental impact whilst preserving the integrity of the existing dams. This option prevents the overland flow of untreated coal seam water reaching the Isaac River and minimises the risk of damaging older dams which are built prior to the new standards and lacking engineered spillways. When the facility was originally developed the water management scheme was significantly different to now and included a wet weather discharge. At present our existing infrastructure is not sufficient to comply with the conditions of the current Environmental Authority particularly during extended wet periods.

Our system of dams has an area of 125,100 m^2, this equates to a gain of 0.125ML per mm of rainfall. The system is designed to transfer water to the major storage dams 1, 2 and 10 this contribute to the catchments of these structures, each 1 mm of rainfall will cause an increase in dam height of 1.6 mm in dams 1, 2 and 10. When all the input rainfall is directed to dam 10 each 1 mm of rainfall causes an increase in dam height of 2.7 mm in dam 10.

Table 1 Key Dam Variables Dams 1, 2, 5 and 10

Dam		1	2	5	10
Volume at Spill level	ML	119.66	92.64	7.64	203.70
Spillway		No	No	No	Yes
Liner type		CCL	CCL	0.5mm HDPE	1.5mm HDPE
Hydraulic height	m	5.60	5.50	3.5	4.75
MRL	m	5.25	5.15	3.15	4.40
DSA	m	4.75	4.65	2.65	3.90
Target dam fill height [b]	m	4.75	0.65	2.65	3.90
Current level (below MRL)[a]	mm	100	870	Varies[c]	40
Remaining rainfall *(to spill)*[d]	mm	281	762	>800	244

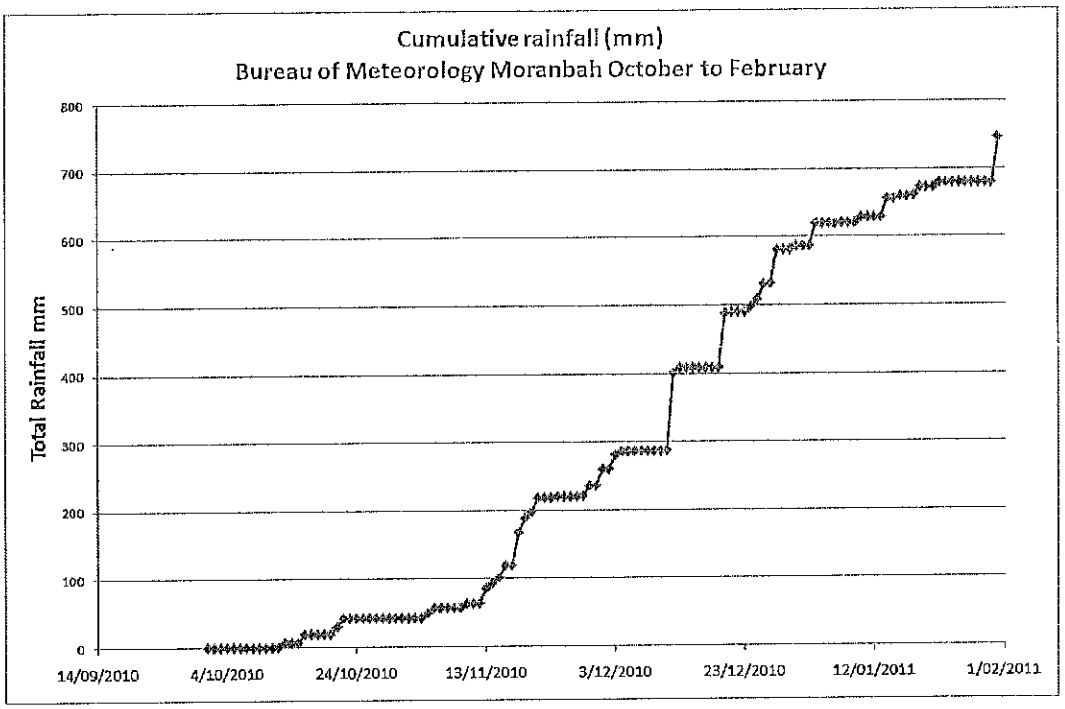
[a] Levels 27 January 2010, negative denotes level above MRL

[b] Target dam fill height is DSA for dams 1 and 10, 4m below DSA for dam 2. Current target height for dam 2 is based on 3rd party civil engineering assessment completed by URS.

[c] This dam is much smaller than the major storage dams its level can change rapidly during operations

[d] Rainfall based on approximate catchment ratio of 1.6 (based on total catchment area including transfer dams)

Figure 1 Cumulative rainfall between October to December Moranbah



Future water levels will be a product of the rainfall, coal seam water production and evaporation. Our goal is to maintain dams 1 and 10 at DSA levels by employing a discharge to the Isaac River. Dam 2 will be lowered to a level determined by independent third party engineering risk assessment.

Arrow has evaluated 2 scenarios for water requiring discharge from the storage system:

- Scenario 1 – Mean rainfall until end of wet season
- Scenario 2 – 95th percentile rainfall until end of wet season

Rainfall to date is very close to the 95th percentile rainfalls on average from October through to December. We have had a cumulative total of 586mm from the 1st of October to end of December (Figure 1), 95th percentile cumulative rainfall for the period from the start of October to the end of December totals 522mm.

Based on the current progress of the wet season Arrow believes that the next few months will produce above average rainfall. Long range forecasts from the Bureau of Meteorology give a 55% chance of rainfall at or above the 95% percentile values. In determining the water balance for the facility has evaluated 2 scenarios – mean and 95th Percentile rainfall (refer to Table 2).

Table 2 Discharge scenarios

Scenario	Volume to reach DSA (ML)	Additional removal from Dam 2 (ML) [b]	Expected Net [a] Water to Storage (ML)	Total (ML)
Mean Rainfall	69	75	54.5	198.5
95th Percentile	69	75	130	274

[a] *Net water to storage is produced water, less evaporation plus expected rainfall.*
[b] *This is based on a dam 2 target of 4000mm below DSA.*

Arrow proposes a discharge of up to 7.5ML/day when dams are above the target dam fill height shown in Table 1. The release will commence when the Isaac River is flowing above 12.6m^3/s (at this starting flow only 2.4ML/day could be discharged) measured upstream at the Goonyella river gauge (operated by DERM). Discharge will be maintained at a 400:1 dilution ratio on the basis of maintaining Australian drinking water guidelines (NHMRC,2004) downstream of the discharge. Based on a predicted salinity impact as detailed in Appendix B. This discharge rate and the dilution factor will be reviewed throughout the TEP in consultation with DERM and informed on the basis of the upstream/downstream river monitoring in line with the proposed conditions detailed within this document.

Sampling will be conducted in line with the conditions detailed in this TEP under the procedure attached as Appendix D. Appendix A contains indicative water quality to characterise the coal seam water to be discharged.

Supporting Information

Consideration of the management hierarchy for the management of coal seam water at the MGP

Evaluation as per the management hierarchy of preferred procedures from Environmental Protection (Water) Policy 2009:

Step 1—evaluate water conservation measures to reduce the use of water and the production of waste water or contaminants;
Water is not employed in the coal seam gas production process but must be removed from the coal seam to allow the gas to be extracted. Water conservation measures will not reduce the amount of coal seam water associated with the gas extracted.

Step 2—evaluate waste prevention options and implement appropriate waste prevention measures;
The key waste prevention measure employed is maximisation of the coal seam gas to water ratio. The coal seams targeted by MGP have relatively low ratios of water to gas in comparison to other fields. In an effort to manage our recent water storage constraints Arrow has shut in a large number of wells, targeting the wells with high water to gas ratios to minimise the production of coal seam water associated with our operations.

Whilst this has reduced our coal seam water production, shutting in further wells will yield limited benefits in terms of water reduction but will cause significant reduction in gas output.

Use of dam 11 in its current uncompleted, unlined state has been investigated. The pipe work and major civil infrastructure is complete but the floor of the dam is incomplete – as discussed (in our meeting on the 1st of December) it lacks its intended second liner, more importantly the clay liner has not been sufficiently compacted to allow its use. Key elements of the pipework connecting dam 11 to the rest of the network remain incomplete. Employing dam 11 would require its use for an extended period to allow subsequent emptying and upgrade of the existing dam infrastructure.

Step 3—if waste prevention does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate treatment and recycling options and implement appropriate treatment and recycling;
The construction of Dam 11 is the first component of our coal seam water management strategy. It is a large lined dam, intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies. Rainfall is delaying the construction of dam 11 and contributing to the current water storage problems.

Installation of water treatment (such as a mobile RO plant) is limited by the logistics (such as civil engineering, chemical storage and power supply), cost and the challenges posed during current wet conditions. Another option considered was employing water entitlements to dilute the untreated coal seam water to the current environmental authority specification. This option was ruled out since a large quantity of good quality water would be required to dilute and dispose of a limited amount of coal seam water from our dams.

Step 4—if treatment and recycling does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate the following options
for waste water or contaminants, in the order in which they are listed—
(i) appropriate treatment and release to a waste facility or sewer;
(ii) appropriate treatment and release to land;
(iii) appropriate treatment and release to surface waters or ground waters.

I) We cannot practically truck water from the dams given the large quantities and the lack of disposal options. Wet weather is likely to complicate trucking of water by limiting access to some points within the MGP. Infrastructure does not exist to process this water via sewer or other industrial water treatment options. Our landholders have expressed concern of minimising truck movements during the wet season.

II) Until our water treatment management strategy is implemented we cannot treat the water to a standard that is suitable for use on land.

III) We consider the water in its current state is suitable for discharge into the Isaac – this was the water management strategy employed by the facility until earlier EA conditions were amended, we are seeking permission from DERM to allow this discharge as previously authorised until we can implement our water management strategy for the MGP. We consider a temporary discharge to the Isaac river during high flow conditions to be compliant with section 51 of the Environmental Protection Regulation 2008.

Objectives

To achieve compliance with the Environmental Authority with respect to coal seam water management and dam standards by April 2011.

This will be achieved in the short term by the release of water to the Isaac River. This measure will protect the integrity of our storage infrastructure and is consistent with the operational philosophy that our existing infrastructure was designed to accommodate.

In the medium term compliance with the new EA will be achieved by the completion of Dam 11. Completion of dam 11 will require Arrow energy to utilise the cleared area north of dam 11.

In the long term, compliance with our EA will be achieved by completion of water treatment facilities that allow beneficial use and disposal within Arrows Environmental Authority conditions. Arrow is to provide DERM with a detailed plan concerning future water management for approval.

Table 3 – Achieving TEP objectives

OBJECTIVE	ACTION	RESPONSIBILITY	TIME FRAME	PERFORMANCE INDICATOR
1. Lower dam levels for (dams 1, 2, 5, 10) to below the 'Target dam fill height" as shown in Table 1.	Manage via discharge (RP1) to Isaac river	Arrow site personnel	Immediate	Manage dams within appropriate levels as detailed in Tables 1 and 2. Discharge is to be subject to monitoring and reporting requirements
2. Monitor Discharge	Monitor discharge in accordance with Table 5, for the contaminants listed in Table 6 and Table 7	Arrow site personnel	During discharge	Lab results to be reported to DERM within 10 business days of collection.
3. Pond 2	Develop management plan to restore dam integrity or remove from service	Arrow	15 March 2010	Submission of management plan to DERM
4. Cease discharge	Cease discharge to Isaac river under TEP	Arrow	31 March 2011	Cease discharge to Isaac river
5. TEP report submission	Provide DERM with final TEP report detailing how the objectives of this TEP have been met	Arrow	31 May 2011	Submission of TEP report to DERM

Monitoring

Table 4 Contaminant release points, sources and receiving waters

Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point	Receiving waters
TEP RP 1	148° 2' 35"	-21° 57' 41"	untreated CSG water from PL191/196	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
				Upstream from discharge – Isaac River Crossing	
				Downstream from discharge – Blair Athol Bridge	

Table 5 Contaminant release monitoring points

Monitoring point (TEP MP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point location	Receiving waters
TEP MP 1	148° 2' 35"	-21° 57' 41"	Untreated CSG water from PL191	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
TEP MP 2	148° 2' 46"	-21° 57' 55"	Downstream from discharge – Blair Athol Bridge	Blair Athol Railway Bridge	na
TEP MP 3	148° 2' 20"	-21° 57' 41"	Upstream from discharge	Isaac River Crossing	
TEP MP 4	148° 1' 10"	-21° 58' 00"	Untreated CSG water dam 1	Dam 1	
TEP MP 5	148° 2' 8"	-21° 58' 01"	Untreated CSG water dam 2	Dam 2	
TEP MP 6	148° 2' 32"	-21° 57' 44"	Untreated CSG water dam 5	Dam 5	
TEP MP 7	148° 1' 14"	-21° 58' 4"	Untreated CSG water dam 10	Dam 10	

Table 6 Contaminant release limits

Quality characteristic	Release Limit	Monitoring Frequency	Sample Type	Monitoring Point
Electrical conductivity (uS/cm)	13000	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1 TEP MP2 TEPMP3
			Samples require laboratory analysis[2]	TEP MP 1 TEP MP2 TEPMP3
pH (pH Unit)	6.5 (minimum) 9.5 (maximum)	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1 TEP MP 2 TEP MP 3
			Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3
Turbidity (NTU)	500	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3
BTEX Benzene, Ethylbenzene, Toluene and Xylene (mg/L)	Benzene 0.001 Ethylbenzene 0.3 Toluene 0.8 Xylene 0.02	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3

[1] *In situ samples can be taken using electronic sampling equipment.*
[2] *Samples are required to be analysed at a NATA accredited facility in accordance with this Transitional Environmental Program.*

Table 7 Downstream contaminant trigger investigation levels

Quality characteristic	Trigger levels (µg/L)	Monitoring frequency	Monitoring Point
Aluminium	55	Commencement of release and thereafter weekly during release	TEP MP 2 TEP MP 3
Arsenic	10		
Cadmium	0.2		
Chromium	1.0		
Copper	2.0		
Iron	300		
Lead	10		
Mercury	0.2		
Nickel	11		
Zinc	8.0		
Boron	370		
Cobalt	90		
Manganese	500		
Molybdenum	34		
Selenium	10		
Silver	1.0		
Uranium	1.0		
Vanadium	10		
Ammonia	900		
Nitrate	1100		
Petroleum hydrocarbons (C6-C9)	20		
Petroleum hydrocarbons (C10-C36)	100		
Fluoride (total)	1500		
EC	350µs/cm		
Chloride	250mg/L		
Sodium	180mg/L		

Table 8 Contaminant release during flow events

Receiving waters	Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Minimum flow in receiving water required for a release event	Flow recording frequency
Isaac River	TEP RP1	148° 2' 35"	-21° 57' 41"	1090ML/day	Twice Daily from Goonyella Gauging station

Table 9 Receiving water downstream monitoring points

Monitoring points (TEP MP)	Receiving waters location description	Easting (GDA94)	Northing (GDA94)
TEP MP 2	Blair Athol Bridge 500 metres downstream of RP1	148° 2' 46"	-21° 57' 55"

Conditions

In carrying out this Transitional Environmental Program, CH4 Ltd (Arrow Energy) will undertake all activities in accordance with the following conditions.

Undertaking the release of untreated coal seam methane water

1 Contaminants that will, or have the potential to cause environmental harm must not be released directly or indirectly released to any waters except as permitted under this Transitional Environmental Approval.

2 The release of contaminants to waters must only occur from the release points specified in Table 4 and depicted in Appendix C attached to this Transitional Environmental Program.

3 The release of contaminants to waters must not exceed the release limits stated in Table 6 at the monitoring points specified in Table 5 and Table 6 of this Transitional Environmental Program.

4 The release of contaminants to waters from the release points must be monitored at the locations specified in Table 5 and Table 9 for each quality characteristic and at the frequency specified in Table 7 and Table 8 of this Transitional Environmental Program.

5 If quality characteristics of the release exceed any of the trigger levels specified in Table 7 during a release event, the Transitional Environmental Program holder must compare MP2 to the trigger values specified in Table 7 and:

a) where the trigger values are not exceeded then no action is to be taken

b) where the downstream results exceed the trigger values specified Table 7 for any quality characteristic, compare the results of the downstream site to the data from the upstream monitoring sites (MP3)

i) if the result is less than that recorded at Monitoring Point 3 (MP3), then no action is to be taken or

ii) if the result is greater than the background monitoring site data, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology, into the potential for environmental harm and provide a written report 20 business days after receiving results, outlining

- details of the investigations carried out
- actions taken to prevent environmental harm.

6 If an exceedance in accordance with condition 5(b)(ii) is identified, the holder of the Transitional Environmental Program must notify the administering authority within 24 hours of receiving the result. The notification must include written verification of the exceedance forwarded to the administering authority.

Contaminant Release Events

7 The release of coal seam water from the release point shown in Table 4 will not occur until -

a) - flow in the Isaac River flow reaches 1090 ML/day as shown in Table 8 (at Goonyella Gauging Station); and

b) -- At least one dam in Table 1 has exceeded the 'Target Dam Fill Height' shown in Table 1; and

c) – A dilution of at least 400 parts river flow to 1 part discharge can be maintained at all times (0.25% of receiving flow).

8 The daily quantity of contaminants released from each release point must be measured and recorded at the monitoring points in Table 4

9 The daily quantity of contaminants is not to exceed 7.5ML/day in total.

10 Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build up of sediment in such waters.

Notification of Release Events

11 The Transitional Environmental Program holder must notify the administering authority within 24hours of having commenced releasing coal seam water to the receiving environment. Notification must include the submission of written verification to the administering authority of the following information:

a) release commencement date/time
b) expected release cessation date/time
c) release point/s
d) release volume (estimated)

e) receiving water/s including the natural flow rate
f) any details (including available data) regarding likely impacts on the receiving water(s).

12 The Transitional Environmental Program holder must provide the administering authority daily during the release of coal seam water, the following information:
a) all in situ monitoring data for that day
b) the receiving water flow rate
c) the release flow rate.

13 The Transitional Environmental Program holder must notify the administering authority as soon as practicable, (no later than within 24 hours after cessation of a release) of the cessation of a release notified under condition 11 and within 15 business days provide the following information in writing:
a) release cessation date/time
b) natural flow volume in receiving water
c) volume of water released
d) details regarding the compliance of the release with the conditions of this Transitional Environmental Program (i.e. contamination limits, natural flow, discharge volume)
e) all in-situ water quality monitoring results
f) any other matters pertinent to the water release event.

Notification of release event exceedence

14 If the release limits defined in Table 6 are exceeded, the holder of the Transitional Environmental Program must notify the administering authority within 2 business days of receiving the results.

15 The Transitional Environmental Program holder must, within 28 days of a release that exceeds the conditions of this Transitional Environmental Program, provide a report to the administering authority detailing:
a) the reason for the release
b) the location of the release
c) all water quality monitoring results
d) any general observations
e) all calculations

f) any other matters pertinent to the water release event.

Requirements to cease the release of coal seam water

16 The coal seam water discharge must cease immediately if any water quality limit as specified in Table 6 is exceeded or if a dilution of 400 parts river flow to 1 part discharge (0.25% of receiving flow) cannot be achieved.

17 The Department of Environment and Resource Management may require CH4 Pty to cease discharge if the department's water monitoring stations detect any water quality limit exceedance.

18 The release of coals seam water must cease immediately if identified that the release of coal seam waters is causing erosion of the bed and banks of the receiving waters, or is causing a material build up of sediment in such waters.

19 The release of coal seam water will cease immediately if Isaac River flow decreases below 1090ML/day (at Goonyella Gauging Station).

20 The release of coal seam water will cease immediately from any dam in Table 1 once the dams level is more than 100mm lower than the 'Target Dam Fill Height' shown in Table 1.

Monitoring Requirements

21 Where monitoring is a requirement of this Transitional Environmental Program, ensure that a competent person(s) conducts all monitoring.

22 Monitoring will occur at the frequencies identified in Table 6 and Table

23 All monitoring undertaken as a requirement of this Transitional Environmental Program must be undertaken in accordance with the administering authority's Water Sampling Manual.

Notification of emergencies, incidents and exceptions

24 As soon as practicable after becoming aware of any 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 Transitional Environmental Program, the administering authority must be notified of the release by telephone, facsimile or email.

25 The notification of emergencies or incidents must include but not be limited to the following:

a) the holder of the Transitional Environmental Program
b) the location of the emergency or incident
c) the number of the Transitional Environmental Program
d) the name and telephone number of the designated contact person
e) the time of the release
f) the time the holder of the Transitional Environmental Program became aware of the release
g) the suspected cause of the release
h) the environmental harm caused, threatened, or suspected to be caused by the release, and
i) actions taken to prevent any further release and mitigate any environmental harm caused by the release.

26 Not more than 10 business days following the initial notification of an emergency or incident, written advice must be provided of the information supplied to the administering authority in relation to:

a) proposed actions to prevent a recurrence of the emergency or incident, and

b) outcomes of actions taken at the time to prevent or minimise environmental harm.

Appendix A
ALS & Qld Health water sampling results

Client Reference	Collected Date	Received Date	Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmiun	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	3.6	< 0.0001	0.0011	0.076	< 0.0001	0.05	< 0.0001	0.0027	0.0011	0.003	1.7	0.0013	0.056	< 0.0001	0.0007
Discharge_Point	14-Dec-10	17-Dec-10	0.18	< 0.0001	0.0012	4.5	< 0.0001	1.1	< 0.0001	0.0003	0.0002	0.002	0.08	0.0004	0.0046	< 0.0001	0.0019
Pond_2a	16-Dec-10	17-Dec-10	0.1	< 0.0001	0.0015	6.1	< 0.0001	1	< 0.0001	0.0002	0.0003	0.001	0.066	< 0.0001	0.007	< 0.0001	0.0013
Pond_2	16-Dec-10	17-Dec-10	0.09	< 0.0001	0.0014	6	< 0.0001	1	< 0.0001	0.0002	0.0003	< 0.001	0.044	< 0.0001	0.0065	< 0.0001	0.0012
POND1_1	17-Dec-10	20-Dec-10	0.37	< 0.0001	0.0021	5.8	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.18	< 0.0001	0.0057	< 0.0001	0.0028
POND1_2	17-Dec-10	20-Dec-10	0.43	< 0.0001	0.0023	6	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.2	0.0002	0.0065	< 0.0001	0.0031
POND10_1	17-Dec-10	20-Dec-10	0.2	< 0.0001	0.0018	7.7	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.069	< 0.0001	0.0039	< 0.0001	0.0031
POND10_2	17-Dec-10	20-Dec-10	0.18	< 0.0001	0.0019	7.6	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.067	< 0.0001	0.0041	< 0.0001	0.0034

Client Reference	Collected Date	Received Date	Nickel	Selenium	Silver	Stroniu m	Thallium	Titani um	Uranium	Vanadium	Zinc	Benzen e	Toluene	Ethylbenzon e	Meta&Para-Xylenes	Ortho-Xylene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	0.0031	< 0.0010	< 0.001	0.2	< 0.0001	0.14	0.0002	0.012	0.003	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Discharge_Point	14-Dec-10	17-Dec-10	0.0008	< 0.0010	< 0.001	7.3	< 0.0001	0.006	0.0003	0.0029	0.013	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2a	16-Dec-10	17-Dec-10	0.0012	< 0.0010	< 0.001	9.6	< 0.0001	0.003	0.0003	0.0051	0.006	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2	16-Dec-10	17-Dec-10	0.0011	< 0.0010	< 0.001	9.4	< 0.0001	0.002	0.0003	0.005	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_1	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	10	< 0.0001	0.017	0.0009	0.0059	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_2	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	11	< 0.0001	0.015	0.0009	0.0062	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_1	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.026	0.0008	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_2	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.01	0.0007	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

ALS	21/12/2010	Sample ID 1	DAM 1	DAM 10	DAM 4	DAM 3	D1	D2	DAM 5	DAM2	TRIP BLANK
		Sample ID 2									
ES1025292	Results	Date Sampled	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010
Analyte	CAS #	Units	LOR	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
EA005: pH											
pH Value		pH Unit	0.01	9.17	9.28	9.34	9.38	9.4	9.42	9.27	9.15	-
EA010P: Conductivity by PC Titrator											
Electrical Conductivity @ 25°C		µS/cm	1	12600	14000	16400	25900	25800	26100	10700	10600	-
EG020T: Total Metals by ICP-MS											
Arsenic	7440-38-2	mg/L	0.001	0.003	0.003	0.002	<0.001	0.004	0.004	<0.001	0.002	-
Barium	7440-39-3	mg/L	0.001	6.54	8.33	4.35	1.93	1.92	1.98	6.4	9.31	-
Beryllium	7440-41-7	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cadmium	7440-43-9	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Cobalt	7440-48-4	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	-
Chromium	7440-47-3	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	-
Copper	7440-50-8	mg/L	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004	-
Manganese	7439-96-5	mg/L	0.001	0.008	0.003	0.002	0.001	0.001	0.003	0.002	0.038	-
Nickel	7440-02-0	mg/L	0.001	0.001	<0.001	0.001	0.002	0.002	0.002	<0.001	0.003	-
Lead	7439-92-1	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Vanadium	7440-62-2	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Zinc	7440-66-6	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	-
EG035T: Total Recoverable Mercury by FIMS											
Mercury	7439-97-6	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
EK055G: Ammonia as N by Discrete Analyser											
Ammonia as N	7664-41-7	mg/L	0.01	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
EK057G: Nitrite as N by Discrete Analyser											
Nitrite as N		mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EK058G: Nitrate as N by Discrete Analyser											
Nitrate as N	14797-55-8	mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser											
Nitrite + Nitrate as N		mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser											
Total Kjeldahl Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser											
Total Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK067G: Total Phosphorus as P by Discrete Analyser											
Total Phosphorus as P		mg/L	0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EP080: BTEX											
Benzene	71-43-2	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	108-88-3	µg/L	2	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	100-41-4	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
EP080S: TPH(V)/BTEX Surrogates											
1,2-Dichloroethane-D4	17060-07-0	%	surrogate	113	111	103	112	105	110	110	106	106
Toluene-D8	2037-26-5	%	surrogate	110	106	103	109	105	106	107	103	102
4-Bromofluorobenzene	460-00-4	%	surrogate	105	99.7	97.9	104	97.1	98.6	101	97	101

Appendix B
Dilution calculation basis

Table 10 Dilution calculation at 400:1 release

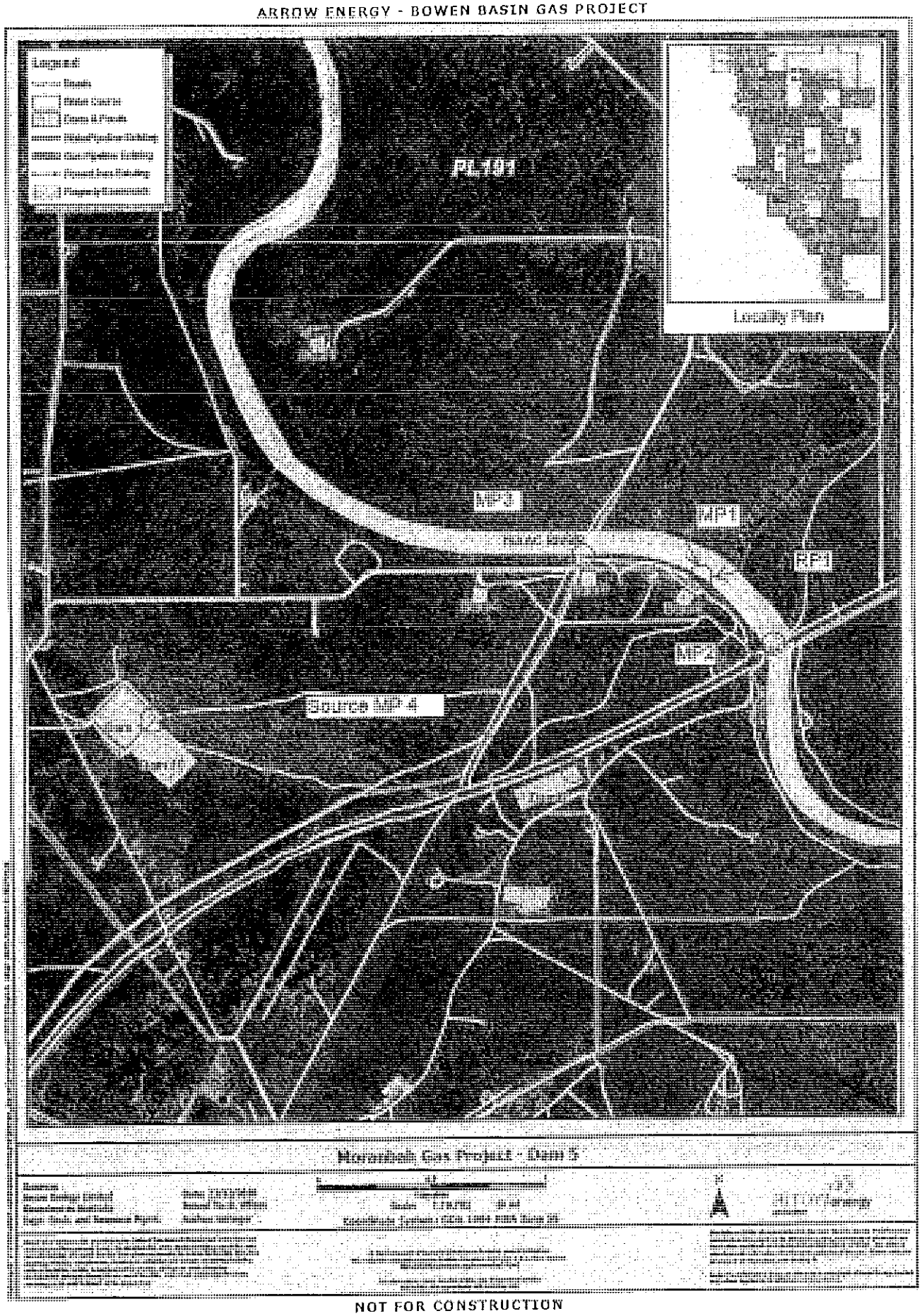
Parameter	Unit	Surface Water Concentration	Concentration of Discharge	Dilution X:1	Surface Concentration after dilution	Guideline[1]
EC	µs/cm	250	13000	400	282.5	746
Sodium	mg/L	65	2970	400	72.4	180
Chloride	mg/L	80	4280	400	90.7	250

[1] *Australian drinking water guidelines (NHMRC,2004)*
Sodium and Chloride based on EC, common soil quality (run off) and historical data from upstream

Appendix C

Mapping showing PL191 and location of key Dams

ARROW ENERGY - BOWEN BASIN GAS PROJECT



NOT FOR CONSTRUCTION

Appendix D
Sampling Procedure

SUMMARY

1.1	This procedure outlines general sampling protocols and work practices to be followed during the sampling of surface water, during the discharge of untreated CSG well water to the Isaac River. This procedure includes details on: ▪ Sampling equipment requirements; ▪ Surface water sampling techniques; ▪ Quality control requirements. ▪ Sample locations (Figure 1) ▪ Analytical requirements

EQUIPMENT

2.1	▪ Documentation o Sampling and analysis plan. o Health and safety plan o Personal protective equipment (PPE) as identified in the HSP, inc. Life Jacket and other specialised PPE, as per the HSP. ▪ Water sampling equipment o sample collection device, (Swing Arm Sampler/extension sampler) o decontamination solution (e.g. Decon 90™) or use new sample collection container in the swing arm sampler at each location. o Calibrated water quality meter (ensure parameter ranges are suitable for the water being tested), o laboratory supplied sample containers, o Chilled ice chest. o Field sample Record Sheet o Chain of Custody Form (Attached).

3.0 REFERENCES & PROFORMA

3.1	▪ AS NZS 5667.1-1998 *Water quality - Sampling - Guidance on the design of sampling programs sampling techniques* ▪ AS NZS 5667.4-1998 *Water quality - Sampling - Guidance on sampling from lakes natural and man-made* ▪ AS NZS 5667.6-1998 *Water quality - Sampling - Guidance on sampling of rivers and streams* ▪ Monitoring and Sampling Manual 2009 Environmental Protection (Water) Policy 2009, *Monitoring and Sampling Manual 2009*, Version 2 September 2010

4.0 PROCEDURE

4.1	**Safety**
	Unless specifically required, the following general safety requirements should be noted: 1. Appropriate personal protective equipment should be worn as specified in the Health and Safety Plan (HSP). When working in or around water bodies, a life jacket is required to be worn and a minimum of two persons to be present should be assessed. 2. Assess hidden hazards (eg. trip hazards, snakes, leeches, etc.). 3. Assess risks from slippery or unstable banks. 4. Assess whether the water body / drain may constitute a confined space. 5. Assess the likelihood that surface conditions within and around the water body may change rapidly in the event of heavy rainfall or tidal change.

4.2	Sampling

1. The sampling frequency during and following discharge to the Isaac River shall be as follows:
   - daily during discharge; and
   - daily for two days following discharge stopping.
2. The sampling sequence should commence where the lowest likely contaminant concentrations are expected (e.g. downstream and work upstream), to reduce the risk of cross contamination between samples. On this basis, the samples shall be collected at the following locations (in order): (See **Figure 1** for sampling locations)
   I. **River crossing** (upstream), (One **primary sample (S1)**, plus **one duplicate sample (QC1)**)
   II. **Blair Athol Bridge** (downstream), One **primary sample (S2)**, plus **one duplicate sample (QC2)**)
   III. At the **Discharge Point**, One **primary sample (S3)**, plus **one duplicate sample (QC3)**)
   IV. At the **Source (Dam)** One **primary sample (S4)**, plus **one duplicate sample (QC4)**)
   V. QC samples – Field/Trip Blank **(QC5)** and rinsate blank **(QC6)** (if required)
3. At each location, a water sample should be collected for standard field parameters using a calibrated water quality meter. The following parameters should be recorded:
   a. pH,
   b. conductivity,
   c. dissolved oxygen,
   d. redox potential,
   e. temperature and
   f. turbidity.

Notes:

- Follow the manufacturer's instructions for use and calibration of instruments to measure water parameters. A calibration record must be kept.
- When recording dissolved oxygen readings, it is important to note whether the results are reported as % saturation or ppm.
- With conductivity, record whether units are mS or µS.

4. Based on the nature of the sampling locations, heterogeneous distribution of potential contaminants in the water samples is considered likely. Therefore, the following Quality Control Samples should be collected and analysed for this program:
    a. One duplicate sample per sample location for TPH, BTEX and 8 Metals analysis **(QC1 – QC4)**.
    b. One Blank Sample per esky (laboratory prepared DI Water for TPH (C6 – C9) and BTEX analysis) **(QC5)**.
5. One rinsate sample per day (unless using new sample collection medium between sample locations i.e. a new container in the swing arm sampler) for TPH (C6 – C9) and BTEX analysis) **(QC6)**.
6. At each location sample bottles should be filled based on a decreasing order of potential volatility (i.e. VOCs, BTEX and TPH first, followed by metals and other inorganic samples).
7. Note: **DO NOT** field filter samples for total metals. Perform field filtering for dissolved metals samples only.
8. When sampling shallow waters, contamination from bottom sediments should be avoided. Samples should be collected by submerging a clean sample collection container (up-side down) into the water and to approximately 100mm below the surface, rotate the container to allow it to fill.
9. The sampling location should be as representative as possible of the event being monitored. i.e. do not sample stagnant water at the edge, attempt to sample .
10. Record the appearance of the water body, i.e. colour, turbidity, odour, surface crusts, films or floating material, algae, water velocity, etc. In addition, record the weather conditions at the time of sampling and note any other relevant observations, e.g. dead or distressed flora/fauna, surface rubbish, spills, etc.
11. All measurements and field notes should be documented on the field sheet (**Attachment A**)

5.0 ANALYTICAL/SAMPLE CONTAINER REQUIREMENTS

5.1	1. The analytical suite includes the following: a. pH, EC, TDS, Turbidity b. Ions: Magnesium, Calcium, Sodium, Sulphate, Chloride, Ammonia, Nitrate, Fluoride (total). c. Metals, Aluminium, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Zinc, Boron, Cobalt, Manganese, Molybdenum, Selenium, Silver, Uranium, Vanadium. d. Organics: BTEX, PAH, TPH 2. Each Sample Requires the following containers: a. 60ml Plastic Bottle for metals (with red and green striped label border) (tick 'Total Metals') b. 500ml Plastic Bottle for anions/cations (with green label border) c. 250ml Amber Glass Bottle (with purple label border) d. One pair of BTEX vials (40 mL glass cylindrical containers with purple label border).
	Notes: • The selection of sample containers depends on the laboratories being used. The above list is based on ALS requirements only. When ultra trace analysis is being requested, additional sample volume may be required. Always check with the laboratory prior to submitting samples to the laboratory. • When filling the vials it is important that they are filled to the top with no air space remaining. • Use new sample gloves between sample locations.
5.2	1. Place samples immediately in a chilled ice chest 2. Complete sample request form and include in sealed bag in the cooler 3. Courier samples to the receiving laboratory.

12	Surface Water Sampling							Form
Site					Sampling Method:			
Job Number					Local Air Temperature:			
Date:	Time:				Wind Force:			
Weather:		Cloudiness %			Direction of Wind:			
Location	Sample No.	Water Flow (l/s)	Field Readings				Depth (m)	Comments: including turbidity (plankton and/or sediment), colour, water plants, weather conditions, etc
			pH	Conductivity	Temperature	Dissolved Oxygen		
Comments concerning treatment of samples, especially preservation:								
Name:		Signed:			Project Manager:			adapted from AS 5667.4

Analytes

Quality characteristic	
pH	
EC	Ammonia
Turbidity	Nitrate
Magnesium	Fluoride (total)
Calcium	BTEX
Sodium	PAH
Sulphate	TPH
Chloride	
Aluminium	
Arsenic	
Cadmium	
Chromium	
Copper	
Iron	
Lead	
Mercury	
Nickel	
Zinc	
Boron	
Cobalt	
Manganese	
Molybdenum	
Selenium	
Silver	
Uranium	
Vanadium	

Appendix E
URS Dam 2 Assessment

Ben McMahon

From: [redacted]
Sent: Friday, 4 February 2011 1:18 PM
To: Ben McMahon; [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: RE: MGP TEP

Categories: Red Category

Ben

I will have a read of this now. Once I have read it I will get back to you.

Regards

From: Ben McMahon [redacted]
Sent: Friday, 4 February 2011 10:30 AM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: MGP TEP

Hi [redacted]

Round 4 (I think)

I have updated the TEP based on the comments received yesterday afternoon. I think we have reached an appropriate point to issue this TEP We would like to focus on meeting the requirements of a granted TEP. This is difficult for us if the requirements keep changing.

Please be advised that we are presently refraining from discharge until we have a granted TEP.

Best regards

Ben

DERM comment	*Arrow Response*
Data from 27 December is not appropriate. Update table with current details of dam levels – If the TEP is resubmitted on 3 or 4 Feb I would accept data from 31 Jan onwards..	This data is in fact from 27th of January. Text has been updated to reflect the correct dat
Could this table be updated to include rainfall to 31 January 2011, or a later date?	This has been updated.
Given this was resubmitted on 28 Jan cant this be updated?	The rainfall up to the first submission of the TEP
Could this table be updated to reflect releases/rainfall to date?	cause of the TEP - much of this requirement to r data does not change the circumstances leading TEP
How is discharge proposed? Provide info on release point placement please.	This discharge point is pre-existing and within hi and current EA's
At 1090ML/day 400:1 would allow 2.4ML to be discharged. Once 3000ML or 35m3/s flow was reached then the max of 7.5ML could be discharged.	This was our understanding but it seems worthv clarify this point within the EA

1090ML/day flow in the river is appropriate when discharging up to 2.4 ML/day, however for 7.5ML/day discharge requires 3000ML/day of flow in the river or as proposed; 34.72 m3/second.	
Please include the newer data emailed separately on 28 jan and in a format that makes it possible to compare against TEP sample locations.	This data will be reported under the TEP and sh not be part of the current revisions. The text ha updated to reflect this better
EC should be monitored upstream and downstream and not just at discharge point. QLD Health also support this.	This is happening in practice we agree with the
This list should be consistent with the list in Appendix D – Analytes. For example sodium and chloride are listed in that table but not in this table.	Sodium, Chloride and EC have been added.
QLD Health have advised trigger levels for Chloride should be 250mg/L and sodium 180mg/L	Added
EC should be added with trigger of 350us/cm	We have accepted these changes. This is the se round of comments from Q Health we are conce that they are adding new requirements.
QLD Health advice this should be ADWG level of 10	
Q Health advice as above	
As above	
Table 4 RP1 and this RP1 easting/northing do not match.	
I apologise for this backflip given my earlier advice about ML/day. Given the nature of the hydrograph for the river I have been advised that m3/s is more appropriate.	This is not a material change our understanding the DERM monitoring reports daily totals in ML/ will stick with this units. We base the decision t discharge on the cumulative daily total not on instantaneous flow
Recognise that Arrow intend on using DERM data for flow information. Suggest due to the nature of the hydro graph Arrow commit to monitoring levels on at least a twice daily basis.	We check at 8am and 8pm. The decision to discl based on the daily total.
I note the comment that one downstream monitoring location is in Arrows view enough. QLD Health and DERM water scientist require another one downstream. Please advise if it is physically possible to safely get samples from an accessible downstream location.	The current downstream location is consistent v historic EA requirements. Arrow has safety and concerns in adding additional sites particularly s they require access during periods of wet weath
This previously referred to a condition that was not relevant	Noted
Given an end of pipe of 13000 EC has been sought this table should reflect that. For example water discharged in early Jan was higher than 10600 coming in at 11200	This has been updated to the 13000 value

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T:
F:
M:
www.arrowenergy.com.au

Ben McMahon

From: Ben McMahon
Sent: Friday, 4 February 2011 2:07 PM
To: [redacted]
Subject: MGP CSW TEP
Attachments: Arrow Energy MGP Coal Seam Water Management TEP.doc; Arrow Energy MGP Coal Seam Water Management TEP.pdf

Categories: Red Category

As discussed

Thanks

Ben McMahon
Manager Compliance & Reporting

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www.arrowenergy.com.au

DRAFT TRANSITIONAL ENVIRONMENTAL PROGRAM UNDER SECTION 333 OF THE *ENVIRONMENTAL PROTECTION ACT 1994*

Principal Holder:	CH4 Pty Ltd **AM-60** Level 19 42 Albert Street Brisbane QLD 4000
EA Number:	PEN100015907
Title:	Coal Seam Water Management Moranbah Gas
Project	Moranbah Gas Project PL191/196
Program notice submitted:	3 December 2010
Revision date	Version 4, 4 February 2011
Finish Date:	31 May 2011

Introduction

The Moranbah Gas Project lacks sufficient water storage capacity as previously indicated in correspondence to DERM (dated 25 October 2010) and subsequent responses to information requests and the program notice documentation submitted by Arrow (dated 3 December 2010). This has been caused by an early start to the wet season contributing to existing dam levels and causing construction delays. This has prevented Arrow from making additional storage available via the completion of dam 11. The synthetic lining for the dam cannot be installed during periods of rainfall; the civil engineering also requires careful control of the moisture content of the construction materials to achieve the required specifications.

Dam 11 has been designed and is being constructed in line with the most current dam standards stipulated by DERM and contained in the previously submitted and assessed dam design report. It is a large lined dam – intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, develop beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies.

The continued rain has delayed the completion of dam 11. This has put Arrow in a position where it cannot comply with the current EA conditions. Arrow intends to employ this transitional environmental program (TEP) as defined in Chapter 7, Part 4 of the *Environmental Protection Act 1994 to bring our operation back into compliance with its current Environmental Authority*. In initiating this process Arrow intends to work with DERM to minimise the potential for environmental harm.

Background

Arrow currently employs a network of 10 dams across PL191 and PL196. Dams 1 through to 7 are shown in the attached drawing (Appendix C). Dams 8 and 9 in the network are SW of the main area depicted in the provided drawing. Approximately 90% of the total storage capacity for coal seam water is held in Arrow's major storage dams 1, 2 and 10. The other dams are employed to move water between groups of remote wells and the major storage dams. Dam 3 is employed to store more concentrated brine. An important feature of the petroleum lease is the Isaac River which divides the lease along a NW to SE axis and its tributary Teviot Brook. Isaac River is an ephemeral river; during periods of high flow it limits access to infrastructure on the north eastern side of the petroleum lease via river crossings.

Situation

Our strategy is to maintain low levels in the older and less accessible dams (particularly dams 6,7, 8 and 9) by moving water to dams 1 and 10. Dam 10 is our most recently constructed dam and has an engineered spillway, dam 1 is in reasonable condition and adjacent to dam 10 which allows water to be transferred readily between dams.

Our risk assessment process and an independent third party geotechnical evaluation by URS has identified particular concerns with the integrity of dam 2 (refer to Appendix E). Arrow has concerns regarding the condition of dam 2 – it is scheduled to be brought out of service on the completion of Dam 11. Based on geotechnical evaluation we intend to lower the level of water in Dam 2 to 4m below DSA. The goal of this strategy is to maintain pond integrity and minimise discharge to the environment when a suitable plan to restore the operational integrity of dam 2 is developed or the dam is retired from operational duty.

Arrow believes that a controlled discharge during high flow conditions in the Isaac River via the existing infrastructure would result in the least environmental impact whilst preserving the integrity of the existing dams. This option prevents the overland flow of untreated coal seam water reaching the Isaac River and minimises the risk of damaging older dams which are built prior to the new standards and lacking engineered spillways. When the facility was originally developed the water management scheme was significantly different to now and included a wet weather discharge. At present our existing infrastructure is not sufficient to comply with the conditions of the current Environmental Authority particularly during extended wet periods.

Our system of dams has an area of 125,100 m^2, this equates to a gain of 0.125ML per mm of rainfall. The system is designed to transfer water to the major storage dams 1, 2 and 10 this contribute to the catchments of these structures, each 1 mm of rainfall will cause an increase in dam height of 1.6 mm in dams 1, 2 and 10. When all the input rainfall is directed to dam 10 each 1 mm of rainfall causes an increase in dam height of 2.7 mm in dam 10.

Table 1 Key Dam Variables Dams 1, 2, 5 and 10

Dam		1	2	5	10
Volume at Spill level	ML	119.66	92.64	7.64	203.70
Spillway		No	No	No	Yes
Liner type		CCL	CCL	0.5mm HDPE	1.5mm HDPE
Hydraulic height	m	5.60	5.50	3.5	4.75
MRL	m	5.25	5.15	3.15	4.40
DSA	m	4.75	4.65	2.65	3.90
Target dam fill height[b]	m	4.75	0.65	2.65	3.90
Current level (below MRL)[a]	mm	100	870	Varies[c]	40
Remaining rainfall *(to spill)*[d]	mm	281	762	>800	244

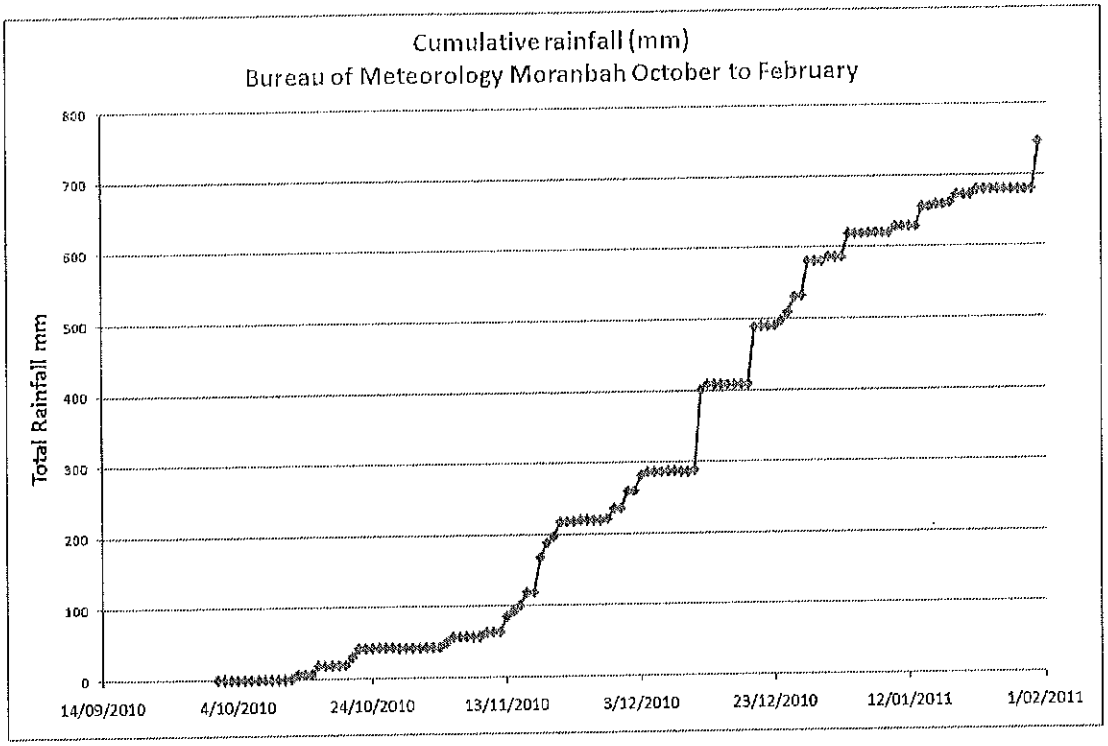
[a] Levels 27 January 2010, negative denotes level above MRL

[b] Target dam fill height is DSA for dams 1 and 10, 4m below DSA for dam 2. Current target height for dam 2 is based on 3rd party civil engineering assessment completed by URS.

[c] This dam is much smaller than the major storage dams its level can change rapidly during operations

[d] Rainfall based on approximate catchment ratio of 1.6 (based on total catchment area including transfer dams)

Figure 1 Cumulative rainfall between October to December Moranbah



Future water levels will be a product of the rainfall, coal seam water production and evaporation. Our goal is to maintain dams 1 and 10 at DSA levels by employing a discharge to the Isaac River. Dam 2 will be lowered to a level determined by independent third party engineering risk assessment.

Arrow has evaluated 2 scenarios for water requiring discharge from the storage system:

- Scenario 1 – Mean rainfall until end of wet season
- Scenario 2 – 95th percentile rainfall until end of wet season

Rainfall to date is very close to the 95th percentile rainfalls on average from October through to December. We have had a cumulative total of 586mm from the 1st of October to end of December (Figure 1), 95th percentile cumulative rainfall for the period from the start of October to the end of December totals 522mm.

Based on the current progress of the wet season Arrow believes that the next few months will produce above average rainfall. Long range forecasts from the Bureau of Meteorology give a 55% chance of rainfall at or above the 95% percentile values. In determining the water balance for the facility has evaluated 2 scenarios – mean and 95th Percentile rainfall (refer to Table 2).

Table 2 Discharge scenarios

Scenario	Volume to reach DSA (ML)	Additional removal from Dam 2 (ML) [b]	Expected Net [a] Water to Storage (ML)	Total (ML)
Mean Rainfall	69	75	54.5	198.5
95th Percentile	69	75	130	274

[a] *Net water to storage is produced water, less evaporation plus expected rainfall.*
[b] *This is based on a dam 2 target of 4000mm below DSA.*

Arrow proposes a discharge of up to 7.5ML/day when dams are above the target dam fill height shown in Table 1. The release will commence when the Isaac River is flowing above 12.6m^3/s (at this starting flow only 2.4ML/day could be discharged) measured upstream at the Goonyella river gauge (operated by DERM). Discharge will be maintained at a 400:1 dilution ratio on the basis of maintaining Australian drinking water guidelines (NHMRC,2004) downstream of the discharge. Based on a predicted salinity impact as detailed in Appendix B. This discharge rate and the dilution factor will be reviewed throughout the TEP in consultation with DERM and informed on the basis of the upstream/downstream river monitoring in line with the proposed conditions detailed within this document.

Sampling will be conducted in line with the conditions detailed in this TEP under the procedure attached as Appendix D. Appendix A contains indicative water quality to characterise the coal seam water to be discharged.

Supporting Information

Consideration of the management hierarchy for the management of coal seam water at the MGP

Evaluation as per the management hierarchy of preferred procedures from Environmental Protection (Water) Policy 2009:

Step 1—evaluate water conservation measures to reduce the use of water and the production of waste water or contaminants;
Water is not employed in the coal seam gas production process but must be removed from the coal seam to allow the gas to be extracted. Water conservation measures will not reduce the amount of coal seam water associated with the gas extracted.

Step 2—evaluate waste prevention options and implement appropriate waste prevention measures;
The key waste prevention measure employed is maximisation of the coal seam gas to water ratio. The coal seams targeted by MGP have relatively low ratios of water to gas in comparison to other fields. In an effort to manage our recent water storage constraints Arrow has shut in a large number of wells, targeting the wells with high water to gas ratios to minimise the production of coal seam water associated with our operations.

Whilst this has reduced our coal seam water production, shutting in further wells will yield limited benefits in terms of water reduction but will cause significant reduction in gas output.

Use of dam 11 in its current uncompleted, unlined state has been investigated. The pipe work and major civil infrastructure is complete but the floor of the dam is incomplete – as discussed (in our meeting on the 1st of December) it lacks its intended second liner, more importantly the clay liner has not been sufficiently compacted to allow its use. Key elements of the pipework connecting dam 11 to the rest of the network remain incomplete. Employing dam 11 would require its use for an extended period to allow subsequent emptying and upgrade of the existing dam infrastructure.

Step 3—if waste prevention does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate treatment and recycling options and implement appropriate treatment and recycling;
The construction of Dam 11 is the first component of our coal seam water management strategy. It is a large lined dam, intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies. Rainfall is delaying the construction of dam 11 and contributing to the current water storage problems.

Installation of water treatment (such as a mobile RO plant) is limited by the logistics (such as civil engineering, chemical storage and power supply), cost and the challenges posed during current wet conditions. Another option considered was employing water entitlements to dilute the untreated coal seam water to the current environmental authority specification. This option was ruled out since a large quantity of good quality water would be required to dilute and dispose of a limited amount of coal seam water from our dams.

Step 4—if treatment and recycling does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate the following options
for waste water or contaminants, in the order in which they are listed—
(i) appropriate treatment and release to a waste facility or sewer;
(ii) appropriate treatment and release to land;
(iii) appropriate treatment and release to surface waters or ground waters.

I) We cannot practically truck water from the dams given the large quantities and the lack of disposal options. Wet weather is likely to complicate trucking of water by limiting access to some points within the MGP. Infrastructure does not exist to process this water via sewer or other industrial water treatment options. Our landholders have expressed concern of minimising truck movements during the wet season.

II) Until our water treatment management strategy is implemented we cannot treat the water to a standard that is suitable for use on land.

III) We consider the water in its current state is suitable for discharge into the Isaac – this was the water management strategy employed by the facility until earlier EA conditions were amended, we are seeking permission from DERM to allow this discharge as previously authorised until we can implement our water management strategy for the MGP. We consider a temporary discharge to the Isaac river during high flow conditions to be compliant with section 51 of the Environmental Protection Regulation 2008.

Objectives

To achieve compliance with the Environmental Authority with respect to coal seam water management and dam standards by April 2011.

This will be achieved in the short term by the release of water to the Isaac River. This measure will protect the integrity of our storage infrastructure and is consistent with the operational philosophy that our existing infrastructure was designed to accommodate.

In the medium term compliance with the new EA will be achieved by the completion of Dam 11. Completion of dam 11 will require Arrow energy to utilise the cleared area north of dam 11.

In the long term, compliance with our EA will be achieved by completion of water treatment facilities that allow beneficial use and disposal within Arrows Environmental Authority conditions. Arrow is to provide DERM with a detailed plan concerning future water management for approval.

Table 3 – Achieving TEP objectives

OBJECTIVE	ACTION	RESPONSIBILITY	TIME FRAME	PERFORMANCE INDICATOR
1. Lower dam levels for (dams 1, 2, 5, 10) to below the 'Target dam fill height" as shown in Table 1.	Manage via discharge (RP1) to Isaac river	Arrow site personnel	Immediate	Manage dams within appropriate levels as detailed in Tables 1 and 2. Discharge is to be subject to monitoring and reporting requirements
2. Monitor Discharge	Monitor discharge in accordance with Table 5, for the contaminants listed in Table 6 and Table 7	Arrow site personnel	During discharge	Lab results to be reported to DERM within 10 business days of collection.
3. Pond 2	Develop management plan to restore dam integrity or remove from service	Arrow	15 March 2010	Submission of management plan to DERM
4. Cease discharge	Cease discharge to Isaac river under TEP	Arrow	31 March 2011	Cease discharge to Isaac river
5. TEP report submission	Provide DERM with final TEP report detailing how the objectives of this TEP have been met	Arrow	31 May 2011	Submission of TEP report to DERM

Monitoring

Table 4 Contaminant release points, sources and receiving waters

Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point	Receiving waters
TEP RP 1	148° 2' 35"	-21° 57' 41"	untreated CSG water from PL191/196	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
				Upstream from discharge – Isaac River Crossing	
				Downstream from discharge – Blair Athol Bridge	

Table 5 Contaminant release monitoring points

Monitoring point (TEP MP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point location	Receiving waters
TEP MP 1	148° 2' 35"	-21° 57' 41"	Untreated CSG water from PL191	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
TEP MP 2	148° 2' 46"	-21° 57' 55"	Downstream from discharge – Blair Athol Bridge	Blair Athol Railway Bridge	na
TEP MP 3	148° 2' 20"	-21° 57' 41"	Upstream from discharge	Isaac River Crossing	
TEP MP 4	148° 1' 10"	-21° 58' 00"	Untreated CSG water dam 1	Dam 1	
TEP MP 5	148° 2' 8"	-21° 58' 01"	Untreated CSG water dam 2	Dam 2	
TEP MP 6	148° 2' 32"	-21° 57' 44"	Untreated CSG water dam 5	Dam 5	
TEP MP 7	148° 1' 14"	-21° 58' 4"	Untreated CSG water dam 10	Dam 10	

Table 6 Contaminant release limits

Quality characteristic	Release Limit	Monitoring Frequency	Sample Type	Monitoring Point
Electrical conductivity (uS/cm)	13000	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1 TEP MP2 TEPMP3
			Samples require laboratory analysis[2]	TEP MP 1 TEP MP2 TEPMP3
pH (pH Unit)	6.5 (minimum) 9.5 (maximum)	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1 TEP MP 2 TEP MP 3
			Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3
Turbidity (NTU)	500	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3
BTEX Benzene, Ethylbenzene, Toluene and Xylene (mg/L)	Benzene 0.001 Ethylbenzene 0.3 Toluene 0.8 Xylene 0.02	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3

[1] *In situ samples can be taken using electronic sampling equipment.*
[2] *Samples are required to be analysed at a NATA accredited facility in accordance with this Transitional Environmental Program.*

Table 7 Downstream contaminant trigger investigation levels

Quality characteristic	Trigger levels (µg/L)	Monitoring frequency	Monitoring Point
Aluminium	55	Commencement of release and thereafter weekly during release	TEP MP 2 TEP MP 3
Arsenic	10		
Cadmium	0.2		
Chromium	1.0		
Copper	2.0		
Iron	300		
Lead	10		
Mercury	0.2		
Nickel	11		
Zinc	8.0		
Boron	370		
Cobalt	90		
Manganese	500		
Molybdenum	34		
Selenium	10		
Silver	1.0		
Uranium	1.0		
Vanadium	10		
Ammonia	900		
Nitrate	1100		
Petroleum hydrocarbons (C6-C9)	20		
Petroleum hydrocarbons (C10-C36)	100		
Fluoride (total)	1500		
EC	350µs/cm		
Chloride	250mg/L		
Sodium	180mg/L		

Table 8 Contaminant release during flow events

Receiving waters	Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Minimum flow in receiving water required for a release event	Flow recording frequency
Isaac River	TEP RP1	148° 2' 35"	-21° 57' 41"	1090ML/day	Twice Daily from Goonyella Gauging station

Table 9 Receiving water downstream monitoring points

Monitoring points (TEP MP)	Receiving waters location description	Easting (GDA94)	Northing (GDA94)
TEP MP 2	Blair Athol Bridge 500 metres downstream of RP1	148° 2' 46"	-21° 57' 55"

Conditions

In carrying out this Transitional Environmental Program, CH4 Ltd (Arrow Energy) will undertake all activities in accordance with the following conditions.

Undertaking the release of untreated coal seam methane water

1 Contaminants that will, or have the potential to cause environmental harm must not be released directly or indirectly released to any waters except as permitted under this Transitional Environmental Approval.

2 The release of contaminants to waters must only occur from the release points specified in Table 4 and depicted in Appendix C attached to this Transitional Environmental Program.

3 The release of contaminants to waters must not exceed the release limits stated in Table 6 at the monitoring points specified in Table 5 and Table 6 of this Transitional Environmental Program.

4 The release of contaminants to waters from the release points must be monitored at the locations specified in Table 5 and Table 9 for each quality characteristic and at the frequency specified in Table 7 and Table 8 of this Transitional Environmental Program.

5 If quality characteristics of the release exceed any of the trigger levels specified in Table 7 during a release event, the Transitional Environmental Program holder must compare MP2 to the trigger values specified in Table 7 and:

a) where the trigger values are not exceeded then no action is to be taken

b) where the downstream results exceed the trigger values specified Table 7 for any quality characteristic, compare the results of the downstream site to the data from the upstream monitoring sites (MP3)

i) if the result is less than that recorded at Monitoring Point 3 (MP3), then no action is to be taken or

ii) if the result is greater than the background monitoring site data, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology, into the potential for environmental harm and provide a written report 20 business days after receiving results, outlining

- details of the investigations carried out
- actions taken to prevent environmental harm.

6 If an exceedance in accordance with condition 5(b)(ii) is identified, the holder of the Transitional Environmental Program must notify the administering authority within 24 hours of receiving the result. The notification must include written verification of the exceedance forwarded to the administering authority.

Contaminant Release Events

7 The release of coal seam water from the release point shown in Table 4 will not occur until -

a) - flow in the Isaac River flow reaches 1090 ML/day as shown in Table 8 (at Goonyella Gauging Station); and

b) – At least one dam in Table 1 has exceeded the 'Target Dam Fill Height' shown in Table 1; and

c) – A dilution of at least 400 parts river flow to 1 part discharge can be maintained at all times (0.25% of receiving flow).

8 The daily quantity of contaminants released from each release point must be measured and recorded at the monitoring points in Table 4

9 The daily quantity of contaminants is not to exceed 7.5ML/day in total.

10 Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build up of sediment in such waters.

Notification of Release Events

11 The Transitional Environmental Program holder must notify the administering authority within 24hours of having commenced releasing coal seam water to the receiving environment. Notification must include the submission of written verification to the administering authority of the following information:

a) release commencement date/time
b) expected release cessation date/time
c) release point/s
d) release volume (estimated)

e) receiving water/s including the natural flow rate
f) any details (including available data) regarding likely impacts on the receiving water(s).

12 The Transitional Environmental Program holder must provide the administering authority daily during the release of coal seam water, the following information:
a) all in situ monitoring data for that day
b) the receiving water flow rate
c) the release flow rate.

13 The Transitional Environmental Program holder must notify the administering authority as soon as practicable, (no later than within 24 hours after cessation of a release) of the cessation of a release notified under condition 11 and within 15 business days provide the following information in writing:
a) release cessation date/time
b) natural flow volume in receiving water
c) volume of water released
d) details regarding the compliance of the release with the conditions of this Transitional Environmental Program (i.e. contamination limits, natural flow, discharge volume)
e) all in-situ water quality monitoring results
f) any other matters pertinent to the water release event.

Notification of release event exceedence

14 If the release limits defined in Table 6 are exceeded, the holder of the Transitional Environmental Program must notify the administering authority within 2 business days of receiving the results.

15 The Transitional Environmental Program holder must, within 28 days of a release that exceeds the conditions of this Transitional Environmental Program, provide a report to the administering authority detailing:
a) the reason for the release
b) the location of the release
c) all water quality monitoring results
d) any general observations
e) all calculations

f) any other matters pertinent to the water release event.

Requirements to cease the release of coal seam water

16 The coal seam water discharge must cease immediately if any water quality limit as specified in Table 6 is exceeded or if a dilution of 400 parts river flow to 1 part discharge (0.25% of receiving flow) cannot be achieved.

17 The Department of Environment and Resource Management may require CH4 Pty to cease discharge if the department's water monitoring stations detect any water quality limit exceedance.

18 The release of coals seam water must cease immediately if identified that the release of coal seam waters is causing erosion of the bed and banks of the receiving waters, or is causing a material build up of sediment in such waters.

19 The release of coal seam water will cease immediately if Isaac River flow decreases below 1090ML/day (at Goonyella Gauging Station).

20 The release of coal seam water will cease immediately from any dam in Table 1 once the dams level is more than 100mm lower than the 'Target Dam Fill Height' shown in Table 1.

Monitoring Requirements

21 Where monitoring is a requirement of this Transitional Environmental Program, ensure that a competent person(s) conducts all monitoring.

22 Monitoring will occur at the frequencies identified in Table 6 and Table

23 All monitoring undertaken as a requirement of this Transitional Environmental Program must be undertaken in accordance with the administering authority's Water Sampling Manual.

Notification of emergencies, incidents and exceptions

24 As soon as practicable after becoming aware of any 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 Transitional Environmental Program, the administering authority must be notified of the release by telephone, facsimile or email.

25 The notification of emergencies or incidents must include but not be limited to the following:

a) the holder of the Transitional Environmental Program
b) the location of the emergency or incident
c) the number of the Transitional Environmental Program
d) the name and telephone number of the designated contact person
e) the time of the release
f) the time the holder of the Transitional Environmental Program became aware of the release
g) the suspected cause of the release
h) the environmental harm caused, threatened, or suspected to be caused by the release, and
i) actions taken to prevent any further release and mitigate any environmental harm caused by the release.

26 Not more than 10 business days following the initial notification of an emergency or incident, written advice must be provided of the information supplied to the administering authority in relation to:

a) proposed actions to prevent a recurrence of the emergency or incident, and

b) outcomes of actions taken at the time to prevent or minimise environmental harm.

Appendix A
ALS & Qld Health water sampling results

Client Reference	Collected Date	Received Date	Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmiun	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	3.8	< 0.0001	0.0011	0.076	< 0.0001	0.05	< 0.0001	0.0027	0.0011	0.003	1.7	0.0013	0.056	< 0.0001	0.0007
Discharge_Point	14-Dec-10	17-Dec-10	0.18	< 0.0001	0.0012	4.5	< 0.0001	1.1	< 0.0001	0.0003	0.0002	0.002	0.08	0.0004	0.0046	< 0.0001	0.0019
Pond_2a	16-Dec-10	17-Dec-10	0.1	< 0.0001	0.0015	6.1	< 0.0001	1	< 0.0001	0.0002	0.0003	0.001	0.066	< 0.0001	0.007	< 0.0001	0.0013
Pond_2	16-Dec-10	17-Dec-10	0.09	< 0.0001	0.0014	6	< 0.0001	1	< 0.0001	0.0002	0.0003	< 0.001	0.044	< 0.0001	0.0065	< 0.0001	0.0012
POND1_1	17-Dec-10	20-Dec-10	0.37	< 0.0001	0.0021	5.8	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.18	< 0.0001	0.0057	< 0.0001	0.0028
POND1_2	17-Dec-10	20-Dec-10	0.43	< 0.0001	0.0023	6	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.2	0.0002	0.0065	< 0.0001	0.0031
POND10_1	17-Dec-10	20-Dec-10	0.2	< 0.0001	0.0018	7.7	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.069	< 0.0001	0.0039	< 0.0001	0.0031
POND10_2	17-Dec-10	20-Dec-10	0.18	< 0.0001	0.0019	7.6	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.067	< 0.0001	0.0041	< 0.0001	0.0034

Client Reference	Collected Date	Received Date	Nickel	Selenium	Silver	Stroniu m	Thallium	Titani um	Uranium	Vanadium	Zinc	Benzen e	Toluene	Ethylbenzon e	Meta&Para-Xylenes	Ortho-Xylene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	0.0031	< 0.0010	< 0.001	0.2	< 0.0001	0.14	0.0002	0.012	0.003	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Discharge_Point	14-Dec-10	17-Dec-10	0.0008	< 0.0010	< 0.001	7.3	< 0.0001	0.006	0.0003	0.0029	0.013	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2a	16-Dec-10	17-Dec-10	0.0012	< 0.0010	< 0.001	9.6	< 0.0001	0.003	0.0003	0.0051	0.006	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2	16-Dec-10	17-Dec-10	0.0011	< 0.0010	< 0.001	9.4	< 0.0001	0.002	0.0003	0.005	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_1	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	10	< 0.0001	0.017	0.0009	0.0059	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_2	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	11	< 0.0001	0.015	0.0009	0.0062	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_1	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.026	0.0008	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_2	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.01	0.0007	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

ALS	21/12/2010	Sample ID 1	DAM 1	DAM 10	DAM 4	DAM 3	D1	D2	DAM 5	DAM2	TRIP BLANK
		ID 2									
ES1025292	Results	Date Sampled	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010
Analyte	CAS #	Units LOR	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
EA005: pH											
pH Value		pH Unit 0.01	9.17	9.28	9.34	9.38	9.4	9.42	9.27	9.15	-
EA010P: Conductivity by PC Titrator											
Electrical Conductivity @ 25°C		µS/cm 1	12600	14000	16400	25900	25800	26100	10700	10600	-
EG020T: Total Metals by ICP-MS											
Arsenic	7440-38-2	mg/L 0.001	0.003	0.003	0.002	<0.001	0.004	0.004	<0.001	0.002	-
Barium	7440-39-3	mg/L 0.001	6.54	8.33	4.35	1.93	1.92	1.98	6.4	9.31	-
Beryllium	7440-41-7	mg/L 0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cadmium	7440-43-9	mg/L 0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Cobalt	7440-48-4	mg/L 0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	-
Chromium	7440-47-3	mg/L 0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	-
Copper	7440-50-8	mg/L 0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004	-
Manganese	7439-96-5	mg/L 0.001	0.008	0.008	0.002	0.001	0.001	0.008	0.002	0.038	-
Nickel	7440-02-0	mg/L 0.001	0.001	<0.001	0.001	0.002	0.002	0.002	<0.001	0.003	-
Lead	7439-92-1	mg/L 0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Vanadium	7440-62-2	mg/L 0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Zinc	7440-66-6	mg/L 0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	-
EG035T: Total Recoverable Mercury by FIMS											
Mercury	7439-97-6	mg/L 0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
EK055G: Ammonia as N by Discrete Analyser											
Ammonia as N	7664-41-7	mg/L 0.01	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
EK057G: Nitrite as N by Discrete Analyser											
Nitrite as N		mg/L 0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EK058G: Nitrate as N by Discrete Analyser											
Nitrate as N	14797-55-8	mg/L 0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser											
Nitrite + Nitrate as N		mg/L 0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser											
Total Kjeldahl Nitrogen as N		mg/L 0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser											
Total Nitrogen as N		mg/L 0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK067G: Total Phosphorus as P by Discrete Analyser											
Total Phosphorus as P		mg/L 0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EP080: BTEX											
Benzene	71-43-2	µg/L 1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	108-88-3	µg/L 2	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	100-41-4	µg/L 2	<2	<2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	µg/L 2	<2	<2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	µg/L 2	<2	<2	<2	<2	<2	<2	<2	<2	<2
EP080S: TPH(V)/BTEX Surrogates											
1,2-Dichloroethane-D4	17060-07-0	% surrogate	113	111	103	112	105	110	110	106	106
Toluene-D8	2037-26-5	% surrogate	110	106	103	109	105	106	107	103	102
4-Bromofluorobenzene	460-00-4	% surrogate	106	99.7	97.9	104	97.1	98.6	101	97	101

Appendix B
Dilution calculation basis

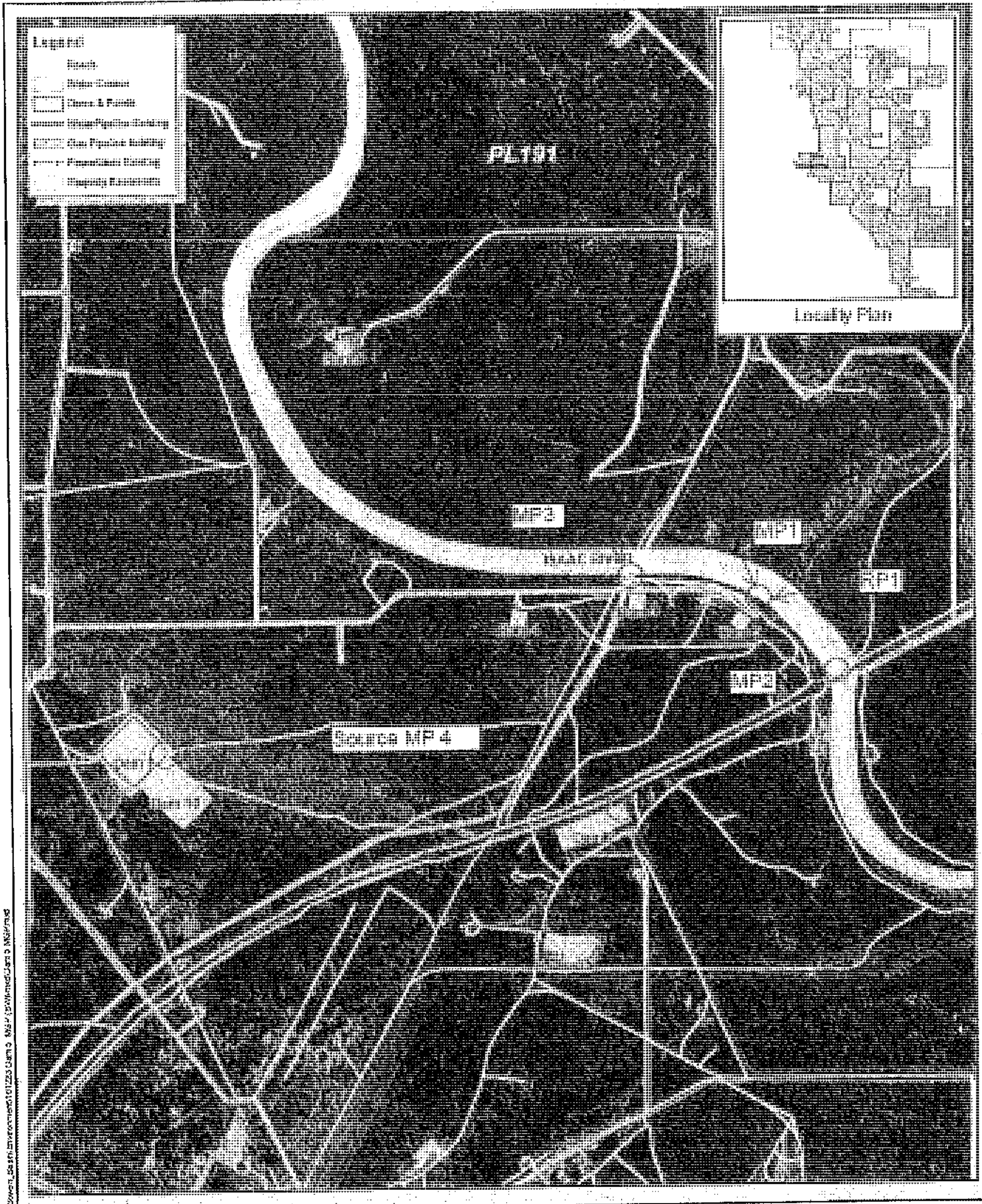
Table 10 Dilution calculation at 400:1 release

Parameter	Unit	Surface Water Concentration	Concentration of Discharge	Dilution X:1	Surface Concentration after dilution	Guideline[1]
EC	µs/cm	250	13000	400	282.5	746
Sodium	mg/L	65	2970	400	72.4	180
Chloride	mg/L	80	4280	400	90.7	250

[1] *Australian drinking water guidelines (NHMRC,2004)*
Sodium and Chloride based on EC, common soil quality (run off) and historical data from upstream

Appendix C
Mapping showing PL191 and location of key Dams

ARROW ENERGY - BOWEN BASIN GAS PROJECT



Moranbah Gas Project - Dam 5

Source:
Arrow Energy Limited
Geosciences Australia
Dept. Envir. and Resource Mgmt.

Date: 23/12/2010
Issued To: B. Wilson
Author: tstringer

0 0.5 1
Kilometres
Scale: 1:10,782 @ A4
Coordinate System: GDA 1994 MGA Zone 55

N

arrow energy

NOT FOR CONSTRUCTION

Appendix D
Sampling Procedure

SUMMARY

1.1	This procedure outlines general sampling protocols and work practices to be followed during the sampling of surface water, during the discharge of untreated CSG well water to the Isaac River. This procedure includes details on: ▪ Sampling equipment requirements; ▪ Surface water sampling techniques; ▪ Quality control requirements. ▪ Sample locations (Figure 1) ▪ Analytical requirements

EQUIPMENT

2.1	▪ Documentation o Sampling and analysis plan. o Health and safety plan o Personal protective equipment (PPE) as identified in the HSP, inc. Life Jacket and other specialised PPE, as per the HSP. ▪ Water sampling equipment o sample collection device, (Swing Arm Sampler/extension sampler) o decontamination solution (e.g. Decon 90™) or use new sample collection container in the swing arm sampler at each location. o Calibrated water quality meter (ensure parameter ranges are suitable for the water being tested), o laboratory supplied sample containers, o Chilled ice chest. o Field sample Record Sheet o Chain of Custody Form (Attached).

3.0 REFERENCES & PROFORMA

3.1	▪ AS NZS 5667.1-1998 *Water quality - Sampling - Guidance on the design of sampling programs sampling techniques* ▪ AS NZS 5667.4-1998 *Water quality - Sampling - Guidance on sampling from lakes natural and man-made* ▪ AS NZS 5667.6-1998 *Water quality - Sampling - Guidance on sampling of rivers and streams* ▪ Monitoring and Sampling Manual 2009 Environmental Protection (Water) Policy 2009, *Monitoring and Sampling Manual 2009*, Version 2 September 2010

4.0 PROCEDURE

4.1	**Safety**
	Unless specifically required, the following general safety requirements should be noted: 1. Appropriate personal protective equipment should be worn as specified in the Health and Safety Plan (HSP). When working in or around water bodies, a life jacket is required to be worn and a minimum of two persons to be present should be assessed. 2. Assess hidden hazards (eg. trip hazards, snakes, leeches, etc.). 3. Assess risks from slippery or unstable banks. 4. Assess whether the water body / drain may constitute a confined space. 5. Assess the likelihood that surface conditions within and around the water body may change rapidly in the event of heavy rainfall or tidal change.

4.2	Sampling

1. The sampling frequency during and following discharge to the Isaac River shall be as follows:
   - daily during discharge; and
   - daily for two days following discharge stopping.
2. The sampling sequence should commence where the lowest likely contaminant concentrations are expected (e.g. downstream and work upstream), to reduce the risk of cross contamination between samples. On this basis, the samples shall be collected at the following locations (in order): (See **Figure 1** for sampling locations)
   I. **River crossing** (upstream), (One **primary sample (S1)**, plus **one duplicate sample (QC1)**)
   II. **Blair Athol Bridge** (downstream), One **primary sample (S2)**, plus **one duplicate sample (QC2)**)
   III. At the **Discharge Point**, One **primary sample (S3)**, plus **one duplicate sample (QC3)**)
   IV. At the **Source (Dam)** One **primary sample (S4)**, plus **one duplicate sample (QC4)**)
   V. QC samples – Field/Trip Blank **(QC5)** and rinsate blank **(QC6)** (if required)
3. At each location, a water sample should be collected for standard field parameters using a calibrated water quality meter. The following parameters should be recorded:
   a. pH,
   b. conductivity,
   c. dissolved oxygen,
   d. redox potential,
   e. temperature and
   f. turbidity.

Notes:

- Follow the manufacturer's instructions for use and calibration of instruments to measure water parameters. A calibration record must be kept.
- When recording dissolved oxygen readings, it is important to note whether the results are reported as % saturation or ppm.
- With conductivity, record whether units are mS or µS.

4. Based on the nature of the sampling locations, heterogeneous distribution of potential contaminants in the water samples is considered likely. Therefore, the following Quality Control Samples should be collected and analysed for this program:
    a. One duplicate sample per sample location for TPH, BTEX and 8 Metals analysis **(QC1 – QC4)**.
    b. One Blank Sample per esky (laboratory prepared DI Water for TPH (C6 – C9) and BTEX analysis) **(QC5)**.
5. One rinsate sample per day (unless using new sample collection medium between sample locations i.e. a new container in the swing arm sampler) for TPH (C6 – C9) and BTEX analysis) **(QC6)**.
6. At each location sample bottles should be filled based on a decreasing order of potential volatility (i.e. VOCs, BTEX and TPH first, followed by metals and other inorganic samples).
7. Note: **DO NOT** field filter samples for total metals. Perform field filtering for dissolved metals samples only.
8. When sampling shallow waters, contamination from bottom sediments should be avoided. Samples should be collected by submerging a clean sample collection container (up-side down) into the water and to approximately 100mm below the surface, rotate the container to allow it to fill.
9. The sampling location should be as representative as possible of the event being monitored. i.e. do not sample stagnant water at the edge, attempt to sample .
10. Record the appearance of the water body, i.e. colour, turbidity, odour, surface crusts, films or floating material, algae, water velocity, etc. In addition, record the weather conditions at the time of sampling and note any other relevant observations, e.g. dead or distressed flora/fauna, surface rubbish, spills, etc.
11. All measurements and field notes should be documented on the field sheet (Attachment A)

5.0 ANALYTICAL/SAMPLE CONTAINER REQUIREMENTS

5.1	1. The analytical suite includes the following: a. pH, EC, TDS, Turbidity b. Ions: Magnesium, Calcium, Sodium, Sulphate, Chloride, Ammonia, Nitrate, Fluoride (total). c. Metals, Aluminium, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Zinc, Boron, Cobalt, Manganese, Molybdenum, Selenium, Silver, Uranium, Vanadium. d. Organics: BTEX, PAH, TPH 2. Each Sample Requires the following containers: a. 60ml Plastic Bottle for metals (with red and green striped label border) (tick 'Total Metals') b. 500ml Plastic Bottle for anions/cations (with green label border) c. 250ml Amber Glass Bottle (with purple label border) d. One pair of BTEX vials (40 mL glass cylindrical containers with purple label border).
	Notes: • The selection of sample containers depends on the laboratories being used. The above list is based on ALS requirements only. When ultra trace analysis is being requested, additional sample volume may be required. Always check with the laboratory prior to submitting samples to the laboratory. • When filling the vials it is important that they are filled to the top with no air space remaining. • Use new sample gloves between sample locations.
5.2	1. Place samples immediately in a chilled ice chest 2. Complete sample request form and include in sealed bag in the cooler 3. Courier samples to the receiving laboratory.

12			Surface Water Sampling					Form
Site				Sampling Method:				
Job Number				Local Air Temperature:				
Date:	Time:			Wind Force:				
Weather:		Cloudiness %		Direction of Wind:				
Location	Sample No.	Water Flow (l/s)	Field Readings				Depth (m)	Comments: including turbidity (plankton and/or sediment), colour, water plants, weather conditions, etc
			pH	Conductivity	Temperature	Dissolved Oxygen		

Comments concerning treatment of samples, especially preservation:

Name: Signed: Project Manager: adapted from AS 5667.4

Analytes

Quality characteristic	
pH	
EC	Ammonia
Turbidity	Nitrate
Magnesium	Fluoride (total)
Calcium	BTEX
Sodium	PAH
Sulphate	TPH
Chloride	
Aluminium	
Arsenic	
Cadmium	
Chromium	
Copper	
Iron	
Lead	
Mercury	
Nickel	
Zinc	
Boron	
Cobalt	
Manganese	
Molybdenum	
Selenium	
Silver	
Uranium	
Vanadium	

Appendix E
URS Dam 2 Assessment

DRAFT TRANSITIONAL ENVIRONMENTAL PROGRAM UNDER SECTION 333 OF THE *ENVIRONMENTAL PROTECTION ACT 1994*

Principal Holder:	CH4 Pty Ltd AM-60 Level 19 42 Albert Street Brisbane QLD 4000
EA Number:	PEN100015907
Title:	**Coal Seam Water Management Moranbah Gas**
Project	**Moranbah Gas Project PL191/196**
Program notice submitted:	3 December 2010
Revision date	Version 4, 4 February 2011
Finish Date:	31 May 2011

Introduction

The Moranbah Gas Project lacks sufficient water storage capacity as previously indicated in correspondence to DERM (dated 25 October 2010) and subsequent responses to information requests and the program notice documentation submitted by Arrow (dated 3 December 2010). This has been caused by an early start to the wet season contributing to existing dam levels and causing construction delays. This has prevented Arrow from making additional storage available via the completion of dam 11. The synthetic lining for the dam cannot be installed during periods of rainfall; the civil engineering also requires careful control of the moisture content of the construction materials to achieve the required specifications.

Dam 11 has been designed and is being constructed in line with the most current dam standards stipulated by DERM and contained in the previously submitted and assessed dam design report. It is a large lined dam – intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, develop beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies.

The continued rain has delayed the completion of dam 11. This has put Arrow in a position where it cannot comply with the current EA conditions. Arrow intends to employ this transitional environmental program (TEP) as defined in Chapter 7, Part 4 of the *Environmental Protection Act 1994 to bring our operation back into compliance with its current Environmental Authority*. In initiating this process Arrow intends to work with DERM to minimise the potential for environmental harm.

Background

Arrow currently employs a network of 10 dams across PL191 and PL196. Dams 1 through to 7 are shown in the attached drawing (Appendix C). Dams 8 and 9 in the network are SW of the main area depicted in the provided drawing. Approximately 90% of the total storage capacity for coal seam water is held in Arrow's major storage dams 1, 2 and 10. The other dams are employed to move water between groups of remote wells and the major storage dams. Dam 3 is employed to store more concentrated brine. An important feature of the petroleum lease is the Isaac River which divides the lease along a NW to SE axis and its tributary Teviot Brook. Isaac River is an ephemeral river; during periods of high flow it limits access to infrastructure on the north eastern side of the petroleum lease via river crossings.

Situation

Our strategy is to maintain low levels in the older and less accessible dams (particularly dams 6,7, 8 and 9) by moving water to dams 1 and 10. Dam 10 is our most recently constructed dam and has an engineered spillway, dam 1 is in reasonable condition and adjacent to dam 10 which allows water to be transferred readily between dams.

Our risk assessment process and an independent third party geotechnical evaluation by URS has identified particular concerns with the integrity of dam 2 (refer to Appendix E). Arrow has concerns regarding the condition of dam 2 – it is scheduled to be brought out of service on the completion of Dam 11. Based on geotechnical evaluation we intend to lower the level of water in Dam 2 to 4m below DSA. The goal of this strategy is to maintain pond integrity and minimise discharge to the environment when a suitable plan to restore the operational integrity of dam 2 is developed or the dam is retired from operational duty.

Arrow believes that a controlled discharge during high flow conditions in the Isaac River via the existing infrastructure would result in the least environmental impact whilst preserving the integrity of the existing dams. This option prevents the overland flow of untreated coal seam water reaching the Isaac River and minimises the risk of damaging older dams which are built prior to the new standards and lacking engineered spillways. When the facility was originally developed the water management scheme was significantly different to now and included a wet weather discharge. At present our existing infrastructure is not sufficient to comply with the conditions of the current Environmental Authority particularly during extended wet periods.

Our system of dams has an area of 125,100 m^2, this equates to a gain of 0.125ML per mm of rainfall. The system is designed to transfer water to the major storage dams 1, 2 and 10 this contribute to the catchments of these structures, each 1 mm of rainfall will cause an increase in dam height of 1.6 mm in dams 1, 2 and 10. When all the input rainfall is directed to dam 10 each 1 mm of rainfall causes an increase in dam height of 2.7 mm in dam 10.

Table 1 Key Dam Variables Dams 1, 2, 5 and 10

Dam		1	2	5	10
Volume at Spill level	ML	119.66	92.64	7.64	203.70
Spillway		No	No	No	Yes
Liner type		CCL	CCL	0.5mm HDPE	1.5mm HDPE
Hydraulic height	m	5.60	5.50	3.5	4.75
MRL	m	5.25	5.15	3.15	4.40
DSA	m	4.75	4.65	2.65	3.90
Target dam fill height[b]	m	4.75	0.65	2.65	3.90
Current level (below MRL)[a]	mm	100	870	Varies[c]	40
Remaining rainfall *(to spill)*[d]	mm	281	762	>800	244

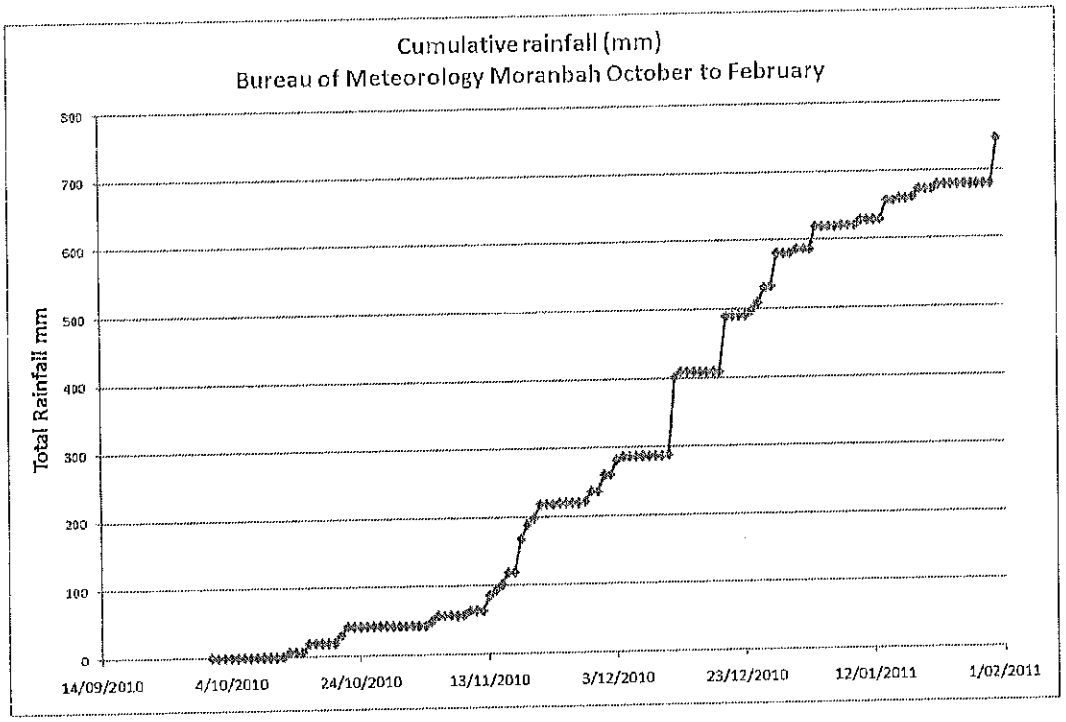
[a] Levels 27 January 2010, negative denotes level above MRL

[b] Target dam fill height is DSA for dams 1 and 10, 4m below DSA for dam 2. Current target height for dam 2 is based on 3rd party civil engineering assessment completed by URS.

[c] This dam is much smaller than the major storage dams its level can change rapidly during operations

[d] Rainfall based on approximate catchment ratio of 1.6 (based on total catchment area including transfer dams)

Figure 1 Cumulative rainfall between October to December Moranbah



Future water levels will be a product of the rainfall, coal seam water production and evaporation. Our goal is to maintain dams 1 and 10 at DSA levels by employing a discharge to the Isaac River. Dam 2 will be lowered to a level determined by independent third party engineering risk assessment.

Arrow has evaluated 2 scenarios for water requiring discharge from the storage system:

- Scenario 1 – Mean rainfall until end of wet season
- Scenario 2 – 95th percentile rainfall until end of wet season

Rainfall to date is very close to the 95th percentile rainfalls on average from October through to December. We have had a cumulative total of 586mm from the 1st of October to end of December (Figure 1), 95th percentile cumulative rainfall for the period from the start of October to the end of December totals 522mm.

Based on the current progress of the wet season Arrow believes that the next few months will produce above average rainfall. Long range forecasts from the Bureau of Meteorology give a 55% chance of rainfall at or above the 95% percentile values. In determining the water balance for the facility has evaluated 2 scenarios – mean and 95th Percentile rainfall (refer to Table 2).

Table 2 Discharge scenarios

Scenario	Volume to reach DSA (ML)	Additional removal from Dam 2 (ML) [b]	Expected Net [a] Water to Storage (ML)	Total (ML)
Mean Rainfall	69	75	54.5	198.5
95th Percentile	69	75	130	274

[a] *Net water to storage is produced water, less evaporation plus expected rainfall.*
[b] *This is based on a dam 2 target of 4000mm below DSA.*

Arrow proposes a discharge of up to 7.5ML/day when dams are above the target dam fill height shown in Table 1. The release will commence when the Isaac River is flowing above 12.6m^3/s (at this starting flow only 2.4ML/day could be discharged) measured upstream at the Goonyella river gauge (operated by DERM). Discharge will be maintained at a 400:1 dilution ratio on the basis of maintaining Australian drinking water guidelines (NHMRC,2004) downstream of the discharge. Based on a predicted salinity impact as detailed in Appendix B. This discharge rate and the dilution factor will be reviewed throughout the TEP in consultation with DERM and informed on the basis of the upstream/downstream river monitoring in line with the proposed conditions detailed within this document.

Sampling will be conducted in line with the conditions detailed in this TEP under the procedure attached as Appendix D. Appendix A contains indicative water quality to characterise the coal seam water to be discharged.

Supporting Information

Consideration of the management hierarchy for the management of coal seam water at the MGP

Evaluation as per the management hierarchy of preferred procedures from Environmental Protection (Water) Policy 2009:

Step 1—evaluate water conservation measures to reduce the use of water and the production of waste water or contaminants;
Water is not employed in the coal seam gas production process but must be removed from the coal seam to allow the gas to be extracted. Water conservation measures will not reduce the amount of coal seam water associated with the gas extracted.

Step 2—evaluate waste prevention options and implement appropriate waste prevention measures;
The key waste prevention measure employed is maximisation of the coal seam gas to water ratio. The coal seams targeted by MGP have relatively low ratios of water to gas in comparison to other fields. In an effort to manage our recent water storage constraints Arrow has shut in a large number of wells, targeting the wells with high water to gas ratios to minimise the production of coal seam water associated with our operations.

Whilst this has reduced our coal seam water production, shutting in further wells will yield limited benefits in terms of water reduction but will cause significant reduction in gas output.

Use of dam 11 in its current uncompleted, unlined state has been investigated. The pipe work and major civil infrastructure is complete but the floor of the dam is incomplete – as discussed (in our meeting on the 1st of December) it lacks its intended second liner, more importantly the clay liner has not been sufficiently compacted to allow its use. Key elements of the pipework connecting dam 11 to the rest of the network remain incomplete. Employing dam 11 would require its use for an extended period to allow subsequent emptying and upgrade of the existing dam infrastructure.

Step 3—if waste prevention does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate treatment and recycling options and implement appropriate treatment and recycling;
The construction of Dam 11 is the first component of our coal seam water management strategy. It is a large lined dam, intended to provide sufficient storage until Arrow can complete the planned development of the Reverse Osmosis water treatment facility, beneficial uses and the upgrade of existing infrastructure to the new standards. Basically dam 11 is the key early component in a scheme that is consistent with the conditions of the new Environmental Authority and intent of the relevant DERM policies. Rainfall is delaying the construction of dam 11 and contributing to the current water storage problems.

Installation of water treatment (such as a mobile RO plant) is limited by the logistics (such as civil engineering, chemical storage and power supply), cost and the challenges posed during current wet conditions. Another option considered was employing water entitlements to dilute the untreated coal seam water to the current environmental authority specification. This option was ruled out since a large quantity of good quality water would be required to dilute and dispose of a limited amount of coal seam water from our dams.

Step 4—if treatment and recycling does not, or is not likely to, eliminate the release of waste water or contaminants to waters, evaluate the following options
for waste water or contaminants, in the order in which they are listed—
(i) appropriate treatment and release to a waste facility or sewer;
(ii) appropriate treatment and release to land;
(iii) appropriate treatment and release to surface waters or ground waters.

I) We cannot practically truck water from the dams given the large quantities and the lack of disposal options. Wet weather is likely to complicate trucking of water by limiting access to some points within the MGP. Infrastructure does not exist to process this water via sewer or other industrial water treatment options. Our landholders have expressed concern of minimising truck movements during the wet season.

II) Until our water treatment management strategy is implemented we cannot treat the water to a standard that is suitable for use on land.

III) We consider the water in its current state is suitable for discharge into the Isaac – this was the water management strategy employed by the facility until earlier EA conditions were amended, we are seeking permission from DERM to allow this discharge as previously authorised until we can implement our water management strategy for the MGP. We consider a temporary discharge to the Isaac river during high flow conditions to be compliant with section 51 of the Environmental Protection Regulation 2008.

Objectives

To achieve compliance with the Environmental Authority with respect to coal seam water management and dam standards by April 2011.

This will be achieved in the short term by the release of water to the Isaac River. This measure will protect the integrity of our storage infrastructure and is consistent with the operational philosophy that our existing infrastructure was designed to accommodate.

In the medium term compliance with the new EA will be achieved by the completion of Dam 11. Completion of dam 11 will require Arrow energy to utilise the cleared area north of dam 11.

In the long term, compliance with our EA will be achieved by completion of water treatment facilities that allow beneficial use and disposal within Arrows Environmental Authority conditions. Arrow is to provide DERM with a detailed plan concerning future water management for approval.

Table 3 – Achieving TEP objectives

OBJECTIVE	ACTION	RESPONSIBILITY	TIME FRAME	PERFORMANCE INDICATOR
1. Lower dam levels for (dams 1, 2, 5, 10) to below the 'Target dam fill height" as shown in Table 1.	Manage via discharge (RP1) to Isaac river	Arrow site personnel	Immediate	Manage dams within appropriate levels as detailed in Tables 1 and 2. Discharge is to be subject to monitoring and reporting requirements
2. Monitor Discharge	Monitor discharge in accordance with Table 5, for the contaminants listed in Table 6 and Table 7	Arrow site personnel	During discharge	Lab results to be reported to DERM within 10 business days of collection.
3. Pond 2	Develop management plan to restore dam integrity or remove from service	Arrow	15 March 2010	Submission of management plan to DERM
4. Cease discharge	Cease discharge to Isaac river under TEP	Arrow	31 March 2011	Cease discharge to Isaac river
5. TEP report submission	Provide DERM with final TEP report detailing how the objectives of this TEP have been met	Arrow	31 May 2011	Submission of TEP report to DERM

Monitoring

Table 4 Contaminant release points, sources and receiving waters

Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point	Receiving waters
TEP RP 1	148° 2' 35"	-21° 57' 41"	untreated CSG water from PL191/196	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
				Upstream from discharge – Isaac River Crossing	
				Downstream from discharge – Blair Athol Bridge	

Table 5 Contaminant release monitoring points

Monitoring point (TEP MP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point location	Receiving waters
TEP MP 1	148° 2' 35"	-21° 57' 41"	Untreated CSG water from PL191	Discharge point – end of pipe	Isaac River – Dam 5 discharge point
TEP MP 2	148° 2' 46"	-21° 57' 55"	Downstream from discharge – Blair Athol Bridge	Blair Athol Railway Bridge	na
TEP MP 3	148° 2' 20"	-21° 57' 41"	Upstream from discharge	Isaac River Crossing	
TEP MP 4	148° 1' 10"	-21° 58' 00"	Untreated CSG water dam 1	Dam 1	
TEP MP 5	148° 2' 8"	-21° 58' 01"	Untreated CSG water dam 2	Dam 2	
TEP MP 6	148° 2' 32"	-21° 57' 44"	Untreated CSG water dam 5	Dam 5	
TEP MP 7	148° 1' 14"	-21° 58' 4"	Untreated CSG water dam 10	Dam 10	

Table 6 Contaminant release limits

Quality characteristic	Release Limit	Monitoring Frequency	Sample Type	Monitoring Point
Electrical conductivity (uS/cm)	13000	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1 TEP MP2 TEPMP3
			Samples require laboratory analysis[2]	TEP MP 1 TEP MP2 TEPMP3
pH (pH Unit)	6.5 (minimum) 9.5 (maximum)	Daily during release (the first sample must be taken within 2 hours of commencement of release)	*In situ*[1]	TEP MP 1 TEP MP 2 TEP MP 3
			Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3
Turbidity (NTU)	500	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3
BTEX Benzene, Ethylbenzene, Toluene and Xylene (mg/L)	Benzene 0.001 Ethylbenzene 0.3 Toluene 0.8 Xylene 0.02	Daily during release (the first sample must be taken within 2 hours of commencement of release)	Samples require laboratory analysis[2]	TEP MP 1 TEP MP 2 TEP MP 3

[1] *In situ samples can be taken using electronic sampling equipment.*
[2] *Samples are required to be analysed at a NATA accredited facility in accordance with this Transitional Environmental Program.*

Table 7 Downstream contaminant trigger investigation levels

Quality characteristic	Trigger levels (µg/L)	Monitoring frequency	Monitoring Point
Aluminium	55	Commencement of release and thereafter weekly during release	TEP MP 2 TEP MP 3
Arsenic	10		
Cadmium	0.2		
Chromium	1.0		
Copper	2.0		
Iron	300		
Lead	10		
Mercury	0.2		
Nickel	11		
Zinc	8.0		
Boron	370		
Cobalt	90		
Manganese	500		
Molybdenum	34		
Selenium	10		
Silver	1.0		
Uranium	1.0		
Vanadium	10		
Ammonia	900		
Nitrate	1100		
Petroleum hydrocarbons (C6-C9)	20		
Petroleum hydrocarbons (C10-C36)	100		
Fluoride (total)	1500		
EC	350µs/cm		
Chloride	250mg/L		
Sodium	180mg/L		

Table 8 Contaminant release during flow events

Receiving waters	Release point (TEP RP)	Easting (GDA94)	Northing (GDA94)	Minimum flow in receiving water required for a release event	Flow recording frequency
Isaac River	TEP RP1	148° 2' 35"	-21° 57' 41"	1090ML/day	Twice Daily from Goonyella Gauging station

Table 9 Receiving water downstream monitoring points

Monitoring points (TEP MP)	Receiving waters location description	Easting (GDA94)	Northing (GDA94)
TEP MP 2	Blair Athol Bridge 500 metres downstream of RP1	148° 2' 46"	-21° 57' 55"

Conditions

In carrying out this Transitional Environmental Program, CH4 Ltd (Arrow Energy) will undertake all activities in accordance with the following conditions.

Undertaking the release of untreated coal seam methane water

1 Contaminants that will, or have the potential to cause environmental harm must not be released directly or indirectly released to any waters except as permitted under this Transitional Environmental Approval.

2 The release of contaminants to waters must only occur from the release points specified in Table 4 and depicted in Appendix C attached to this Transitional Environmental Program.

3 The release of contaminants to waters must not exceed the release limits stated in Table 6 at the monitoring points specified in Table 5 and Table 6 of this Transitional Environmental Program.

4 The release of contaminants to waters from the release points must be monitored at the locations specified in Table 5 and Table 9 for each quality characteristic and at the frequency specified in Table 7 and Table 8 of this Transitional Environmental Program.

5 If quality characteristics of the release exceed any of the trigger levels specified in Table 7 during a release event, the Transitional Environmental Program holder must compare MP2 to the trigger values specified in Table 7 and:

a) where the trigger values are not exceeded then no action is to be taken

b) where the downstream results exceed the trigger values specified Table 7 for any quality characteristic, compare the results of the downstream site to the data from the upstream monitoring sites (MP3)

i) if the result is less than that recorded at Monitoring Point 3 (MP3), then no action is to be taken or

ii) if the result is greater than the background monitoring site data, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology, into the potential for environmental harm and provide a written report 20 business days after receiving results, outlining

- details of the investigations carried out
- actions taken to prevent environmental harm.

6 If an exceedance in accordance with condition 5(b)(ii) is identified, the holder of the Transitional Environmental Program must notify the administering authority within 24 hours of receiving the result. The notification must include written verification of the exceedance forwarded to the administering authority.

Contaminant Release Events

7 The release of coal seam water from the release point shown in Table 4 will not occur until -

a) - flow in the Isaac River flow reaches 1090 ML/day as shown in Table 8 (at Goonyella Gauging Station); and

b) – At least one dam in Table 1 has exceeded the 'Target Dam Fill Height' shown in Table 1; and

c) – A dilution of at least 400 parts river flow to 1 part discharge can be maintained at all times (0.25% of receiving flow).

8 The daily quantity of contaminants released from each release point must be measured and recorded at the monitoring points in Table 4

9 The daily quantity of contaminants is not to exceed 7.5ML/day in total.

10 Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build up of sediment in such waters.

Notification of Release Events

11 The Transitional Environmental Program holder must notify the administering authority within 24hours of having commenced releasing coal seam water to the receiving environment. Notification must include the submission of written verification to the administering authority of the following information:

a) release commencement date/time
b) expected release cessation date/time
c) release point/s
d) release volume (estimated)

e) receiving water/s including the natural flow rate
f) any details (including available data) regarding likely impacts on the receiving water(s).

12 The Transitional Environmental Program holder must provide the administering authority daily during the release of coal seam water, the following information:
a) all in situ monitoring data for that day
b) the receiving water flow rate
c) the release flow rate.

13 The Transitional Environmental Program holder must notify the administering authority as soon as practicable, (no later than within 24 hours after cessation of a release) of the cessation of a release notified under condition 11 and within 15 business days provide the following information in writing:
a) release cessation date/time
b) natural flow volume in receiving water
c) volume of water released
d) details regarding the compliance of the release with the conditions of this Transitional Environmental Program (i.e. contamination limits, natural flow, discharge volume)
e) all in-situ water quality monitoring results
f) any other matters pertinent to the water release event.

Notification of release event exceedence

14 If the release limits defined in Table 6 are exceeded, the holder of the Transitional Environmental Program must notify the administering authority within 2 business days of receiving the results.

15 The Transitional Environmental Program holder must, within 28 days of a release that exceeds the conditions of this Transitional Environmental Program, provide a report to the administering authority detailing:
a) the reason for the release
b) the location of the release
c) all water quality monitoring results
d) any general observations
e) all calculations

f) any other matters pertinent to the water release event.

Requirements to cease the release of coal seam water

16 The coal seam water discharge must cease immediately if any water quality limit as specified in Table 6 is exceeded or if a dilution of 400 parts river flow to 1 part discharge (0.25% of receiving flow) cannot be achieved.

17 The Department of Environment and Resource Management may require CH4 Pty to cease discharge if the department's water monitoring stations detect any water quality limit exceedance.

18 The release of coals seam water must cease immediately if identified that the release of coal seam waters is causing erosion of the bed and banks of the receiving waters, or is causing a material build up of sediment in such waters.

19 The release of coal seam water will cease immediately if Isaac River flow decreases below 1090ML/day (at Goonyella Gauging Station).

20 The release of coal seam water will cease immediately from any dam in Table 1 once the dams level is more than 100mm lower than the 'Target Dam Fill Height' shown in Table 1.

Monitoring Requirements

21 Where monitoring is a requirement of this Transitional Environmental Program, ensure that a competent person(s) conducts all monitoring.

22 Monitoring will occur at the frequencies identified in Table 6 and Table

23 All monitoring undertaken as a requirement of this Transitional Environmental Program must be undertaken in accordance with the administering authority's Water Sampling Manual.

Notification of emergencies, incidents and exceptions

24 As soon as practicable after becoming aware of any 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 Transitional Environmental Program, the administering authority must be notified of the release by telephone, facsimile or email.

25 The notification of emergencies or incidents must include but not be limited to the following:

a) the holder of the Transitional Environmental Program
b) the location of the emergency or incident
c) the number of the Transitional Environmental Program
d) the name and telephone number of the designated contact person
e) the time of the release
f) the time the holder of the Transitional Environmental Program became aware of the release
g) the suspected cause of the release
h) the environmental harm caused, threatened, or suspected to be caused by the release, and
i) actions taken to prevent any further release and mitigate any environmental harm caused by the release.

26 Not more than 10 business days following the initial notification of an emergency or incident, written advice must be provided of the information supplied to the administering authority in relation to:

a) proposed actions to prevent a recurrence of the emergency or incident, and

b) outcomes of actions taken at the time to prevent or minimise environmental harm.

Appendix A
ALS & Qld Health water sampling results

Client Reference	Collected Date	Received Date	Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmiun	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	3.8	< 0.0001	0.0011	0.076	< 0.0001	0.05	< 0.0001	0.0027	0.0011	0.003	1.7	0.0013	0.056	< 0.0001	0.0007
Discharge_Point	14-Dec-10	17-Dec-10	0.18	< 0.0001	0.0012	4.5	< 0.0001	1.1	< 0.0001	0.0003	0.0002	0.002	0.08	0.0004	0.0046	< 0.0001	0.0019
Pond_2a	16-Dec-10	17-Dec-10	0.1	< 0.0001	0.0015	6.1	< 0.0001	1	< 0.0001	0.0002	0.0003	0.001	0.066	< 0.0001	0.007	< 0.0001	0.0013
Pond_2	16-Dec-10	17-Dec-10	0.09	< 0.0001	0.0014	6	< 0.0001	1	< 0.0001	0.0002	0.0003	< 0.001	0.044	< 0.0001	0.0065	< 0.0001	0.0012
POND1_1	17-Dec-10	20-Dec-10	0.37	< 0.0001	0.0021	5.8	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.18	< 0.0001	0.0057	< 0.0001	0.0028
POND1_2	17-Dec-10	20-Dec-10	0.43	< 0.0001	0.0023	6	< 0.0001	1.5	< 0.0001	0.0008	0.0005	0.001	0.2	0.0002	0.0065	< 0.0001	0.0031
POND10_1	17-Dec-10	20-Dec-10	0.2	< 0.0001	0.0018	7.7	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.069	< 0.0001	0.0039	< 0.0001	0.0031
POND10_2	17-Dec-10	20-Dec-10	0.18	< 0.0001	0.0019	7.6	< 0.0001	1.7	< 0.0001	0.0003	0.0003	< 0.001	0.067	< 0.0001	0.0041	< 0.0001	0.0034

Client Reference	Collected Date	Received Date	Nickel	Selenium	Silver	Stroniu m	Thallium	Titani um	Uranium	Vanadium	Zinc	Benzen e	Toluene	Ethylbenzon e	Meta&Para-Xylenes	Ortho-Xylene
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Isaac_2	14-Dec-10	17-Dec-10	0.0031	< 0.0010	< 0.001	0.2	< 0.0001	0.14	0.0002	0.012	0.003	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Discharge_Point	14-Dec-10	17-Dec-10	0.0008	< 0.0010	< 0.001	7.3	< 0.0001	0.006	0.0003	0.0029	0.013	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2a	16-Dec-10	17-Dec-10	0.0012	< 0.0010	< 0.001	9.6	< 0.0001	0.003	0.0003	0.0051	0.006	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pond_2	16-Dec-10	17-Dec-10	0.0011	< 0.0010	< 0.001	9.4	< 0.0001	0.002	0.0003	0.005	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_1	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	10	< 0.0001	0.017	0.0009	0.0059	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND1_2	17-Dec-10	20-Dec-10	0.0008	< 0.0010	< 0.001	11	< 0.0001	0.015	0.0009	0.0062	0.004	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_1	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.026	0.0008	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
POND10_2	17-Dec-10	20-Dec-10	0.0005	< 0.0010	< 0.001	12	< 0.0001	0.01	0.0007	0.0071	0.005	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

ALS	21/12/2010	Sample ID 1	DAM 1	DAM 10	DAM 4	DAM 3	D1	D2	DAM 5	DAM2	TRIP BLANK
		ID 2									
ES1025292	Results	Date Sampled	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010	6/12/2010
Analyte	CAS #	Units	LOR	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
EA005: pH											
pH Value		pH Unit	0.01	9.17	9.28	9.34	9.38	9.4	9.42	9.27	9.15	-
EA010P: Conductivity by PC Titrator											
Electrical Conductivity @ 25°C		µS/cm	1	12600	14000	16400	25900	25800	26100	10700	10600	-
EG020T: Total Metals by ICP-MS											
Arsenic	7440-38-2	mg/L	0.001	0.003	0.003	0.002	<0.001	0.004	0.004	<0.001	0.002	-
Barium	7440-39-3	mg/L	0.001	6.54	8.33	4.35	1.93	1.92	1.98	6.4	9.31	-
Beryllium	7440-41-7	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cadmium	7440-43-9	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Cobalt	7440-48-4	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	-
Chromium	7440-47-3	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	-
Copper	7440-50-8	mg/L	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004	-
Manganese	7439-96-5	mg/L	0.001	0.008	0.003	0.002	0.001	0.001	0.003	0.002	0.038	-
Nickel	7440-02-0	mg/L	0.001	0.001	<0.001	0.001	0.002	0.002	0.002	<0.001	0.003	-
Lead	7439-92-1	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Vanadium	7440-62-2	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Zinc	7440-66-6	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	-
EG035T: Total Recoverable Mercury by FIMS											
Mercury	7439-97-6	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
EK055G: Ammonia as N by Discrete Analyser											
Ammonia as N	7664-41-7	mg/L	0.01	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
EK057G: Nitrite as N by Discrete Analyser											
Nitrite as N		mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EK058G: Nitrate as N by Discrete Analyser											
Nitrate as N	14797-55-8	mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser											
Nitrite + Nitrate as N		mg/L	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.03	-
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser											
Total Kjeldahl Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser											
Total Nitrogen as N		mg/L	0.1	1.7	0.5	0.5	1	1.1	1	0.9	1.2	-
EK067G: Total Phosphorus as P by Discrete Analyser											
Total Phosphorus as P		mg/L	0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
EP080: BTEX											
Benzene	71-43-2	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	108-88-3	µg/L	2	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	100-41-4	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2
EP080S: TPH(V)/BTEX Surrogates											
1,2-Dichloroethane-D4	17060-07-0	%	surrogate	113	111	103	112	105	110	110	106	106
Toluene-D8	2037-26-5	%	surrogate	110	106	103	109	105	106	107	103	102
4-Bromofluorobenzene	460-00-4	%	surrogate	106	99.7	97.9	104	97.1	98.6	101	97	101

Appendix B
Dilution calculation basis

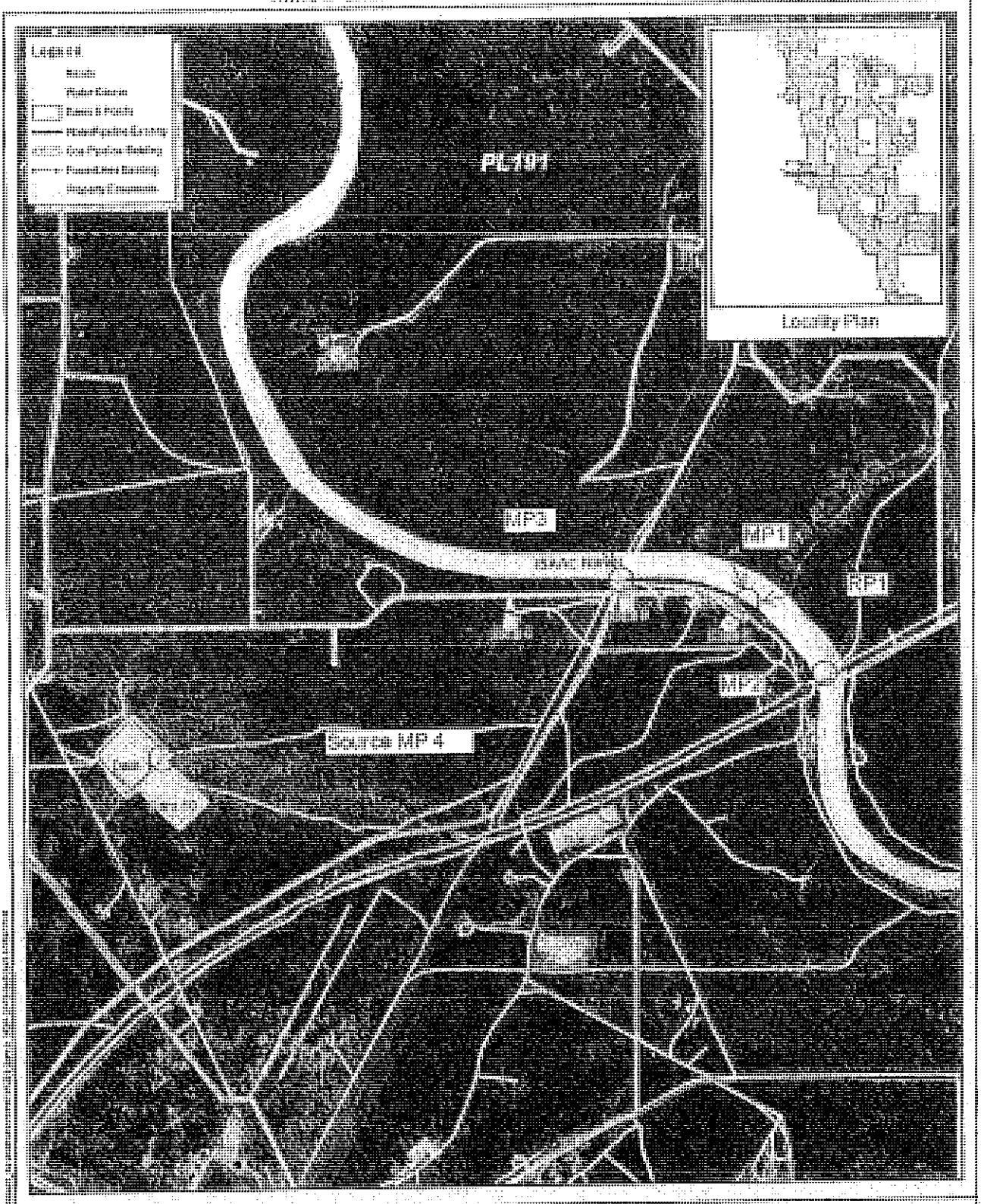
Table 10 Dilution calculation at 400:1 release

Parameter	Unit	Surface Water Concentration	Concentration of Discharge	Dilution X:1	Surface Concentration after dilution	Guideline[1]
EC	µs/cm	250	13000	400	282.5	746
Sodium	mg/L	65	2970	400	72.4	180
Chloride	mg/L	80	4280	400	90.7	250

[1] *Australian drinking water guidelines (NHMRC,2004)*
Sadium and Chloride based on EC, common soil quality (run off) and historical data from upstream

Appendix C
Mapping showing PL191 and location of key Dams

ARROW ENERGY - BOWEN BASIN GAS PROJECT



Moranbah Gas Project – Item 5

NOT FOR CONSTRUCTION

Appendix D
Sampling Procedure

SUMMARY

1.1	This procedure outlines general sampling protocols and work practices to be followed during the sampling of surface water, during the discharge of untreated CSG well water to the Isaac River. This procedure includes details on: ▪ Sampling equipment requirements; ▪ Surface water sampling techniques; ▪ Quality control requirements. ▪ Sample locations (Figure 1) ▪ Analytical requirements

EQUIPMENT

2.1	▪ Documentation o Sampling and analysis plan. o Health and safety plan o Personal protective equipment (PPE) as identified in the HSP, inc. Life Jacket and other specialised PPE, as per the HSP. ▪ Water sampling equipment o sample collection device, (Swing Arm Sampler/extension sampler) o decontamination solution (e.g. Decon 90™) or use new sample collection container in the swing arm sampler at each location. o Calibrated water quality meter (ensure parameter ranges are suitable for the water being tested), o laboratory supplied sample containers, o Chilled ice chest. o Field sample Record Sheet o Chain of Custody Form (Attached).

3.0 REFERENCES & PROFORMA

3.1	▪ AS NZS 5667.1-1998 *Water quality - Sampling - Guidance on the design of sampling programs sampling techniques* ▪ AS NZS 5667.4-1998 *Water quality - Sampling - Guidance on sampling from lakes natural and man-made* ▪ AS NZS 5667.6-1998 *Water quality - Sampling - Guidance on sampling of rivers and streams* ▪ Monitoring and Sampling Manual 2009 Environmental Protection (Water) Policy 2009, *Monitoring and Sampling Manual 2009*, Version 2 September 2010

4.0 PROCEDURE

4.1	**Safety**
	Unless specifically required, the following general safety requirements should be noted: 1. Appropriate personal protective equipment should be worn as specified in the Health and Safety Plan (HSP). When working in or around water bodies, a life jacket is required to be worn and a minimum of two persons to be present should be assessed. 2. Assess hidden hazards (eg. trip hazards, snakes, leeches, etc.). 3. Assess risks from slippery or unstable banks. 4. Assess whether the water body / drain may constitute a confined space. 5. Assess the likelihood that surface conditions within and around the water body may change rapidly in the event of heavy rainfall or tidal change.

4.2	Sampling
	1. The sampling frequency during and following discharge to the Isaac River shall be as follows: • daily during discharge; and • daily for two days following discharge stopping. 2. The sampling sequence should commence where the lowest likely contaminant concentrations are expected (e.g. downstream and work upstream), to reduce the risk of cross contamination between samples. On this basis, the samples shall be collected at the following locations (in order): (See **Figure 1** for sampling locations) I. **River crossing** (upstream), (One **primary sample (S1)**, plus **one duplicate sample (QC1)**) II. **Blair Athol Bridge** (downstream), One **primary sample (S2)**, plus **one duplicate sample (QC2)**) III. At the **Discharge Point**, One **primary sample (S3)**, plus **one duplicate sample (QC3)**) IV. At the **Source (Dam)** One **primary sample (S4)**, plus **one duplicate sample (QC4)**) V. QC samples – Field/Trip Blank **(QC5)** and rinsate blank **(QC6)** (if required) 3. At each location, a water sample should be collected for standard field parameters using a calibrated water quality meter. The following parameters should be recorded: a. pH, b. conductivity, c. dissolved oxygen, d. redox potential, e. temperature and f. turbidity. Notes: • Follow the manufacturer's instructions for use and calibration of instruments to measure water parameters. A calibration record must be kept. • When recording dissolved oxygen readings, it is important to note whether the results are reported as % saturation or ppm. • With conductivity, record whether units are mS or µS.

4. Based on the nature of the sampling locations, heterogeneous distribution of potential contaminants in the water samples is considered likely. Therefore, the following Quality Control Samples should be collected and analysed for this program:
    a. One duplicate sample per sample location for TPH, BTEX and 8 Metals analysis **(QC1 – QC4)**.
    b. One Blank Sample per esky (laboratory prepared DI Water for TPH (C6 – C9) and BTEX analysis) **(QC5)**.
5. One rinsate sample per day (unless using new sample collection medium between sample locations i.e. a new container in the swing arm sampler) for TPH (C6 – C9) and BTEX analysis) **(QC6)**.
6. At each location sample bottles should be filled based on a decreasing order of potential volatility (i.e. VOCs, BTEX and TPH first, followed by metals and other inorganic samples).
7. Note: **DO NOT** field filter samples for total metals. Perform field filtering for dissolved metals samples only.
8. When sampling shallow waters, contamination from bottom sediments should be avoided. Samples should be collected by submerging a clean sample collection container (up-side down) into the water and to approximately 100mm below the surface, rotate the container to allow it to fill.
9. The sampling location should be as representative as possible of the event being monitored. i.e. do not sample stagnant water at the edge, attempt to sample .
10. Record the appearance of the water body, i.e. colour, turbidity, odour, surface crusts, films or floating material, algae, water velocity, etc. In addition, record the weather conditions at the time of sampling and note any other relevant observations, e.g. dead or distressed flora/fauna, surface rubbish, spills, etc.
11. All measurements and field notes should be documented on the field sheet (**Attachment A**)

5.0 ANALYTICAL/SAMPLE CONTAINER REQUIREMENTS

5.1	1. The analytical suite includes the following: a. pH, EC, TDS, Turbidity b. Ions: Magnesium, Calcium, Sodium, Sulphate, Chloride, Ammonia, Nitrate, Fluoride (total). c. Metals, Aluminium, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Zinc, Boron, Cobalt, Manganese, Molybdenum, Selenium, Silver, Uranium, Vanadium. d. Organics: BTEX, PAH, TPH 2. Each Sample Requires the following containers: a. 60ml Plastic Bottle for metals (with red and green striped label border) (tick 'Total Metals') b. 500ml Plastic Bottle for anions/cations (with green label border) c. 250ml Amber Glass Bottle (with purple label border) d. One pair of BTEX vials (40 mL glass cylindrical containers with purple label border).
	Notes: • The selection of sample containers depends on the laboratories being used. The above list is based on ALS requirements only. When ultra trace analysis is being requested, additional sample volume may be required. Always check with the laboratory prior to submitting samples to the laboratory. • When filling the vials it is important that they are filled to the top with no air space remaining. • Use new sample gloves between sample locations.
5.2	1. Place samples immediately in a chilled ice chest 2. Complete sample request form and include in sealed bag in the cooler 3. Courier samples to the receiving laboratory.

12	Surface Water Sampling						Form
Site				Sampling Method:			
Job Number				Local Air Temperature:			
Date:	Time:			Wind Force:			
Weather:		Cloudiness %		Direction of Wind:			

Location	Sample No.	Water Flow (l/s)	Field Readings				Depth (m)	Comments: including turbidity (plankton and/or sediment), colour, water plants, weather conditions, etc
			pH	Conductivity	Temperature	Dissolved Oxygen		

Comments concerning treatment of samples, especially preservation:

Name: Signed: Project Manager:

adapted from AS 5667.4

Analytes

Quality characteristic	
pH	
EC	Ammonia
Turbidity	Nitrate
Magnesium	Fluoride (total)
Calcium	BTEX
Sodium	PAH
Sulphate	TPH
Chloride	
Aluminium	
Arsenic	
Cadmium	
Chromium	
Copper	
Iron	
Lead	
Mercury	
Nickel	
Zinc	
Boron	
Cobalt	
Manganese	
Molybdenum	
Selenium	
Silver	
Uranium	
Vanadium	

Appendix E
URS Dam 2 Assessment

Ben McMahon

From: [redacted]
Sent: Friday, 4 February 2011 3:32 PM
To: Ben McMahon
Cc: [redacted]
Subject: RE: MGP CSW TEP
Attachments: Notice of DECISION Draft TEP CH4 Pty Ltd.pdf; Moranbah approved TEP feb 2011.pdf

Categories: Red Category

Ben

As discussed please find attached a Notice of Approval and Certificate of Approval in regards to the Moranbah Gas Plant TEP.

I understand another discharge will commence today on receipt of this?

Regards

[redacted]

From: Ben McMahon [redacted]
Sent: Friday, 4 February 2011 2:07 PM
To: [redacted]
Subject: MGP CSW TEP

As discussed

Thanks

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T [redacted]
F
M
www.arrowenergy.com.au

Department of Environment and Resource Management

Notice

Environmental Protection Act

Decision to grant an approval for a draft transitional environmental program

This statutory notice is issued by the administering authority pursuant to section 340 of the Environmental Protection Act 1994, *to advise you of a decision or action.*

Your reference :
Our reference : CH4 Moranbah TEP

[redacted]
CH4 Pty Ltd
AM-60
42 Albert Street
Brisbane QLD 4000

ENV11-IN-043

Attention: [redacted]

Re: **Application for an approval for a transitional environmental program for management and release of produced coal seam gas water at the Moranbah Gas Project site located on tenures PL191 and PL196.**

Thank you for your application for an approval for a transitional environmental program.

Your application, which was received by this office on 23 December 2010, has been approved.

A copy of the certificate of approval is attached.

Fees apply for the assessment of a draft transitional environmental program and any subsequent annual returns. The fees are outlined in the attached operational policy *Transitional Environmental Program (TEP) fees.*

The Department will calculate this fee and invoice CH4 Pty Ltd during February 2011.

Department of Environment and Resource Management
www.derm.qld.gov.au. ABN 46 640 294 485

Notice

Decision notice regarding a transitional environmental program

Should you have any queries in relation to this notice, contact [redacted] of the Department of Environment and Resource Management on telephone [redacted]

[redacted]	4/02/2011
SIGNATURE	DATE

[redacted]
Manager Coal Seam Gas Assessment
Department of Environment and Resource Management
Delegate of the administering authority
Environmental Protection Act 1994

Enquiries:
Department of Environment and Resource Management
GPO Box 2454
BRISBANE QLD 4001
Phone: 3330 5527
Fax: 3330 5634

Department of Environment and Resource Management

Environmental Protection Act

Transitional environmental program certificate of approval -- Spring Gully

This certificate of approval is issued by the administering authority pursuant to section 339 of the Environmental Protection Act 1994. *A transitional environmental program is a specific program that, when approved, achieves compliance with the* Environmental Protection Act 1994 *for the matters dealt with by the program by reducing environmental harm, or detailing the transition to an environmental standard.*

Under the provisions of the *Environmental Protection Act 1994*, this certificate of approval is hereby granted to:

[redacted]
CH4 Pty Ltd
AM-60
42 Albert Street
Brisbane QLD 4000

approving the draft transitional environmental program; dated 4 February 2011 titled *"Coal Seam Water Management Moranbah Gas"* for management and release of produced coal seam gas water at the Moranbah Gas Project on tenures PL191 and 196.

The draft transitional environmental program, dated 4 February 2011, was originally received by this office on 23 December 2010.

The transitional environmental program remains in force until 31 May 2011.

In any case where conditions are imposed upon a certificate of approval, you may apply to the administering authority for a review of the decision. You may also appeal against the decision to the Planning and Environment Court.

Information relating to a review of decisions or appeals under the *Environmental Protection Act 1994* is available within the *Environmental Protection Act 1994*.

Should you have any queries in relation to this Notice, please contact [redacted] of the Department of Environment and Resource Management on telephone [redacted]

[redacted]
Signature

4/02/2011
Date

[redacted]
Manager Coal Seam Gas Assessment
Department of Environment and Resource Management

Enquiries:
Department of Environment and Resource Management
GPO Box 2454
BRISBANE QLD 4001
Phone: 3330 5527
Fax: 3330 5634

Department of Environment and Resource Management
www.derm.qld.gov.au ABN 46 640 294 485

Ben McMahon

From: Ben McMahon
Sent: Friday, 4 February 2011 4:00 PM
To: [redacted]
Cc: [redacted] Tim Dean; [redacted]
Subject: MGP discharge notification 2 Febuary 2011
Attachments: MGP discharge notification 2 Febuary 2011.pdf

Categories: Red Category

Hi [redacted]

Please find attached a current discharge notification. We expect to commence discharge in the next few hours.

Best regards

Ben

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Limited
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M
E
W: www.arrowenergy.com.au

04 February 2010

Ref: ENV11-05

[redacted]

Department of Environment & Resource Management
(sent via email 04 February 2010)

RE: Discharge notification

Dea[redacted]

Further to recent correspondence with yourself and your team yesterday I am writing on the behalf of Arrow Energy Limited to provide notification of intent to discharge under TEP relating to Moranbah PL191/196 granted 4 February 2011 (under EA PEN100015907 grated 14th September 2010).

Current Dam levels

Dam 10 is currently 60mm below MRL
Dam 2 is currently 910mm below MRL – the target level is to be <4000mm to ensure integrity
Dam 1 is 130mm below MRL
Dam 5 is 1770mm below MRL

Discharge details

Arrow commenced discharge into Isaac River from RP 1 from the 4 February at a discharge rate of upto 7.5ML/day (depending on available dilution) for the duration that sufficient flow is available in the Isaac river (i.e. greater than 1090ML/day as per the draft TEP conditions). As of the 3 February 2011 available river monitoring data from the Isaac River monitoring station at Goonyella recorded daily values of 6937 ML/day.

At present this flow is falling but we expect forecast rainfall contribute to daily flow and allow for discharge from the site for at least 7 days (Which implies a total discharge of upto 52.5 ML). Daily sampling has recommenced at both upstream and downstream monitoring points.

Regards,

[redacted]

Ben McMahon
Manager Compliance & Reporting

T +61 7 3012 4000 ARROW ENERGY LTD LEVEL 19, AM-60, 42-60 ALBERT STREET GPO BOX 5202 BRISBANE QLD 4001 Info@arrowenergy.com.au
F +61 7 3012 4001 ABN 73 078 521 936 BRISBANE QLD 4000 ASX CODE AOE arrowenergy.com.au

Ben McMahon

From: [redacted]
Sent: Friday, 4 February 2011 4:52 PM
To: Ben McMahon
Cc: [redacted]
Subject: RE: MGP CSW TEP
Attachments: Certificate of Approval TEP Spring Gully CH4 Pty Ltd.pdf

Categories: Red Category

Ben

Certificate now attached.

Regards

[redacted]

From: [redacted]
Sent: Friday, 4 February 2011 3:32 PM
To: Ben McMahon
Cc: [redacted]
Subject: RE: MGP CSW TEP

Ben

As discussed please find attached a Notice of Approval and Certificate of Approval in regards to the Moranbah Gas Plant TEP.

I understand another discharge will commence today on receipt of this?

Regards

[redacted]

From: Ben McMahon [redacted]
Sent: Friday, 4 February 2011 2:07 PM
To: [redacted]
Subject: MGP CSW TEP

As discussed

Thanks

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
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M:
www.arrowenergy.com.au

+----------+

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

+----------+

Department of Environment and Resource Management

Environmental Protection Act

Transitional environmental program certificate of approval – Spring Gully

This certificate of approval is issued by the administering authority pursuant to section 339 of the Environmental Protection Act 1994. *A transitional environmental program is a specific program that, when approved, achieves compliance with the* Environmental Protection Act 1994 *for the matters dealt with by the program by reducing environmental harm, or detailing the transition to an environmental standard.*

Under the provisions of the *Environmental Protection Act 1994*, this certificate of approval is hereby granted to:

[redacted]
CH4 Pty Ltd
AM-60
42 Albert Street
Brisbane QLD 4000

approving the draft transitional environmental program; dated 4 February 2011 titled *"Coal Seam Water Management Moranbah Gas"* for management and release of produced coal seam gas water at the Moranbah Gas Project on tenures PL191 and 196.

The draft transitional environmental program, dated 4 February 2011, was originally received by this office on 23 December 2010.

The transitional environmental program remains in force until 31 May 2011.

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Information relating to a review of decisions or appeals under the *Environmental Protection Act 1994* is available within the *Environmental Protection Act 1994*.

Should you have any queries in relation to this Notice, please contact Rod Kent of the Department of Environment and Resource Management on telephone 3330 5227.

[redacted]
Signature

4/02/2011
Date

[redacted]
Manager Coal Seam Gas Assessment
Department of Environment and Resource Management

Enquiries:
Department of Environment and Resource Management
GPO Box 2454
BRISBANE QLD 4001
Phone: 3330 5527
Fax: 3330 5634

Department of Environment and Resource Management
www.derm.qld.gov.au ABN 46 640 294 485
Queensland Government

Ben McMahon

From: Ben McMahon
Sent: Sunday, 6 February 2011 9:42 PM
To: [redacted]
Cc:
Subject: RE: Daily discharge update
Attachments: MGP daily update 6 Feb.xlsx

Categories: Red Category

Todays data

Site has reduced discharge rate overnight to allow for fall in flow. We will re-evaluate dilution again tomorrow. The forecast for the next few days is thunderstorms - will expect the flow to continue above discharge threshold rates but Arrow will need to manage the discharge to ensure adquate dilution is maintained.

Best regards

Ben

From: Ben McMahon
Sent: Sat 5/02/2011 4:59 PM
To: [redacted]
Cc:
Subject: Daily discharge update

Todays data

Best regards

Ben

Date	Riverflow ML/day 8am	8pm	Total	Volume discharged L/day Total	Approximate Dilution	Electrical conductivity MP3	MP1	MP2	pH MP3	MP1	MP2	Notes
21/12/2010	4134	6778	5456	4,924,800	1108	674	9510	426	9.14	9.12	9.28	Release commenced 9pm
22/12/2010	2594	3442	3018	2,700,000	1118	746	10480	336	8.47	9.09	8.35	
23/12/2010	1559	2132	1845.5	2,854,800	646	392	8810	382	8.14	8.95	8.53	Release stopped 4pm
24/12/2010			5156.5	1,029,600	5008	185.7	10360	179.1	8.02	7.96	9.09	Release commenced 10:30am
25/12/2010	7035	9900	8467.5	3,801,600	2227	247.1	10280	190.5	7.88	9.09	7.88	
26/12/2010	19583	10385	14984	1,771,200	8460	198.9	10250	178.8	8.57	9.12	8.52	
27/12/2010	5572	8988	7280	1,798,200	4048	344	10580	188.7	8.22	9.12	8.6	
28/12/2010	40190	9388	24789	864,000	28691	160.4	8770	137.9	8.13	9	8.33	
29/12/2010	7164	14679	10921.5	1,209,600	9029	191.1	10350	198.2	7.8	9.01	8.8	
30/12/2010	6271	5026	6680	2,962,800	2255	187.3	9970	194.3	8.01	9.08	8.48	
31/12/2010	4372	7243	4272	3,418,200	1250	252.1	8770	213.9	8.03	9.01	7.78	
1/01/2011	2772	3360	2650	820,800	3229	258.7	9600	202.4	7.9	8.9	8.7	
2/01/2011	1753	2311	2119	1,468,800	1443	195.4	10620	189.4	8.2	9.05	8.2	Release stopped 5pm
3/01/2011	5586	4260	3551	1,910,880	1858	464	9900	288	8.07	8.9	8.6	Release started 7am
4/01/2011	2494	1948	2526	1,609,200	1570	321	8710	336	7.52	8.8	7.07	
5/01/2011	2000	2200	4953	818,100	6054	734	8780	423	8.62	9.03	8.78	Release stopped 5pm
31/01/2011	36660	19855	18099	1,940,400	9327	734	8780	423	8.62	9.03	8.78	Release started 10:50am
1/02/2011	6300	15751	5867	6,523,200	899	470	11370	450	7.51	8.12	7.6	
2/02/2011	2668		2668	1,902,600	1402	405	na	435	8.09	na	8.12	Release stopped 6pm
3/02/2011												
4/02/2011												
5/02/2011	2612	2178	2395	1,915,200	1251	828	12810	345	8.9	9.34	8.58	Release started 8:30 am
6/02/2011	3411	2872	3141.5	6,955,200	452	698	na	333	8.23	8.99	8.01	Release has been reduced overnight due to uncertainity in flows (patchy storms)
7/02/2011												
8/02/2011												
9/02/2011												

Provisional based on average of two instantaneous values

Ben McMahon

From: [redacted]
Sent: Monday, 7 February 2011 4:18 PM
To: Ben McMahon
Cc: [redacted]
Subject: FW: Daily discharge update
Attachments: MGP daily update 6 Feb.xlsx

Categories: Red Category

Hi Ben

Thanks for sending through the reports on the weekend.

- On reviewing this data I noted that on Saturday the EC recording at the discharge was 12 810 us/cm but on Sunday a reading of N/A was entered, which I assume means Not Applicable.

  - Please explain the missing data and ensure all future reports contain explanations for any missing data rather than N/A entries.

- I also noted very high downstream EC readings of well more than double the EC upstream level.

  - Please explain how the downstream water quality (EC 345us/cm) is better than the upstream background sample (EC 828 us/cm), after receiving CSG water with an EC of 12 810 us/cm? I note on the site plan there appears to be a tributary entering on the North bank of the Isaacs River just upstream of MP2. Is it possible to provide advice about flows from this tributary into the main river? Can samples be obtained? This might explain the anomaly. Monitoring data of the unauthorised release also shows the same anomaly occurring on several days.

Regards

[redacted]

-----Original Message-----
From: Ben McMahon [redacted]
Sent: Sunday, 6 February 2011 9:42 PM
To: [redacted]
Cc:
Subject: RE: Daily discharge update

Todays data

Site has reduced discharge rate overnight to allow for fall in flow. We will re-evaluate dilution again tomorrow. The forecast for the next few days is thunderstorms - will expect the flow to continue above discharge threshold rates but Arrow will need to manage the discharge to ensure adquate dilution is maintained.

Best regards

Ben

From: Ben McMahon
Sent: Sat 5/02/2011 4:59 PM
To: [redacted]
Cc:

Subject: Daily discharge update

Todays data

Best regards

Ben

+----------+

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

+----------+

Date	Riverflow ML/day			Volume discharged L/day			Approximate Dilution	Electrical conductivity			pH			
	8am	8pm	Total	Pond 5 direct	Pond 5	Total		MP3	MP1	MP2	MP3	MP1	MP2	
21/12/2010	4134	6778	5456	1036800	3888000	4924800	1108	674	9510	426	9.14	9.12	9.28	Release commenced 9pm
22/12/2010	2594	3442	3018	1663200	1036800	2700000	1118	746	10480	336	8.47	9.09	8.35	
23/12/2010	1559	2132	1845.5	2170800	684000	2854800	646	392	8810	382	8.14	8.95	8.53	Release stopped 4pm
24/12/2010			5156.5	772200	257400	1029600	5008	185.7	10360	179.1	8.02	7.96	9.09	Release commenced 10:30am
25/12/2010	7035	9900	8467.5	2851200	950400	3801600	2227	247.1	10280	190.5	7.88	9.09	7.88	
26/12/2010	19583	10385	14984	907200	864000	1771200	8460	198.9	10250	178.8	8.57	9.12	8.52	
27/12/2010	5572	8988	7280	891000	907200	1798200	4048	344	10580	188.7	8.22	9.12	8.6	
28/12/2010	40190	9388	24789	0	864000	864000	28691	160.4	8770	137.9	8.13	9	8.33	
29/12/2010	7164	14679	10921.5	259200	950400	1209600	9029	191.1	10350	198.2	7.8	9.01	8.8	
30/12/2010	6271	5026	6680	2142000	820800	2962800	2255	187.3	9970	194.3	8.01	9.08	8.48	
31/12/2010	4372	7243	4272	2554200	864000	3418200	1250	252.1	8770	213.9	8.03	9.01	7.78	
1/01/2011	2772	3360	2650		820800	820800	3229	258.7	9600	202.4	7.9	8.9	8.7	
2/01/2011	1753	2311	2119	819000	649800	1468800	1443	195.4	10620	189.4	8.2	9.05	8.2	Release stopped 5pm
3/01/2011	5586	4260	3551	1562400	348480	1910880	1858	464	9900	288	8.07	8.9	8.6	Release started 7am
4/01/2011	2494	1948	2526	831600	777600	1609200	1570	321	8710	336	7.52	8.8	7.07	
5/01/2011	2000	2200	4953	267300	550800	818100	6054	734	8780	423	8.62	9.03	8.78	Release stopped 5pm
31/01/2011	36660	19855	18099	1638000	302400	1940400	9327.458256	734	8780	423	8.62	9.03	8.78	Release started 10:50am
1/02/2011	6300	15751	5867	5616000	907200	6523200	899.4051999	470	11370	450	7.51	8.12	7.6	
2/02/2011	2668		2668	1638000	264600	1902600	1402.291601	405	na	435	8.09	na	8.12	Release stopped 6pm

Provisional number since daily total is not available

Ben McMahon

From: Ben McMahon
Sent: Monday, 7 February 2011 9:39 PM
To: [redacted]
Cc:
Subject: RE: Daily discharge update
Attachments: MGP daily update 7 Feb.xlsx

Categories: Red Category

Hi [redacted]

Attached is todays results

We have had a bit of trouble accessing the discharge directly to complete the sampling over the last few days and the conductivity measurements appear to be diluted with river water. I have seen a few atypical results (too low - I have included these in todays daily update) I wanted to confirm that these were correct before providing them to DERM (difficult to do on a weekend). I have requested that the daily insitu sampling is now completed upstream from the discharge point from source dams (I will provide an update of the source water conductivities to DERM tomorrow when I recieve the data tomorrow). The monitoring procedure will be reviewed to ensure that this happens on an ongoing basis.

I will have a look into the results further tomorrow to investigate the upstream/downstream conductivities. Not sure that we have any idea of the flows in the Tributary (Teviot Brook from memory). My understanding from visiting the site late last year is that Teviot Brook catchment is a lot more local to the site than the catchment feeding the Isaac so it would be possible to have big swings in the proportion of contribution from each in the downstream monitoring location.

Best regards

Ben

From: [redacted]
Sent: Mon 7/02/2011 4:18 PM
To: Ben McMahon
Cc: [redacted]
Subject: FW: Daily discharge update

Hi Ben

Thanks for sending through the reports on the weekend.

- On reviewing this data I noted that on Saturday the EC recording at the discharge was 12 810 us/cm but on Sunday a reading of N/A was entered, which I assume means Not Applicable.

  - Please explain the missing data and ensure all future reports contain explanations for any missing data rather than N/A entries.

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  - Please explain how the downstream water quality (EC 345us/cm) is better than the upstream background sample (EC 828 us/cm), after receiving CSG water with an EC of 12 810 us/cm? I note on the site plan there appears to be a tributary entering on the North bank of the Isaacs River just upstream of MP2. Is it possible to provide advice about flows from this tributary into the main river? Can samples be obtained? This might explain the anomaly. Monitoring data of the unauthorised release also shows the same anomaly occurring on several days.

Regards

[redacted]

-----Original Message-----
From: Ben McMahon [redacted]
Sent: Sunday, 6 February 2011 9:42 PM
To: [redacted]
Cc: [redacted]
Subject: RE: Daily discharge update

Todays data

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Best regards

Ben

From: Ben McMahon
Sent: Sat 5/02/2011 4:59 PM
To: [redacted]
Cc: [redacted]
Subject: Daily discharge update

Todays data

Best regards

Ben

+----------+

Think B4U Print

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+----------+

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26/12/2010	19583	10385	14984	1,771,200	8460	198.9	10250	178.8	8.57	9.12	8.52	
27/12/2010	5572	8988	7280	1,798,200	4048	344	10580	188.7	8.22	9.12	8.6	
28/12/2010	40190	9388	24789	864,000	28691	160.4	8770	137.9	8.13	9	8.33	
29/12/2010	7164	14679	10921.5	1,209,600	9029	191.1	10350	198.2	7.8	9.01	8.8	
30/12/2010	6271	5026	6680	2,962,800	2255	187.3	9970	194.3	8.01	9.08	8.48	
31/12/2010	4372	7243	4272	3,418,200	1250	252.1	8770	213.9	8.03	9.01	7.78	
1/01/2011	2772	3360	2650	820,800	3229	258.7	9600	202.4	7.9	8.9	8.7	
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2/02/2011	2668		*2668*	1,902,600	1402	405	na	435	8.09	na	8.12	Release stopped 6pm
3/02/2011												
4/02/2011												
5/02/2011	2612	2178	2483	1,915,200	1251	828	12810	345	8.9	9.34	8.58	Release started 8:30 am
6/02/2011	3411	2872	2820	6,955,200	405	698	1615	333	8.23	8.99	8.01	Release has been reduced overnight due to uncertainity in flows (patchy storms)
7/02/2011	1782	1553	1667.5	3,464,640	481	938	3090	188.2	8.81	9.23	8.19	Discharge rate has been reduced to maintain dilution
8/02/2011												
9/02/2011												

Provisional based on average of two instantaneous values

Ben McMahon

From: Ben McMahon
Sent: Friday, 11 February 2011 4:04 PM
To: [redacted]
Cc:
Subject: MGP TEP water quality results
Attachments: Available Water quality results 11FEB11.xls

Categories: Red Category

Hi [redacted]

Updated sampling results. The results indicate that downstream from the discharge are within background concentration ranges for the substances identified in the TEP.

The data for the 24, 25 and 27th Jan has been added to the table (the samples are highlighted in yellow) we are still having issues with 10 business day turn around at this point. More recent testing has been better.

ALS have also been given yet another hurry up to improve on their turn-around times, but have not been able to meet anything near acceptable as yet.

We are currently in the process of making alternative arrangements with two other laboratories.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
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Date	Riverflow ML/day 8am	8pm	Total	Volume discharged L/day Total	Approximate Dilution	Electrical conductivity MP3	MP1	MP2	pH MP3	MP1	MP2	Notes
21/12/2010	4134	6778	5456	4,924,800	1108	674	9510	426	9.14	9.12	9.28	Release commenced 9pm
22/12/2010	2594	3442	3018	2,700,000	1118	746	10480	336	8.47	9.09	8.35	
23/12/2010	1559	2132	1845.5	2,854,800	646	392	8810	382	8.14	8.95	8.53	Release stopped 4pm
24/12/2010			5156.5	1,029,600	5008	185.7	10360	179.1	8.02	7.96	9.09	Release commenced 10:30am
25/12/2010	7035	9900	8467.5	3,801,600	2227	247.1	10280	190.5	7.88	9.09	7.88	
26/12/2010	19583	10385	14984	1,771,200	8460	198.9	10250	178.8	8.57	9.12	8.52	
27/12/2010	5572	8988	7280	1,798,200	4048	344	10580	188.7	8.22	9.12	8.6	
28/12/2010	40190	9388	24789	864,000	28691	160.4	8770	137.9	8.13	9	8.33	
29/12/2010	7164	14679	10921.5	1,209,600	9029	191.1	10350	198.2	7.8	9.01	8.8	
30/12/2010	6271	5026	6680	2,962,800	2255	187.3	9970	194.3	8.01	9.08	8.48	
31/12/2010	4372	7243	4272	3,418,200	1250	252.1	8770	213.9	8.03	9.01	7.78	
1/01/2011	2772	3360	2650	820,800	3229	258.7	9600	202.4	7.9	8.9	8.7	
2/01/2011	1753	2311	2119	1,468,800	1443	195.4	10620	189.4	8.2	9.05	8.2	Release stopped 5pm
3/01/2011	5586	4260	3551	1,910,880	1858	464	9900	288	8.07	8.9	8.6	Release started 7am
4/01/2011	2494	1948	2526	1,609,200	1570	321	8710	336	7.52	8.8	7.07	
5/01/2011	2000	2200	4953	818,100	6054	734	8780	423	8.62	9.03	8.78	Release stopped 5pm
31/01/2011	36660	19855	18099	1,940,400	9327	734	8780	423	8.62	9.03	8.78	Release started 10:50am
1/02/2011	6300	15751	5867	6,523,200	899	470	11370	450	7.51	8.12	7.6	
2/02/2011	2668		*2668*	1,902,600	1402	405	na	435	8.09	na	8.12	Release stopped 6pm
3/02/2011												
4/02/2011												
5/02/2011	2612	2178	*2395*	1,915,200	1251	828	12810	345	8.9	9.34	8.58	Release started 8:30 am
6/02/2011	3411	2872	*3141.5*	6,955,200	452	698	na	333	8.23	8.99	8.01	Release has been reduced overnight due to uncertainity in flows (patchy storms)
7/02/2011												
8/02/2011												
9/02/2011												

*Provisional based on average of two instantaneous values

Ben McMahon

From: Ben McMahon
Sent: Thursday, 17 February 2011 3:55 PM
To: [redacted]
Cc: Tim Dean
Subject: PL191/196 MGP TEP update
Attachments: ENV11-17 PL191 196 TEP update.pdf

Categories: Red Category

Hi [redacted]

Please find attached an update in relation to the status of ALS Lab results in relation to the river discharge under the MGP TEP (PL191/196)

Best regards

Ben McMahon
Manager Compliance & Reporting

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17 February 2011

Ref: ENV11-17

[redacted]

Department of Environment & Resource Management

(sent via email 17 February 2011)

RE: MGP TEP Compliance update

Dear [redacted]

Arrow Energy is currently experiencing delays in obtaining lab results in relation to a number of samples collected between the 4/2/2011 to the 7/2/2011. These results were collected during the last period of discharge to the Isaac River under Transitional Environmental Program titled "Coal Seam Water Management Moranbah Gas Project".

The latest advice received from our laboratory is that the results will be available on the 21/2/2011. This will be outside of the 10 business days stipulated in the conditions of the TEP document. At present the site is not discharging water. This delay in obtaining results does not pose any potential to cause environmental harm.

Arrow Energy will provide the results to DERM when they become available

Best regards,

[redacted]

Ben McMahon
Manager Compliance and Reporting

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08/03/2011

Ref: Env11-025

Department of Environment and Resource Management (DERM)

Via email: [redacted] 8 March 2011

Dear [redacted]

Subject: Update report – Detailed Data Assessment - TEP for PEN100015907/ PL191/196

This letter addresses Condition 5 in TEP PEN100015907, which states:

> "If quality characteristics of the release exceed any of the trigger levels specified in Table 7 during a release event, the Transitional Environmental Program holder must compare MP2 to the trigger values specified in Table 7 and:
>
> a) where the trigger values are not exceeded then no action to be taken.
> b) where the downstream results exceed the trigger values specified Table 7 for any quality characteristics, compare the results of the downstream site to the data from the upstream monitoring sites (MP3)
>
> i) If the result is less that recorded at Monitoring Point 3 (MP3) then no action is to be taken or
> ii) If the result is greater than the background monitoring site data, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology, into the potential for environmental harm and provide a written report **20 business days after receiving results**, outlining:
> - details of the investigations carried out
> - actions taken to prevent environmental harm."

This notification summarises the analytical results of the sampling and analysis program undertaken prior to and post commencement of the TEP (dated 4 February 2011). The data have been assessed against trigger levels, as outlined in TEP PEN100015907 as provided to DERM in tabular format as the data has been received from the NATA accredited laboratory.

As previously indicated via email to [redacted] on 28 January 2011, the background water quality has exceeded the TEP trigger values for a number of analytes tested during the sampling and analysis program. As part of this assessment, the exceedances have been reviewed for both the Isaac River samples (upstream and downstream) and the discharge water samples. A comparison has been made between the upstream and downstream results, (i.e. including the results of quality control samples); and where the downstream values exceed both the TEP trigger levels and the upstream results further investigation has been undertaken (**Table 1**), including an assessment of the wastewater results. Where the discharge water quality results exceed the trigger levels and exceed the Isaac River results, an assessment of the analyte concentrations against both the ANZECC Fresh Water Aquatic Guidelines and the Australian Drinking Water Guidelines has been undertaken (**Table 2**). Based on a detailed review of the results from the monitoring program to date, the following has been reported:

Analytes that consistently exceeded the TEP Trigger levels included aluminium, chromium, copper, iron, nickel, zinc, and vanadium. The results were reported as follows.

The maximum concentration of aluminium was reported at 21.1 mg/L (upstream) and 22 mg/L (downstream), with an average concentration of 10.5 mg/L and 11.2 mg/L for the upstream and downstream sites respectively. The maximum concentration reported for the discharge location was 16.3 mg/L with an average concentration of 4.53 mg/L reported over the monitoring period assessed. On 21, 24, 25 and 27 of

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December 2010, concentrations of aluminium in the discharge water exceeded the reported concentrations at the upstream location. Based on review of the results and an assessment of the relative percentage difference (RPD) between the upstream water results and the discharge water results (see Table 2), the RPD was calculated to between 3% and 16%. On this basis, the concentrations of aluminium at the upstream sampling location and the discharge point are not considered significantly different. Based on the average concentrations of aluminium in the wastewater compared to the average concentrations in the Isaac River, the discharge of wastewater would have likely diluted the aluminium concentrations in the Isacc River over time. There are no health based guidelines currently available for aluminium.

The maximum concentration of chromium was reported at 0.07 mg/L (upstream) and 0.06 mg/L (downstream), with an average concentration of 0.019 mg/L for both the upstream and downstream sites. The maximum concentration reported for the discharge location was 1.53 mg/L with an average concentration of 0.255 mg/L reported over the monitoring period assessed. On 24, 25 and 27 of December 2010, 31 Jan 2011 and 1 February 2011 concentrations of chromium in the discharge water exceeded the reported concentrations at the upstream location. The RPD was calculated to between 5% and 142%. The concentrations of chromium in the discharge water were found to be periodically significantly different from the water quality in the Isaac River. It is considered highly unlikely that the chromium concentrations present is hexavalent chromium, as there are no identified sources of chromium VI. Insufficient data are currently available to assign an assessment criterion for chromium III in freshwater ecosystems and there are no health based guidelines currently available for chromium III in drinking water. No further investigation is considered warranted for chromium on the basis that no adverse environmental or human health risks were identified.

The maximum concentration of copper was reported at 0.021 mg/L (upstream) and 0.020 mg/L (downstream), with an average concentration of 0.09 mg/L and 0.10 mg/L for the upstream and downstream sites respectively. The maximum concentration reported for the discharge location was 0.020 mg/L with an average concentration of 0.007 mg/L reported over the monitoring period assessed. On 24 and 25 December 2010, concentrations of copper in the discharge water marginally exceeded the reported concentrations at the upstream location. The RPD was calculated to between 10% and 12%. On this basis, the concentrations of copper at the upstream sampling location and the discharge point are not considered significantly different. Based on the average concentrations of copper in the wastewater compared to the average concentrations in the Isaac River, the discharge of wastewater would have likely diluted the copper concentrations in the Isaac River during discharge. There are no health based guidelines currently available for copper; however the fresh water aquatic ecosystem guideline of 0.0014 mg/L was consistently exceeded in both the upstream and downstream sampling locations. Based on the quality of the receiving water body, no significant environmental harm is considered likely to have occurred on the basis that the discharge water appeared to be indicative of typical background conditions. No further investigation is considered warranted.

The maximum concentration of iron was reported at 29.4 mg/L (upstream) and 28.8 mg/L (downstream), with an average concentration of 13.50 mg/L and 14.66 mg/L for the upstream and downstream sites respectively. The maximum concentration reported for the discharge location was 23.5 mg/L with an average concentration of 5.6 mg/L reported over the monitoring period assessed. On 24, 25 and 27 December 2010, concentrations of iron in the discharge water marginally exceeded the reported concentrations at the upstream location. The RPD was calculated to between 2% and 19%. On this basis, the concentrations of iron at the upstream sampling location and the discharge point are not considered significantly different. Based on the average concentrations of iron in the wastewater compared to the average concentrations in the Isaac River, the discharge of wastewater would have likely diluted the iron concentrations in the Isaac River during discharge. There are no health based, or freshwater aquatic guidelines currently available for iron. Based on the quality of the receiving water body, no significant environmental harm is considered likely to have occurred on the basis that the discharge water appeared to be indicative or of better general quality than typical background conditions. No further investigation is considered warranted for iron.

The maximum concentration of nickel was reported at 0.226 mg/L (upstream) and 0.237 mg/L (downstream), with an average concentration of 0.039 mg/L and 0.040 mg/L for the upstream and downstream sites respectively. The maximum concentration reported for the discharge location was 0.030 mg/L with an average concentration of 0.011 mg/L reported over the monitoring period assessed. Nickel in the discharge water did not exceed the reported concentrations at the upstream location at any for the assessed data. Based on the quality of the receiving water body, no significant environmental harm is considered likely to

have occurred based on the concentrations of nickel added to the Isaac River. No further investigation is considered warranted for nickel.

The maximum concentration of zinc was reported at 0.844 mg/L (upstream) and 0.822 mg/L (downstream), with an average concentration of 0.105 mg/L and 0.110 mg/L for the upstream and downstream sites respectively. The maximum concentration reported for the discharge location was 0.040 mg/L with an average concentration of 0.018 mg/L reported over the monitoring period assessed. On 21, 24 and 27 December 2010, concentrations of zinc in the discharge water marginally exceeded the reported concentrations at the upstream location. The RPD was calculated to between 11% and 29%. Based on the reported concentrations at the upstream sampling location, the quality of water discharged to the Isaac River are not considered significant and would not have adversely affected the quality of water in the Isaac River. There are no health based guidelines currently available for zinc; however the fresh water aquatic ecosystem guideline of 0.008 mg/L was consistently exceeded in both the upstream and downstream sampling locations. Based on the quality of the receiving water body, no significant environmental harm is considered likely to have occurred on the basis that the discharge water appeared to be indicative of typical background conditions, if not generally better. No further investigation is considered warranted for zinc.

The maximum concentration of vanadium was reported at 0.06 mg/L (upstream) and 0.05 mg/L (downstream), with an average concentration of 0.024 mg/L and 0.026 mg/L for the upstream and downstream sites respectively. The maximum concentration reported for the discharge location was 0.06 mg/L with an average concentration of 0.029 mg/L reported over the monitoring period assessed. On 24, 25 and 27 December 2010, concentrations of vanadium in the discharge water marginally exceeded the reported concentrations at the upstream location. The RPD was calculated to between 13% and 22%. Based on the reported concentrations over the sampling period, concentrations of vanadium are considered indicative of background, receiving water conditions. The water discharged to the Isaac River is not considered likely to have significantly affected in the quality of water the Isaac River. There are no health based, or freshwater aquatic guidelines currently available for vanadium. No further investigation is considered warranted.

Analytes that were observed above the TEP Trigger levels, either rarely or intermittently, included arsenic, cadmium, lead, boron, silver, uranium, fluoride and recoverable hydrocarbons. Of these, arsenic, cadmium, lead, silver and uranium are not considered to be a result of or influenced by the wastewater discharge program, on the basis of the reported concentrations. Boron, fluoride and petroleum hydrocarbons are discussed as follows:

- Concentrations of boron were observed above the trigger levels in discharge water on the 2 – 7 January 2011. The reported concentrations ranged from 1.03 and 1.39 mg/L during this January discharge period, which is in excess of the trigger level of 0.37 mg/L. These results pushed the average concentration of Boron for the entire monitoring period to 0.91 mg/L, which is also above the trigger level. Based on the foregoing, the drinking water guidelines and freshwater quality guidelines were reviewed, reporting the following:
    - The maximum concentration of boron of 1.39 mg/L was reported below the drinking water guideline of 4 mg/L
    - The maximum concentration of boron of 1.39 mg/L was reported above the freshwater aquatic guideline for 95% protection 0.37 mg/L.
    - It is noted that the dilution factor for discharge is at 400:1 and therefore, the adverse affect of discharge on the quality of the receiving water body is considered insignificant.
- Concentrations of boron were observed above the trigger levels in discharge water on 1 February 2011. The reported concentration was 2.4 mg/L, marginally above the trigger level of 2.0 mg/L. Based on the dilution factor of a minimum of 400:1 the adverse affect of discharge on the quality of the receiving water body is considered insignificant.
- On one occasion (31 Jan 2011), concentrations of total recoverable hydrocarbons (TRH) in the C15 – C36 fraction were reported at 240 ug/L, above the trigger level of 100 ug/L. The source of the petroleum hydrocarbons was investigated, but remains unknown. On the basis that BTEX and PAHs were reported below the level of reporting for this sample, it is considered possible that the TRH is indicative of naturally occurring organic material. At the reported concentration, it is considered unlikely that the petroleum hydrocarbon would cause a visible sheen. On the basis that the discharge pumps are submerged pumps and the results are inconsistent with the larger data set, the potential for sample anomaly (e.g. cross contamination of the sample) cannot be discounted.

Based on review of the available data, the quality of discharge waters is considered unlikely to detrimentally affect the environmental status of the Isaac River. In addition, based on the contaminants that were reported at concentrations above the investigations levels, the likelihood of impacting the potential health and safety of receptors is considered low. Further details will be provided in the final report.

Regards,

Graham Cordingley
Senior Operations Support Coordinator

Table 1																				
ALS		Analyte	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Nickel	Zinc	Boron	Silver	Uranium	Vanadium	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
Sample ID		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		Date Sampled/LOR	0.01	0.01-0.001	0.005 - 0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.01-0.001	0.01-0.005	0.1-0.05	0.001	0.001	0.01	20	50	100	50	50
Draft TEP Trigger Investigation Level			0.055	0.013	0.0002	0.001	0.002	0.3	0.01	0.011	0.008	0.37	0.001	0.001	0.01	20	100	[illegible]	[illegible]	100
= Downstream Concentration > Trigger Level and > Upstream Concentration																				
ISAAC 1	Up Stream (MP3)	21/12/2010	13.3	<0.01	<0.005	0.04	0.02	29	0.01	0.03	0.03	<0.1		<0.001	0.06	<20	-	-	-	-
ISAAC 2	Downstream (MP2)	21/12/2010	18.1	0.02	<0.005	0.03	0.02	28.1	<0.01	0.03	0.05	<0.1		<0.001	0.05	<20	-	-	-	-
ISSAC 2	Downstream (MP2) QC	21/12/2010	12.8	<0.01	<0.005	0.02	0.02	20.1	<0.01	0.02	0.03	<0.1		<0.001	0.04	<20	-	-	-	-
		21/12/2010																		
Downstream	Downstream (MP2)	23/12/2010	-	0.002	<0.0001	0.013	0.009	-	0.006	0.015	0.018	-	-	-		<20	<50	<100	<50	<50
ISAAC 2	Downstream (MP2) QC	23/12/2010	-	0.001	<0.0001	0.013	0.01	-	0.006	0.015	0.019	-	-	-		<20	<50	<100	<50	<50
		23/12/2010																		
ISAAC 1-S1	Up Stream (MP3)	24/12/2010	15.2	<0.001	<0.0001	0.012	0.015	10.7	0.006	0.013	0.016	<0.05	<0.001	-	0.02	<20	<50	<100	<50	60
ISAAC 1-QC1	Up Stream (MP3) QC	24/12/2010	9.18	0.001	<0.0001	0.012	0.009	10.9	0.006	0.013	0.02	<0.05	<0.001	-	0.02	<20	<50	<100	<50	<50
ISAAC 2- S2	Downstream (MP2)	24/12/2010	16.4	0.002	<0.0001	0.017	0.012	19.7	0.009	0.02	0.034	<0.05	<0.001	-	0.03	<20	<50	<100	<50	<50
ISAAC 2- QC2	Downstream (MP2) QC	24/12/2010	11.1	0.002	<0.0001	0.017	0.013	15.6	0.007	0.016	0.026	<0.05	<0.001	-	0.03	<20	<50	<100	50	<50
		24/12/2010																		
ISAAC 1-S1	Up Stream (MP3)	24/12/2010	8.83	<0.001	<0.0001	0.012	0.01	10	0.006	0.014	0.017	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
ISAAC 1-QC1	Up Stream (MP3) QC	24/12/2010	9.16	0.001	<0.0001	0.012	0.01	10.5	0.006	0.014	0.018	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
ISAAC 2- S2	Downstream (MP2)	24/12/2010	11.9	0.002	<0.0001	0.017	0.012	14.4	0.007	0.017	0.034	<0.05	<0.001	<0.001	0.03	<20	<50	<100	<50	<50
ISAAC 2- QC2	Downstream (MP2) QC	24/12/2010	11.1	0.001	<0.0001	0.016	0.011	13.5	0.007	0.016	0.056	<0.05	<0.001	<0.001	0.03	<20	<50	<100	50	50
		24/12/2010																		
ISAAC 1-S1	Up Stream (MP3)	25/12/2010	15.2	0.002	<0.0001	0.021	0.015	18.4	0.009	0.023	0.03	<0.05	<0.001	<0.001	0.04	<20	<50	<100	60	60
ISAAC 1-QC1	Up Stream (MP3) QC	25/12/2010	15.2	0.001	<0.0001	0.021	0.016	17.5	0.009	0.023	0.035	<0.05	<0.001	<0.001	0.03	<20	<50	<100	<50	<50
ISAAC 2- S2	Downstream (MP2)	25/12/2010	16.4	0.002	<0.0001	0.023	0.016	19.7	0.009	0.024	0.055	<0.05	<0.001	<0.001	0.04	<20	<50	<100	<50	<50
ISAAC 2- QC2	Downstream (MP2) QC	25/12/2010	16.2	0.002	<0.0001	0.023	0.016	19.5	0.009	0.024	0.03	<0.05	<0.001	<0.001	0.04	<20	<50	<100	<50	<50
		25/12/2010																		
ISAAC 1-S1	Up Stream (MP3)	27/12/2010	9.41	0.002	<0.0001	0.012	0.01	10.7	0.006	0.013	0.016	0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
ISAAC 1-QC1	Up Stream (MP3) QC	27/12/2010	9.18	0.001	<0.0001	0.012	0.009	10.9	0.006	0.013	0.02	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
ISAAC 2- S2	Downstream (MP2)	27/12/2010	14.3	0.002	<0.0001	0.019	0.014	17.5	0.009	0.02	0.08	<0.05	<0.001	<0.001	0.03	<20	<50	<100	<50	<50
ISAAC 2- QC2	Downstream (MP2) QC	27/12/2010	12.7	0.001	<0.0001	0.017	0.013	15.6	0.009	0.018	0.026	<0.05	<0.001	<0.001	0.03	<20	<50	<100	<50	<50
		27/12/2010																		
ISAAC1-S1	Up Stream (MP3)	29/12/2010	-	<0.001	<0.0001	0.009	0.008	-	0.004	0.011	0.015	-	-	-	0.02	<20	<50	<100	<50	<50
ISAAC1-QC1	Up Stream (MP3)QC	29/12/2010	-	<0.001	0.0002	0.008	0.008	-	0.004	0.01	0.014	-	-	-	0.02	<20	<50	<100	<50	<50
ISAAC2-S2	Downstream (MP2)	29/12/2010	-	<0.001	0.0001	0.01	0.009	-	0.005	0.012	0.017	-	-	-	0.02	<20	<50	<100	<50	<50
ISAAC2-QC2	Downstream (MP2) QC	29/12/2010	-	<0.001	<0.0001	0.008	0.008	-	0.004	0.01	0.013	-	-	-	0.02	<20	<50	<100	<50	<50
		29/12/2010																		
ISAAC 1	Up Stream (MP3)	31/12/2010	-	<0.001	<0.0001	0.008	0.006	-	0.004	0.009	0.014	-	-	-	0.01	<20	<50	<100	<50	<50
Issac 1 - s1	Up Stream (MP3)	02/01/2011	7.94	0.002	<0.0001	0.011	0.005	10.2	0.012	0.206	0.02	0.09	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
Issac 1 - qc1	Up Stream (MP3) QC	02/01/2011	7.25	0.001	<0.0001	0.011	0.004	9.65	0.012	0.199	0.02	0.09	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
Issac 2 - s2	Downstream (MP2)	02/01/2011	6.96	0.001	<0.0001	0.01	0.004	9.2	0.012	0.208	0.02	<0.05	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
Issac 2 - qc2	Downstream (MP2)QC	02/01/2011	6.94	0.001	<0.0001	0.01	0.005	9.23	0.012	0.209	0.02	<0.05	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
		02/01/2011																		
Issac 1 - s1	Up Stream (MP3)	03/01/2011	7.07	0.001	<0.0001	0.017	0.006	9.96	0.015	0.186	0.02	0.05	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
Issac 1 - qc1	Up Stream (MP3) QC	03/01/2011	8.47	0.001	<0.0001	0.023	0.008	13.6	0.019	0.226	0.03	0.06	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
Issac 2 - s2	Downstream (MP2)	03/01/2011	8.48	0.001	<0.0001	0.022	0.008	13.7	0.019	0.233	0.03	<0.05	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
Issac 2 - qc2	Downstream (MP2)QC	03/01/2011	9.04	0.001	<0.0001	0.022	0.008	14.3	0.02	0.237	0.03	<0.05	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
		03/01/2011																		
Isaac 1 - s1	Up Stream (MP3)	04/01/2011	8.18	0.002	<0.0001	0.015	0.008	11.2	0.005	0.014	0.015	0.08	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Isaac 1 - qc1	Up Stream (MP3) QC	04/01/2011	8.57	0.002	<0.0001	0.016	0.009	11.7	0.005	0.014	0.017	0.08	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Isaac 2 - s2	Downstream (MP2)	04/01/2011	7.1	0.002	<0.0001	0.013	0.007	9.41	0.004	0.011	0.012	0.06	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Isaac 2 - qc2	Downstream (MP2)QC	04/01/2011	8.19	0.002	<0.0001	0.015	0.008	10.3	0.006	0.012	0.014	0.06	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
		04/01/2011																		
Isaac 1 - s1	Up Stream (MP3)	05/01/2011	6.07	0.001	<0.0001	0.009	0.006	7.64	0.004	0.009	0.011	0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Isaac 1 - qc1	Up Stream (MP3) QC	05/01/2011	6.87	0.002	<0.0001	0.01	0.007	8.51	0.004	0.01	0.012	0.08	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Isaac 2 - s2	Downstream (MP2)	05/01/2011	6.44	0.001	<0.0001	0.009	0.006	7.91	0.004	0.009	0.012	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Isaac 2 - qc2	Downstream (MP2)QC	05/01/2011	6.36	0.001	<0.0001	0.009	0.007	7.91	0.004	0.01	0.011	0.06	<0.001	<0.001	0.02	<20	<50	<100	<50	<50

Table 1																					
ALS		Analyte	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Nickel	Zinc	Boron	Silver	Uranium	Vanadium	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
Sample ID		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		Date Sampled/LOR	0.01	0.01-0.001	0.005 - 0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.01-0.001	0.01-0.005	0.1-0.05	0.001	0.001	0.01	20	50	100	50	50
Draft TEP Trigger Investigation Level >			0.055	0.0133	0.00027	0.001	0.0027	0.317	0.01	0.0011	0.008	0.0378	0.001	0.001	0.01	<20	<100			<100
Downstream Concentration > Trigger Level and > Upstream Concentration																				
		05/01/2011																		
S1	Up Stream (MP3)	06/01/2011	6.37	<0.001	<0.0001	0.009	0.007	7.99	0.004	0.009	0.01	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
QC1	Up Stream (MP3) QC	06/01/2011	6.93	<0.001	<0.0001	0.009	0.007	7.84	0.004	0.009	0.01	0.06	<0.001	<0.001	0.021	<20	<50	<100	<50	<50
S2	Downstream (MP2)	06/01/2011	6.15	<0.001	<0.0001	0.008	0.006	7.36	0.004	0.008	0.01	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
QC2	Downstream (MP2)QC	06/01/2011	5.88	<0.001	<0.0001	0.008	0.006	6.7	0.004	0.008	0.009	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
		06/01/2011																		
S1	Up Stream (MP3)	07/01/2011	10.6	0.002	<0.0001	0.015	0.016	13.7	0.006	0.015	0.021	0.07	<0.001	<0.001	0.03	<20	<50	<100	<50	<50
QC1	Up Stream (MP3) QC	07/01/2011	12.1	0.002	<0.0001	0.017	0.011	15.9	0.006	0.016	0.019	0.09	<0.001	<0.001	0.03	<20	<50	<100	<50	<50
S2	Downstream (MP2)	07/01/2011	9.11	0.002	<0.0001	0.013	0.009	11.6	0.005	0.012	0.016	0.06	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
QC2	Downstream (MP2)QC	07/01/2011	9.39	0.002	<0.0001	0.012	0.009	12	0.005	0.013	0.016	0.07	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
		07/01/2011																		
S1	Up Stream (MP3)	31/01/2011	21.4	<0.010	0.002	<0.05	0.021	29.4	0.046	<0.0001	0.844	0.043	0.07	0.014	0.049	<20	<50	<100	<50	<50
QC1	Up Stream (MP3) QC	31/01/2011	17.4	<0.010	0.001	<0.05	0.017	23.4	0.036	<0.0001	0.724	0.034	0.05	0.011	0.035	<20	<50	<100	<50	<50
S2	Downstream (MP2)	31/01/2011	21.2	<0.010	0.001	<0.05	0.019	28.8	0.047	<0.0001	0.81	0.045	0.07	0.014	0.041	<20	<50	<100	<50	<50
QC2	Downstream (MP2)QC	31/01/2011	22	<0.010	0.002	<0.05	0.02	28.3	0.046	<0.0001	0.822	0.046	0.07	0.014	0.044	<20	<50	<100	<50	<50
		31/01/2011																		
S1 ISAC 2	Up Stream (MP3)	01/02/2011	13	<0.010	0.002	<0.05	0.009	17.8	0.025	<0.0001	0.433	0.022	0.05	0.008	0.021	<20	<50	<100	<50	<50
QC1 ISAC 2	Up Stream (MP3) QC	01/02/2011	11.7	<0.010	0.002	<0.05	0.009	14.4	0.021	<0.0001	0.422	0.018	0.04	0.008	0.019	<20	<50	<100	<50	<50
S2 ISAC 1	Downstream (MP2)	01/02/2011	17	<0.010	0.002	<0.05	0.014	23.8	0.032	<0.0001	0.583	0.035	0.05	0.012	0.031	<20	<50	<100	<50	<50
QC2 ISAC 1	Downstream (MP2)QC	01/02/2011	17.4	<0.010	0.002	<0.06	0.013	22.8	0.032	<0.0001	0.567	0.034	0.05	0.011	0.029	<20	<50	<100	<50	<50
		01/02/2011																		
S1	Up Stream (MP3)	02/02/2011	11.9	<0.010	0.002	<0.07	0.008	15.6	0.02	0.0002	0.341	0.022	0.04	0.007	0.018	<20	<50	<100	<50	<50
QC1	Up Stream (MP3) QC	02/02/2011	12.9	<0.010	0.002	<0.06	0.007	16.4	0.02	<0.0001	0.321	0.02	0.04	0.007	0.018	<20	<50	<100	<50	<50
S2	Downstream (MP2)	02/02/2011	10.3	<0.010	0.001	<0.05	0.006	13.4	0.017	<0.0001	0.295	0.017	0.04	0.006	0.015	<20	<50	<100	<50	<50
QC2	Downstream (MP2)QC	02/02/2011	11	<0.010	0.002	<0.06	0.006	14	0.016	<0.0001	0.264	0.016	0.04	0.006	0.015	<20	<50	<100	<50	<50
		02/02/2011																		
ISAC 2 S1	Up Stream (MP3)	03/02/2011	12.1	0.002	<0.0001	0.021	0.007	15.4	0.3	0.007	0.002	0.06	<0.001	0.04	0.019	<20	<50	140	100	240
ISAC 2 QC1	Up Stream (MP3) QC	03/02/2011	12.5	0.002	<0.0001	0.021	0.007	16.2	0.322	0.007	0.001	0.06	<0.001	0.04	0.021	<20	<50	<100	<50	<50
ISAC 1 S1	Downstream (MP2)	03/02/2011	12.8	0.002	<0.0001	0.021	0.008	16.7	0.357	0.007	0.001	0.06	<0.001	0.04	0.024	<20	<50	<100	<50	<50
ISAC 1 QC1	Downstream (MP2)QC	03/02/2011	13.6	0.002	<0.0001	0.022	0.008	17.6	0.366	0.008	0.001	0.06	<0.001	0.04	0.026	<20	<50	<100	<50	<50
		03/02/2011																		
Upstream MP3 - S1	Upstream MP3 - S1	09/02/2011	6.49	0.001	<0.0001	0.008	0.007	7.93	0.004	0.009	0.022	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Downstream - MP2 -	Downstream - MP2 - S2	09/02/2011	5.94	0.001	<0.0001	0.008	0.007	7.32	0.004	0.009	0.027	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
QC2	Downstream (MP2)QC	09/02/2011	5.69	<0.001	<0.0001	0.007	0.007	6.69	0.004	0.009	0.022	<0.05	<0.001	<0.001	0.01	<20	<50	<100	<50	<50
		09/02/2011																		
Upstream MP3 - S1	Up Stream (MP3)	10/02/2011	4.9	<0.001	<0.0001	0.006	0.006	5.565	0.004	0.008	0.018	<0.05	<0.001	<0.001	0.01	<20	<50	<100	<50	<50
Downstream - MP2 -	Downstream (MP2)	10/02/2011	5.99	<0.001	<0.0001	0.007	0.007	7.23	0.004	0.009	0.017	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
QC2	Downstream (MP2)QC	10/02/2011	6.82	<0.001	<0.0001	0.008	0.008	8.85	0.004	0.01	0.073	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
		10/02/2011																		

Table 2

ALS		Analyte	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Nickel	Zinc	Boron	Silver	Uranium	Vanadium		C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	Fluoride
Sample ID		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		µg/L	µg/L	µg/L	µg/L	µg/L	mg/L
		Date Sampled/LOR	0.01	0.01-0.001	0.005 - 0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.0001	0.01-0.001	0.01-0.005	0.1-0.05	0.001	0.001	0.01		20	50	100	50	50	0.1
Drake TEF Trigger Investigation Level			0.055	0.013	0.0002	0.001	0.002	0.3	0.01	0.0002	0.011	0.008	0.37	0.001	0.001	0.01		20	100			100	2
Discharge Concentrations > Upstream Concentrations																							
ISAAC 1	Up Stream (MP3)	21/12/2010	3.93	<0.01	<0.005	0.04	0.02	29	0.01	<0.0001	0.03	0.03	<0.1		<0.001	0.06		<20	-	-	-	-	-
ISAAC 2	Downstream (MP2)	21/12/2010	3.11	0.02	<0.005	0.03	0.02	28	<0.01	<0.0001	0.03	0.05	<0.1		<0.001	0.05		<20	-	-	-	-	-
ISSAC 2	Downstream (MP2) QC	21/12/2010	3.28	<0.01	<0.005	0.03	0.02	20.1	<0.01	<0.0001	0.02	0.03	<0.1		<0.001	0.04		<20	-	-	-	-	-
DISCHARGE POINT	Discharge Point (MP1)	21/12/2010	1.56	<0.01	<0.005	0.04	0.02	23.5	0.01	<0.0001	0.03	0.04	<0.1		<0.001	0.06		<20	-	-	-	-	-
	RPD (%)	21/12/2010	16%									50%											
Downstream	Downstream (MP2)	23/12/2010	-	0.002	<0.0001	0.013	0.009	-	0.006	<0.0001	0.015	0.018	-	-	-			<20	<50	<100	<50	<50	-
ISAAC 2	Downstream (MP2) QC	23/12/2010	-	0.001	<0.0001	0.016	0.01	-	0.006	<0.0001	0.015	0.019	-	-	-			<20	<50	<100	<50	<50	-
DISCHARGE POINT	Discharge Point (MP1)	23/12/2010	-	0.001	<0.0001	0.012	0.009	-	0.006	<0.0001	0.014	0.022	-	-	-			<20	<50	<100	<50	<50	-
		23/12/2010																					
ISAAC 1-S1	Up Stream (MP3)	24/12/2010	3.52	<0.001	<0.0001	0.012	0.015	16.7	0.006	<0.0001	0.013	0.016	<0.05	<0.001	-	0.02		<20	<50	<100	<50	60	-
ISAAC 1-QC1	Up Stream (MP3) QC	24/12/2010	3.18	0.001	<0.0001	0.012	0.009	20.9	0.006	<0.0001	0.013	0.02	<0.05	<0.001	-	0.02		<20	<50	<100	<50	<50	-
ISAAC 2- S2	Downstream (MP2)	24/12/2010	3.64	0.002	<0.0001	0.017	0.012	19.7	0.009	<0.0001	0.02	0.034	<0.05	<0.001	-	0.03		<20	<50	<100	<50	<50	-
ISAAC 2- QC2	Downstream (MP2) QC	24/12/2010	3.41	0.002	<0.0001	0.017	0.013	15.6	0.007	<0.0001	0.016	0.026	<0.05	<0.001	-	0.03		<20	<50	<100	<50	<50	-
DISCHARGE-S3	Discharge Point (MP1)	24/12/2010	1.09	0.001	<0.0001	0.023	0.011	13.4	0.007	<0.0001	0.016	0.021	<0.05	<0.001	-	0.03		<20	<50	<100	50	<50	-
DISCHARGE-QC3	Discharge Point (MP1) QC	24/12/2010	1.11	0.002	<0.0001	0.023	0.016	128	0.007	<0.0001	0.016	0.019	<0.05	<0.001	-	0.02		<20	<50	<100	<50	<50	-
	RPD (%)	24/12/2010	2%			35%	42%	4%				14%				22%							
ISAAC 1-S1	Up Stream (MP3)	24/12/2010	3.83	<0.001	<0.0001	0.012	0.01	20	0.006	<0.0001	0.014	0.017	<0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	
ISAAC 1-QC1	Up Stream (MP3) QC	24/12/2010	3.76	0.001	<0.0001	0.012	0.01	20.5	0.006	<0.0001	0.014	0.018	<0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	
ISAAC 2- S2	Downstream (MP2)	24/12/2010	3.19	0.002	<0.0001	0.017	0.012	17.4	0.007	<0.0001	0.017	0.03	<0.05	<0.001	<0.001	0.03		<20	<50	<100	<50	<50	
ISAAC 2- QC2	Downstream (MP2) QC	24/12/2010	3.17	0.001	<0.0001	0.016	0.01	13.5	0.007	<0.0001	0.016	0.056	<0.05	<0.001	<0.001	0.03		<20	<50	<100	50	50	
DISCHARGE-S3	Discharge Point (MP1)	24/12/2010	1.01	0.001	<0.0001	0.014	0.011	11.9	0.007	<0.0001	0.015	0.020	<0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	
DISCHARGE-QC3	Discharge Point (MP1) QC	24/12/2010	1.11	0.001	<0.0001	0.015	0.011	128	0.007	<0.0001	0.016	0.020	<0.05	<0.001	<0.001	0.03		<20	<50	<100	<50	<50	
	RPD (%)	24/12/2010	10%			15%	10%	19%				13%				22%							
ISAAC 1-S1	Up Stream (MP3)	25/12/2010	3.52	0.002	<0.0001	0.02	0.015	18.4	0.009	<0.0001	0.023	0.03	<0.05	<0.001	<0.001	0.04		<20	<50	<100	60	60	
ISAAC 1-QC1	Up Stream (MP3) QC	25/12/2010	3.52	0.001	<0.0001	0.021	0.016	17.5	0.009	<0.0001	0.023	0.035	<0.05	<0.001	<0.001	0.03		<20	<50	<100	<50	<50	
ISAAC 2- S2	Downstream (MP2)	25/12/2010	3.64	0.002	<0.0001	0.023	0.016	19.7	0.009	<0.0001	0.024	0.035	<0.05	<0.001	<0.001	0.04		<20	<50	<100	<50	<50	
ISAAC 2- QC2	Downstream (MP2) QC	25/12/2010	3.62	0.002	<0.0001	0.023	0.016	19.5	0.009	<0.0001	0.022	0.03	<0.05	<0.001	<0.001	0.04		<20	<50	<100	<50	<50	
DISCHARGE-S3	Discharge Point (MP1)	25/12/2010	1.04	0.001	<0.0001	0.021	0.01	17.7	0.008	<0.0001	0.022	0.027	0.17	<0.001	<0.001	0.04		<20	<50	<100	<50	<50	
DISCHARGE-QC3	Discharge Point (MP1) QC	25/12/2010	1.03	0.002	<0.0001	0.023	0.016	19.1	0.009	<0.0001	0.023	0.029	0.16	<0.001	<0.001	0.04		<20	<50	<100	<50	<50	
	RPD (%)	25/12/2010	2%			5%		7%								4%							
ISAAC 1-S1	Up Stream (MP3)	27/12/2010	3.61	0.002	<0.0001	0.012	0.01	16.7	0.006	<0.0001	0.013	0.016	0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	
ISAAC 1-QC1	Up Stream (MP3) QC	27/12/2010	3.16	0.001	<0.0001	0.0128	0.009	16.9	0.006	<0.0001	0.013	0.02	<0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	
ISAAC 2- S2	Downstream (MP2)	27/12/2010	3.49	0.002	<0.0001	0.019	0.014	17.5	0.009	<0.0001	0.025	0.08	<0.05	<0.001	<0.001	0.03		<20	<50	<100	<50	<50	
ISAAC 2- QC2	Downstream (MP2) QC	27/12/2010	3.27	0.001	<0.0001	0.017	0.013	15.6	0.009	<0.0001	0.018	0.026	<0.05	<0.001	<0.001	0.03		<20	<50	<100	<50	<50	
DISCHARGE-S3	Discharge Point (MP1)	27/12/2010	1.09	0.001	<0.0001	0.014	0.011	13.4	0.007	<0.0001	0.016	0.02	<0.05	<0.001	<0.001	0.03		<20	<50	<100	<50	<50	
DISCHARGE-QC3	Discharge Point (MP1) QC	27/12/2010	1.09	0.001	<0.0001	0.012	0.01	11.7	0.006	<0.0001	0.014	0.019	<0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	
	RPD (%)	27/12/2010	1%			8%	10%	16%				16%				22%							
ISAAC1-S1	Up Stream (MP3)	29/12/2010	-	<0.001	<0.0001	0.009	0.008	-	0.004	<0.0001	0.011	0.015	-	-	-	0.02		<20	<50	<100	<50	<50	-
ISAAC1-QC1	Up Stream (MP3)QC	29/12/2010	-	<0.001	0.0002	0.008	0.008	-	0.004	<0.0001	0.01	0.014	-	-	-	0.02		<20	<50	<100	<50	<50	-
ISAAC2-S2	Downstream (MP2)	29/12/2010	-	<0.001	0.0001	0.01	0.009	-	0.005	<0.0001	0.012	0.017	-	-	-	0.02		<20	<50	<100	<50	<50	-

Table 2

ALS		Analyte	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Nickel	Zinc	Boron	Silver	Uranium	Vanadium		C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	Fluoride
Sample ID		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		µg/L	µg/L	µg/L	µg/L	µg/L	mg/L
		Date Sampled/LOR	0.01	0.01-0.001	0.005 - 0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.0001	0.01-0.001	0.01-0.005	0.1-0.05	0.001	0.001	0.01		20	50	100	50	50	0.1
Draft TEP Trigger Investigation Level			0.055	0.013	0.0002	0.001	0.002	0.3	0.01	0.0002	0.011	0.008	0.37	0.001	0.001	0.01		20	100			100	2
Discharge Concentrations > Upstream Concentrations																							
ISAAC2-QC2	Downstream (MP2) QC	29/12/2010	-	<0.001	<0.0001	0.008	0.008	-	0.004	<0.0001	0.01	0.015	-	-	-	0.02		<20	<50	<100	<50	<50	-
DISCHARGE-S3	Discharge Point (MP1)	29/12/2010	-	0.003	<0.0001	<0.001	0.002	-	<0.001	<0.0001	0.001	<0.005	-	-	-	<0.01		<20	<50	<100	<50	<50	-
DISCHARGE-QC3	Discharge Point (MP1) QC	29/12/2010	-	0.002	<0.0001	<0.001	0.002	-	<0.001	<0.0001	0.001	<0.005	-	-	-	<0.01		<20	<50	<100	<50	<50	-
		29/12/2010																					
ISAAC 1	Up Stream (MP3)	31/12/2010	-	<0.001	<0.0001	0.008	0.008	-	0.004	<0.0001	0.009	0.014	-	-	-	0.01		<20	<50	<100	<50	<50	-
ISAAC 2	Downstream (MP2)	31/12/2010	-	0.001	<0.0001	0.009	0.007	-	0.004	<0.0001	0.011	0.016	-	-	-	0.02		<20	<50	<100	<50	<50	-
DISCHARGE POINT	Discharge Point (MP1)	31/12/2010	-	<0.001	<0.0001	<0.001	0.002	-	<0.001	<0.0001	0.002	0.007	-	-	-	<0.01		<20	<50	<100	<50	<50	-
		31/12/2010																					
Issac 1 - s1	Up Stream (MP3)	02/01/2011	7.94	0.002	<0.0001	0.011	0.005	10.2	0.012	<0.0001	0.206	0.02	0.09	<0.01	<0.001	<0.001		<20	<50	<100	<50	<50	IS
Issac 1 - qc1	Up Stream (MP3) QC	02/01/2011	7.25	0.001	<0.0001	<0.01	0.004	9.65	0.012	<0.0001	0.199	0.02	0.09	<0.01	<0.001	<0.001		<20	<50	<100	<50	<50	IS
Issac 2 - s2	Downstream (MP2)	02/01/2011	6.96	0.001	<0.0001	<0.01	0.004	9.2	0.012	<0.0001	0.208	0.02	<0.05	<0.01	<0.001	<0.001		<20	<50	<100	<50	<50	IS
Issac 2 - qc2	Downstream (MP2)QC	02/01/2011	6.94	0.001	<0.0001	0.01	0.005	9.23	0.012	<0.0001	0.209	0.02	<0.05	<0.01	<0.001	<0.001		<20	<50	<100	<50	<50	IS
Discharge point - s3	Discharge Point (MP1)	02/01/2011	0.14	0.002	<0.0001	0.001	<0.001	0.16	<0.001	<0.0001	0.008	<0.01	1.15	<0.01	<0.001	<0.001		<20	<50	<100	<50	<50	IS
Discharge point = qc3	Discharge Point (MP1) QC	02/01/2011	0.17	0.002	<0.0001	0.001	<0.001	0.19	0.001	<0.0001	0.008	<0.01	1.17	<0.01	<0.001	<0.001		<20	<50	<100	<50	<50	IS
													17.6%										
Issac 1 - s1	Up Stream (MP3)	03/01/2011	7.07	0.001	<0.0001	0.017	0.006	9.96	0.015	<0.0001	0.186	0.02	0.05	<0.01	<0.001	<0.001		<20	<50	<100	<50	<50	0.1
Issac 1 - qc1	Up Stream (MP3) QC	03/01/2011	8.47	0.001	<0.0001	0.023	0.008	13.6	0.019	<0.0001	0.226	0.03	0.06	<0.01	<0.001	<0.001		<20	<50	<100	<50	<50	0.1
Issac 2 - s2	Downstream (MP2)	03/01/2011	8.48	0.001	<0.0001	0.022	0.008	13.7	0.019	<0.0001	0.233	0.03	<0.05	<0.01	<0.001	<0.001		<20	<50	<100	<50	<50	<0.1
Issac 2 - qc2	Downstream (MP2)QC	03/01/2011	9.04	0.001	<0.0001	0.022	0.008	14.3	0.02	<0.0001	0.237	0.03	<0.05	<0.01	<0.001	<0.001		<20	<50	<100	<50	<50	1.8
Discharge point - s3	Discharge Point (MP1)	03/01/2011	0.14	0.002	<0.0001	<0.001	<0.001	0.14	0.001	<0.0001	0.01	<0.01	1.06	<0.01	<0.001	<0.001		<20	<50	<100	<50	<50	1.9
Discharge point - qc3	Discharge Point (MP1) QC	03/01/2011	0.13	0.002	<0.0001	<0.001	<0.001	0.15	0.001	<0.0001	0.01	<0.01	1.12	<0.01	<0.001	<0.001		<20	<50	<100	<50	<50	1.9
													181%										
Isaac 1 - s1	Up Stream (MP3)	04/01/2011	8.18	0.002	<0.0001	0.015	0.008	11.2	0.005	<0.0001	0.014	0.015	0.08	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	0.1
Isaac 1 - qc1	Up Stream (MP3) QC	04/01/2011	8.57	0.002	<0.0001	0.016	0.009	11.7	0.005	<0.0001	0.014	0.017	0.08	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	0.1
Isaac 2 - s2	Downstream (MP2)	04/01/2011	7.71	0.002	<0.0001	0.013	0.007	9.41	0.004	<0.0001	0.011	0.012	0.06	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	0.1
Isaac 2 - qc2	Downstream (MP2)QC	04/01/2011	8.13	0.002	<0.0001	0.015	0.008	10.3	0.006	<0.0001	0.012	0.014	0.06	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	1.6
Discharge point - s3	Discharge Point (MP1)	04/01/2011	0.08	0.002	<0.0001	<0.001	0.002	0.12	<0.001	<0.0001	<0.001	<0.005	1.39	<0.001	<0.001	<0.01		<20	<50	<100	<50	<50	1.6
Discharge point - s3	Discharge Point (MP1) QC	04/01/2011	0.09	0.002	<0.0001	<0.001	0.002	0.12	<0.001	<0.0001	<0.001	<0.005	1.33	<0.001	<0.001	<0.01		<20	<50	<100	<50	<50	1.6
													175%										
Isaac 1 - s1	Up Stream (MP3)	05/01/2011	6.07	0.001	<0.0001	0.009	0.005	7.64	0.004	<0.0001	0.009	0.011	0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	0.1
Isaac 1 - qc1	Up Stream (MP3) QC	05/01/2011	6.87	0.002	<0.0001	0.01	0.007	8.51	0.004	<0.0001	0.01	0.012	0.08	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	0.1
Isaac 2 - s2	Downstream (MP2)	05/01/2011	6.44	0.001	<0.0001	0.009	0.006	7.91	0.004	<0.0001	0.009	0.012	<0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	0.2
Isaac 2 - qc2	Downstream (MP2)QC	05/01/2011	6.36	0.001	<0.0001	0.009	0.007	7.91	0.004	<0.0001	0.01	0.011	0.06	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	0.1
Discharge point - s3	Discharge Point (MP1)	05/01/2011	0.09	0.002	<0.0001	<0.001	0.002	0.12	<0.001	<0.0001	<0.001	0.008	1.33	<0.001	<0.001	<0.01		<20	<50	<100	<50	<50	1.6
Discharge point - s3	Discharge Point (MP1) QC	05/01/2011	0.09	0.002	<0.0001	<0.001	0.002	0.13	<0.001	<0.0001	<0.001	0.008	1.39	<0.001	<0.001	<0.01		<20	<50	<100	<50	<50	1.6
													183%										
S1	Up Stream (MP3)	06/01/2011	5.37	<0.001	<0.0001	0.009	0.007	7.99	0.004	<0.0001	0.009	0.014	<0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	0.1
QC1	Up Stream (MP3) QC	06/01/2011	6.33	<0.001	<0.0001	0.009	0.007	7.81	0.004	<0.0001	0.009	0.01	0.06	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	0.1
S2	Downstream (MP2)	06/01/2011	5.16	<0.001	<0.0001	0.008	0.006	7.36	0.004	<0.0001	0.008	0.01	<0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	0.1
QC2	Downstream (MP2)QC	06/01/2011	5.68	<0.001	<0.0001	0.008	0.006	6.7	0.004	<0.0001	0.008	0.009	<0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	1.5
S3	Discharge Point (MP1)	06/01/2011	0.11	<0.001	<0.0001	0.001	0.002	0.13	<0.001	<0.0001	0.001	<0.005	1.09	<0.001	<0.001	<0.01		<20	<50	<100	<50	<50	1.5

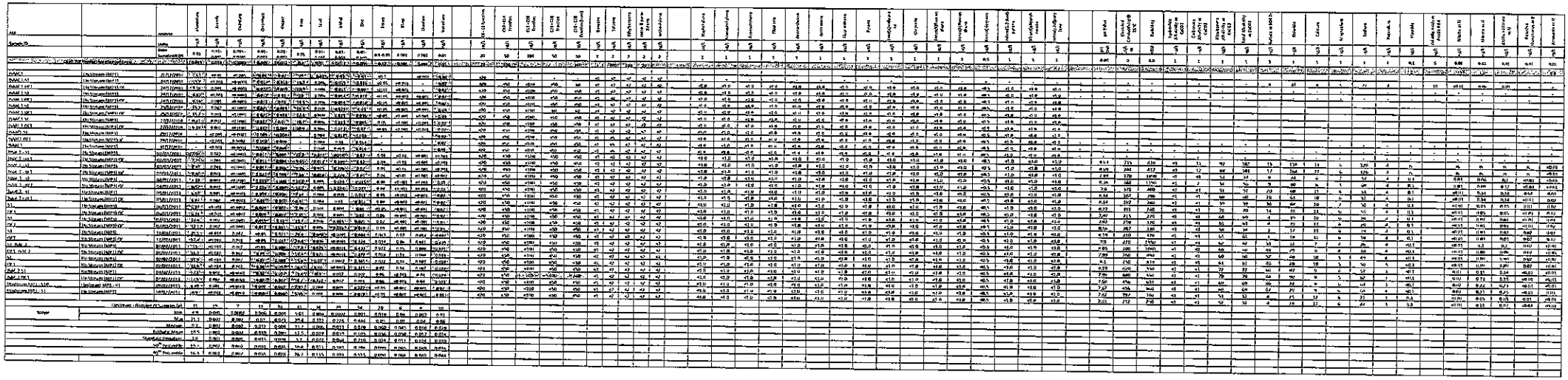
Table 2

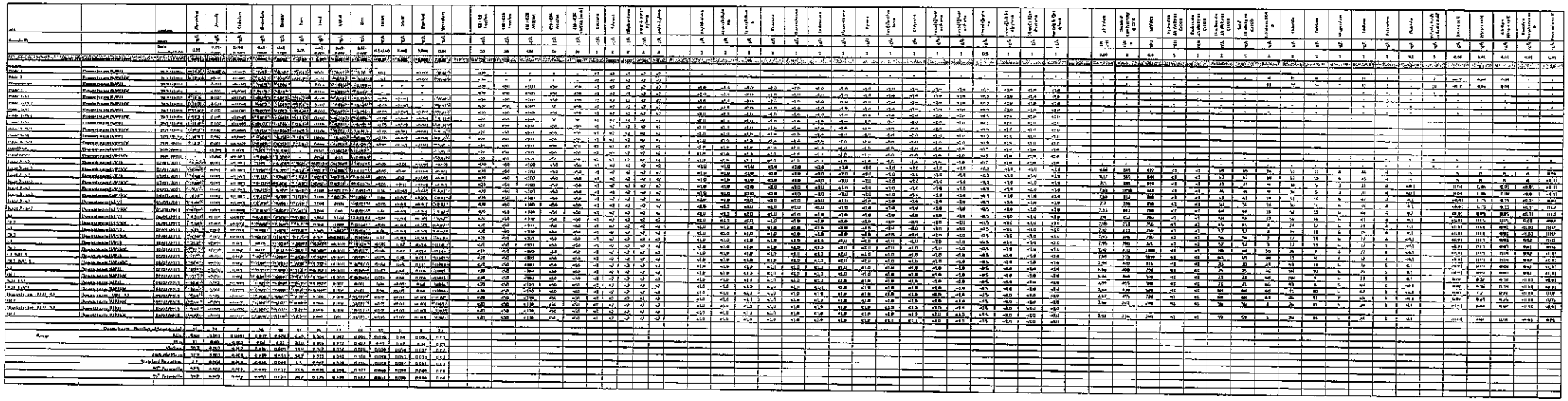
ALS		Analyte	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Nickel	Zinc	Boron	Silver	Uranium	Vanadium		C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	Fluoride
Sample ID		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		µg/L	µg/L	µg/L	µg/L	µg/L	mg/L
		Date Sampled/LOR	0.01	0.01-0.001	0.005-0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.0001	0.01-0.001	0.01-0.005	0.1-0.05	0.001	0.001	0.01		20	50	100	50	50	0.1
Draft TEP Trigger Investigation Level			0.055	0.013	0.0002	0.001	0.002	0.3	0.01	0.0002	0.011	0.008	0.37	0.001	0.001	0.01		20	100			100	2
Discharge concentration > Upstream Concentration																							
QC3	Discharge Point (MP1) QC	06/01/2011	0.12	<0.001	<0.0001	0.001	0.002	0.15	<0.001	<0.0001	0.001	<0.005	1.03	<0.001	<0.001	<0.01		<20	<50	<100	<50	<50	1.4
													2.62										
S1	Up Stream (MP3)	07/01/2011	10.6	0.002	<0.0001	0.015	0.01	3.7	0.006	<0.0001	0.015	0.022	0.07	<0.001	<0.001	0.03		<20	<50	<100	<50	<50	0.1
QC1	Up Stream (MP3) QC	07/01/2011	12.9	0.002	<0.0001	0.017	0.01	5.9	0.006	<0.0001	0.016	0.019	0.09	<0.001	<0.001	0.03		<20	<50	<100	<50	<50	0.1
S2	Downstream (MP2)	07/01/2011	9.11	0.002	<0.0001	0.013	0.009	4.16	0.005	<0.0001	0.012	0.016	0.06	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	<0.1
QC2	Downstream (MP2)QC	07/01/2011	9.39	0.002	<0.0001	0.012	0.009	4.2	0.005	<0.0001	0.013	0.016	0.07	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	<0.1
S3	Discharge Point (MP1)	07/01/2011	0.12	<0.001	<0.0001	0.001	0.003	0.28	<0.001	<0.0001	0.003	0.005	1.04	<0.001	<0.001	<0.01		<20	<50	<100	<50	<50	1.4
QC3	Discharge Point (MP1) QC	07/01/2011	0.18	<0.001	<0.0001	0.002	0.003	0.3	<0.001	<0.0001	0.003	0.016	1.03	<0.001	<0.001	<0.01		<20	<50	<100	<50	<50	1.4
													2.70										
S1	Up Stream (MP3)	31/01/2011	21.4	<0.010	0.002	<0.05	0.021	29.4	0.046	<0.0001	<0.0001	0.842	0.043	0.07	0.014	0.047		<20	<50	<100	<50	<50	<0.1
QC1	Up Stream (MP3) QC	31/01/2011	17.4	<0.010	0.001	<0.05	0.017	24.7	0.036	<0.0001	<0.0001	0.724	0.034	0.06	0.013	0.035		<20	<50	<100	<50	<50	<0.1
S2	Downstream (MP2)	31/01/2011	21.2	<0.010	0.001	<0.05	0.019	28.8	0.047	<0.0001	<0.0001	0.81	0.045	0.07	0.014	0.041		<20	<50	<100	<50	<50	<0.1
QC2	Downstream (MP2)QC	31/01/2011	22	<0.010	0.002	<0.05	0.024	28.3	0.046	<0.0001	<0.0001	0.822	0.046	0.07	0.014	0.044		<20	<50	<100	<50	<50	<0.1
S3	Discharge Point (MP1)	31/01/2011	0.55	<0.010	0.002	1.01	<0.001	0.62	0.003	<0.0001	<0.0001	0.028	<0.005	0.02	<0.001	0.001		<20	<50	<100	<50	<50	1.9
QC3	Discharge Point (MP1) QC	31/01/2011	0.44	<0.010	0.002	0.95	<0.001	0.56	0.002	<0.0001	<0.0001	0.025	<0.005	0.02	<0.001	<0.001		<20	<50	130	80	210	1.9
		31/01/2011				1.992																	
S1 ISAC 2	Up Stream (MP3)	01/02/2011	23	<0.010	0.002	<0.05	0.009	17.8	0.025	<0.0001	<0.0001	0.483	0.022	0.05	0.008	0.027		<20	<50	<100	<50	<50	<0.1
QC1 ISAC 2	Up Stream (MP3) QC	01/02/2011	17.7	<0.010	0.002	<0.05	0.009	14.4	0.021	<0.0001	<0.0001	0.422	0.018	0.04	0.008	0.019		<20	<50	<100	<50	<50	<0.1
S2 ISAC 1	Downstream (MP2)	01/02/2011	0.147	<0.010	0.002	0.05	0.0145	23.8	0.032	<0.0001	<0.0001	0.583	0.035	0.05	0.012	0.031		<20	<50	<100	<50	<50	0.1
QC2 ISAC 1	Downstream (MP2)QC	01/02/2011	17.4	<0.010	0.002	0.06	0.013	22.8	0.032	<0.0001	<0.0001	0.567	0.034	0.05	0.011	0.029		<20	<50	<100	<50	<50	0.1
S3 DISCHARGE	Discharge Point (MP1)	01/02/2011	0.04	<0.010	0.002	1.34	<0.001	0.08	0.001	<0.0001	<0.0001	0.005	0.011	0.01	<0.001	<0.001		<20	<50	<100	<50	<50	2.4
QC3 DISCHARGE	Discharge Point (MP1) QC	01/02/2011	0.04	<0.010	0.002	1.53	<0.001	0.07	<0.001	<0.0001	<0.0001	0.004	0.009	0.01	<0.001	<0.001		<20	<50	<100	<50	<50	2.44
		01/02/2011				1.722																	
S1	Up Stream (MP3)	02/02/2011	19.9	<0.010	0.002	0.07	0.008	15.6	0.02	<0.0001	0.0002	0.341	0.022	0.04	0.007	0.018		<20	<50	<100	<50	<50	<0.1
QC1	Up Stream (MP3) QC	02/02/2011	19.2	<0.010	0.002	0.05	0.007	16.4	0.02	<0.0001	<0.0001	0.321	0.02	0.04	0.007	0.018		<20	<50	<100	<50	<50	<0.1
S2	Downstream (MP2)	02/02/2011	0.3	<0.010	0.001	0.05	0.006	13.4	0.017	<0.0001	<0.0001	0.255	0.017	0.04	0.006	0.015		<20	<50	<100	<50	<50	0.1
QC2	Downstream (MP2)QC	02/02/2011	0.3	<0.010	0.002	0.06	0.006	14	0.016	<0.0001	<0.0001	0.264	0.016	0.04	0.006	0.015		<20	<50	<100	<50	<50	<0.1
		02/02/2011																					
ISAC 2 S1	Up Stream (MP3)	03/02/2011	12.1	0.002	<0.0001	0.02	0.007	15.4	0.3	0.0002	0.007	0.002	0.06	<0.001	0.04	0.019		<20	<50	140	100	240	<0.1
ISAC 2 QC1	Up Stream (MP3) QC	03/02/2011	12.5	0.002	<0.0001	0.02	0.007	16.2	0.322	<0.0001	0.007	0.001	0.06	<0.001	0.04	0.021		<20	<50	<100	<50	<50	<0.1
ISAC 1 S1	Downstream (MP2)	03/02/2011	12.8	0.002	<0.0001	0.021	0.008	16.7	0.357	0.0001	0.007	0.001	0.06	<0.001	0.04	0.024		<20	<50	<100	<50	<50	<0.1
ISAC 1 QC1	Downstream (MP2)QC	03/02/2011	13.8	0.002	<0.0001	0.022	0.008	17.6	0.366	<0.0001	0.008	0.001	0.06	<0.001	0.04	0.026		<20	<50	<100	<50	<50	<0.1
		03/02/2011																					
Upstream MP3 - S10	Upstream MP3 - S1	09/02/2011	5.49	0.001	<0.0001	0.008	0.007	7.93	0.004	<0.0001	0.009	0.022	<0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	0.1
Downstream - MP2 - S2	Downstream - MP2 - S2	09/02/2011	5.94	0.001	<0.0001	0.008	0.007	7.32	0.004	<0.0001	0.009	0.021	<0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	0.1
QC2	Downstream - (MP2) QC	09/02/2011	5.69	<0.001	<0.0001	0.007	0.007	6.69	0.004	<0.0001	0.009	0.022	<0.05	<0.001	<0.001	0.01		<20	<50	<100	<50	<50	
Upstream MP3 - S1	Up Stream (MP3)	10/02/2011	5.91	<0.001	<0.0001	0.006	0.006	5.65	0.004	<0.0001	0.008	0.018	<0.05	<0.001	<0.001	0.01		<20	<50	<100	<50	<50	0.1
Downstream - MP2 - S2	Downstream (MP2)	10/02/2011	5.99	<0.001	<0.0001	0.007	0.007	7.23	0.004	<0.0001	0.009	0.017	<0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	0.1
QC2	Downstream (MP2)QC	10/02/2011	6.82	<0.001	<0.0001	0.008	0.008	8.5	0.004	<0.0001	0.01	0.073	<0.05	<0.001	<0.001	0.02		<20	<50	<100	<50	<50	

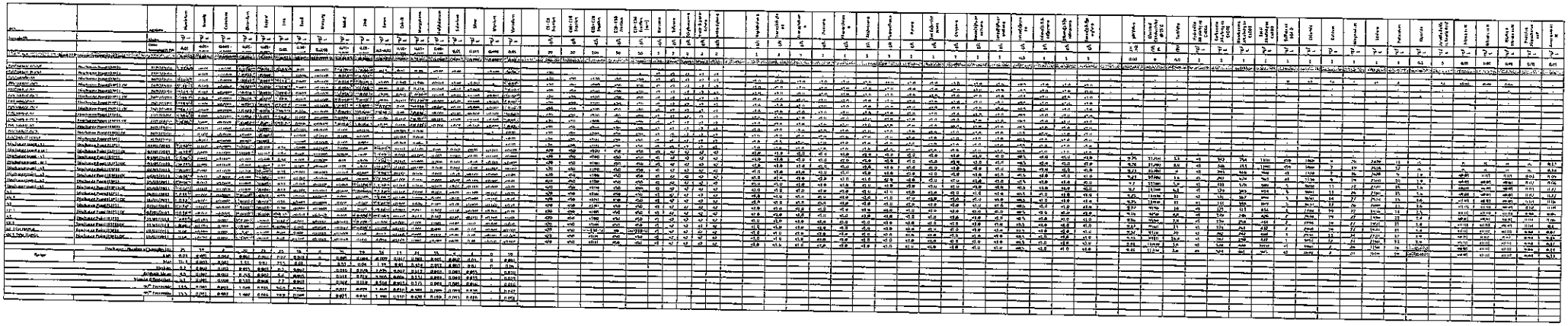
Table 2

ALS		Analyte	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Nickel	Zinc	Boron	Silver	Uranium	Vanadium		C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	Fluoride
Sample ID		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		µg/L	µg/L	µg/L	µg/L	µg/L	mg/L
		Date Sampled/LOR	0.01	0.01-0.001	0.005 - 0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.0001	0.01-0.001	0.01-0.005	0.1-0.05	0.001	0.001	0.01		20	50	100	50	50	0.1
Draft CCME Trigger Investigation Level			0.055	0.013	0.0002	0.001	0.002	0.3	0.01	0.0002	0.011	0.008	0.37	0.001	0.001	0.01		20	100			100	
Discharge Concentrations - Upstream Concentrations																							
Upstream - Number of Samples above LOR (n)			31	19	7	31	34	31	34	1	29	34	20	6	8	30							
Range		Min	4.9	0.001	0.0002	0.006	0.004	5.65	0.004	0.0002	0.0002	0.001	0.018	0.04	0.007	0.01							
		Max	21.1	0.002	0.002	0.07	0.021	29.4	0.322	0.0002	0.226	0.844	0.09	0.07	0.04	0.06							
		Median	9.18	0.002	0.002	0.012	0.008	11.2	0.006	0.0002	0.013	0.020	0.06	0.045	0.010	0.02							
		Arithatic Mean	10.5	0.002	0.002	0.019	0.009	13.50	0.029	0.000	0.039	0.105	0.056	0.050	0.017	0.024							
		Standard Deviation	3.8	0.001	0.001	0.015	0.004	5.75	0.072	#DIV/0!	0.068	0.210	0.024	0.013	0.014	0.010							
		90th Percentile	15.2	0.002	0.002	0.040	0.016	18.4	0.038	0.0002	0.189	0.398	0.09	0.065	0.04	0.036							
		95th Percentile	16.3	0.002	0.002	0.055	0.018	26.2	0.135	0.000	0.203	0.535	0.09	0.068	0.04	0.044							
Downstream - Number of Samples above LOR (n)			34	24	7	36	38	34	36	1	32	38	13	6	8	32							
Range		Min	5.68	0.001	0.0001	0.007	0.004	6.69	0.004	0.0001	0.007	0.001	0.016	0.04	0.006	0.01							
		Max	22	0.02	0.002	0.06	0.020	28.8	0.366	0.0001	0.237	0.822	0.07	0.07	0.04	0.05							
		Median	10.7	0.002	0.002	0.016	0.0085	13.85	0.007	0.0001	0.014	0.026	0.06	0.05	0.013	0.022							
		Arithatic Mean	11.2	0.002	0.0014	0.019	0.010	14.66	0.03097	0.0001	0.040	0.110	0.04792	0.053	0.018	0.026							
		Standard Deviation	4.7	0.004	0.0008	0.014	0.004	6.485	0.082	#DIV/0!	0.070	0.216	0.018	0.014	0.014	0.00952							
		90th Percentile	17.28	0.002	0.002	0.04	0.017	23.5	0.039	0.0001	0.1902	0.3766	0.06	0.07	0.04	0.04							
		95th Percentile	19.19	0.002	0.002	0.053	0.02	28.2	0.125	0.0001	0.220	0.617	0.064	0.07	0.04	0.042							
Discharge - Number of Samples above LOR (n)			25	19	4	20	21	25	16	0	21	19	16	4	0	10							
Range		Min	0.04	0.001	0.002	0.001	0.002	0.07	0.001	0	0.001	0.004	0.009	0.01	0	0.001							
		Max	16.3	0.003	0.002	1.53	0.020	23.5	0.01	0	0.03	0.040	1.39	0.02	0	0.06							
		Median	0.17	0.002	0.002	0.015	0.003	0.28	0.007	-	0.010	0.020	1.08	0.015	-	0.03							
		Arithatic Mean	4.53	0.002	0.002	0.255	0.007	5.6	0.005	-	0.011	0.018	0.91	0.015	-	0.029							
		Standard Deviation	6.13	0.001	0	0.510	0.00603	7.7	0.003	-	0.008	0.010	0.50	0.006	-	0.016							
		90th Percentile	13.5	0.002	0.002	1.049	0.016	16.0	0.009	-	0.022	0.028	1.36	0.020	-	0.042							
		95th Percentile	15.5	0.0021	0.002	1.407	0.016	18.8	0.009	-	0.023	0.030	1.39	0.020	-	0.051							

Note: Statistics performed on data above LOR only.







[redacted]

From: Ben McMahon
Sent: Friday, 25 March 2011 9:15 AM
To: [redacted]
Cc:
Subject: ENV11-040 MGP discharge notification 25 March 2010
Attachments: ENV11-040 MGP discharge notification 25 March 2010.pdf

Hi [redacted]

Please find attached a discharge notification in relation to the MGP TEP.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

25 March 2010

arrowenergy
go further

Ref: ENV11-040

[redacted]
Environmental Officer
Department of Environment & Resource Management
(sent via email 25March 2010)

RE: Discharge notification

Dear [redacted]

I am writing on the behalf of Arrow Energy Limited to provide notification of intent to discharge under TEP relating to Moranbah PL191/196 granted 4 February 2011 (under EA PEN100015907 grated 14th September 2010).

Current Dam levels

Dam 10 is at MRL
Dam 2 is currently 1435mm below MRL – the target level is to be <4000mm to ensure integrity
Dam 1 is 120mm below MRL
Dam 5 is 2550mm below MRL

Discharge details

Arrow plans to commenced discharge into Isaac River from RP 1 from the 25 March at a discharge rate of upto 7.5ML/day (depending on available dilution) for the duration that sufficient flow is available in the Isaac river (i.e. greater than 1090ML/day as per the draft TEP conditions). As of the 25March 2011 available river monitoring data from the Isaac River monitoring station at Goonyella indicates cumulative flows sufficient to meet the TEP trigger level.

At present we expect daily flow to allow for discharge from the site for at least 2 days (Which implies a total discharge of upto 15ML). Daily sampling has recommenced at both upstream and downstream monitoring points. Further updates on this discharge will be provided in the daily monitoring reported to DERM.

TEP Status

Arrow notes that this TEP has an objective to cease discharge by 30 March. At present we do not expect the flows to be sufficient to allow discharge from the site beyond this date.

Arrow Energy is currently negotiating with DERM to extend the duration indicated in the TEP to allow discharge from the site during future significant flow events as contingency against future wet weather conditions.

Regards,

[redacted]

Ben McMahon
Manager Compliance & Reporting

T +61 7 3012 4000 ARROW ENERGY LTD LEVEL 19, AM-60, 42-60 ALBERT STREET GPO BOX 5262 BRISBANE QLD 4001 info@arrowenergy.com.au
F +61 7 3012 4001 ABN 73 078 521 936 BRISBANE QLD 4000 ASX CODE AOE arrowenergy.com.au

[redacted]

From: Ben McMahon
Sent: Sunday, 27 March 2011 9:40 PM
To: [redacted]
Cc: Environment Mailbox [redacted] Tim Dean [redacted]
Subject: Extension to MGP TEP objective
Attachments: ENV11-043 MGP TEP extension 26 March 2010.pdf

[redacted]

Please find attached a letter requesting an extension to objective 4 of the MGP TEP. As discussed late last week

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

28 March 2010

Ref: ENV11-043

[redacted]
Environmental Officer
Department of Environment & Resource Management
(sent via email 28 March 2010)

RE: Discharge notification

Dea[redacted]

I am writing on the behalf of Arrow Energy Limited to request an extension to objective 4 in the TEP relating to Moranbah PL191/196 granted 4 February 2011 (under EA PEN100015907 grated 14th September 2010).

Current Dam levels

Dam 10 is at MRL
Dam 2 is currently 1435mm below MRL – the target level is to be <4000mm
Dam 1 is 120mm below MRL
Dam 5 is 2550mm below MRL

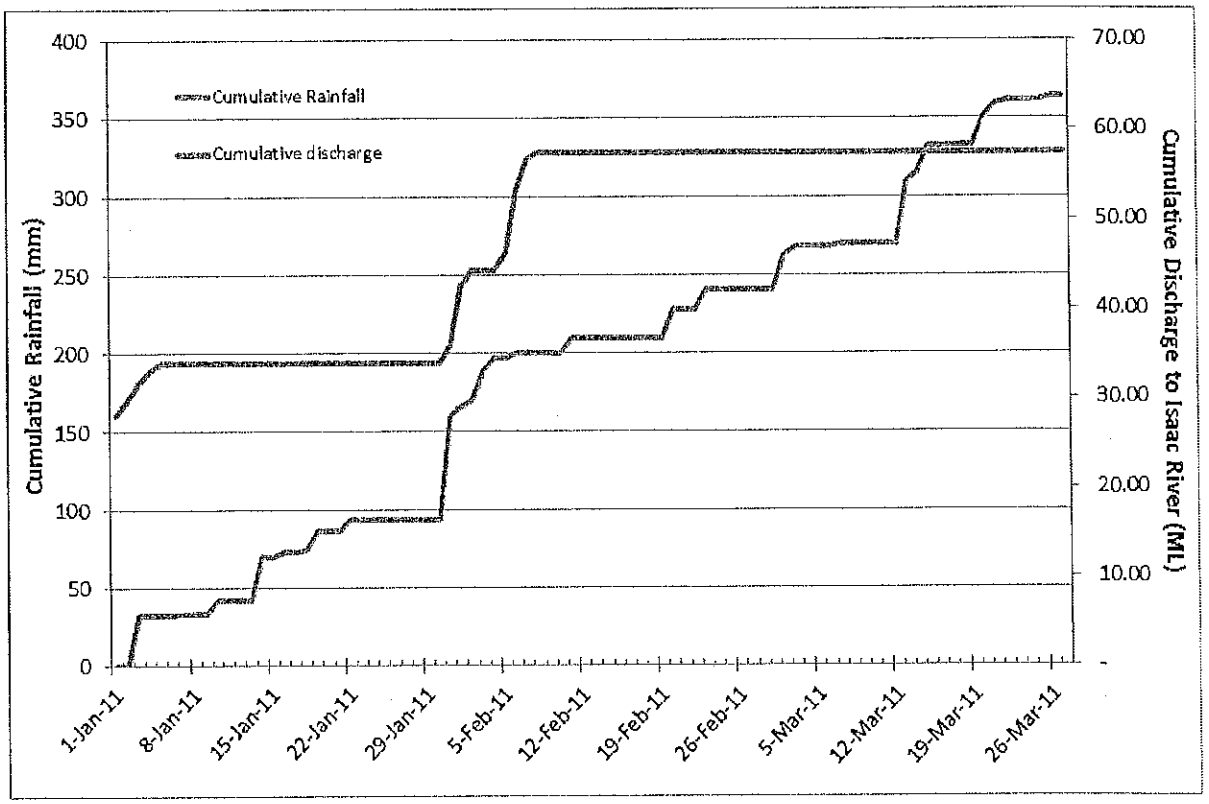


Figure 1 Cumulative rainfall to date Moranbah treatment plant (BOM station 034038)

T +61 7 3012 4000
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ARROW ENERGY LTD
ABN 73 078 521 936
LEVEL 19, AM-60, 42-60 ALBERT STREET
BRISBANE QLD 4000
GPO BOX 5262 BRISBANE QLD 4001
ASX CODE AOE
Info@arrowenergy.com.au
arrowenergy.com.au

Discharge details

In complying with the flow and dilution constraints within the TEP approximately 57.5 ML has been discharged to date (refer to blue line in Figure 1) during two major discharge events (commencing late December and late January) , from the facility under this TEP against projections of approximately 200ML based on mean rainfall. Rainfall has continued to fall at the Moranbah site over February and March but not in the upstream Isaac catchment adding to dam levels but not contributing to flow in the Isaac River.

The solution to managing our water in the medium term remains the completion of Dam 11. We have sufficient storage available to operate the facility under dry conditions. Arrow wishes to maintain the authorisation to discharge as a contingency in the event of heavy rainfall. At present the TEP conditions regarding flows in the Isaac River and dilution requirement prevent discharge under other circumstances.

Dam 11 progress

Work on Dam 11 has been delayed by intermittent rainfall over the past two months which has prevented the finalisation of the HDPE lining. Dam 11 is currently projected for completion in late April but is dependent upon weather conditions. We require long spell of relatively dry weather to finalise the HDPE lining installation. The figure above shows the significant rainfall events since the start of this year have been frequent and contributed to delays.

Alternatives

The situation regarding available alternative water disposal options remains largely unchanged as described by the TEP until Dam 11 in completed. At this stage the only practical alternative is discharge to the Isaac River.

Regards,

[redacted]

Ben McMahon
Manager Compliance & Reporting

[redacted]

From: Ben McMahon
Sent: Thursday, 31 March 2011 4:35 PM
To: [redacted]
Cc: Environment Mailbox; [redacted]
Subject: Exclusion Decision Application Arrow Energy MGP
Attachments: Exclusion Decision Application Arrow Energy MGP.pdf; 08_03_2011 Discharge Results Report.docx; Report Available Water quality results.xls; Notice of DECISION Draft TEP CH4 Pty Ltd.pdf; Moranbah approved TEP feb 2011.pdf; PL191, PL196, PPL115 & PPL116 PEN100015907 (10.12.10).pdf; Cover Letter ENV11-051 Exclusion Decision Application MGP.pdf

[redacted]

As discussed earlier today please find attached an Exclusion Decision Application for CH4 Pty Ltd (owned by Arrow Energy) under the Water Supply (Safety and Reliability) Act 2008 section 322.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M:
www.arrowenergy.com.au

Exclusion Decision Application

Water Supply (Safety and Reliability) Act 2008, section 322

Queensland Government

Privacy Disclaimer: Collection of information provided in this approved form and any attachments is authorised under the *Water Supply (Safety and Reliability) Act 2008* (the Act) and is being used for the purpose of applying to the regulator under the Act for an exclusion decision excluding the coal seam gas (CSG) water produced or supplied under a CSG recycled water scheme from the requirements of Chapter 3 of the Act. The Department of Environment and Resource Management will endeavour to maintain any confidentiality of information relating to your form. However, consideration of your form may involve consultation and if so, details of your form may be disclosed to third parties. This information will not otherwise be disclosed outside of the department unless required or authorised by law (for example as under the *Right to Information Act 2009*).

Note: This is an approved form under the Act, to be used by a responsible entity for a CSG recycled water scheme as defined in Schedule 3 of the Act to apply for an exclusion decision excluding the CSG water produced or supplied under a CSG recycled water scheme from the requirements of Chapter 3 of the Act. Exclusion decision applications are assessed on a case by case basis and may be granted with conditions imposed.

1. Responsible Entity Details

Scheme Manager ☐ Recycled Water Provider ☒

Name of organisation / individual: CH4 Pty Ltd

ABN / ACN: 73 078 521 936

Street address: AM-60 Level 19 42 Albert Street BRISBANE QLD Postcode 4000

Postal address (if different from above): Postcode

Telephone number: [redacted] Fax number: ( ) Mobile number:

Email address:

Principal Contact

Family name: McMahon Given name(s): Benjamin Position: Manager Compliance & Reporting

Telephone number: [redacted] Fax number: [redacted] Mobile number: [redacted]

Email address: [redacted]

2. Scheme Details

Details of the CSG recycled water scheme are to be recorded here.

Name of recycled water scheme: NA

Scheme reference number: NA

Street address: Lot 9 Thorpe Street Moranbah QLD Postcode 4744

Source water: Coal seam gas water

Description of infrastructure: Evaporation dams and pipework associated with Coal Seam Gas processing facility. This facility is discharging water to the Isaac River under a DERM EA (PEN100015907) under an agreed Transitional Environmental Program.

2. Scheme Details continued ...

Exclusion decision application for a scheme in which:

☐ Recycled water is proposed to be supplied under the scheme by its direct release into an aquifer

☒ Recycled water is proposed to be supplied under the scheme by its release, directly or indirectly, into a water source (other than direct release into an aquifer)

Drinking water service provider(s) which will receive water

(If space provided is insufficient, additional information may be attached)

3. Relevant Documents

Please attach any relevant documents which support the exclusion decision application.

	Supporting information	Yes	N/A
1.	Infrastructure/distribution systems used to produce and supply the CSG recycled water including: - Treatment plants - Storage facilities - Pipelines - Map and grid co-ordinates of all infrastructure associated with the scheme - Supply points - Monitoring points	☒	☐
2.	Pre-supply water quality data as defined under s. 201A of the Act	☒	☐
3.	Hydraulic impact zone from release of CSG recycled water as defined in Schedule 3 of the Act	☐	☒
4.	Relevant location of drinking water service provider	☒	☐
5.	Water quality criteria for CSG recycled water	☒	☐
6.	Calculations and modelling results, including - ratio of CSG water to other water at relevant location of drinking water service provider; and - duration of the ratio of CSG water to other water at the relevant location of drinking water service provider	☒	☐

4. Specific Obligations of the CSG Responsible Entity

To ensure compliance with an approved exclusion decision a CSG responsible entity should:

1.	Meet the specified water quality criteria and conditions (if any) of the approved exclusion decision application
2.	Immediately give the regulator notice if there has been a change in the circumstances under which an exclusion decision was granted. This will enable the regulator to amend (or if necessary cancel) the exclusion decision
3.	Prepare and submit an annual report to the regulator for each financial year after an exclusion decision application has been granted

If the CSG recycled water scheme is a multiple-entity recycled water scheme as defined in Schedule 3 of the Act, the applicant must, as soon as practicable after the application is made, give each other responsible entity for the scheme a copy of the application (see s. 322(4) of the Act).

5. Infrastructure Owner(s) for the CSG Recycled Water Scheme

The purpose of this table is to identify the owner(s) of the infrastructure for the CSG recycled water scheme. An owner of infrastructure for the production and/or supply of CSG recycled water is a CSG responsible entity.

Please list below the owner(s) of all infrastructure for the production and/or supply of CSG recycled water in this application.

Name of organisation / individual	Infrastructure
CH4 Limited	Moranbah Gas Processing facility

(If space provided is insufficient, additional information may be attached)

6. Declaration

I/we declare and warrant that I/we have all the necessary and appropriate authority on behalf of the Scheme Manager/CSG recycled water provider of the scheme to declare that the information in this approved form, including any attachments or supporting information provided, is true and accurate to the best of my/our knowledge.

Family name: McMahon

Given name(s): Benjamin

Position: Manager Compliance and Reporting

Signature: [redacted]

Date (dd/mm/yyyy): 31 / 03 / 2011

Family name:

Given name(s):

Position:

Signature:

Date (dd/mm/yyyy): / /

7. Submission

Complete and sign this form, attaching a printed and electronic copy (on CD) of all relevant materials and **send** to:

Recycled and Drinking Water Quality
Office of the Water Supply Regulator
GPO Box 2454
Brisbane Qld 4001

Note: If you are unable to provide an electronic copy, please send a minimum of two (2) printed copies of all relevant materials.

Office use only

Customer Service Centre

Date Received Stamp

Please complete this portion

Responsible entity

Address

Postcode

Date Received Stamp

Table 1																					
ALS		Analyte	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Nickel	Zinc	Boron	Silver	Uranium	Vanadium	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
Sample ID		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		Date Sampled/LOR	0.01	0.01-0.001	0.005 - 0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.01-0.001	0.01-0.005	0.1-0.05	0.001	0.001	0.01	20	50	100	50	50
Draft TEP Trigger Investigation Level			0.055	0.013	0.0002	0.001	0.002	0.3	0.01	0.011	0.008	0.37	0.001	0.001	0.01	20	100			100
Downstream Concentration > Trigger Level and > Upstream Concentration																				
ISAAC 1	Up Stream (MP3)	21/12/2010	13.3	<0.01	<0.005	0.04	0.02	29	0.01	0.03	0.03	<0.1		<0.001	0.06	<20	-	-	-	-
ISAAC 2	Downstream (MP2)	21/12/2010	18.1	0.02	<0.005	0.03	0.02	28.1	<0.01	0.03	0.05	<0.1		<0.001	0.05	<20	-	-	-	-
ISSAC 2	Downstream (MP2) QC	21/12/2010	12.8	<0.01	<0.005	0.02	0.02	20.1	<0.01	0.02	0.03	<0.1		<0.001	0.04	<20	-	-	-	-
		21/12/2010																		
Downstream	Downstream (MP2)	23/12/2010	-	0.002	<0.0001	0.013	0.009	-	0.006	0.015	0.018	-	-	-		<20	<50	<100	<50	<50
ISAAC 2	Downstream (MP2) QC	23/12/2010	-	0.001	<0.0001	0.013	0.01	-	0.006	0.015	0.019	-	-	-		<20	<50	<100	<50	<50
		23/12/2010																		
ISAAC 1-S1	Up Stream (MP3)	24/12/2010	15.2	<0.001	<0.0001	0.012	0.015	10.7	0.006	0.013	0.016	<0.05	<0.001	-	0.02	<20	<50	<100	<50	60
ISAAC 1-QC1	Up Stream (MP3) QC	24/12/2010	9.18	0.001	<0.0001	0.012	0.009	10.9	0.006	0.013	0.02	<0.05	<0.001	-	0.02	<20	<50	<100	<50	<50
ISAAC 2- S2	Downstream (MP2)	24/12/2010	16.4	0.002	<0.0001	0.017	0.012	19.7	0.009	0.02	0.034	<0.05	<0.001	-	0.03	<20	<50	<100	<50	<50
ISAAC 2- QC2	Downstream (MP2) QC	24/12/2010	11.1	0.002	<0.0001	0.017	0.013	15.6	0.007	0.016	0.026	<0.05	<0.001	-	0.03	<20	<50	<100	50	<50
		24/12/2010																		
ISAAC 1-S1	Up Stream (MP3)	24/12/2010	8.83	<0.001	<0.0001	0.012	0.01	10	0.006	0.014	0.017	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
ISAAC 1-QC1	Up Stream (MP3) QC	24/12/2010	9.76	0.001	<0.0001	0.012	0.01	10.5	0.006	0.014	0.018	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
ISAAC 2- S2	Downstream (MP2)	24/12/2010	11.9	0.002	<0.0001	0.017	0.012	14.4	0.007	0.017	0.034	<0.05	<0.001	<0.001	0.03	<20	<50	<100	<50	<50
ISAAC 2- QC2	Downstream (MP2) QC	24/12/2010	11.1	0.001	<0.0001	0.016	0.011	13.5	0.007	0.016	0.056	<0.05	<0.001	<0.001	0.03	<20	<50	<100	50	50
		24/12/2010																		
ISAAC 1-S1	Up Stream (MP3)	25/12/2010	15.2	0.002	<0.0001	0.021	0.015	18.4	0.009	0.023	0.03	<0.05	<0.001	<0.001	0.04	<20	<50	<100	60	60
ISAAC 1-QC1	Up Stream (MP3) QC	25/12/2010	15.2	0.001	<0.0001	0.021	0.016	17.5	0.009	0.023	0.035	<0.05	<0.001	<0.001	0.03	<20	<50	<100	<50	<50
ISAAC 2- S2	Downstream (MP2)	25/12/2010	16.4	0.002	<0.0001	0.023	0.016	19.7	0.009	0.024	0.055	<0.05	<0.001	<0.001	0.04	<20	<50	<100	<50	<50
ISAAC 2- QC2	Downstream (MP2) QC	25/12/2010	16.2	0.002	<0.0001	0.023	0.016	19.5	0.009	0.024	0.03	<0.05	<0.001	<0.001	0.04	<20	<50	<100	<50	<50
		25/12/2010																		
ISAAC 1-S1	Up Stream (MP3)	27/12/2010	9.41	0.002	<0.0001	0.012	0.01	10.7	0.006	0.013	0.016	0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
ISAAC 1-QC1	Up Stream (MP3) QC	27/12/2010	9.18	0.001	<0.0001	0.012	0.009	10.9	0.006	0.013	0.02	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
ISAAC 2- S2	Downstream (MP2)	27/12/2010	14.3	0.002	<0.0001	0.019	0.014	17.5	0.009	0.02	0.08	<0.05	<0.001	<0.001	0.03	<20	<50	<100	<50	<50
ISAAC 2- QC2	Downstream (MP2) QC	27/12/2010	12.7	0.001	<0.0001	0.017	0.013	15.6	0.009	0.018	0.026	<0.05	<0.001	<0.001	0.03	<20	<50	<100	<50	<50
		27/12/2010																		
ISAAC1-S1	Up Stream (MP3)	29/12/2010	-	<0.001	<0.0001	0.008	0.008	-	0.004	0.011	0.015	-	-	-	0.02	<20	<50	<100	<50	<50
ISAAC1-QC1	Up Stream (MP3)QC	29/12/2010	-	<0.001	0.0002	0.008	0.008	-	0.004	0.01	0.014	-	-	-	0.02	<20	<50	<100	<50	<50
ISAAC2-S2	Downstream (MP2)	29/12/2010	-	<0.001	0.0001	0.01	0.009	-	0.005	0.012	0.017	-	-	-	0.02	<20	<50	<100	<50	<50
ISAAC2-QC2	Downstream (MP2) QC	29/12/2010	-	<0.001	<0.0001	0.008	0.008	-	0.004	0.01	0.013	-	-	-	0.02	<20	<50	<100	<50	<50
		29/12/2010																		
ISAAC 1	Up Stream (MP3)	31/12/2010	-	<0.001	<0.0001	0.008	0.006	-	0.004	0.009	0.014	-	-	-	0.01	<20	<50	<100	<50	<50

Table 1																					
ALS		Analyte	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Nickel	Zinc	Boron	Silver	Uranium	Vanadium	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
Sample ID		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		Date Sampled/LOR	0.01	0.01-0.001	0.005-0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.01-0.001	0.01-0.005	0.1-0.05	0.001	0.001	0.01	20	50	100	50	50
Draft TEP Trigger Investigation Level			0.055	0.013	0.0002	0.001	0.002	0.3	0.01	0.011	0.008	0.37	0.001	0.001	0.01	20	100			100
Downstream Concentration > Trigger Level and > Upstream Concentration																				
Issac 1 - s1	Up Stream (MP3)	02/01/2011	7.94	0.002	<0.0001	0.011	0.005	10.2	0.012	0.206	0.02	0.09	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
Issac 1 - qc1	Up Stream (MP3) QC	02/01/2011	7.75	0.001	<0.0001	0.011	0.004	9.65	0.012	0.199	0.02	0.09	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
Issac 2 - s2	Downstream (MP2)	02/01/2011	6.96	0.001	<0.0001	0.01	0.004	9.2	0.012	0.208	0.02	<0.05	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
Issac 2 - qc2	Downstream (MP2)QC	02/01/2011	6.94	0.001	<0.0001	0.01	0.005	9.23	0.012	0.209	0.02	<0.05	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
		02/01/2011																		
Issac 1 - s1	Up Stream (MP3)	03/01/2011	7.07	0.001	<0.0001	0.017	0.006	9.95	0.015	0.186	0.02	0.05	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
Issac 1 - qc1	Up Stream (MP3) QC	03/01/2011	8.47	0.001	<0.0001	0.023	0.008	13.6	0.019	0.226	0.03	0.05	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
Issac 2 - s2	Downstream (MP2)	03/01/2011	8.48	0.001	<0.0001	0.022	0.008	13.7	0.019	0.233	0.03	<0.05	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
Issac 2 - qc2	Downstream (MP2)QC	03/01/2011	9.04	0.001	<0.0001	0.022	0.008	14.3	0.02	0.237	0.03	<0.05	<0.01	<0.001	<0.001	<20	<50	<100	<50	<50
		03/01/2011																		
Isaac 1 - s1	Up Stream (MP3)	04/01/2011	5.18	0.002	<0.0001	0.015	0.008	11.2	0.005	0.014	0.015	0.08	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Isaac 1 - qc1	Up Stream (MP3) QC	04/01/2011	5.57	0.002	<0.0001	0.016	0.009	11.7	0.005	0.014	0.017	0.08	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Isaac 2 - s2	Downstream (MP2)	04/01/2011	7.1	0.002	<0.0001	0.013	0.007	9.41	0.004	0.011	0.012	0.06	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Isaac 2 - qc2	Downstream (MP2)QC	04/01/2011	8.13	0.002	<0.0001	0.015	0.008	10.3	0.006	0.012	0.014	0.06	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
		04/01/2011																		
Isaac 1 - s1	Up Stream (MP3)	05/01/2011	6.07	0.001	<0.0001	0.009	0.006	7.64	0.004	0.009	0.011	0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Isaac 1 - qc1	Up Stream (MP3) QC	05/01/2011	6.87	0.002	<0.0001	0.01	0.007	8.51	0.004	0.01	0.012	0.08	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Isaac 2 - s2	Downstream (MP2)	05/01/2011	6.44	0.001	<0.0001	0.009	0.006	7.91	0.004	0.009	0.012	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Isaac 2 - qc2	Downstream (MP2)QC	05/01/2011	6.36	0.001	<0.0001	0.009	0.007	7.91	0.004	0.01	0.011	0.06	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
		05/01/2011																		
S1	Up Stream (MP3)	06/01/2011	6.37	<0.001	<0.0001	0.009	0.007	7.99	0.004	0.009	0.01	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
QC1	Up Stream (MP3) QC	06/01/2011	6.33	<0.001	<0.0001	0.009	0.007	7.81	0.004	0.009	0.01	0.06	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
S2	Downstream (MP2)	06/01/2011	6.16	<0.001	<0.0001	0.008	0.006	7.36	0.004	0.008	0.01	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
QC2	Downstream (MP2)QC	06/01/2011	5.68	<0.001	<0.0001	0.008	0.006	6.7	0.004	0.008	0.009	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
		06/01/2011																		
S1	Up Stream (MP3)	07/01/2011	10.6	0.002	<0.0001	0.015	0.01	13.7	0.006	0.015	0.021	0.07	<0.001	<0.001	0.03	<20	<50	<100	<50	<50
QC1	Up Stream (MP3) QC	07/01/2011	12.1	0.002	<0.0001	0.017	0.011	15.9	0.006	0.016	0.019	0.09	<0.001	<0.001	0.03	<20	<50	<100	<50	<50
S2	Downstream (MP2)	07/01/2011	9.11	0.002	<0.0001	0.013	0.009	11.6	0.005	0.012	0.016	0.06	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
QC2	Downstream (MP2)QC	07/01/2011	9.39	0.002	<0.0001	0.012	0.009	12	0.005	0.013	0.016	0.07	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
		07/01/2011																		
S1	Up Stream (MP3)	31/01/2011	21.1	<0.010	0.002	<0.05	0.021	29.4	0.046	<0.0001	0.844	0.043	0.07	0.016	0.047	<20	<50	<100	<50	<50
QC1	Up Stream (MP3) QC	31/01/2011	17.4	<0.010	0.001	<0.05	0.017	23.4	0.036	<0.0001	0.724	0.034	0.06	0.011	0.035	<20	<50	<100	<50	<50
S2	Downstream (MP2)	31/01/2011	21.2	<0.010	0.001	<0.05	0.019	28.8	0.047	<0.0001	0.81	0.045	0.07	0.014	0.041	<20	<50	<100	<50	<50

Table 1

ALS		Analyte	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Nickel	Zinc	Boron	Silver	Uranium	Vanadium	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)
Sample ID		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		Date Sampled/LOR	0.01	0.01-0.001	0.005 - 0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.01-0.001	0.01-0.005	0.1-0.05	0.001	0.001	0.01	20	50	100	50	50
Draft TEP Trigger Investigation Level			0.055	0.013	0.0002	0.001	0.002	0.3	0.01	0.011	0.008	0.37	0.001	0.001	0.01	20	100			100
Downstream Concentration > Trigger Level and > Upstream Concentration																				
QC2	Downstream (MP2)QC	31/01/2011	22	<0.010	0.002	<0.05	0.02	28.3	0.046	<0.0001	0.822	0.046	0.07	0.014	0.044	<20	<50	<100	<50	<50
		31/01/2011																		
S1 ISAC 2	Up Stream (MP3)	01/02/2011	13	<0.010	0.002	<0.05	0.009	17.8	0.025	<0.0001	0.433	0.022	0.05	0.008	0.021	<20	<50	<100	<50	<50
QC1 ISAC 2	Up Stream (MP3) QC	01/02/2011	11.7	<0.010	0.002	0.05	0.009	14.4	0.021	<0.0001	0.422	0.018	0.04	0.008	0.019	<20	<50	<100	<50	<50
S2 ISAC 1	Downstream (MP2)	01/02/2011	17	<0.010	0.002	0.05	0.014	23.8	0.032	<0.0001	0.583	0.035	0.05	0.012	0.031	<20	<50	<100	<50	<50
QC2 ISAC 1	Downstream (MP2)QC	01/02/2011	17.4	<0.010	0.002	0.06	0.013	21.8	0.032	<0.0001	0.567	0.034	0.05	0.011	0.029	<20	<50	<100	<50	<50
		01/02/2011																		
S1	Up Stream (MP3)	02/02/2011	11.9	<0.010	0.002	0.07	0.008	15.6	0.02	0.0002	0.341	0.022	0.04	0.007	0.018	<20	<50	<100	<50	<50
QC1	Up Stream (MP3) QC	02/02/2011	12.9	<0.010	0.002	0.06	0.007	16.4	0.02	<0.0001	0.321	0.02	0.04	0.007	0.018	<20	<50	<100	<50	<50
S2	Downstream (MP2)	02/02/2011	10.3	<0.010	0.001	0.05	0.006	13.4	0.017	<0.0001	0.295	0.017	0.04	0.006	0.015	<20	<50	<100	<50	<50
QC2	Downstream (MP2)QC	02/02/2011	11	<0.010	0.002	0.06	0.006	14	0.018	<0.0001	0.264	0.016	0.04	0.006	0.015	<20	<50	<100	<50	<50
		02/02/2011																		
ISAC 2 S1	Up Stream (MP3)	03/02/2011	12.1	0.002	<0.0001	0.02	0.007	15.4	0.3	0.007	0.002	0.06	<0.001	0.04	0.019	<20	<50	140	100	240
ISAC 2 QC1	Up Stream (MP3) QC	03/02/2011	12.5	0.002	<0.0001	0.02	0.007	16.2	0.322	0.007	0.001	0.06	<0.001	0.04	0.021	<20	<50	<100	<50	<50
ISAC 1 S1	Downstream (MP2)	03/02/2011	12.8	0.002	<0.0001	0.021	0.008	16.7	0.357	0.007	0.001	0.06	<0.001	0.04	0.024	<20	<50	<100	<50	<50
ISAC 1 QC1	Downstream (MP2)QC	03/02/2011	13.6	0.002	<0.0001	0.022	0.008	17.6	0.366	0.008	0.001	0.06	<0.001	0.04	0.026	<20	<50	<100	<50	<50
		09/02/2011																		
Upstream MP3 - S1	Upstream MP3 - S1	09/02/2011	5.48	0.001	<0.0001	0.008	0.007	7.33	0.004	0.009	0.022	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
Downstream - MP2 -	Downstream - MP2 - S2	09/02/2011	5.94	0.001	<0.0001	0.008	0.007	7.32	0.004	0.009	0.027	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
QC2	Downstream (MP2)QC	09/02/2011	5.69	<0.001	<0.0001	0.007	0.007	5.69	0.004	0.009	0.022	<0.05	<0.001	<0.001	0.01	<20	<50	<100	<50	<50
		09/02/2011																		
Upstream MP3 - S1	Up Stream (MP3)	10/02/2011	4.9	<0.001	<0.0001	0.006	0.006	5.65	0.004	0.008	0.018	<0.05	<0.001	<0.001	0.01	<20	<50	<100	<50	<50
Downstream - MP2 -	Downstream (MP2)	10/02/2011	5.99	<0.001	<0.0001	0.007	0.007	7.23	0.004	0.009	0.017	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
QC2	Downstream (MP2)QC	10/02/2011	6.82	<0.001	<0.0001	0.008	0.008	8.5	0.004	0.01	0.073	<0.05	<0.001	<0.001	0.02	<20	<50	<100	<50	<50
		10/02/2011																		

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08/03/2011

Ref: Env11-025

Department of Environment and Resource Management (DERM)

Via email: [redacted] 8 March 2011

Dear [redacted]

Subject: Update report – Detailed Data Assessment - TEP for PEN100015907/ PL191/196

This letter addresses Condition 5 in TEP PEN100015907, which states:

> "If quality characteristics of the release exceed any of the trigger levels specified in Table 7 during a release event, the Transitional Environmental Program holder must compare MP2 to the trigger values specified in Table 7 and:
>
> a) where the trigger values are not exceeded then no action to be taken.
> b) where the downstream results exceed the trigger values specified Table 7 for any quality characteristics, compare the results of the downstream site to the data from the upstream monitoring sites (MP3)
>
> i) if the result is less that recorded at Monitoring Point 3 (MP3) then no action is to be taken or
> ii) If the result is greater than the background monitoring site data, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology, into the potential for environmental harm and provide a written report **20 business days after receiving results**, outlining:
> - details of the investigations carried out
> - actions taken to prevent environmental harm."

This notification summarises the analytical results of the sampling and analysis program undertaken prior to and post commencement of the TEP (dated 4 February 2011). The data have been assessed against trigger levels, as outlined in TEP PEN100015907 as provided to DERM in tabular format as the data has been received from the NATA accredited laboratory.

As previously indicated via email to [redacted] on 28 January 2011, the background water quality has exceeded the TEP trigger values for a number of analytes tested during the sampling and analysis program. As part of this assessment, the exceedances have been reviewed for both the Isaac River samples (upstream and downstream) and the discharge water samples. A comparison has been made between the upstream and downstream results, (i.e. including the results of quality control samples); and where the downstream values exceed both the TEP trigger levels and the upstream results further investigation has been undertaken (**Table 1**), including an assessment of the wastewater results. Where the discharge water quality results exceed the trigger levels and exceed the Isaac River results, an assessment of the analyte concentrations against both the ANZECC Fresh Water Aquatic Guidelines and the Australian Drinking Water Guidelines has been undertaken (**Table 2**). Based on a detailed review of the results from the monitoring program to date, the following has been reported:

Analytes that consistently exceeded the TEP Trigger levels included aluminium, chromium, copper, iron, nickel, zinc, and vanadium. The results were reported as follows.

The maximum concentration of aluminium was reported at 21.1 mg/L (upstream) and 22 mg/L (downstream), with an average concentration of 10.5 mg/L and 11.2 mg/L for the upstream and downstream sites respectively. The maximum concentration reported for the discharge location was 16.3 mg/L with an average concentration of 4.53 mg/L reported over the monitoring period assessed. On 21, 24, 25 and 27 of

December 2010, concentrations of aluminium in the discharge water exceeded the reported concentrations at the upstream location. Based on review of the results and an assessment of the relative percentage difference (RPD) between the upstream water results and the discharge water results (see Table 2), the RPD was calculated to between 3% and 16%. On this basis, the concentrations of aluminium at the upstream sampling location and the discharge point are not considered significantly different. Based on the average concentrations of aluminium in the wastewater compared to the average concentrations in the Isaac River, the discharge of wastewater would have likely diluted the aluminium concentrations in the Isacc River over time. There are no health based guidelines currently available for aluminium.

The maximum concentration of chromium was reported at 0.07 mg/L (upstream) and 0.06 mg/L (downstream), with an average concentration of 0.019 mg/L for both the upstream and downstream sites. The maximum concentration reported for the discharge location was 1.53 mg/L with an average concentration of 0.255 mg/L reported over the monitoring period assessed. On 24, 25 and 27 of December 2010, 31 Jan 2011 and 1 February 2011 concentrations of chromium in the discharge water exceeded the reported concentrations at the upstream location. The RPD was calculated to between 5% and 142%. The concentrations of chromium in the discharge water were found to be periodically significantly different from the water quality in the Isaac River. It is considered highly unlikely that the chromium concentrations present is hexavalent chromium, as there are no identified sources of chromium VI. Insufficient data are currently available to assign an assessment criterion for chromium III in freshwater ecosystems and there are no health based guidelines currently available for chromium III in drinking water. No further investigation is considered warranted for chromium on the basis that no adverse environmental or human health risks were identified.

The maximum concentration of copper was reported at 0.021 mg/L (upstream) and 0.020 mg/L (downstream), with an average concentration of 0.09 mg/L and 0.10 mg/L for the upstream and downstream sites respectively. The maximum concentration reported for the discharge location was 0.020 mg/L with an average concentration of 0.007 mg/L reported over the monitoring period assessed. On 24 and 25 December 2010, concentrations of copper in the discharge water marginally exceeded the reported concentrations at the upstream location. The RPD was calculated to between 10% and 12%. On this basis, the concentrations of copper at the upstream sampling location and the discharge point are not considered significantly different. Based on the average concentrations of copper in the wastewater compared to the average concentrations in the Isaac River, the discharge of wastewater would have likely diluted the copper concentrations in the Isaac River during discharge. There are no health based guidelines currently available for copper; however the fresh water aquatic ecosystem guideline of 0.0014 mg/L was consistently exceeded in both the upstream and downstream sampling locations. Based on the quality of the receiving water body, no significant environmental harm is considered likely to have occurred on the basis that the discharge water appeared to be indicative of typical background conditions. No further investigation is considered warranted.

The maximum concentration of iron was reported at 29.4 mg/L (upstream) and 28.8 mg/L (downstream), with an average concentration of 13.50 mg/L and 14.66 mg/L for the upstream and downstream sites respectively. The maximum concentration reported for the discharge location was 23.5 mg/L with an average concentration of 5.6 mg/L reported over the monitoring period assessed. On 24, 25 and 27 December 2010, concentrations of iron in the discharge water marginally exceeded the reported concentrations at the upstream location. The RPD was calculated to between 2% and 19%. On this basis, the concentrations of iron at the upstream sampling location and the discharge point are not considered significantly different. Based on the average concentrations of iron in the wastewater compared to the average concentrations in the Isaac River, the discharge of wastewater would have likely diluted the iron concentrations in the Isaac River during discharge. There are no health based, or freshwater aquatic guidelines currently available for iron. Based on the quality of the receiving water body, no significant environmental harm is considered likely to have occurred on the basis that the discharge water appeared to be indicative or of better general quality than typical background conditions. No further investigation is considered warranted for iron.

The maximum concentration of nickel was reported at 0.226 mg/L (upstream) and 0.237 mg/L (downstream), with an average concentration of 0.039 mg/L and 0.040 mg/L for the upstream and downstream sites respectively. The maximum concentration reported for the discharge location was 0.030 mg/L with an average concentration of 0.011 mg/L reported over the monitoring period assessed. Nickel in the discharge water did not exceed the reported concentrations at the upstream location at any for the assessed data. Based on the quality of the receiving water body, no significant environmental harm is considered likely to

have occurred based on the concentrations of nickel added to the Isaac River. No further investigation is considered warranted for nickel.

The maximum concentration of zinc was reported at 0.844 mg/L (upstream) and 0.822 mg/L (downstream), with an average concentration of 0.105 mg/L and 0.110 mg/L for the upstream and downstream sites respectively. The maximum concentration reported for the discharge location was 0.040 mg/L with an average concentration of 0.018 mg/L reported over the monitoring period assessed. On 21, 24 and 27 December 2010, concentrations of zinc in the discharge water marginally exceeded the reported concentrations at the upstream location. The RPD was calculated to between 11% and 29%. Based on the reported concentrations at the upstream sampling location, the quality of water discharged to the Isaac River are not considered significant and would not have adversely affected the quality of water in the Isaac River. There are no health based guidelines currently available for zinc; however the fresh water aquatic ecosystem guideline of 0.008 mg/L was consistently exceeded in both the upstream and downstream sampling locations. Based on the quality of the receiving water body, no significant environmental harm is considered likely to have occurred on the basis that the discharge water appeared to be indicative of typical background conditions, if not generally better. No further investigation is considered warranted for zinc.

The maximum concentration of vanadium was reported at 0.06 mg/L (upstream) and 0.05 mg/L (downstream), with an average concentration of 0.024 mg/L and 0.026 mg/L for the upstream and downstream sites respectively. The maximum concentration reported for the discharge location was 0.06 mg/L with an average concentration of 0.029 mg/L reported over the monitoring period assessed. On 24, 25 and 27 December 2010, concentrations of vanadium in the discharge water marginally exceeded the reported concentrations at the upstream location. The RPD was calculated to between 13% and 22%. Based on the reported concentrations over the sampling period, concentrations of vanadium are considered indicative of background, receiving water conditions. The water discharged to the Isaac River is not considered likely to have significantly affected in the quality of water the Isaac River. There are no health based, or freshwater aquatic guidelines currently available for vanadium. No further investigation is considered warranted.

Analytes that were observed above the TEP Trigger levels, either rarely or intermittently, included arsenic, cadmium, lead, boron, silver, uranium, fluoride and recoverable hydrocarbons. Of these, arsenic, cadmium, lead, silver and uranium are not considered to be a result of or influenced by the wastewater discharge program, on the basis of the reported concentrations. Boron, fluoride and petroleum hydrocarbons are discussed as follows:

- Concentrations of boron were observed above the trigger levels in discharge water on the 2 – 7 January 2011. The reported concentrations ranged from 1.03 and 1.39 mg/L during this January discharge period, which is in excess of the trigger level of 0.37 mg/L. These results pushed the average concentration of Boron for the entire monitoring period to 0.91 mg/L, which is also above the trigger level. Based on the foregoing, the drinking water guidelines and freshwater quality guidelines were reviewed, reporting the following:
    - The maximum concentration of boron of 1.39 mg/L was reported below the drinking water guideline of 4 mg/L
    - The maximum concentration of boron of 1.39 mg/L was reported above the freshwater aquatic guideline for 95% protection 0.37 mg/L.
    - It is noted that the dilution factor for discharge is at 400:1 and therefore, the adverse affect of discharge on the quality of the receiving water body is considered insignificant.
- Concentrations of boron were observed above the trigger levels in discharge water on 1 February 2011. The reported concentration was 2.4 mg/L, marginally above the trigger level of 2.0 mg/L. Based on the dilution factor of a minimum of 400:1 the adverse affect of discharge on the quality of the receiving water body is considered insignificant.
- On one occasion (31 Jan 2011), concentrations of total recoverable hydrocarbons (TRH) in the C15 – C36 fraction were reported at 240 ug/L, above the trigger level of 100 ug/L. The source of the petroleum hydrocarbons was investigated, but remains unknown. On the basis that BTEX and PAHs were reported below the level of reporting for this sample, it is considered possible that the TRH is indicative of naturally occurring organic material. At the reported concentration, it is considered unlikely that the petroleum hydrocarbon would cause a visible sheen. On the basis that the discharge pumps are submerged pumps and the results are inconsistent with the larger data set, the potential for sample anomaly (e.g. cross contamination of the sample) cannot be discounted.

Based on review of the available data, the quality of discharge waters is considered unlikely to detrimentally affect the environmental status of the Isaac River. In addition, based on the contaminants that were reported at concentrations above the investigations levels, the likelihood of impacting the potential health and safety of receptors is considered low. Further details will be provided in the final report.

Regards,

Graham Cordingley
Senior Operations Support Coordinator

ALS		Analyte	Aluminium	Arsenic
Sample ID		Units	mg/L	mg/L
		Date Sampled/LOR	0.01	0.01-0.001
Draft TEP Trigger Investigation Level			0.055	0.013
DISCHARGE POINT	Discharge Point (MP1)	21/12/2010	15.6	<0.01
ISAAC 1	Up Stream (MP3)	21/12/2010	13.3	<0.01
ISAAC 2	Downstream (MP2)	21/12/2010	18.1	0.02
DISCHARGE POINT		21/12/2010	-	-
ISAAC 1		21/12/2010	-	-
ISSAC 2	Downstream (MP2) QC	21/12/2010	12.8	<0.01
DISCHARGE POINT	Discharge Point (MP1)	23/12/2010	-	0.001
Downstream	Downstream (MP2)	23/12/2010	-	0.002
ISAAC 2	Downstream (MP2) QC	23/12/2010	-	0.001
ISAAC 1-S1	Up Stream (MP3)	24/12/2010	15.2	<0.001
ISAAC 1-QC1	Up Stream (MP3) QC	24/12/2010	9.18	0.001
ISAAC 2- S2	Downstream (MP2)	24/12/2010	16.4	0.002
ISAAC 2- QC2	Downstream (MP2) QC	24/12/2010	11.1	0.002
DISCHARGE-S3	Discharge Point (MP1)	24/12/2010	10.9	0.001
DISCHARGE-QC3	Discharge Point (MP1) QC	24/12/2010	11	0.002
QC 5		24/12/2010		
S5		25/12/2010		
ISAAC 1-S1	Up Stream (MP3)	24/12/2010	8.83	<0.001
ISAAC 1-QC1	Up Stream (MP3) QC	24/12/2010	9.16	0.001
ISAAC 2- S2	Downstream (MP2)	24/12/2010	11.9	0.002
ISAAC 2- QC2	Downstream (MP2) QC	24/12/2010	11.1	0.001
DISCHARGE-S3	Discharge Point (MP1)	24/12/2010	10.1	0.001
DISCHARGE-QC3	Discharge Point (MP1) QC	24/12/2010	11	0.001
ISAAC 1-S1	Up Stream (MP3)	25/12/2010	15.2	0.002
ISAAC 1-QC1	Up Stream (MP3) QC	25/12/2010	15.2	0.001
ISAAC 2- S2	Downstream (MP2)	25/12/2010	16.4	0.002
ISAAC 2- QC2	Downstream (MP2) QC	25/12/2010	16.2	0.002
DISCHARGE-S3	Discharge Point (MP1)	25/12/2010	15.1	0.001
DISCHARGE-QC3	Discharge Point (MP1) QC	25/12/2010	16.3	0.002
ISAAC 1-S1	Up Stream (MP3)	27/12/2010	9.41	0.002
ISAAC 1-QC1	Up Stream (MP3) QC	27/12/2010	9.18	0.001
ISAAC 2- S2	Downstream (MP2)	27/12/2010	14.3	0.002
ISAAC 2- QC2	Downstream (MP2) QC	27/12/2010	12.7	0.001
DISCHARGE-S3	Discharge Point (MP1)	27/12/2010	10.9	0.001
DISCHARGE-QC3	Discharge Point (MP1) QC	27/12/2010	9.76	0.001
TRIP-S5		29/12/2010		

S5		25/12/2010		
QC 5		24/12/2010		
QC 5		25/12/2010		
ISAAC1-S1	Up Stream (MP3)	29/12/2010	-	<0.001
ISAAC1-QC1	Up Stream (MP3)QC	29/12/2010	-	<0.001
ISAAC2-S2	Downstream (MP2)	29/12/2010	-	<0.001
ISAAC2-QC2	Downstream (MP2) QC	29/12/2010	-	<0.001
DISCHARGE-S3	Discharge Point (MP1)	29/12/2010	-	0.003
DISCHARGE-QC3	Discharge Point (MP1) QC	29/12/2010	-	0.002
TRIP-QC5		29/12/2010		
TRIP-S5		29/12/2010		
DISCHARGE POINT	Discharge Point (MP1)	31/12/2010	-	<0.001
ISAAC 1	Up Stream (MP3)	31/12/2010	-	<0.001
ISAAC 2		31/12/2010	-	0.001
TRIP 1 2		31/12/2010		
Issac 1 - s1	Up Stream (MP3)	02/01/2011	7.94	0.002
Issac 2 - s2	Downstream (MP2)	02/01/2011	6.96	0.001
Discharge point - s3	Discharge Point (MP1)	02/01/2011	0.14	0.002
Issac 1 - qc1	Up Stream (MP3) QC	02/01/2011	7.25	0.001
Issac 2 - qc2	Downstream (MP2)QC	02/01/2011	6.94	0.001
Discharge point = qc3	Discharge Point (MP1) QC	02/01/2011	0.17	0.002
Trip - QC5		02/01/2011	-	-
Issac 1 - s1	Up Stream (MP3)	03/01/2011	7.07	0.001
Issac 2 - s2	Downstream (MP2)	03/01/2011	8.48	0.001
Discharge point - s3	Discharge Point (MP1)	03/01/2011	0.14	0.002
Issac 1 - qc1	Up Stream (MP3) QC	03/01/2011	8.47	0.001
Issac 2 - qc2	Downstream (MP2)QC	03/01/2011	9.04	0.001
Discharge point - qc3	Discharge Point (MP1) QC	03/01/2011	0.13	0.002
Trip - QC5		03/01/2011	-	-
Isaac 1 - s1	Up Stream (MP3)	04/01/2011	8.18	0.002
Isaac 2 - s2	Downstream (MP2)	04/01/2011	7.1	0.002
Discharge point - s3	Discharge Point (MP1)	04/01/2011	0.08	0.002
Isaac 1 - qc1	Up Stream (MP3) QC	04/01/2011	8.57	0.002
Isaac 2 - qc2	Downstream (MP2)QC	04/01/2011	8.13	0.002
Discharge point - s3	Discharge Point (MP1) QC	04/01/2011	0.09	0.002
Trip - s5		04/01/2011	-	-
Isaac 1 - s1	Up Stream (MP3)	05/01/2011	6.07	0.001
Isaac 2 - s2	Downstream (MP2)	05/01/2011	6.44	0.001
Discharge point - s3	Discharge Point (MP1)	05/01/2011	0.09	0.002
Isaac 1 - qc1	Up Stream (MP3) QC	05/01/2011	6.87	0.002
Isaac 2 - qc2	Downstream (MP2)QC	05/01/2011	6.36	0.001
Discharge point - s3	Discharge Point (MP1) QC	05/01/2011	0.09	0.002
S1	Up Stream (MP3)	06/01/2011	6.37	<0.001
S2	Downstream (MP2)	06/01/2011	6.16	<0.001
S3	Discharge Point (MP1)	06/01/2011	0.11	<0.001
QC1	Up Stream (MP3) QC	06/01/2011	6.33	<0.001
QC2	Downstream (MP2)QC	06/01/2011	5.68	<0.001

QC3	Discharge Point (MP1) QC	06/01/2011	0.12	<0.001
QC4		06/01/2011		
S1	Up Stream (MP3)	07/01/2011	10.6	0.002
S2	Downstream (MP2)	07/01/2011	9.11	0.002
S3	Discharge Point (MP1)	07/01/2011	0.14	<0.001
QC1	Up Stream (MP3) QC	07/01/2011	12.1	0.002
QC2	Downstream (MP2)QC	07/01/2011	9.39	0.002
QC3	Discharge Point (MP1) QC	07/01/2011	0.18	<0.001
QC4		07/01/2011		
S1	Up Stream (MP3)	31/01/2011	21.1	<0.010
S2	Downstream (MP2)	31/01/2011	21.2	<0.010
S3	Discharge Point (MP1)	31/01/2011	0.55	<0.010
QC1	Up Stream (MP3) QC	31/01/2011	17.4	<0.010
QC2	Downstream (MP2)QC	31/01/2011	22	<0.010
QC3	Discharge Point (MP1) QC	31/01/2011	0.44	<0.010
QC4		31/01/2011		
S1 ISAC 2	Up Stream (MP3)	01/02/2011	13	<0.010
S2 ISAC 1	Downstream (MP2)	01/02/2011	17	<0.010
S3 DISCHARGE	Discharge Point (MP1)	01/02/2011	0.04	<0.010
QC1 ISAC 2	Up Stream (MP3) QC	01/02/2011	11.7	<0.010
QC2 ISAC 1	Downstream (MP2)QC	01/02/2011	17.4	<0.010
QC3 DISCHARGE	Discharge Point (MP1) QC	01/02/2011	0.04	<0.010
QC4 TRIP		01/02/2011		
S1	Up Stream (MP3)	02/02/2011	11.9	<0.010
S2	Downstream (MP2)	02/02/2011	10.3	<0.010
QC1	Up Stream (MP3) QC	02/02/2011	12.9	<0.010
QC2	Downstream (MP2)QC	02/02/2011	11	<0.010
QC4		02/02/2011		
ISAC 2 S1	Up Stream (MP3)	03/02/2011	12.1	0.002
ISAC 1 S1	Downstream (MP2)	03/02/2011	12.8	0.002
ISAC 2 QC1	Up Stream (MP3) QC	03/02/2011	12.5	0.002
ISAC 1 QC1	Downstream (MP2)QC	03/02/2011	13.6	0.002
TRIP QC4		03/02/2011		
Upstream MP3 - S10	Upstream MP3 - S1	09/02/2011	6.49	0.001
Downstream - MP2 - S2	Downstream - MP2 - S2	09/02/2011	5.94	0.001
QC2	QC2	09/02/2011	5.69	<0.001
QC3	QC3	09/02/2011		
Upstream MP3 - S1	Up Stream (MP3)	10/02/2011	4.9	<0.001
Downstream - MP2 - S2	Downstream (MP2)	10/02/2011	5.99	<0.001
QC2	Downstream (MP2)QC	10/02/2011	6.82	<0.001
QC3		10/02/2011		

March 2011 Discharge

Upstream MP3-S1	Upstream MP3-S1	26/03/2011	17.5	0.001
Downstrream-MP2-S2	Downstrream-MP2-S2	26/03/2011	16.7	0.001

Discharge-MP1-S3	Discharge-MP1-S3	26/03/2011	0.03	<0.001
Upstream QC1	Upstream QC1	26/03/2011	19	0.002
Downstream QC2	Downstream QC2	26/03/2011	17.6	0.002
Discharge QC3	Discharge QC3	26/03/2011	0.04	0.001
TRip QC4	TRip QC4	26/03/2011		
Rinsate QC5	Rinsate QC5	26/03/2011		
Upstream MP3-S1	Upstream MP3-S1	27/03/2011	15	0.002
Downstream-MP2-S2	Downstream-MP2-S2	27/03/2011	10.4	0.002
Upstream QC1	Upstream QC1	27/03/2011	10.3	0.002
Downstream QC2	Downstream QC2	27/03/2011	10.3	0.002
Trip QC4		27/03/2011		
Rinsate QC5		27/03/2011		

March 2011 Discharge Dam Monitoring Program

Pond 1	P1-S1	26/03/2011	0.06	0.003
Pond 2	P2-S2	26/03/2011	0.24	0.003
Pond 5	P5-S5	26/03/2011	0.02	0.002
Pond 10	P10-S10	26/03/2011	0.03	0.002
Pond 1 Duplicate	P1-QC1	26/03/2011	0.07	0.003
Pond 2 Duplicate	P2-QC2	26/03/2011	0.27	0.003
Pond 5 Duplicate	P5-QC5	26/03/2011	0.02	0.002
Pond 10 Duplicate	P10-QC10	26/03/2011	0.01	0.002
Trip Blank	Trip QC4	26/03/2011		
Rinsate Sample	Rinsate QC5	26/03/2011		

Cadmium	Chromium	Copper	Iron	Lead	Nickel	Zinc	Boron	Silver	Uranium	Vanadium
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
0.005 - 0.0001	0.01-0.001	0.01-0.001	0.05	0.01-0.001	0.01-0.001	0.01-0.005	0.1-0.05	0.001	0.001	0.01
0.0002	0.001	0.002	0.3	0.01	0.011	0.008	0.37	0.001	0.001	0.01
<0.005	0.04	0.02	23.5	0.01	0.03	0.04	<0.1		<0.001	0.06
<0.005	0.04	0.02	29	0.01	0.03	0.03	<0.1		<0.001	0.06
<0.005	0.03	0.02	28.1	<0.01	0.03	0.05	<0.1		<0.001	0.05
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
<0.005	0.02	0.02	20.1	<0.01	0.02	0.03	<0.1		<0.001	0.04
<0.0001	0.012	0.009	-	0.006	0.014	0.022	-	-	-	
<0.0001	0.013	0.009	-	0.006	0.015	0.018	-	-	-	
<0.0001	0.013	0.01	-	0.006	0.015	0.019	-	-	-	
<0.0001	0.012	0.015	10.7	0.006	0.013	0.016	<0.05	<0.001	-	0.02
<0.0001	0.012	0.009	10.9	0.006	0.013	0.02	<0.05	<0.001	-	0.02
<0.0001	0.017	0.012	19.7	0.009	0.02	0.034	<0.05	<0.001	-	0.03
<0.0001	0.017	0.013	15.6	0.007	0.016	0.026	<0.05	<0.001	-	0.03
<0.0001	0.021	0.011	13.4	0.007	0.016	0.021	<0.05	<0.001	-	0.03
<0.0001	0.023	0.016	12.8	0.007	0.016	0.019	<0.05	<0.001	-	0.02
<0.0001	0.012	0.01	10	0.006	0.014	0.017	<0.05	<0.001	<0.001	0.02
<0.0001	0.012	0.01	10.5	0.006	0.014	0.018	<0.05	<0.001	<0.001	0.02
<0.0001	0.017	0.012	14.4	0.007	0.017	0.034	<0.05	<0.001	<0.001	0.03
<0.0001	0.016	0.011	13.5	0.007	0.016	0.056	<0.05	<0.001	<0.001	0.03
<0.0001	0.014	0.011	11.9	0.007	0.016	0.02	<0.05	<0.001	<0.001	0.02
<0.0001	0.015	0.011	12.8	0.007	0.016	0.02	<0.05	<0.001	<0.001	0.03
<0.0001	0.021	0.015	18.4	0.009	0.023	0.03	<0.05	<0.001	<0.001	0.04
<0.0001	0.021	0.016	17.5	0.009	0.023	0.035	<0.05	<0.001	<0.001	0.03
<0.0001	0.023	0.016	19.7	0.009	0.024	0.055	<0.05	<0.001	<0.001	0.04
<0.0001	0.023	0.016	19.5	0.009	0.024	0.03	<0.05	<0.001	<0.001	0.04
<0.0001	0.021	0.015	17.7	0.008	0.022	0.027	0.17	<0.001	<0.001	0.04
<0.0001	0.023	0.016	19.1	0.009	0.023	0.029	0.16	<0.001	<0.001	0.04
<0.0001	0.012	0.01	10.7	0.006	0.013	0.016	0.05	<0.001	<0.001	0.02
<0.0001	0.012	0.009	10.9	0.006	0.013	0.02	<0.05	<0.001	<0.001	0.02
<0.0001	0.019	0.014	17.5	0.009	0.02	0.08	<0.05	<0.001	<0.001	0.03
<0.0001	0.017	0.013	15.6	0.009	0.018	0.026	<0.05	<0.001	<0.001	0.03
<0.0001	0.014	0.011	13.4	0.007	0.016	0.021	<0.05	<0.001	<0.001	0.03
<0.0001	0.012	0.01	11.7	0.006	0.014	0.019	<0.05	<0.001	<0.001	0.02

<0.0001	0.009	0.008	-	0.004	0.011	0.015	-	-	-	0.02
0.0002	0.008	0.008	-	0.004	0.01	0.014	-	-	-	0.02
0.0001	0.01	0.009	-	0.005	0.012	0.017	-	-	-	0.02
<0.0001	0.008	0.008	-	0.004	0.01	0.013	-	-	-	0.02
<0.0001	<0.001	0.002	-	<0.001	0.001	<0.005	-	-	-	<0.01
<0.0001	<0.001	0.002	-	<0.001	0.001	<0.005	-	-	-	<0.01
<0.0001	<0.001	0.002	-	<0.001	0.002	0.007	-	-	-	<0.01
<0.0001	0.008	0.006	-	0.004	0.009	0.014	-	-	-	0.01
<0.0001	0.009	0.007	-	0.004	0.011	0.016	-	-	-	0.02
<0.0001	0.011	0.005	10.2	0.012	0.206	0.02	0.09	<0.01	<0.001	<0.001
<0.0001	0.01	0.004	9.2	0.012	0.208	0.02	<0.05	<0.01	<0.001	<0.001
<0.0001	0.001	<0.001	0.16	<0.001	0.008	<0.01	1.15	<0.01	<0.001	<0.001
<0.0001	0.011	0.004	9.65	0.012	0.199	0.02	0.09	<0.01	<0.001	<0.001
<0.0001	0.01	0.005	9.23	0.012	0.209	0.02	<0.05	<0.01	<0.001	<0.001
<0.0001	0.001	<0.001	0.19	0.001	0.008	<0.01	1.17	<0.01	<0.001	<0.001
-	-	-	-	-	-	-	-	-	-	-
<0.0001	0.017	0.006	9.96	0.015	0.186	0.02	0.05	<0.01	<0.001	<0.001
<0.0001	0.022	0.008	13.7	0.019	0.233	0.03	<0.05	<0.01	<0.001	<0.001
<0.0001	<0.001	<0.001	0.14	0.001	0.01	<0.01	1.06	<0.01	<0.001	<0.001
<0.0001	0.023	0.008	13.6	0.019	0.226	0.03	0.06	<0.01	<0.001	<0.001
<0.0001	0.022	0.008	14.3	0.02	0.237	0.03	<0.05	<0.01	<0.001	<0.001
<0.0001	<0.001	<0.001	0.15	0.001	0.01	<0.01	1.12	<0.01	<0.001	<0.001
-	-	-	-	-	-	-	-	-	-	-
<0.0001	0.015	0.008	11.2	0.005	0.014	0.015	0.08	<0.001	<0.001	0.02
<0.0001	0.013	0.007	9.41	0.004	0.011	0.012	0.06	<0.001	<0.001	0.02
<0.0001	<0.001	0.002	0.12	<0.001	<0.001	<0.005	1.39	<0.001	<0.001	<0.01
<0.0001	0.016	0.009	11.7	0.005	0.014	0.017	0.08	<0.001	<0.001	0.02
<0.0001	0.015	0.008	10.3	0.006	0.012	0.014	0.06	<0.001	<0.001	0.02
<0.0001	<0.001	0.002	0.12	<0.001	<0.001	<0.005	1.33	<0.001	<0.001	<0.01
-	-	-	-	-	-	-	-	-	-	-
<0.0001	0.009	0.006	7.64	0.004	0.009	0.011	0.05	<0.001	<0.001	0.02
<0.0001	0.009	0.006	7.91	0.004	0.009	0.012	<0.05	<0.001	<0.001	0.02
<0.0001	<0.001	0.002	0.12	<0.001	<0.001	0.008	1.33	<0.001	<0.001	<0.01
<0.0001	0.01	0.007	8.51	0.004	0.01	0.012	0.08	<0.001	<0.001	0.02
<0.0001	0.009	0.007	7.91	0.004	0.01	0.011	0.06	<0.001	<0.001	0.02
<0.0001	<0.001	0.002	0.13	<0.001	<0.001	0.008	1.39	<0.001	<0.001	<0.01
<0.0001	0.009	0.007	7.99	0.004	0.009	0.01	<0.05	<0.001	<0.001	0.02
<0.0001	0.008	0.006	7.36	0.004	0.008	0.01	<0.05	<0.001	<0.001	0.02
<0.0001	0.001	0.002	0.13	<0.001	0.001	<0.005	1.09	<0.001	<0.001	<0.01
<0.0001	0.009	0.007	7.81	0.004	0.009	0.01	0.06	<0.001	<0.001	0.02
<0.0001	0.008	0.006	6.7	0.004	0.008	0.009	<0.05	<0.001	<0.001	0.02

<0.0001	0.001	0.002	0.15	<0.001	0.001	<0.005	1.03	<0.001	<0.001	<0.01
<0.0001	0.015	0.01	13.7	0.006	0.015	0.021	0.07	<0.001	<0.001	0.03
<0.0001	0.013	0.009	11.6	0.005	0.012	0.016	0.06	<0.001	<0.001	0.02
<0.0001	0.001	0.003	0.28	<0.001	0.003	0.005	1.04	<0.001	<0.001	<0.01
<0.0001	0.017	0.011	15.9	0.006	0.016	0.019	0.09	<0.001	<0.001	0.03
<0.0001	0.012	0.009	12	0.005	0.013	0.016	0.07	<0.001	<0.001	0.02
<0.0001	0.002	0.003	0.3	<0.001	0.003	0.016	1.03	<0.001	<0.001	<0.01
0.002	<0.05	0.021	29.4	0.046	<0.0001	0.844	0.043	0.07	0.014	0.047
0.001	<0.05	0.019	28.8	0.047	<0.0001	0.81	0.045	0.07	0.014	0.041
0.002	1.01	<0.001	0.62	0.003	<0.0001	0.028	<0.005	0.02	<0.001	0.001
0.001	<0.05	0.017	23.4	0.036	<0.0001	0.724	0.034	0.06	0.011	0.035
0.002	<0.05	0.02	28.3	0.046	<0.0001	0.822	0.046	0.07	0.014	0.044
0.002	0.96	<0.001	0.56	0.002	<0.0001	0.025	<0.005	0.02	<0.001	<0.001
0.002	<0.05	0.009	17.8	0.025	<0.0001	0.433	0.022	0.05	0.008	0.021
0.002	0.05	0.014	23.8	0.032	<0.0001	0.583	0.035	0.05	0.012	0.031
0.002	1.4	<0.001	0.08	0.001	<0.0001	0.005	0.011	0.01	<0.001	<0.001
0.002	0.05	0.009	14.4	0.021	<0.0001	0.422	0.018	0.04	0.008	0.019
0.002	0.06	0.013	22.8	0.032	<0.0001	0.567	0.034	0.05	0.011	0.029
0.002	1.53	<0.001	0.07	<0.001	<0.0001	0.004	0.009	0.01	<0.001	<0.001
0.002	0.07	0.008	15.6	0.02	0.0002	0.341	0.022	0.04	0.007	0.018
0.001	0.05	0.006	13.4	0.017	<0.0001	0.295	0.017	0.04	0.006	0.015
0.002	0.06	0.007	16.4	0.02	<0.0001	0.321	0.02	0.04	0.007	0.018
0.002	0.06	0.006	14	0.016	<0.0001	0.264	0.016	0.04	0.006	0.015
<0.0001	0.02	0.007	15.4	0.3	0.007	0.002	0.06	<0.001	0.04	0.019
<0.0001	0.021	0.008	16.7	0.357	0.007	0.001	0.06	<0.001	0.04	0.024
<0.0001	0.02	0.007	16.2	0.322	0.007	0.001	0.06	<0.001	0.04	0.021
<0.0001	0.022	0.008	17.6	0.366	0.008	0.001	0.06	<0.001	0.04	0.026
<0.0001	0.008	0.007	7.93	0.004	0.009	0.022	<0.05	<0.001	<0.001	0.02
<0.0001	0.008	0.007	7.32	0.004	0.009	0.027	<0.05	<0.001	<0.001	0.02
<0.0001	0.007	0.007	6.69	0.004	0.009	0.022	<0.05	<0.001	<0.001	0.01
<0.0001	0.006	0.006	5.65	0.004	0.008	0.018	<0.05	<0.001	<0.001	0.01
<0.0001	0.007	0.007	7.23	0.004	0.009	0.017	<0.05	<0.001	<0.001	0.02
<0.0001	0.008	0.008	8.5	0.004	0.01	0.073	<0.05	<0.001	<0.001	0.02
<0.0001	0.023	0.015	16.2	0.007	0.027	0.033	0.06	<0.001	<0.001	0.03
<0.0001	0.025	0.016	18.7	0.007	0.029	0.034	0.1	<0.001	<0.001	0.03

0.0004	0.001	0.005	0.11	<0.001	0.006	0.007	1.22	<0.001	<0.001	<0.01
<0.0001	0.025	0.016	18.6	0.007	0.03	0.04	0.08	<0.001	<0.001	0.03
<0.0001	0.026	0.016	19.1	0.008	0.029	0.034	0.09	<0.001	<0.001	0.03
0.0002	<0.001	0.004	0.08	<0.001	0.003	0.01	1.27	<0.001	<0.001	<0.01
<0.0001	0.02	0.019	17.3	0.008	0.03	0.041	0.08	<0.001	<0.001	0.03
<0.0001	0.019	0.017	15.4	0.007	0.027	0.035	0.07	<0.001	<0.001	0.03
<0.0001	0.018	0.017	15.1	0.007	0.027	0.033	0.07	<0.001	<0.001	0.03
<0.0001	0.019	0.017	16.1	0.007	0.027	0.035	0.07	<0.001	<0.001	0.03

[redacted]

<0.0001	<0.001	0.002	0.09	<0.001	<0.001	<0.005	1.14	<0.001	0.001	<0.01
<0.0001	0.001	0.004	0.32	<0.001	0.002	<0.005	0.86	<0.001	<0.001	<0.01
0.0002	<0.001	0.002	0.05	<0.001	0.003	<0.005	1.16	<0.001	<0.001	<0.01
<0.0001	<0.001	0.002	<0.05	<0.001	<0.001	<0.005	1.19	<0.001	<0.001	<0.01
<0.0001	0.001	0.002	0.12	<0.001	<0.001	<0.005	1.15	<0.001	0.001	<0.01
<0.0001	0.001	0.003	0.34	<0.001	0.002	<0.005	0.9	<0.001	<0.001	<0.01
0.0001	<0.001	0.002	<0.05	<0.001	0.002	0.045	1.2	<0.001	<0.001	<0.01
<0.0001	<0.001	0.002	<0.05	<0.001	<0.001	<0.005	1.2	<0.001	<0.001	<0.01

	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	20	50	100	50	50	1	2	2	2	2
	20	100			100	1	800	300	20	
	<20	-	-	-	-	<1	<2	<2	<2	<2
	<20	-	-	-	-	<1	<2	<2	<2	<2
	<20	-	-	-	-	<1	<2	<2	<2	<2
	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
	<20	-	-	-	-	<1	<2	<2	<2	<2
	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2
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	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2
	<20	<50	<100	<50	60	<1	<2	<2	<2	<2
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	<20	<50	<100	<50	<50	<1	<2	<2	<2	<2
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	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	1	1	1	1	1	1	1	1
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
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	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
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	-	-	-	-	-	-	-	-
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	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	-	-	-	-	-	-	-	-
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
[redacted]								
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
[redacted]								
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1.2.3.cd)pyrene	Dibenz(a.h)anthracene	Benzo(g.h.i)perylene	
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
1	1	1	1	0.5	1	1	1	
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
								-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.9	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	

<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	-
-	-	-	-	-	-	-	-	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
-	-	-	-	-	-	-	-	-
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	

<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
[redacted]								
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	

<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
[redacted]								
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	
<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	

pH Value	Electrical Conductivity @ 25°C	Turbidity	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4 2-	Chloride
pH Unit	µS/cm	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
0.00	0	0.0	1	1	1	1	1	1
-	-	-	-	-	-	-	8	53
-	-	-	-	-	-	-	8	47
-	-	-	-	-	-	-	8	21
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	11	38
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-

-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
8.63	735	438	<1	11	92	102	15	158
8.06	345	422	<1	<1	69	69	16	51
9.25	11200	3.3	<1	342	754	1100	<10	3460
8.69	744	417	<1	12	88	101	17	164
8.12	345	484	<1	<1	67	67	18	53
9.26	11200	3.9	<1	346	753	1100	<10	3460
-	-	-	-	-	-	-	-	-
7.89	370	1890	<1	<1	53	53	9	74
7.5	185	920	<1	<1	43	43	9	30
9.23	10700	4	<1	293	666	960	<1	3320
8.38	368	1190	<1	2	54	56	9	80
7.65	1850	940	<1	<1	46	46	9	30
9.23	10700	3.6	<1	292	670	963	<1	3330
-	-	-	-	-	-	-	-	-
7.6	370	400	<1	<1	51	51	20	60
7.66	332	400	<1	<1	63	63	19	51
9.2	11100	5.8	<1	331	578	909	5	3690
8.14	367	390	<1	<1	60	60	20	61
7.7	336	450	<1	<1	50	50	18	50
9.2	11100	6.1	<1	329	585	914	5	3690
-	-	-	-	-	-	-	-	-
8.14	387	280	<1	<1	59	59	16	68
7.33	341	280	<1	<1	68	68	15	52
9.25	11000	11	<1	331	567	898	5	3650
8.27	391	260	<1	<1	70	70	14	70
7.9	352	280	<1	<1	58	58	17	50
9.25	11000	11	<1	331	558	889	5	3630
7.97	215	270	<1	<1	60	60	4	19
7.89	211	250	<1	<1	65	65	4	24
9.07	9190	10	<1	121	313	434	1	2780
7.92	218	320	<1	<1	61	61	4	19
7.82	211	260	<1	<1	57	57	4	19

9.16	9250	4.8	<1	178	248	426	2	2940
8.16	207	330	<1	<1	58	58	3	17
7.95	206	280	<1	<1	56	56	3	17
9.16	9550	7.8	<1	178	258	434	2	2890
8.19	210	370	<1	<1	61	61	3	18
7.95	206	340	<1	<1	57	57	3	17
9.17	9560	13	<1	171	261	432	2	2960
7.9	220	1550	<1	<1	62	62	51	32
7.82	210	1380	<1	<1	60	60	50	35
9.32	9370	20	<1	282	202	484	3	2930
8.05	200	1080	<1	<1	60	60	48	29
7.89	215	1690	<1	<1	60	60	48	33
9.33	9410	16.4	<1	287	190	477	1	3010
7.99	260	890	<1	<1	60	60	57	40
7.98	440	810	<1	<1	70	70	43	91
9.41	11800	3.4	<1	524	480	1000	<1	3960
8.1	250	830	<1	<1	61	61	46	40
8.06	400	790	<1	<1	75	75	46	88
9.41	11700	3.6	<1	524	461	985	<1	4640
8.19	470	550	<1	<1	72	72	66	87
8.04	480	540	<1	<1	73	73	68	104
7.98	440	550	<1	<1	70	70	64	90
7.99	455	580	<1	<1	71	71	66	93
7.68	456	630	<1	<1	69	69	66	24
7.68	456	620	<1	<1	68	68	60	45
7.67	456	860	<1	<1	69	69	67	29
7.67	455	770	<1	<1	68	68	63	46
7.82	197	300	<1	<1	53	53	4	25
7.86	201	240	<1	<1	56	56	4	26
7.91	212	290	<1	<1	57	57	4	28
7.92	216	290	<1	<1	59	59	5	28
7.72	324	500	<1	<1	74	74	14	42
8.14	666	500	<1	<1	92	92	13	145

7.5	552	600	<1	<1	82	82	25	99
7.5	553	600	<1	<1	82	82	27	104

[redacted]

9.18	11400	21	<1	445	725	1170	9	3590
9.2	9570	37	<1	240	240	480	2	3270
9.36	12500	13	<1	515	567	1080	2	3700
9.38	12800	13	<1	551	571	1120	2	3980

Calcium	Magnesium	Sodium	Potassium	Fluoride	Volatile Acids as Acetic Acid	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1	1	1	1	0.1	5	0.01	0.01	0.01
				2			1.1	
10	5	45	4	-	14	<0.01	0.08	0.06
8	5	27	4	-	10	<0.01	0.06	0.06
8	4	23	3	-	7	<0.01	0.06	0.06
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
10	5	35	3	-	10	<0.01	0.09	0.09
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
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-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
11	6	128	4	IS		IS	IS	IS
11	6	44	4	IS		IS	IS	IS
8	20	2470	11	IS		IS	IS	IS
11	6	126	4	IS		IS	IS	IS
12	6	43	4	IS		IS	IS	IS
7	19	2510	12	IS		IS	IS	IS
-	-	-	-	-	-	-	-	-
6	3	57	4	0.1		0.03	0.06	0.1
5	3	31	4	<0.1		0.04	0.06	0.09
7	16	2620	9	1.8		<0.01	0.03	0.03
6	3	68	4	0.1		0.03	0.08	0.12
5	3	20	4	<0.1		0.03	0.06	0.08
9	19	2500	10	1.9		<0.01	<0.01	<0.01
-	-	-	-	-	-	-	-	-
11	6	51	4	0.1		<0.01	0.14	0.14
10	6	47	4	0.1		<0.01	0.15	0.15
13	27	2420	15	1.6		<0.01	<0.01	<0.01
10	6	51	4	0.1		<0.01	0.14	0.14
10	6	46	4	0.1		<0.01	0.15	0.15
13	26	2380	15	1.6		<0.01	<0.01	<0.01
-	-	-	-	-	-	-	-	-
10	7	50	4	0.1		<0.01	0.05	0.05
11	6	46	4	0.2		<0.01	0.05	0.05
14	27	2520	15	1.6		<0.01	<0.01	<0.01
11	6	55	4	0.1		<0.01	0.05	0.05
10	6	41	4	0.1		<0.01	0.05	0.05
12	26	2600	13	1.6		<0.01	<0.01	<0.01
10	6	20	4	0.1		<0.01	0.01	0.01
12	6	21	4	0.1		<0.01	0.01	0.01
19	27	1930	11	1.5		<0.01	<0.01	<0.01
11	6	20	4	0.1		<0.01	0.01	0.01
11	6	19	4	0.1		<0.01	0.01	0.01

19	27	1940	11	1.4		<0.01	<0.01	<0.01
11	6	18	4	0.1		<0.01	0.03	0.03
11	6	17	4	<0.1		<0.01	0.03	0.03
19	27	1950	11	1.4		<0.01	<0.01	<0.01
11	6	18	4	0.1		<0.01	0.03	0.03
11	6	17	4	<0.1		<0.01	0.03	0.03
19	27	1970	11	1.4		<0.01	<0.01	<0.01
7	4	28	4	<0.1		<0.01	0.1	0.1
7	4	27	4	<0.1		<0.01	0.09	0.09
13	24	2270	12	1.9		<0.01	0.07	0.07
8	4	30	4	<0.1		<0.01	0.08	0.08
8	4	32	4	<0.1		<0.01	0.09	0.09
12	24	2100	13	1.9		<0.01	<0.01	<0.01
10	5	49	4	<0.1		<0.01	0.09	0.09
11	6	79	5	0.1		<0.01	0.09	0.09
2	20	3150	16	2.4		<0.01	<0.01	<0.01
10	5	50	5	<0.1		<0.01	0.09	0.09
10	5	79	5	0.1		<0.01	0.09	0.09
2	20	3610	19	2.4		<0.01	<0.01	<0.01
9	6	57	3	<0.1		0.03	0.11	0.14
9	6	73	3	0.1		0.02	0.12	0.14
8	5	62	3	<0.1		0.02	0.13	0.15
8	5	68	3	<0.1		0.02	0.16	0.18
8	6	63	3	<0.1		0.02	0.22	0.23
10	6	67	3	<0.1		0.03	0.2	0.24
9	6	64	4	<0.1		0.02	0.23	0.25
11	7	68	4	<0.1		0.02	0.23	0.25
12	6	21	3	0.1		<0.01	0.05	0.05
11	5	20	3	0.1		<0.01	0.04	0.04
13	6	22	3	0.1		<0.01	0.03	0.03
13	6	24	3	0.1		<0.01	0.04	0.04
12	7	37	4	0.1		<0.01	0.12	0.12
13	7	114	4	9		<0.01	0.12	0.12

16	9	79	4	0.5		<0.01	0.24	0.24
16	9	83	4	0.5		<0.01	0.21	0.21
12	28	2670	17	2.1		<0.01	0.01	0.01
18	27	2070	13	1.8		<0.01	0.02	0.02
9	28	2600	20	2.3		<0.01	0.02	0.02
9	29	2780	22	2.4		<0.01	0.02	0.02

Reactive Phosphorus as P	Ammonia as N							
mg/L	mg/L							
0.01	0.01							
	0.9							
-	-							
-	-							
-	-							
-	-							
-	-							
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-	-							
-	-							
-	-							
-	-							
-	-							
-	-							
IS	<0.01							
IS	0.08							
IS	0.12							
IS	<0.01							
IS	<0.01							
IS	0.14							
-	-							
<0.01	<0.01							
<0.01	<0.01							
0.03	0.09							
<0.01	<0.01							
<0.01	<0.01							
0.02	0.06							
-	-							
0.02	0.01							
<0.01	0.02							
0.03	0.22							
<0.01	0.02							
<0.01	0.02							
0.02	0.22							
-	-							
0.01	0.02							
<0.01	0.04							
0.03	0.06							
<0.01	0.02							
0.01	0.02							
0.02	0.09							
<0.01	0.01							
<0.01	0.02							
0.04	0.06							
<0.01	0.02							
<0.01	0.02							

0.04	0.06							
0.02	0.02							
0.02	0.01							
0.04	0.1							
0.02	0.02							
0.01	0.04							
0.04	0.07							
0.02	<0.01							
0.02	<0.01							
0.04	0.18							
0.02	<0.01							
0.02	<0.01							
0.04	0.17							
0.02	<0.01							
0.02	<0.01							
0.04	0.13							
0.02	<0.01							
0.02	<0.01							
0.04	0.13							
<0.01	<0.01							
<0.01	<0.01							
<0.01	<0.01							
<0.01	<0.01							
<0.01	<0.01							
<0.01	0.02							
<0.01	0.03							
<0.01	0.05							
0.01	<0.01							
<0.01	<0.01							
<0.01	<0.01							
<0.01	0.01							
[redacted]								
0.01	0.02							
<0.01	0.05							

<0.01	0.05
<0.01	0.08
[redacted]	
0.03	0.03
0.02	0.08
0.05	0.02
0.05	0.03

[redacted]

From: [redacted]
Sent: Monday, 4 April 2011 4:41 PM
To: [redacted]
Subject: RE: TEP Extension for MGP

Hi [redacted]

I have spoken to [redacted] and the amendment to the TEP will be approved tomorrow

regards

[redacted]

From: [redacted]
Sent: Monday, 4 April 2011 3:06 PM
To: [redacted]
Subject: TEP Extension for MGP
Importance: High

Hi [redacted]
Can you please give a 'nudge' to [redacted] re our request to extend the TEP for MGP? Arrow provided them with a letter of request 30/3/11 and we have not yet had a response, despite following up.

As you are aware there has been significant rainfall up north at present and we are missing out on valuable opportunities to discharge – we also need to account for the fact that the dam levels are increasing in response to the rain which may lead to potential integrity issues.

I would appreciate your prompt response.
Regards

[redacted]
Environment Manager

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia

[redacted]

+----------+

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

+----------+

[redacted]

From: [redacted]
Sent: Tuesday, 5 April 2011 5:03 PM
To: Ben McMahon
Cc: [redacted] Environment Mailbox; [redacted]
Subject: RE: Arrow Energy DXP discharge locations Exclusion Decision Application
Attachments: 1-KEEPER-929607-Guideline__Guideline__CSG_RWMP_and_Validation_Guideline_Including_Exclusion_Decision_Application_Guidel.pdf; QH Minimum Ongoing WQ Standards.doc

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Ben,

Thankyou for your recent enquiry regarding the draft TEP, temporary and permanent discharge options, whilst we appreciate the submission of the water quality results that you have collected for the TEP there are a significant number of water quality parameters that are required for the assessment of public health impacts that have not been analysed for, further information is provided in the body of this email.

With the expiration of the transitional period for recent amendments to the *Water Supply (Safety and Reliability) Act 2008*, on the 1st of April 2011, there is now a requirement for all CSG schemes proposing to discharge treated or untreated CSG water to hold an approved plan or exclusion decision from the Office of the Water Supply Regulator prior to discharge.

A TEP application may be made and approved for emergency discharge reasons. Approval of a TEP may temporarily provide for allowances to discharge CSG waters, without an approved plan or exclusion decision under the Act, however whenever possible an exclusion decision should also be held for these releases.

Please note: The ongoing routine discharge of CSG water will require an approved plan or exclusion decision from the regulator.

In your email you refer to the potential to apply for an exclusion decision for your temporary and permanent/ ongoing releases or RO permeate. Given your email indicated that there will be a different release point for each scenario, and our "schemes" relate to infrastructure ownership, it would appear that 2 separate applications will be required as the delivery infrastructure will be different, even though the treatment infrastructure may be the same, this particular occurrence is known as an overlaid scheme. This is quite clearly defined in the RWMP guidelines.

In the draft for public consultation of the "Coal Seam Gas Recycled Water Management Plan and Validation Guideline – Including Exclusion Decision Application Guideline" there are a number of components required by the regulator to enable a decision to be made. Please refer to the attached guideline with reference to section 2 and specific requirements outlined in section 2.3. Please note these guidelines have not been

made available to the public as we are awaiting Ministerial approval to commence public consultation as such these guidelines have been provided to you for your use in preparing applications for submission to the Department and are not to be shared with others or used for any other purpose bar that expressly stated in this email.

As an overarching response, your application will be required to be on the appropriate form which can be found on the Department's website at http://www.derm.qld.gov.au/water/regulation/forms.html#forms_for_csg_recycled_water and specifically must include the description of the scheme and associated infrastructures. To enable the regulator to make a decision on your application we will require results for the suite of parameters stated in Appendix 1 of the Guidelines. The location (source water, treated water and upstream of the discharge point) and frequency (3 discreet samples at each location collected on non-consecutive days) of sampling is also included in the guidelines. This monitoring data is to accompany the application and an assessment of the potential impacts to water quality at downstream drinking water service providers, such as Chinchilla. Please note that should an exclusion decision be granted there is likely to be ongoing monitoring required. Please find attached the minimum ongoing water quality monitoring list, the frequency of testing may be negotiated during the decision phase of the assessment.

For the regulator to deem a scheme eligible for an exclusion decision, the scheme proponents will need to establish that there is no material impact on the source water for any downstream drinking water service provider, such as the Chinchilla Weir off-take location downstream of your proposed release point. This could be established by presenting data on the final water quality achieved by the plant, highlighting the plants ability to consistently meet the water quality criteria. As outlined in section 2.3.3 of the guideline, there is a water quality collection program required to be presented to the regulator.

In your specific case where you are proposing to discharge to stream, which forms part of an urban community's drinking water supply source water, a presentation of the modelled ratio of scheme release waters expected at a drinking water suppliers off take location and the duration of the ratios of CSG waters to river waters at the location, for example the Department uses IQQM modelling for this purpose.

Whilst this response gives you an outline of some components within the regulators draft guidelines, careful review of the attached draft guidelines will assist you in ensuring you provide the regulator with enough pertinent information for it to make its decision.

Whilst we appreciate your desire for a rapid turn around in decision making, there are a number of schemes which have recently entered the assessment phase and require responses by legislative due dates. Prompt submission of an application containing the necessary information will assist the regulator in assessing your application in a timely fashion however, the *Water Supply (Safety and Reliability) Act 2008*, allows the regulator 60 business days within which to assess an exclusion decision application and 80 business days to assess an RWMP application, this timeframe is reset if an additional information request is issued. It is unlikely that an approval for either the short term or ongoing release of CSG water under an exclusion decision application will be achieved within the fortnight indicated in your email.

Regards,

[redacted]
Team Leader (Coal Seam Gas Water)
Recycled Water Regulation
Office of the Water Supply Regulator
Department of Environment and Resource Management

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From: Ben McMahon [redacted]
Sent: Friday, 1 April 2011 5:24 PM
To: [redacted]
Cc: [redacted] Environment Mailbox
Subject: Arrow Energy DXP discharge locations Exclusion Decision Application

Hi [redacted]

Attached is the draft TEP in relation to the proposed temporary discharge into Wilkie Creek. Refer to Tables 1 for the location (it is discharged over land to Wilkie Creek) and Table 2 for the water quality. I appreciate that this is not the full Q Health suite but should give you a good impression of the water quality that we are dealing with. We would like to commence this discharge in the next few weeks basically we have the approvals in place under the EP Act. Compliance under the Water Supply (Safety and Reliability) Act 2008 is the only remaining obstacle. This discharge is required urgently to relieve very high dam levels following the flooding around the Dalby region earlier this year.

In the future we would like to discharge similar quality water from a different (ie permanent) location under our Environmental Approval. This location is shown in the attached document Theten Pipeline Schematic – Wilkie Creek Outlet. We are still working with the relevant DERM people regarding the flows and conditions of the permanent discharge location. This discharge under the EA will not continuous but employed under wet conditions when other uses for the water are not available. Is it possible to apply for one exclusion for both or should these be separate exclusion applications?

Best regards

Ben McMahon
Manager Compliance & Reporting

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Department of Environment
and Resource Management

Coal Seam Gas Recycled Water Management Plan and Validation Guideline

Including Exclusion Decision Application Guideline

January 2011

Prepared by:

Office of the Water Supply Regulator

Department of Environment and Resource Management

January 2011

Job Ref Number

Contents

1 Introduction

The recycled water provisions for coal seam gas (CSG) water of the *Water Supply (Safety and Reliability) Act 2008* (the Act) commenced on 1 December 2010 and are administered by the Department of Environment and Resource Management (DERM). The chief executive of DERM is the regulator under the Act.

The primary objective of the Act in relation to CSG water is to protect public health.

Under the Act, for a CSG recycled water scheme[1] to supply CSG recycled water[2] (directly or indirectly) either into a water source[3] used as a drinking water supply or directly to a drinking water service provider as a source of drinking water, a responsible entity[4] must have:

- an exclusion decision made by the regulator, or
- an interim CSG Recycled Water Management Plan (RWMP) approved by the regulator or as deemed by sections 641, 642 and 643 of the Act, or
- a full CSG RWMP approved by the regulator.

The Act is available on line at <www.legislation.qld.gov.au>.

1.1 Scope of the *Water Supply (Safety and Reliability) Act 2008*

1.1.1 What is recycled water?

The Act covers specific sources of recycled water that are intended to be reused. The term 'reused' includes treatment to improve the source water quality for beneficial use by agricultural, industrial, residential or drinking water purposes.

The following sources of recycled water are covered by the Act:

- sewage or effluent sourced from a service provider's sewerage
- wastewater
- CSG water; that means underground water brought to the surface of the earth in connection with exploring for or producing CSG, and includes CSG water:
    - whether it is treated or untreated; or
    - that is mixed with other water.

Note: For further information on RWMPs for recycled water sourced from sewage or wastewater please refer to DERM's Recycled Water Management Plan and Validation Guideline 2008.

1.1.2 Who is a recycled water provider?

A recycled water provider is an entity that owns infrastructure[5] for:

- the production and supply of recycled water other than CSG water; or
- the production and supply, or the supply only, of recycled water that is CSG water.

[1] A CSG recycled water scheme under which recycled water that is CSG water is supplied, or produced and supplied.

[2] CSG water that augments a supply of drinking water.

[3] Means any of the following: a watercourse or lake, including a dam or weir across the watercourse or lake; an aquifer; a dam or weir that is not located across a watercourse or lake; another source of water prescribed under a regulation.

[4] For a CSG recycled water scheme, means: if the CSG recycled water scheme is a single-entity recycled water scheme, the recycled water provider for the scheme; or if the CSG recycled water scheme is a multiple-entity recycled water scheme, the scheme manager and each recycled water provider or declared entity for the scheme.

[5] Examples of infrastructure for the production and supply, or supply only, of recycled water, that is CSG water includes feed ponds, petroleum wells, storage and distribution infrastructure and treatment plants.

1.1.3 What is a recycled water scheme?

A recycled water scheme involves all the entities and infrastructure related to the production and supply of recycled water, and may be either:

- a single-entity recycled water scheme involving:
    - the production and supply of recycled water, other than CSG water, by only one recycled water provider; or
    - the production and supply, or supply only, of recycled water that is CSG water by only one recycled water provider; and

including the infrastructure, owned by the provider, for the production and supply, or the supply only, of the water.

- a multiple-entity recycled water scheme involving:
    - the production and supply of recycled water other than CSG water; or
    - the production and supply, or the supply, of recycled water that is CSG water;

by more than one recycled water provider, or at least one recycled water provider and another entity.

Note: For multiple-entity recycled water schemes a scheme manager must be nominated[6]. A multiple-entity recycled water scheme is made up of:

- each recycled water provider and other entity declared to be part of the scheme made under chapter 3, part 8; and
- the infrastructure for:
    - the production and supply of recycled water; or
    - if the recycled water is coal seam gas water, the production and supply, or the supply only, of the recycled water;

that is stated to be part of the scheme under the declaration[7].

1.1.4 What is a critical recycled water scheme?

Under the Act, the regulator may declare a recycled water scheme to be a critical recycled water scheme if the regulator reasonably believes the declaration is necessary:

- to ensure the appropriate management of risks to public health posed by the supply of recycled water under the scheme; or
- to maintain continuity of operation of the scheme to meet the essential water supply needs of the community or industry.

Without limiting the above mentioned points, the regulator must declare a recycled water scheme to be a critical recycled water scheme if:

- recycled water, other than CSG water, is supplied, or proposed to be supplied, under the scheme to augment a supply of drinking water; or
- recycled water that is CSG water is supplied or proposed to be supplied (directly or indirectly) as a source of drinking water to a drinking water service provider under the scheme; or
- under the scheme, at least 500 kL of recycled water a day is supplied, or proposed to be supplied, to premises by way of a reticulation system used only to provide recycled water for outdoor use or for use in flushing toilets or in washing machines; or
- under the scheme, at least 5 ML of recycled water a day is supplied, or proposed to be supplied, for use in electricity generation.

Hence, under the Act, all CSG recycled water schemes supplying water to a water source as a source of drinking water are critical recycled water schemes and may operate as either single-entity or multiple-entity schemes.

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[6] The scheme manager is the entity that all recycled water providers agree is the scheme manager. If the scheme manager is known at the time of declaration this can be stated in the notice. Alternatively, if the scheme manager is not known when the scheme is declared, a notice nominating the scheme manager must be given to the regulator as soon as practical after the scheme is declared.

[7] Refer to section 1.1.4 of this guideline.

1.2 Aim of this guideline

This guideline has been developed to provide information to the responsible entity, about preparing an exclusion decision (if applicable) or RWMP where a scheme is proposing to supply either:

- CSG water into a water source used for a drinking water supply by a drinking water service provider; or
- CSG water directly to a drinking water service provider as a source for a drinking water supply.

It has been prepared using a modular format. While separate sections within the guideline may appear repetitive, the intent is to provide the responsible entity with all the relevant information in a single location, dependent on the type of exclusion decision application or RWMP being prepared.

CSG water has a different public health risk profile compared to other recycled water sources. The principal public health concern is adequate management of the chemical and radiological quality of water including management of long term exposure. To cater for these differences an adaptive CSG RWMP approval regime and this guideline have been developed.

This guideline aims to provide information about:

- exclusion decision applications
- the requirements of the Act and related criteria for different methods of supply to a drinking water service provider including:
    - direct supply of CSG water to a drinking water service provider as a source of drinking water
    - direct and indirect supply to a water source used for a drinking water supply by a drinking water service provider
- the adaptive approach to preparing RWMPs including:
    - interim RWMP
    - full RWMP
- submitting documents for approval by the regulator
- matters considered by the regulator in assessing RWMPs
- seeking amendments to an RWMP
- additional responsibilities of recycled water providers, or scheme managers.

The material in this guideline is indicative of the regulator's policy objectives and the Act's purpose. The regulator may also choose to look at other information, such as industry standards, technical expert advice or other health-based guidance to support policy objectives and the Act's purpose.

1.3 Relationships to other guidelines

1.3.1 Are there any other regulatory guidelines?

The regulator must have regard to these guidelines when determining whether to approve an RWMP for CSG water.

These guidelines are part of a suite of guidelines prepared to assist recycled water providers, or scheme managers, in understanding the requirements of the Act. Other regulatory guidelines in this suite include:

- Recycled Water Management Plan and Validation Guideline
- Water Quality Guidelines for Recycled Water Scheme
- Recycled Water Management Plan Exemption Guideline
- Drinking Water Quality Management Plan Guideline
- Water Quality for Drinking Water Guideline
- Audit Reporting Guideline
- Annual Reporting Guideline.

1.3.2 What other useful information is available?

Other sources of valuable information are available for potential recycled water providers, or scheme managers, considering or intending to establish a recycled water scheme.

The Environment Protection and Heritage Council has developed the following suite of guidelines, available online at <www.ephc.gov.au>:

- Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (AGWR Phase 1)
- Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2): Augmentation of Drinking Water Supplies (AGWR Phase 2 Module 1)
- Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2): Stormwater Harvesting and Reuse (AGWR Phase 2 Module 2)
- Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2): Managed Aquifer Recharge (AGWR Phase 2 Module 3).

AGWR Phase 1 focuses on stormwater, treated sewage and greywater as sources of recycled water. They provide specific guidance on the use of treated sewage and greywater for purposes other than augmentation of drinking water supplies and environmental flows.

AGWR Phase 2 Module 1 is an extension of the guidance given in Phase 1 for the use of recycled water, sourced from sewage and stormwater, to augment drinking water supplies. The document focuses on the source of water, initial treatment processes and blending of recycled water with drinking water sources.

AGWR Phase 2 Module 3 focuses on the protection of aquifers and the quality of recovered water in managed aquifer recharge projects. The guidelines should be used in conjunction with other phases and modules of AGWR depending on the source (for example sewage) and use (for example augmenting drinking water supplies) of the water discharged to aquifers.

The Manual for Recycled Water Agreements in Queensland published by the Queensland Government provides information and guidance on writing a contract for the supply and use of recycled water. The manual is available online at the DERM website at <www.derm.qld.gov.au>.

1.4 Relationship to other Queensland legislation and regulations

Recycled water schemes using CSG water may be required to meet a range of legislative requirements including:

- *Environmental Protection Act 1994*
  - Environmental Protection Regulation 2008
  - Environmental Protection (Water) Policy 2009
  - Coal Seam Gas Water Management Policy 2010
  - Environmental Protection (Waste Management) Regulation 2000
- *Plumbing and Drainage Act 2002*
- *Petroleum and Gas (Production and Safety) Act 2004*
- *State Development and Public Works Organisation Act 1971*
- *Water Act 2000*
- *Workplace Health and Safety Act 1995*

The requirements of the *Water Supply (Safety and Reliability) Act 2008* do not negate the requirements of other legislation unless where expressly stated or by implication. It is the responsibility of the responsible entity, to determine and ensure compliance with all relevant legislative obligations.

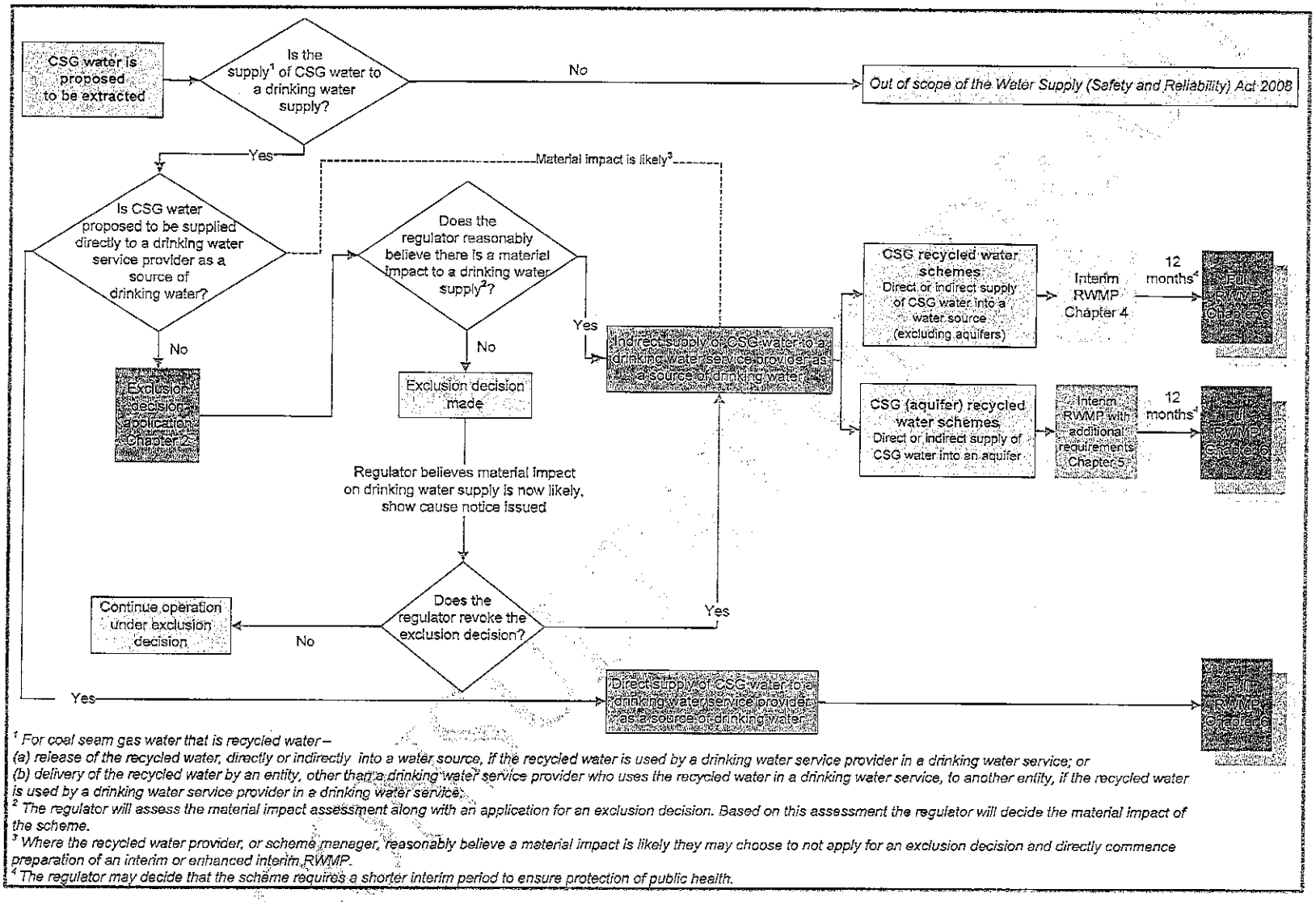
1.5 What is the process for implementing the *Water Supply (Safety and Reliability) Act 2008* requirements?

All CSG recycled water schemes proposing the supply of CSG water into a water source (directly or indirectly) used as a drinking water supply by a drinking water service provider are captured under the Act. In these cases the responsible entity must prepare, submit and have approved by the regulator, prior to the commencement of CSG water supply to the water source, an RWMP (either an interim RWMP (sections 4 and 5 of this guideline) or full RWMP (section 6 of this guideline)) or exclusion decision application (section 2 of this guideline).

An exclusion decision application is used by a responsible entity to demonstrate to the regulator, that the supply of water under the scheme has no material impact on the drinking water supply of the drinking water service provider. An exclusion decision application must be submitted and approved by the regulator prior to the commencement of CSG water supply to a water source. If the regulator reasonably believes that there is no material impact on the drinking water supply an exclusion decision will be made by the regulator. Hence if an exclusion decision is made (a positive decision) by the regulator it excludes the responsible entity from having to submit an RWMP but the responsible entity for the scheme must comply with the relevant conditions contained in the exclusion decision notice. This process is further explained in section 2 of this guideline. If, however an exclusion decision is not made (a negative decision) by the regulator, an interim RWMP or full RWMP must be prepared. The interim RWMP (sections 4 and 5 of this guideline) or full RWMP (section 6 of this guideline) must be submitted and approved by the regulator prior to the commencement of CSG water supply to the water source.

Under section 319 of the Act the regulator may prepare a regulation specifically for aquifers that prescribes circumstances where there is no material impact on a drinking water supply of a drinking water service provider. If the criteria in the regulation were met there would be an exclusion under the regulation and an RWMP would not be required. Except for any obligations placed on the provider, for the purposes of chapter 3 of the Act, the CSG water produced or supplied by such a scheme would not be considered recycled water. There would be no need to make an application to the regulator for an exclusion decision in these circumstances. To date, no such regulation has been prescribed, hence all schemes will be assessed on a case by case basis.

Note: A CSG recycled water scheme proposing the supply of CSG water by direct supply to a drinking water service provider as a source for a drinking water supply must prepare a full RWMP and cannot apply for an exclusion decision. A full RWMP (section 6 of this guideline) must be submitted and approved by the regulator and the drinking water service provider must have an approved drinking water quality management plan, prior to the commencement of CSG water supply to the drinking water service provider.



[1] For coal seam gas water that is recycled water –
(a) release of the recycled water, directly or indirectly into a water source, if the recycled water is used by a drinking water service provider in a drinking water service; or
(b) delivery of the recycled water by an entity, other than a drinking water service provider who uses the recycled water in a drinking water service, to another entity, if the recycled water is used by a drinking water service provider in a drinking water service.
[2] The regulator will assess the material impact assessment along with an application for an exclusion decision. Based on this assessment the regulator will decide the material impact of the scheme.
[3] Where the recycled water provider, or scheme manager, reasonably believe a material impact is likely they may choose to not apply for an exclusion decision and directly commence preparation of an interim or enhanced interim RWMP.
[4] The regulator may decide that the scheme requires a shorter interim period to ensure protection of public health.

Figure 1: RWMP preparation decision processes

2 Exclusion decisions

An RWMP will be required by all CSG schemes proposing the supply of recycled water (directly or indirectly) into a water source used for a drinking water supply by a drinking water service provider, except where there is no material impact on a drinking water supply of a drinking water service provider, or when certain regulatory requirements for aquifers are met.

In these cases the CSG responsible entity can submit, for approval by the regulator, an exclusion decision application (for either part of or the whole CSG recycled water scheme) to be excluded from the requirements of Chapter 3 of the Act.

In order to make an exclusion decision, the regulator must reasonably believe that the supply of CSG recycled water will have no material impact on a drinking water supply of a drinking water service provider. All exclusion decision applications are assessed on a case by case basis by the regulator. If an exclusion decision is approved, it only applies if the responsible entity for the scheme complies with the relevant conditions contained in the exclusion decision notice and excludes the responsible entity from having to submit an RWMP.

Any exclusion decision made by the regulator is not a permanent decision since circumstances may change over time, such as but not limited to:

- a change in the location of the source water
- a change in the cumulative affect within a water source
- a change in the relevant location[8] of a drinking water service provider's intake.

In such circumstances a notice could be issued by the regulator to the relevant CSG recycled water scheme to show cause (section 2.5 of this guideline) why it should continue to be excluded from the requirements of Chapter 3 (i.e. why the relevant scheme should continue to operate with an exclusion decision). Thus, the CSG recycled water scheme would be required to demonstrate to the regulator how the release of CSG water continues to have no material impact on a drinking water supply of a drinking water service provider even when, for example, there is a change of circumstances. If the exclusion decision is revoked an interim RWMP will be required to be submitted to the regulator for approval.

If an exclusion decision is not made by the regulator (i.e. refused), an interim RWMP (sections 4 and 5 of this guideline) or full RWMP (section 6 of this guideline) must be submitted and approved by the regulator prior to the commencement of CSG water supply to a water source.

Note: CSG recycled water schemes proposing the direct supply of CSG water to a drinking water service provider as a source for a drinking water supply are not eligible to apply for an exclusion decision. Under these circumstances a full RWMP (section 6 of this guideline) must be submitted and approved by the regulator, prior to the commencement of CSG water supply to a drinking water service provider.

2.1 Consideration for an exclusion decision application

The method of supply of CSG water into a water source will determine the factors to be considered by the regulator when assessing whether or not there is a material impact on a drinking water supply of a drinking water service provider. There are two different methods of CSG water supply that determine what must be included in an exclusion decision application submitted to the regulator:

- exclusion decision application for recycled water proposed to be supplied under the scheme by its direct release into an aquifer; or
- exclusion decision application for recycled water proposed to be supplied under the scheme by its release, directly or indirectly, into a water source (other than direct release into an aquifer).

2.2 Exclusion decision application for recycled water proposed to be supplied under the scheme by its direct release into an aquifer

It is important for the responsible entity proposing this method of supply of CSG water to demonstrate whether or not the relevant location of a drinking water service provider is within the hydraulic impact zone[9] from the proposed release of the CSG water. This will determine what information must be supplied to the regulator.

[8] A relevant location is the location at which a drinking water service provider is authorised, under the Water Act, to take water, that is, or is intended to be, supplied as drinking water.

[9] The zone in which there is an attributable change in the hydraulic head within the aquifer from the release of CSG water into the aquifer.

2.2.1 What should be submitted to the regulator?

According to section 322 of the Act, a responsible entity who applies for an exclusion decision for this method of CSG water supply, must submit the following to the regulator:

- the completed exclusion decision application in the approved form
- if the relevant location of a drinking water service provider is not within the hydraulic impact zone from the release of CSG water, the documented report(s) containing the assessment factors, as per section 2.2.2 of this guideline
- if the relevant location of a drinking water service provider is within the hydraulic impact zone from the release of CSG water, the documented report(s) containing the assessment factors, as per sections 2.2.2 and 2.2.3 of this guideline
- an application supported by enough information to enable the regulator to decide the application
- the fee prescribed under a regulation.

2.2.2 Contents of this exclusion decision application

The responsible entity must provide the regulator with enough information to enable the regulator to make a decision. This information must be in the form of an exclusion decision application and should include:

- the hydraulic impact zone from the release of CSG water and relevant location of a drinking water service provider which takes water from the aquifer
- water quality criteria for recycled water
- a map and grid coordinates indicating the location of all infrastructure associated with the CSG aquifer recycled water scheme, water sample collection points and supply point(s) to the aquifer(s)
- a description of feed pond(s), storage point(s), treatment processes (including any chemicals used), equipment, cleaning processes (including any chemicals used) and bypass systems within the treatment process and supply points
- a process flow diagram that clearly indicates the locations and process flows between any feed pond(s), storages, treatment processes, equipment and bypass systems.

2.2.3 CSG pre-supply water quality data collection program

If the relevant location of a drinking water service provider is within the hydraulic impact zone from the release of CSG water, prior to the submission of an exclusion decision application the responsible entity, must undertake a CSG pre-supply water quality data collection program. The program must include:

1. three independent sample tests (not collected on consecutive days or as negotiated with the regulator) of the water in the aquifer prior to release of CSG water for the parameters in Table 2 in section 9 (Appendix 1)(excluding parameters identified as disinfection by-products)
2. three independent sample tests (not collected on consecutive days) in varying locations of each storage point for the parameters listed in Table 2 in section 9 (Appendix 1),to ensure a characterisation of the stored CSG water where CSG water is stored (feed ponds) prior to its release and/or treatment
3. three independent sample tests (not collected on consecutive days) of 10 per cent of all active petroleum wells for the parameters in Table 2 in section 9 (Appendix 1) on a rotational basis and to include additional petroleum wells as they commence extraction of CSG water if data from the storage point(s) (feed ponds) is not available
4. three independent sample tests (not collected on consecutive days) of the final water quality, at the nominated point of supply, for the parameters in Table 2 in section 9 (Appendix 1) before release where CSG water is supplied directly after treatment.

Note: The parameters listed in Table 2 in section 9 (Appendix 1) only apply to CSG water that has been subject to cavitation[10]. If the responsible entity, wishes to include CSG water that has been subject to fraccing[11], they must first seek advice from the regulator, as additional testing parameters may be required.

Sampling, tests and analysis

[10] Is the process of collapsing the coal to create a down-hole cavern and de-stressed area at the well bore to enhance production, usually being compressed air.

[11] The process of fracturing and propping open the coal with hydraulic pressure and sand to enhance production and it excludes cavitation.

The responsible entity, must ensure that a suitably qualified, experienced and competent person(s) conducts all required monitoring.

All tests and analysis should be carried out by a laboratory that has National Association of Testing Authorities (NATA) certification for the method used for each parameter. If a NATA certified method is not used, then the alternative methodology used should be provided to the regulator.

All instruments, equipment and measuring devices used for measuring or monitoring must be appropriately calibrated, operated and maintained.

When conducting sampling for the CSG pre-supply water quality data collection program and a test result of 'no result' or 'laboratory error' is recorded, a supplementary sample must be conducted, where possible prior to the next scheduled test. The supplementary sample must be conducted and tested as soon as possible after the responsible entity, receives notification of the original test result.

2.2.4 Regulator considerations when making this exclusion decision

Each exclusion decision application submitted to the regulator will be assessed on a case by case basis to determine whether the release of recycled water will have a material impact on the drinking water supply of a drinking water service provider. The regulator will consider each application based on:

- the application
- whether or not the relevant location of the drinking water service provider is located within the hydraulic impact zone from the release of the CSG water
- if the relevant location of the drinking water service provider is located within the hydraulic impact zone from the release of the CSG water, whether any adverse changes in the quality of the water at the relevant location are detected or likely to be detected. Particular attention will be made to the difference in water quality at the nominated point of supply (release from CSG scheme) and within the aquifer before the recycled water is released
- the cumulative impacts of the release of CSG water, other than the CSG water proposed to be supplied, at the water source at the relevant location of a drinking water service provider
- the water quality criteria for the recycled water
- the pre-supply water quality data collection program (if necessary)
- any other matters the regulator considers relevant
- the environmental management plan, if applicable, for the CSG environmental authority held by the responsible entity
- any additional supporting information received under section 323 of the Act
- the contents of this guideline
- any advice obtained by the regulator under section 324 of the Act.

2.3 Exclusion decision application for recycled water proposed to be supplied under the scheme by its release, directly or indirectly, into a water source (other than direct release into an aquifer)

2.3.1 What should be submitted to the regulator?

According to section 322 of the Act, a responsible entity, who intends to apply for an exclusion decision for this method of CSG water supply, must submit the following to the regulator:

- the completed exclusion decision application in the approved form
- the documented report(s) as per sections 2.3.2 and 2.3.3 of this guideline
- an application supported by enough information to enable the regulator to decide the application
- the fee prescribed under a regulation.

2.3.2 Contents of this exclusion decision application

When applying for an exclusion decision, the responsible entity, must provide the regulator with enough information to enable the regulator to make a decision. This information must be in the form of an exclusion decision application and should include:

- details of the water quality results from a CSG pre-supply water quality data collection program (see section 2.3.3)
- calculations and modelling results of the water source to which supply will occur, demonstrating the ratio of CSG water to natural flow over time at the relevant location of a drinking water service provider. It is expected that the modelling will estimate what percentage of CSG water is present for which duration. For example the modelling might calculate that CSG water makes up 10 per cent of the flow at the relevant location for 48 per cent of the time or CSG water makes up 1 per cent of the flow for 98 per cent of the time
- information on any uptake of water from the water source in question prior to the relevant location of the drinking water service provider. This information should also be incorporated into any modelling of the flows associated with the scheme. Although an allocation is made to an agricultural entity for irrigation, for instance, they may not always use their allocation; modelling of flows should take such variations into account
- a map and grid coordinates indicating the location of all infrastructure associated with the CSG recycled water scheme. This must include petroleum wells extracting CSG water (including wells preparing to commence extraction), feed ponds, storage and distribution infrastructure, treatment components and supply point(s) to water source(s)
- a map and grid coordinates indicating the location of all sample collection points
- a description of any feed pond(s), storage point(s), treatment processes (including any chemicals used), equipment, cleaning processes (including any chemicals used) and bypass systems within the treatment process and supply point(s)
- a process flow diagram that clearly indicates the locations and process flows between any feed pond(s), storages, treatment processes, equipment and bypass systems.

2.3.3 CSG pre-supply water quality data collection program

Prior to the submission of an exclusion decision application the responsible entity, must undertake a CSG pre-supply water quality data collection program. The program must include:

1. three independent sample tests (not collected on consecutive days) of the water source upstream of all supply point(s) or if indirect aquifer release is proposed, the water in the aquifer prior to release of water, for the parameters listed in Table 2 in section 9 (Appendix 1)
2. three independent sample tests (not collected on consecutive days) in varying locations of each storage point for the parameters listed in Table 2 in section 9 (Appendix 1), to ensure a characterisation of the stored CSG water where CSG water is stored (feed ponds) prior to the release and/or treatment of it
3. three independent sample tests (not collected on consecutive days) of 10 per cent of all active petroleum wells for the parameters listed in Table 2 in section 9 (Appendix 1) on a rotational basis and to include additional petroleum wells as they commence extraction of CSG water data from the storage point(s) (feed ponds) is not available
4. three independent sample tests (not collected on consecutive days) of the final water quality, at the nominated point of supply, for the parameters listed in Table 2 in section 9 (Appendix 1) before release where CSG water is supplied directly after treatment
5. three independent sample tests (not collected on consecutive days) of the water quality for the parameters listed in Table 2 in section 9 (Appendix 1) at a downstream location indicative of the water after amalgamation between the CSG water and water source where CSG water is supplied directly to a water source (no storage), other than an aquifer.

Note: The parameters listed in Table 2 in section 9 (Appendix 1) only apply to CSG water that has been subject to cavitation[12]. If the responsible entity, wishes to include CSG water that has been subject to fraccing[13], they must first seek advice from the regulator, as additional testing parameters may be required.

Sampling, tests and analysis

The responsible entity, must ensure that a suitably qualified, experienced and competent person(s) conducts all required monitoring.

All tests and analysis should be carried out by a laboratory that has NATA certification for the method used for each parameter. If a NATA certified method is not used, then the alternative methodology used should be provided to the regulator.

All instruments, equipment and measuring devices used for measuring or monitoring must be appropriately calibrated,

[12] Is the process of collapsing the coal to create a down-hole cavern and de-stressed area at the well bore to enhance production, usually being compressed air.

[13] The process of fracturing and propping open the coal with hydraulic pressure and sand to enhance production and it excludes cavitation.

operated and maintained.

When conducting sampling for the CSG pre-supply water quality data collection program and a test result of 'no result' or 'laboratory error' is recorded, a supplementary sample must be conducted, where possible prior to the next scheduled test. The supplementary sample must be conducted and tested as soon as possible after the responsible entity, receives notification of the original test result.

2.3.4 Regulator considerations when making this exclusion decision

Each exclusion decision application submitted to the regulator will be assessed on a case by case basis to determine whether the release of recycled water will have a material impact on the drinking water supply of a drinking water service provider. The regulator will consider each application based on:

- the application
- the ratio of CSG water to other water at the relevant location for a drinking water service provider;
- the duration of the ratio of CSG water to other water at the relevant location for a drinking water service provider
- the pre-supply water quality data collection program
- the cumulative impacts of the release of CSG water, other than the CSG water proposed to be supplied, in the water source at the relevant location of a drinking water service provider
- the water quality criteria for the recycled water
- any other matters the regulator considers relevant
- the environmental management plan, if applicable, for the CSG environmental authority held by the responsible entity
- any additional supporting information received under section 323 of the Act
- the contents of this guideline
- any advice obtained by the regulator under section 324 of the Act.

2.4 Decisions the regulator can make

The timeframes for the regulator to make an exclusion decision, with or without conditions, or to refuse to make an exclusion decision are as follows:

- if a request for additional information is not made in relation to the application - within 60 business days[14] of receiving the exclusion decision application; or
- if a request for additional information is made in relation to the application – within 60 days after the information has been provided.

After the consideration of an exclusion decision application, the regulator must within 10 days of deciding the application, give the applicant a decision to either:

- make an exclusion decision without conditions and issue a notice of decision
- make an exclusion decision with conditions and issue an information notice
- make an exclusion decision for part of the CSG scheme if the applicant applied for an exclusion decision for the whole scheme and issue an information notice
- refuse to make an exclusion decision and issue an information notice.

Note: If the scheme is a multiple-entity scheme the applicant must, as soon as practical after receiving the notice, give each responsible entity for the scheme a copy of the notice or information notice.

2.4.1 Exclusion decision conditions

If an exclusion decision is made by the regulator, the responsible entity, will not be required to prepare an RWMP, but may be subject to conditions set by the regulator. Examples of conditions in an exclusion decision include, but are not limited to:

[14] Means a day that is not a Saturday or Sunday; a public holiday, special holiday or bank holiday in the place in which any relevant act is to be or may be done.

- monitoring and submission of reports to the regulator about the ongoing quality of recycled water at the final monitoring point (as nominated in the exclusion decision application) and water source after the recycled water has been released into it, under the scheme
- information to confirm the validity of information included in or accompanying the exclusion decision application, for example the validity of the hydraulic impact modelling
- notification to the regulator of any change of circumstance(s) that is, or may be, relevant to whether the supply of recycled water under the scheme has a material impact on a drinking water supply of a drinking water service provider.

An exclusion decision will only apply if each responsible entity for the scheme complies with the conditions of the exclusion decision to the extent they apply to the responsible entity. It is an offence under section 199 of the Act not to comply with any conditions imposed by the regulator.

An exclusion decision commences on the date the decision is made by the regulator or as stated in the exclusion decision notice and ends when the decision is revoked (section 2.5 of this guideline).

When the regulator refuses to make an exclusion decision application the responsible entity will be required to prepare an interim or full RWMP.

2.5 Revocation of exclusion decisions

The regulator may revoke an exclusion decision for a CSG scheme if the regulator reasonably believes the supply of recycled water under the scheme is likely to have a material impact on a drinking water supply of a drinking water service provider. Before revocation of an exclusion decision is made, the regulator must have consideration for section 2.2.4 or 2.3.4 of this guideline.

2.5.1 The process for revocation of an exclusion decision

Before revoking an exclusion decision, the regulator must give the responsible entity, (who applied for the exclusion decision) a show cause notice about the proposed revocation. The show causes process enables the responsible entity to demonstrate that the supply of CSG recycled water from the scheme continues to have no material impact on the drinking water supply of a drinking water service provider even if there has been a change in circumstances.

After considering all properly made submissions the regulator will decide whether the proposed revocation should or should not be made.

If after considering all properly made submissions the regulator decides:

- not to revoke the exclusion decision the regulator must give the original applicant, or for multiple-entity schemes each responsible entity, a notice stating that the exclusion decision has not been revoked.
- to revoke the exclusion decision the regulator must give the original applicant, or for multiple-entity schemes each responsible entity, a notice stating:
    - the day the revocation is revoked
    - that within the compliance period[15], the original applicant, or for multiple-entity schemes the responsible entity, must provide the relevant plan[16] or an amendment to the relevant plan for approval by the regulator.

CSG recycled water may continue to be supplied during the compliance period. Additionally if the responsible entity applies for approval of the RWMP plan or amendment to the plan within the compliance period, CSG recycled water can continue to be supplied until a notice or an information notice (under section 206 of the Act) is given to the original applicant or, for a multiple-entity, each responsible entity.

2.5.2 Appealing a Revocation Decision

If the responsible entity disagrees with the revocation decision, the applicant may appeal for an internal review or appeal the decision.

If during an appeal or review, the Planning and Environment Court stays the decision the regulator may issue a notice requiring the responsible entity to:

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[15] A period of 3 months from the day the revocation of the exclusion decision is given to the original applicant; or the period given by the regulator in the notice that is more than 3 months but less than 6 months.

[16] For a single-entity recycled water scheme means an RWMP for the scheme; and for a multi-entity recycled water scheme is the scheme manager to whom the notice is given and means a scheme manager plan or scheme provider plan for the scheme.

- perform water quality monitoring of recycled water produced or supplied under the scheme, including the water in the storage pond(s) (feed ponds); or if this is not possible the water quality from the petroleum wells; or the water in the water source into which the water is supplied under the scheme
- submit to the regulator reports, at intervals stated in the notice, about the results water quality results mentioned above
- submit to the regulator additional reports about the operation of the CSG scheme and whether the quality of the water produced or supplied under the scheme is consistent with the water quality criteria for recycled water stated in the notice.

In accordance with section 329C of the Act, the responsible entity must comply with the notice unless they have a reasonable excuse.

3 Recycled water management plan (RWMP)

CSG recycled water schemes, which do not have an approved exclusion decision, that supply CSG water into a water source used for a drinking water supply by a drinking water service provider, must have an approved interim or full RWMP prior to the release of CSG water.

CSG recycled water schemes proposing the supply of CSG water by direct supply to a drinking water service provider as a source for a drinking water supply must have an approved full RWMP prior to the release of CSG water. However, this full RWMP cannot be approved if the drinking water service provider for the relevant drinking water service does not have an approved Drinking Water Quality Management Plan (DWQMP) prior to the commencement of supply of CSG water by the CSG recycled water scheme.

The following section of this guideline outlines the Act's requirements when preparing each type of RWMP.

3.1 What is an RWMP?

An RWMP is a documented, risk-based system for managing the production and supply of recycled water. The implementation of an RWMP is intended to ensure safe use of recycled water through the identification and minimisation of public health risks.

Under section 201 of the Act:

- for a single-entity recycled water scheme, an RWMP must be prepared by the recycled water provider for the scheme
- for a multiple-entity recycled water scheme, an RWMP must be prepared, consisting of:
  - a scheme manager plan prepared by the scheme manager
  - a scheme provider plan(s), prepared by each recycled water provider and other declared entity(s) for the scheme.

For example Figure 2, demonstrates how a multiple entity CSG recycled water scheme, proposing the supply of CSG water into a water source used for a drinking water supply by a drinking water service provider functions.

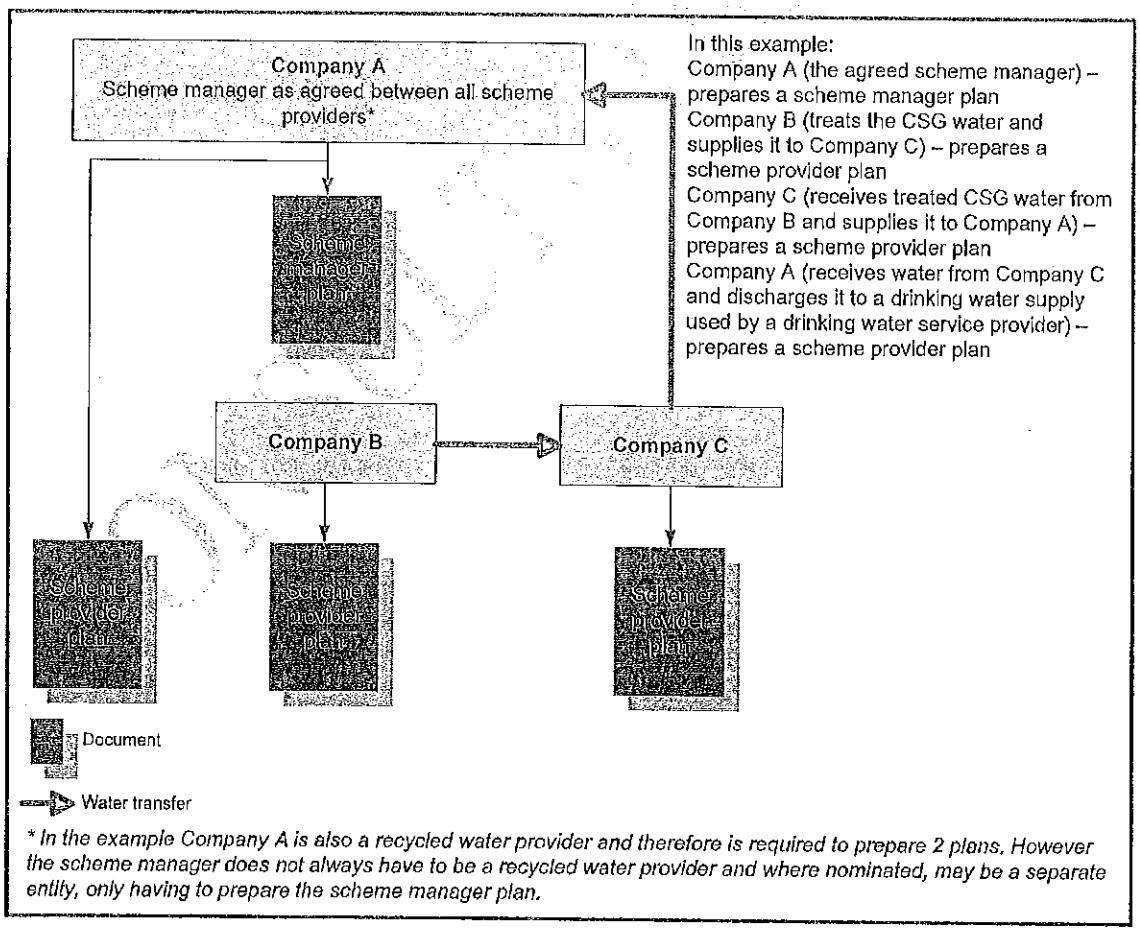

Figure 2: RWMP requirements for multiple-entity schemes

3.2 Using this guideline to prepare RWMPs

Sections 4, 5 and 6 of this guideline have been prepared using a modular format. Whilst these separate sections may appear repetitive, the intent is to provide the responsible entity with all the relevant information in a single location, dependent on the type RWMP being prepared.

Under sections 201 and 329E of the Act, RWMPs must be prepared in accordance with this guideline. Some of the regulator's requirements are mandatory as they are requirements under the Act. Where a regulator's requirement is mandatory, the guideline uses the word 'must'. In this case, the responsible entity, must supply the information required in the manner prescribed. It is the recycled water provider's, or scheme manager's, responsibility to ensure that mandatory legislative requirements are met.

Where the regulator's requirements are not mandatory, the guideline uses the word 'should'. In this case, the responsible entity is able to follow the guideline suggestion, or alternatively, choose their own methods for achieving the requirements.

If a responsible entity chooses to use their own methods for satisfying the regulator's requirements, the regulator will assess the alternative approach against the regulator's policy objectives and the overarching purpose of the Act.

This guideline has been compiled by identifying criteria that the responsible entity, must or should meet. Each section of this guideline has a list of criteria which the regulator will use to assess interim or full RWMPs.

While most criteria apply to all schemes, some criteria are specific for multiple-entity schemes, CSG (aquifer) recycled water schemes[17] or CSG recycled water schemes suppling CSG water directly as a source of drinking water to a drinking water service provider. Recycled water providers, or scheme managers, should ensure they indentify which criteria apply to their scheme.

It is expected that an interim or full RWMP will not be a single document; it is likely to be a collection of documents including an operational component and supporting information.

A recycled water provider may have a current certification or may operate in accordance with recognised management systems, such as:

- ISO 9001
- ISO 14001
- ISO 22000
- AS/NZ ISO:3100 2009
- Hazard Analysis Critical Control Point (HACCP)
- Hazard and Operability Study (HAZOP).

Any certification may be attached to the RWMP. If the recognised standard addresses a criterion under this guideline, the regulator may consider submission of certification as sufficient evidence for meeting the specific criterion. In these instances the responsible entity should specify which criterion the certification is addressing. If the responsible entity chooses not to submit this certification, additional evidence of compliance with a criterion may be sought.

3.3 The types of RWMPs

If no exclusion decision application is submitted to the regulator or, if after considering an exclusion decision application, the regulator reasonably believes that the supply of CSG water from the scheme, or part of the scheme, will have a material impact on a drinking water supply used by a drinking water provider, an interim or full RWMP will be required. The content and type of RWMP required for each scheme will be based on the method of CSG water supply to the water source. It will be one of the following:

- RWMPs for CSG recycled water schemes proposing the direct or indirect supply of CSG water to a water source (excluding aquifers) will require either an interim RWMP (section 4 of this guideline) or full RWMP (section 6 of this guideline). If an interim RWMP is approved a full RWMP must be submitted and approved within 12 months of supply.
- RWMPs for CSG (aquifer) recycled water schemes proposing the direct or indirect supply of CSG water to an aquifer will require either an interim RWMP including additional requirements (section 4 and 5 respectively, of this guideline) or full RWMP with the additional requirements included (section 6 of this guideline). If an interim RWMP is approved a full RWMP must be submitted and approved within 12 months of supply.
- RWMPs for CSG recycled water schemes proposing the direct supply of CSG water to a drinking water service provider as

[17] A CSG recycled water scheme under which recycled water is supplied by its release directly or indirectly, into an aquifer.

a source of drinking water will require a full RWMP (section 6 of this guideline).

Note: The information required to be submitted in a full RWMP (section 6 of this guideline) is in addition to and includes all the information supplied in an interim RWMP submitted for that particular CSG recycled water scheme. If no interim RWMP was submitted to the regulator it is the responsibility of the responsible entity to prepare and submit a full RWMP. Therefore, in addition to section 6 of this guideline all the information described in the relevant sections of interim RWMPs (sections 4 and 5 of this guideline) relating to that particular CSG scheme must be submitted in a full RWMP to the regulator.

3.3.1 RWMPs for CSG recycled water schemes proposing the supply of CSG water into a water source

For CSG recycled water schemes proposing the supply of CSG water (directly or indirectly) into a water source of a drinking water supply used by a drinking water service provider an interim or full RWMP must be submitted to the regulator. The interim RWMP must be assessed and approved prior to the commencement of supply of CSG water and must contain:

- a detailed scheme description to which the plan relates
- details of the infrastructure[18] for the production or supply of the CSG water and how the infrastructure is to be maintained for the scheme
- the pre-supply water quality data
- the water quality criteria for recycled water for the plan
- a verification program[19] for the scheme
- a water quality monitoring and reporting program for the scheme
- a demonstration showing how any risks associated with variations in the quality of the source water will be managed
- an incident and emergency response plan for the scheme.

Section 4 of this guideline provides further information about preparing the requirements for an interim RWMP.

An interim RWMP is approved for an interim period. Before the end of the interim period, a full RWMP must be submitted to the regulator for assessment and approval. It is important that recycled water providers, or scheme managers, are aware of this fact to allow for sufficient time for the approval process.

A full RWMP for this type of CSG scheme must be prepared in accordance with sections 4, 5 and 6 of this guideline. The full RWMP may be submitted to the regulator during the interim period of an interim RWMP. The full RWMP will include a review, and any amendments if required, to the contents of the interim RWMP but must also include:

- the identification of the hazards and hazardous events that may affect the quality of the recycled water
- an assessment of the risks posed by the relevant hazards and hazardous events
- a demonstration of how the risks posed by the relevant hazards and hazardous events are proposed to be managed
- a documented validation program
- an operational monitoring program
- scheme management procedures and supporting documents.

If a full RWMP is not approved by the regulator, the responsible entity will not be able to supply CSG water, or will be required to cease supply of CSG water at the end of the interim period (if an interim RWMP had been approved), until a full RWMP is approved.

3.3.2 RWMPs for CSG (aquifer) recycled water schemes proposing supply of CSG water into an aquifer

For the purposes of this guideline, supply of CSG water into an aquifer is defined as the placement (directly or indirectly) of

[18] Examples of infrastructure for the production or supply of CSG water includes feed ponds, petroleum wells, storage and distribution infrastructure, treatment plants.

[19] Means a documented program about how the recycled water produced or supplied under the scheme will be tested to show the quality of the recycled water consistently meets the water quality criteria for the recycled water relevant to the plan.

CSG water into an aquifer. For the purposes of chapters 4, 5 and 6 of this guideline, an aquifer refers to a drinking water aquifer, an aquifer connected to a drinking water aquifer or a watercourse that recharges and/or supplies a drinking water aquifer.

The supply of CSG water into an aquifer requires particular attention to minimise the risks to public health and ensure the capacity of the aquifer is retained to sustain supply without degradation or detrimental impact. The supply of CSG water into an aquifer may be by injection into wells or bores, infiltration or diversion through the floor of basins or recharge zones within watercourses. It does not include the discharge of the waste (brine) stream component of CSG water that has resulted from any treatment processors into aquifers.

In addition to the interim RWMP requirements of a CSG recycled water scheme (described in 3.3.1), an interim RWMP for a CSG (aquifer) recycled water scheme must include:

- an aquifer baseline monitoring program
- the identification of the hazard and hazardous events that may affect the quality of the relevant water[20] for the scheme (the relevant hazards and hazardous schemes)
- an assessment of the risks posed by the relevant hazards and hazardous events
- a demonstration of how the risks posed by the relevant hazards and hazardous events are proposed to be managed
- a documented validation program for the scheme.

Sections 4 and 5 of this guideline provide further guidance on completing the requirements for this type of interim RWMP. In addition to the criteria for all schemes, specific criteria for CSG (aquifer) recycled water schemes are outlined which should be met by recycled water providers, or scheme managers.

Before the end of the interim period, a full RWMP must be submitted to the regulator for assessment and approval. The full RWMP for this type of CSG scheme must be prepared in accordance with sections 4, 5 and 6 of this guideline. The full RWMP will include a review, and any amendments if required, to the contents of the interim RWMP but must also include:

- an operational monitoring program
- scheme management procedures and supporting documents.

If the full RWMP is not approved by the regulator the responsible entity will be required to cease supply of CSG water after the interim period, until a full RWMP is approved.

3.3.3 RWMPs for CSG recycled water schemes proposing the direct supply of CSG water to a drinking water service provider as a source of drinking water

This type of scheme will not be eligible to apply for an interim RWMP and will be required to submit a full RWMP to the regulator for approval before the supply of CSG water.

The drinking water service provider for the relevant drinking water service will also be required to hold an approved Drinking Water Quality Management Plan (DWQMP) for the part of the drinking water service that uses CSG water prior to the approval of a CSG RWMP. This may require amending an existing DWQMP. Such a management plan should be prepared using the Drinking Water Quality Management Plan Guideline.

Sections 4, 5 and 6 of this guideline provide further guidance for preparing a full RWMP. In addition to the criteria for all schemes, specific criteria for this type of scheme are outlined which should be met by recycled water providers, or scheme managers.

3.4 Post supply obligations

A post supply obligation is only imposed on the responsible entity of CSG (aquifer) recycled water schemes. The post supply obligations may be imposed under a regulator condition for an approved interim and/or a full RWMP and continue to apply after the supply of CSG recycled water under the scheme has ceased.

If a post supply obligation is imposed on a CSG (aquifer) recycled water scheme and supply of recycled water from the scheme has ceased, or is intended to cease, the following applies:

- The entities and infrastructure that comprised the scheme immediately before the supply of recycled water ceased are still considered to comprise the scheme.

[20] Means recycled water supplied by the scheme, water in the aquifer after recycled water has been release into it; water in the aquifer at the relevant location for a drinking water service provider.

- An entity that was a responsible entity for the scheme immediately before the supply of recycled water ceased is still the responsible entity for the scheme.
- The specific post supply obligation conditions for the approved RWMP continue to have effect despite the supply of recycled water having ceased and whether or not the RWMP for the scheme has been suspended or cancelled.

The above three points will only stop applying when all post supply obligations in relation to the CSG (aquifer) recycled water scheme have been complied with.

4 Interim RWMPs

For CSG recycled water schemes and CSG (aquifer) recycled water schemes (other than CSG recycled water schemes proposing supply directly to a drinking water service provider) an interim RWMP may be submitted to the regulator. If approved by the regulator, an interim RWMP will apply for an interim period of either:

- one year from the day CSG water is first supplied under the scheme; or
- a shorter period if the regulator reasonably believes a shorter period is required to protect public health.

If an interim period of less than a one year is decided by the regulator, the regulator must, in a notice given to the responsible CSG scheme, state when the interim period will end. An interim period does not prevent a responsible entity from preparing or applying for approval of a full RWMP before the interim period ends.

The end of an approved interim RWMP will be the earlier of the following:

- The day stated in the notice for the interim period to end.
- The day the regulator approves a full RWMP.

No reviews or audits will be performed for the duration of the interim period for an approved interim RWMP. However, under section 273 of the Act, the relevant entity for a CSG recycled water scheme must prepare an annual report for each financial year after an RWMP (interim or full) for the scheme has been approved.

Under sections 329E and 201A(2)(a) and (b) of the Act, an interim RWMP, for either a CSG recycled water scheme or CSG (aquifer) recycled water scheme, submitted to the regulator must:

- describe the recycled water scheme to which the plan relates
- include details of the infrastructure for the production or supply of recycled water under the scheme and how the infrastructure is to be maintained
- include the pre-supply water quality data for the scheme
- include the water quality criteria for recycled water for the plan
- include details of the water quality monitoring program under the plan and reporting program for the scheme
- include details of the verification program for scheme
- demonstrate how any concerns and/or fluctuations associated with variations in the quality of the source water, including source water from any new petroleum wells, will be managed
- include an incident and emergency response plan for the scheme.

This section outlines the process to be followed by the responsible entity when developing an interim RWMP. However, relevant information in this section will also be used to prepare full RWMPs. This section identifies the criteria all CSG schemes must comply with, and will be assessed against.

The steps involved in developing an interim RWMP are outlined in Figure 3.

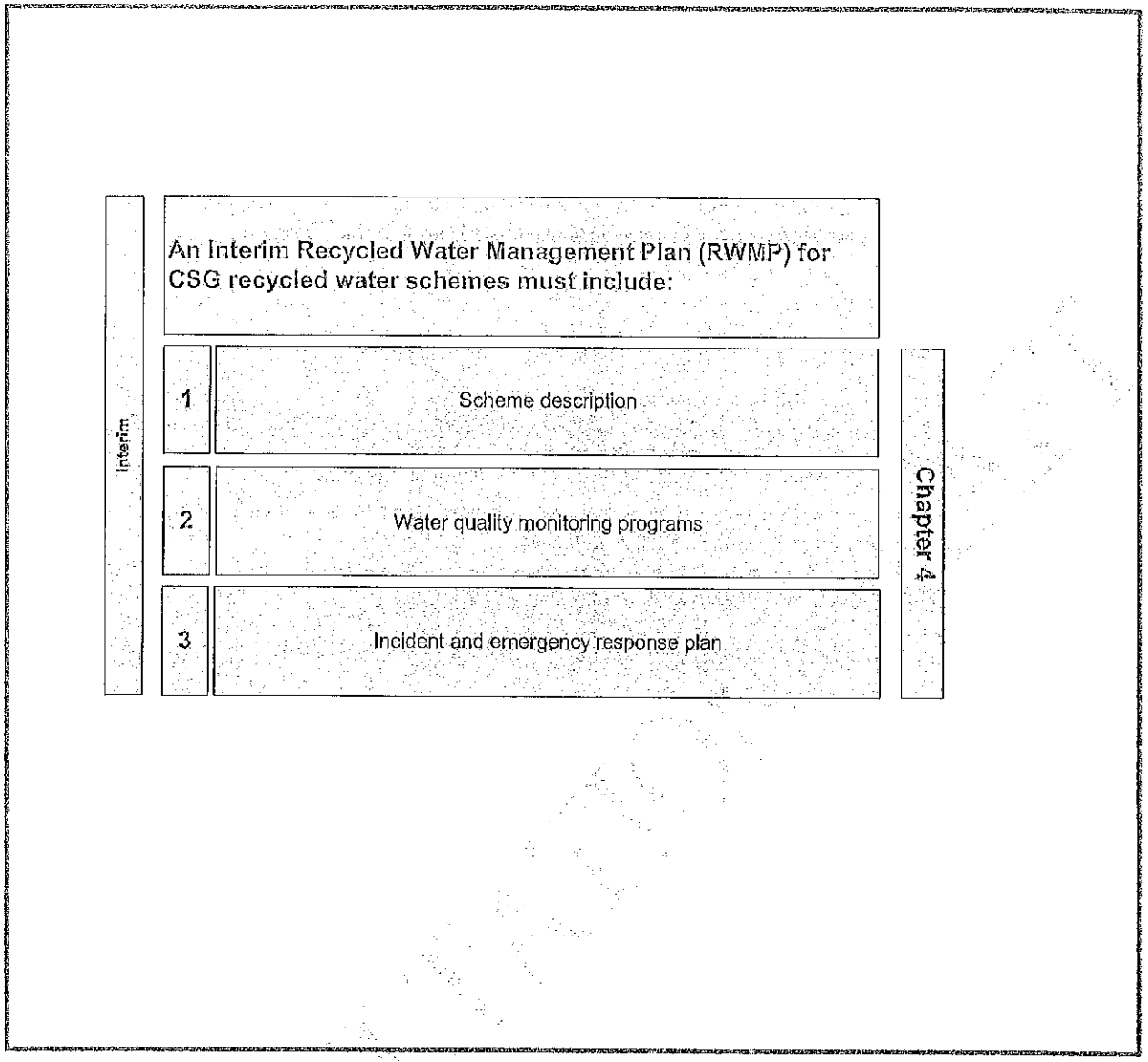

Figure 3: Components in an interim RWMP

4.1 Administrative requirements

4.1.1 Nominee contact details and endorsement

It is essential that the interim RWMP be endorsed by a head of the responsible entity's organisation to ensure that commitment will be drawn down from management through to operational and technical departments.

Criteria for all schemes

- The RWMP should be signed and endorsed by a member with the appropriate level of authority from the organisation of the responsible entity.
- The RWMP should identify the person (nominee) that is responsible for the RWMP and provide full contact details for this person.

Criteria specific to multiple-entity schemes

- Contact details for the nominee responsible for the scheme manager plan (from the scheme manager's organisation) must be provided.
- Each scheme provider plan should have a nominee and include their full contact details. Each nominee must be from the scheme provider's organisation.

Criteria specific to schemes proposing the direct supply of CSG water to a drinking water service provider as a source of drinking water[21]

The plan must contain information on the registered drinking water service, including the:

- service provider identification number (SPID)
- drinking water service provider name and contact details. If the service provider is not the operator of the infrastructure used for the supply of drinking water, then the operator's name and contact details must also be provided.

4.2 Scheme description

The responsible entity needs to have a thorough documented understanding of the entire recycled water scheme, from the source(s) to supply point(s) of CSG water.

Note: If a responsible entity had an exclusion decision made by the regulator that has been revoked, all the information and results from this exclusion decision should be included in this section.

It is important that the difference (if any) between the physical location of the supply point(s) and the nominated final monitoring point are properly understood as they may refer to different locations.

Note: Final monitoring point means the point where the final water quality will be monitored.

Supply point means the point (the physical location) where supply of the CSG water to the water source or aquifer or potable water supply will occur.

Where possible the final monitoring point should be at the supply point. There are instances where this may not be practical and therefore the final monitoring point will not accurately represent the water quality being supplied from the scheme. In these instances the responsible entity should discuss with the regulator options for the location of the final monitoring point in relation to the supply point.

4.2.1 Source water characterisation

Identification of the source(s) of CSG water is the first step in developing an RWMP and describing the scheme. It is critical for the:

- identification of potential public health risks associated with CSG water
- design of treatment system(s)
- establishment of final water quality
- preparation of ongoing source water and final water quality monitoring programs including responses to identification of new contaminants found in the source water.

Criteria for all schemes

- The scheme description must identify the source(s) of CSG water.
- A pre-supply water quality data collection program must be conducted prior to the supply of CSG water[22]. This characterisation should be performed on an ongoing basis, through an implemented source water monitoring program. The pre-supply water quality test data for all source water must include three independent sample tests (not collected on consecutive days) for the parameters listed in Table 2 in section 9 (Appendix 1) (excluding parameters identified as disinfection by-products)
- The scheme description must include pre-supply water quality data for all sources of CSG water:
    - Where CSG water is stored (feed ponds) prior to the release and/or treatment of it, three independent sample tests (not collected on consecutive days) are required in varying locations of each storage point for the

[21] Schemes proposing the direct supply of CSG water to a drinking water service provider as a source of drinking water cannot apply for an interim RWMP but must provide this additional information when applying for a full RWMP.

[22] The provider may apply for RWMP approval with partial water quality data and then provide regulator with the remainder of the pre-supply water quality data in sufficient time for the regulator to make a decision.

parameters listed in Table 2 in section 9 (Appendix 1) to ensure a characterisation of the stored CSG water.

- If data from the storage point(s) (feed ponds) is not available, three independent sample tests (not collected on consecutive days) of 10 per cent of all active petroleum wells for the parameters listed in Table 2 in section 9 (Appendix 1) is required on a rotational basis and must include additional petroleum wells as they commence extraction of CSG water.

Note: The parameters listed in Table 2 in section 9 (Appendix 1) only apply to CSG water that has been subject to cavitation[23]. If the responsible entity wishes to include CSG water that has been subject to fraccing[24], they must first seek advice from the regulator as additional testing parameters may be required.

- The source water characterisation should include:
  - an analysis of seasonal, temporal and spatial fluctuations (for example variations when the CSG water is brought to the surface or kept in storage/feed ponds)
  - an assessment of the data reliability, including identification and justification of gaps in the existing data.
- The ongoing source water characterisation must include responses to changes in the feed water i.e. new wells are brought online, this should include but not be limited to:
  - undertaking an assessment to see whether current treatment processes are appropriate
  - responses when processes are found to be inadequate.

4.2.2 Recycled final water quality

The scheme description must specify the final recycled water quality proposed to be supplied. This product description should be linked to the source water characterisation (parameters in the water) and the infrastructure (parameters removed from the water).

Criteria for all schemes

- The scheme description must include a water quality characterisation of the final recycled water product[25]. This characterisation should include:
  - three independent sample tests (not collected on consecutive days) for the parameters listed in Table 2 in section 9 (Appendix 1) (including parameters identified as disinfection by-products)
  - surrogates and/or indicators[26] of other parameters that can impact on operational efficiency of any treatment processes or public health.
- The scheme description must identify the physical location of the final monitoring point and supply point(s) into the water source. If the final monitoring point is not the same as the supply point, a justification of why the final monitoring point cannot be nominated at the supply point should be given.

4.2.3 Receiving water source quality

A characterisation of the receiving water source and drinking water supply should be provided in the scheme description. This characterisation should lead the design of the scheme and all treatment components by identifying the water quality requirements.

Criteria for all schemes

- The scheme description should include a water quality characterisation of the receiving water source(s) prior to the supply of CSG water into the water source and where possible should include data showing seasonal variations. This characterisation should include:
  - three independent sample tests (not collected on consecutive days or as negotiated with the regulator) for the parameters listed in Table 2 in section 9 (Appendix 1) (including parameters identified as disinfection by-

[23] Is the process of collapsing the coal to create a down-hole cavern and de-stressed area at the well bore to enhance production, usually being compressed air.

[24] The process of fracturing and propping open the coal with hydraulic pressure and sand to enhance production and it excludes cavitation.

[25] The final recycled water criteria identified by this characterisation will impact on the verification monitoring program.

[26] Surrogates and/or indicators may be a specific contaminant, group of contaminants or constituent that signals the presence of something else (e.g. *E.coli* indicate the possible presence of pathogenic bacteria).

products)

- The scheme description should include an assessment of the water source(s) the CSG water is to be supplied to, including:
    - identification and physical location of supply points
    - areas of operating and legal responsibility
    - mapping of the water source extent and linkages.
- The scheme description should include the basis for, demonstrated calculations and modelling results of the water source to which supply will occur. The modelling should demonstrate the ratio of CSG water to natural flow over time at the relevant location of a drinking water service provider. It is expected that the modelling will estimate what percentage of CSG water is present for which duration. For example the modelling might calculate that CSG water makes up 10 per cent of the flow at the relevant location for 48 per cent of the time, or CSG water makes up 1 per cent of the flow for 98 per cent of the time.

Criteria specific to CSG recycled water schemes proposing the direct supply of CSG water to a drinking water service provider as a source of drinking water[27]

- The scheme description (and all schematic representations) should include all components of the scheme from source to consumer including:
    - treatment processes (any water sources that do not undergo a treatment process must be identified and an explanation as to why no treatment process exists must be included in the plan)
    - disinfection processes (any water sources that do not undergo a disinfection process must be identified and an explanation as to why no disinfection process exists must be included in the plan)
    - identification of all stakeholders in the management of drinking water quality and their relevance to the scheme.

4.2.4 Infrastructure description

The scheme description must contain details of the infrastructure used to produce and supply CSG water. The types of infrastructure that must be included (but are not limited to) are feed ponds, petroleum wells, storage and distribution infrastructure and treatment plants. The scheme description must provide sufficient information for the regulator to be confident the infrastructure is robust and capable of producing the proposed recycled water quality.

A combination of schematic diagrams, maps and figures should be used to illustrate the narrative provided in the scheme description.

Criteria for all schemes

- The scheme description must include a description of all the infrastructure for the production or supply of CSG water including:
    - a map (or grid coordinates) indicating the location of all infrastructure associated with the CSG scheme. This must include existing petroleum wells extracting CSG water, feed ponds, storage and distribution infrastructure, treatment components and supply point(s) to the water source(s)
    - details of a forward program of new petroleum wells (where able to be identified by GPS coordinates)
    - details of all feed/storage pond(s), storage point(s), treatment processes (including any chemicals used), equipment, cleaning processes (including any chemicals used) and bypass systems within the treatment process and supply points
    - a map (or grid coordinates) indicating the location of all sample collection points
    - a process flow diagram that clearly indicates the locations and process flows between any feed pond(s), storages, treatment processes, equipment and bypass systems.
- The scheme description should document the operating environment for all aspects of the recycled water scheme, for example details on expected seasonal shutdowns, maintenance schedules and calibration schedules.
- The scheme description should document any contractual agreements between all parties involved in the CSG scheme. For example details of partnerships with landholder(s) or other parties regarding water source or CSG water use(s).

[27] Schemes proposing the direct supply of CSG water to a drinking water service provider as a source of drinking water cannot apply for an interim RWMP but must provide this additional information when applying for a full RWMP.

- The description of the infrastructure should include a reference list of all operational manuals for treatment systems.

Criteria specific to CSG (aquifer) recycled water schemes

- The scheme description should detail the receiving (groundwater) infrastructure, including:
    - any pre-treatment processes employed
    - bore location, depth
    - aquifer description, for example:
        - depth and thickness
        - confined/unconfined
        - fast or slow response to events on surface
    - bore construction details, for example:
        - casing (for example depth, diameter, material, age)
        - borehead details to prevent contamination.

Criteria specific to multiple-entity schemes

- The scheme description must include a diagram which clearly indicates where responsibility of the CSG water changes between recycled water providers, or scheme managers and where the CSG water is supplied to another recycled water provider for further treatment. There should be no gaps in responsibility.
- The scheme manager plan must contain the upstream and/or downstream:
    - contractual relationships, agreements and arrangements between all the entities in the scheme
    - service level agreements relating to volumes and water quality
    - other plans, for example communication or stakeholder strategies between all entities in the scheme.

4.3 Water quality monitoring programs

4.3.1 Source water monitoring

The source water for a CSG recycled water scheme will vary depending on a wide range of factors such as, but not limited to, well location, aquifer type and movement, number of wells and volumes of water extracted. Therefore, it is essential that a comprehensive and robust source water monitoring program is developed. This program should aim to ensure the responsible entity is able to identify and manage water quality risks in a timely manner.

Based on the results of the source water characterisation, the program should identify water quality parameters to be used as indicators of contamination. Additionally the program should also aim to identify new contaminants which could pose risks to public health. The frequency of monitoring for each parameter will depend on the risks posed by the parameter or the uncertainties surrounding the parameter.

Criteria for all schemes

- A documented water quality monitoring program must be included in the RWMP.
- The water monitoring program should include:
    - the location of all sampling points
    - a list of parameters to be monitored and associated limits
    - the frequency of testing for each parameter
    - how samples will be collected
    - how and where samples will be analysed
    - who is responsible for sampling and analysis of samples
    - how and where sampling results will be recorded
    - how analysis of the sampling results and ongoing source water characterisation will be conducted
    - a documented response for any breaches of monitoring limits.

4.3.2 Verification monitoring

Verification monitoring is an assessment of the performance of the scheme used to confirm compliance with the final recycled water quality criteria, as specified in the scheme description. The verification monitoring program should be independent from the operational monitoring program and is not likely to occur in real time.

Analysis of seasonal, temporal and spatial variability of verification monitoring results can be used to identify minor water quality changes that develop over a long period.

In instances where a verification monitoring result does not meet the water quality criteria, the responsible entity must notify the regulator of the details of the noncompliance and the circumstances that gave rise to it (refer to section 7.7 of this guideline for further information).

Criteria for all schemes

- A verification monitoring program that proves the recycled water being supplied is continually of the required quality must be included in the plan.
- The parameters selected for the verification monitoring program must include the parameters listed in section 9 (Appendix 1) and any additional parameters identified during the source water characterisation.
- The frequency at which verification monitoring of identified parameters is undertaken must be specified in the water quality criteria. The basis for each frequency should be documented and be based upon the variability of the parameter, that is, the more variable the parameter, the more frequent the verification should be.
- The frequencies should be responsive to noncompliance. For example, if a sample fails, it should be stated that the routine monitoring frequency will be increased until three successive compliant results have been achieved.
- The location where the verification of recycled water quality is to be conducted must be supplied. It should be conducted at the final monitoring point, which should be the point of supply into the water source.
- Verification monitoring programs should be responsive to drinking water service provider satisfaction.

4.3.3 Laboratory analysis

The following requirements apply to any laboratory analysis undertaken as part of a monitoring program, including source water, operational and verification monitoring programs. Recycled water providers, or scheme managers, must ensure that the data received is obtained from correct sampling and transporting practices and appropriate analysing regimes.

The regulator's preference is that a NATA accredited laboratory be used for the analysis where possible. Where these labs are not used, the responsible entity should provide justification and a description of the methodology applied.

Criteria for all schemes

- The RWMP should document how samples are collected and transported to laboratories.
- The RWMP must include a documented procedure stating how laboratory analysis will be undertaken. This protocol should include:
    - details of the laboratory (that is NATA accredited) that is being used for all analysis that is required by the regulator
    - where a NATA accredited laboratory is not used, the responsible entity should supply details of the methodology used for sampling, testing and analysis of samples and the quality assurance (QA) and quality control (QC) procedures used to ensure consistency in results.
- The procedure should document how all laboratory data and results will be retained through a record keeping system.

Criteria specific to multiple-entity schemes

- The scheme manager plan should have a procedure for consistent reporting of laboratory results obtained from other entities, within the scheme.
- There should be a procedure in the scheme manager plan for reconciling laboratory results that come from different laboratories which may have varying analytical methods or detection limits for the same parameters.

4.3.4 Non–conformance and noncompliance

A non–conformance is a situation where there is an exceedence of a source water and/or operational monitoring program parameter.

A noncompliance relates to the final water quality and is an exceedence of any parameter listed in the verification monitoring

program. Noncompliances must, as soon as practicable, be notified to the regulator.

Criteria for all schemes

- The interim RWMP should contain documented corrective procedures of how to respond to all noncompliances and non-conformances.

4.4 Incident and Emergency Response Plan

An incident and emergency response plan documents the procedures for any incident or emergency which could affect the production, supply or quality of CSG water and in turn affect a drinking water supply.

> **Note:** An emergency is defined as a serious, unexpected and often dangerous situation requiring immediate action. Emergencies may include natural disasters (for example floods and fires), sabotage, terrorist attacks and significant equipment failure.
>
> Incidents are defined as events that have or are likely to lead to noncompliance of water quality standards as set in any approval under the Act.

It is expected that the response plan will be a component of a larger scale incident and emergency management system covering a range of relevant legislative requirements in addition to those under the *Water Supply (Safety and Reliability) Act 2008*, such as the *Environmental Protection Act 2004* and the *Workplace Health and Safety Act 1995*. The response plan should be considered equally with other legislative requirements, ensuring potential conflicts are identified and, where possible, addressed.

Criteria for all schemes

- The response plan should contain how all incidents and emergencies which could occur during operation of the scheme will be managed. It should:
    - identify levels of responsibility (accountable area or business unit within the organisation)
    - include an overview of how all potential incidents and emergencies will be notified, managed and communicated
    - outline how and with what frequency training, drills and refreshers will occur for incident management
    - summarise how and when procedures will be regularly reviewed
    - contain requirements or triggers for a debrief to be held with all relevant staff, contractors or regulator(s) following any incident or emergency
    - specify how records of the event will be kept
    - a diagram may be used to illustrate how the framework will be implemented.
- The response plan should contain all plausible incidents and emergencies (for example disastrous, major, medium and minor incident or emergency) for which a ranking cut off must be documented to identify which incidents or emergencies are considered to be significant.

> **Note:** Incidents and emergencies can be obtained from any risk assessments, critical control point (CCP) identification, historical operational data or industry 'best' practice.
>
> At a minimum, noncompliance with set water quality standards should be categorised as a significant incident or emergency.

- The plan should state that A health risk assessment for each parameter should be undertaken, if compliance with the values listed in section 9 (Appendix 1) is not maintained. This statement should identify how any preventative or corrective actions identified in the risk assessment will be implemented following a noncompliance.

Criteria for multiple-entity schemes

- The scheme manager plan must contain a communication plan that explains how all entities are expected to interact and communicate with each other when managing incidents or emergencies.
- For the scheme manager plan and all service provider plans, the incident and emergency response plan should have detailed communication protocols that:
    - clearly identifies all relevant entities and stakeholders
    - specify how communication is to occur between the different entities in the scheme

- detail what level of responsibility (and who) is to be responsible, informed or briefed
- prescribe in what time frames they need to respond, be informed or briefed.

5 Interim RWMP for CSG (aquifer) recycled water schemes

Note: The criteria from sections 5.2, 5.3, 5.4 and 5.5 in this guideline, will also form part of the full RWMP requirements for CSG recycled water schemes proposing the supply of CSG water to a water source, and for CSG recycled water schemes proposing the direct supply of CSG water to a drinking water service provider as a source of drinking water.

In addition to all the items outlined in section 4 of this guideline, and under section 201A(2)(c) of the Act, an interim RWMP for a CSG (aquifer) recycled water scheme must include:

- the identification of all hazards and hazardous events that may affect the quality of the relevant water for the scheme (the relevant hazards and hazardous events)
- an assessment of the risks posed by the relevant hazards and hazardous events
- a demonstration of how the risks posed by the relevant hazards and hazardous events are proposed to be managed
- a documented validation program for the scheme.

A detailed risk assessment of the public health risks posed by a scheme must be undertaken as part of the interim RWMP for CSG (aquifer) recycled water schemes, and as part of the full RWMP for CSG recycled water schemes and CSG recycled water schemes proposing the direct supply of CSG water to a drinking water service provider as a source of drinking water. A detailed risk assessment should provide an analysis of the operational performance and water quality monitoring data (pre-supply, if applicable) for CSG schemes, with or without an interim RWMP.

The risk assessment will lead to the identification of critical control points (CCP) and their operating critical limits and alert limits.

Validation is then used to ensure that the system components are able to achieve the desired water quality and operational requirements.

Figure 4 shows the process required for developing an interim RWMP with the additional requirements.

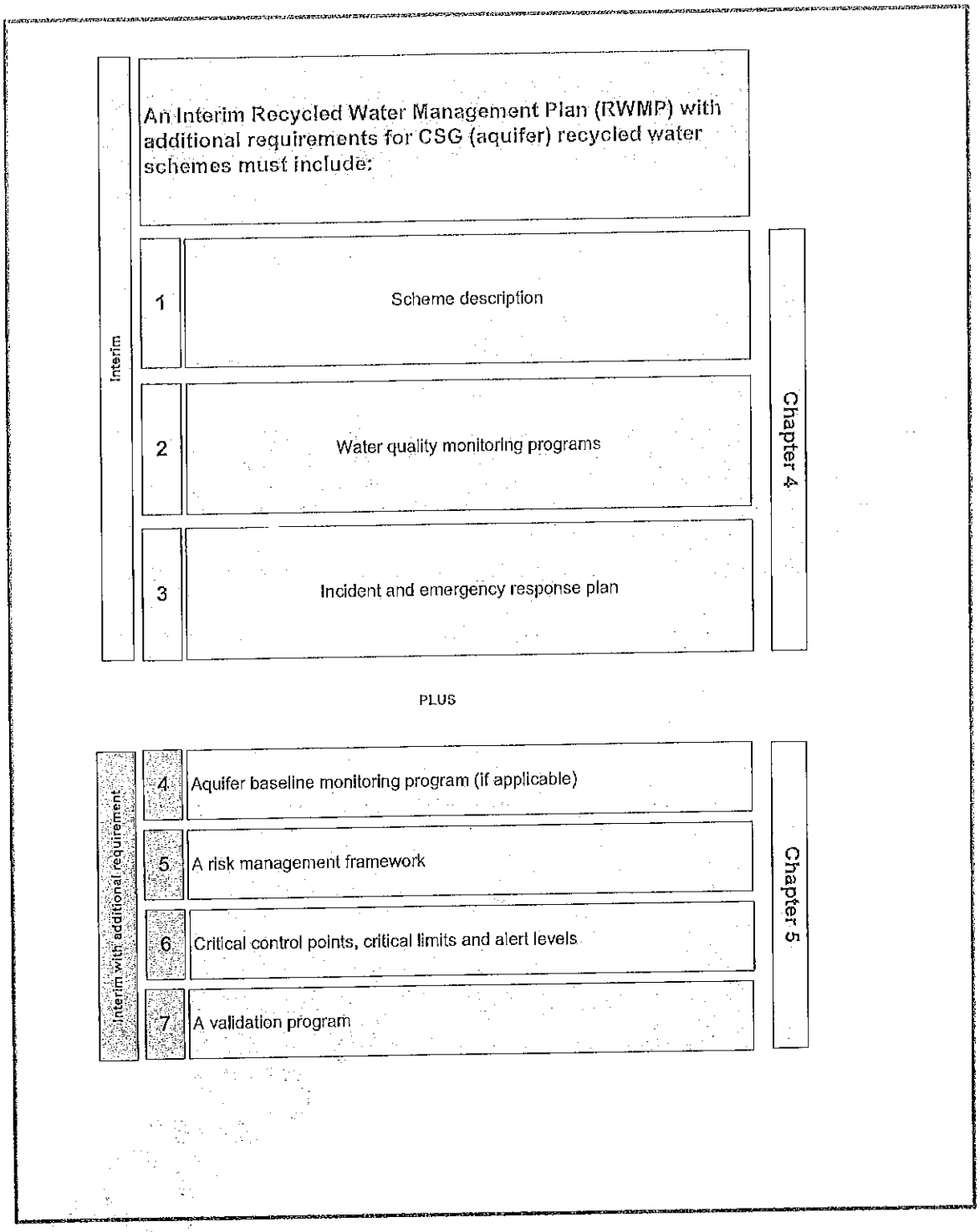

Figure 4: Components in an interim RWMP with additional requirements

5.1 Aquifer baseline monitoring data

Baseline groundwater monitoring data is the collection and analysis of sampling results that will form the characterisation of the groundwater within the aquifer before it is supplied with CSG water. The establishment of baseline data is important so that after commencement of supply of CSG water to an aquifer, ongoing monitoring will identify any unforseen detrimental effects caused by the supply and enable the responsible entity to take corrective actions.

An aquifer baseline monitoring program must be developed and contain the:

- parameters to be monitored
- frequency of sampling
- number and location of sampling points
- data results.

The data collected for the aquifer baseline monitoring program will also assist in identifying the parameters that may be used for ongoing monitoring. For example, if the Sodium Adsorption Ratio (SAR) of the groundwater within the aquifer is similar to that of the CSG water that is intended for supply, then it would not be a suitable parameter to use as an indicator in an ongoing monitoring program.

Sampling for baseline monitoring

Baseline monitoring should ensure the testing is frequent enough to be able to identify any seasonal, temporal, spatial and hydraulic variations within the aquifer.

The number of testing locations, and the distribution pattern of test sites, should be indicative of the volume and rate of CSG water intended to be supplied into the aquifer. The testing locations and distribution pattern of test wells chosen should form the basis of the ongoing groundwater monitoring requirements once CSG water is supplied to the aquifer.

The methodology used for groundwater sampling is extremely important to ensure data reliability. The methodology should comply with either those set out in the latest edition of the DERM's Monitoring and Sampling Manual 2009 which is consistent with the national framework presented in the Australian Guidelines for Water Quality Monitoring and Reporting 2000 or AS/NZS 5667.11:1998 Water quality – Sampling – Part 11: Guidance on Sampling of Groundwaters.

Once supply has commenced, the selected sampling and analysis methodology should be the same chosen for ongoing source water and groundwater monitoring. This will ensure that the baseline data is relevant and that the ongoing groundwater monitoring is indicative of any changes which may occur within the aquifer.

Justification must be provided for the method of sampling chosen. For example, choosing to take groundwater samples within the aquifer in sealed containers instead of at the pump head will give an indication of the groundwater quality within the aquifer without it being influenced by oxidation processes. However, this may impact on the relevance of the data when used for comparison with oxidised CSG supplied water and ongoing groundwater monitoring data post commencement of recharge.

The baseline monitoring data that forms the characterisation of the groundwater within an aquifer must be given due consideration during the risk assessment and hazard identification process (refer to section 5.2 of this guideline).

Criteria specific CSG (aquifer) recycled water schemes

- The supply point must be at the physical location where CSG water is supplied into the aquifer.
- A baseline monitoring program for the aquifer should be included in the interim RWMP. This program should comprise of:
    - baseline data (current status of aquifer)
    - ongoing groundwater monitoring (once supply commences).
- For both the baseline data and the ongoing groundwater monitoring, the program must include:
    - a map/diagram indicating the location, distances and distribution pattern of testing sites
    - documented justification for:
        - the parameters selected
        - the quantity of tests performed
        - the frequency of testing
        - the number of testing sites
        - the methodology of sampling chosen.
    - evidence the aquifer being tested is the same aquifer that is proposed to be supplied
    - results of sampling, including a statistical analysis of the results
    - proposed program for:
        - ongoing groundwater monitoring
        - source water monitoring

- verification monitoring.

- In addition to the parameters listed in section 9 (Appendix 1), the following parameters should be included in the program:
  - E_h (Redox) potential
  - isotope chemistry
  - temperature (within the aquifer)
  - major ion content
  - pH (pH scale)
  - TDS
  - salinity
  - electrical conductivity (mS/cm),
  - Sodium Adsorption Ratio (SAR)
  - silicates (mg/L).
- The collected data must be presented in a similar manner to that of the ongoing groundwater monitoring, source water and verification monitoring data so these data sets can be easily compared and interpreted.
- The baseline monitoring program must include the following prepared/modelled data:
  - the hydraulic impact zone from the release of CSG water and relevant location of the drinking water service provider
  - information on any uptake of water from the aquifer in question prior to the relevant location of the drinking water service provider
  - direction of groundwater flow within the aquifer
  - current standing watertable level, predicted capacity and an evaluation of the condition of the system
  - porosity and conductivity of the aquifer medium
  - transmissivity of water within the aquifer
  - an estimation of the extent of the attenuation zone
  - a description of the temporal variability which indicates the potential effects of recharge and discharge events within the aquifer
  - current supply source(s) for the proposed recharge aquifer
  - an explanation as to the method of supply of CSG water into the aquifer.

5.2 Risk management framework

In the context of this guideline, the risk management framework is designed to identify the hazards and hazardous events with respect to recycled water, and manage the risk these pose to public health.

Risk is defined as the likelihood that identified hazards, or hazardous events, will cause harm to exposed populations (risk = likelihood x impact). Different methodologies may have other definitions for risk. A risk assessment is designed to determine the risks posed by the hazards, or hazardous events, in a qualitative or quantitative manner.

In a plan a responsible entity, where applicable, can use information from any existing risk management methodologies that they have in place if they address public health risks. It is important to recognize these risk management methodologies may not address all the requirements. Therefore it is the responsible entity's responsibility to submit any additional information to meet these requirements.

The RWMP must include a risk management framework that is used to:

- identify the hazards and hazardous events that may affect the quality of the relevant water for the scheme
- assess the risks posed by the relevant hazards and hazardous events
- demonstrate how the risks posed by the relevant hazards and hazardous events are proposed to be managed.

To prepare a risk management framework, a responsible entity may choose to use any risk management methodology as long as it is consistently applied throughout the risk management process and correctly identifies risks to water quality and public health. For an example of a table refer to section 10 (Appendix 2 – Sample table for risk management).

5.2.1 Risk management methodology

There are a range of risk management methodologies that could be used to meet the Act's requirements including:

- AGWR Phase 1
- Australian Drinking Water Guidelines (ADWG)
- AS/NZS ISO 31000:2009
- ISO 22000 and Hazard Analysis and Critical Control Points (HACCP) System.

Criteria for all schemes

- The RWMP should define and describe the risk management methodology used.
- The risk management methodology must be consistently applied throughout the plan to:
    - identify the hazards and hazardous events that may affect the quality of the recycled water
    - assess the risks posed by the hazards and hazardous events
    - demonstrate how the risks are proposed to be managed.

Criteria specific to multiple–entity schemes

- All entities within a multiple-entity scheme should collaboratively decide on, and consistently use, the same risk assessment methodology to allow for consistency within the scheme manager plan and scheme provider plans.

5.2.2 Risk management team

The risk management team is responsible for identifying, analysing and assessing controls for all potential hazards and hazardous events. The members of the team should be involved in all aspects of the scheme, from concept design to implementation, and management to operation. Team members should have appropriate knowledge and expertise in various facets of the CSG recycled water process, from extraction to supply.

Members should include internal personnel from the design, operation, maintenance, management and quality control departments of the recycled water provider's, or scheme manager's, business. External stakeholders, such as samplers, laboratories, drinking water service providers and public health officers should also form part of the team.

Criteria for all schemes

- The risk management team must be multi-disciplinary, including staff from all areas of operations.
- The plan should detail the personnel (i.e. position) responsible for the hazard identification and risk assessment process, their roles and responsibilities and how knowledge of the actual day to day operations of the scheme(s) has been included in this process.
- Key stakeholders who have been actively involved in the hazard identification process, their role and rationale for inclusion must be documented in the plan.
- The role of each member of the risk management team must be documented.

Criteria specific to multiple–entity schemes

- The risk management team for the scheme manager plan should include representatives from each of the entities involved in the scheme.
- For each scheme provider plan:
    - the risk management team should include representatives from the entities upstream and downstream of the relevant scheme provider plan or
    - the recycled water provider should provide evidence that the entities upstream and downstream have received advice from the provider about the risk assessment's outcomes.

5.2.3 Hazard identification

A hazard may be a biological, chemical, radiological or physical agent in, or condition of, recycled water with the potential to cause an adverse health effect. However, depending on the chosen methodology this definition may change. A hazard may already exist in the CSG water when it is extracted, or it may manifest during a process step.

The first step in the risk management process is to identify all hazards associated with the scheme. In order to have the option of controlling or eliminating hazards at their source, all sources of each potential hazard should be identified. This may be achieved by listing all hazards identified through discussions, scheme management diagrams, process flow diagrams and other relevant schematic layouts.

This list should include consideration of identified biological, chemical, radiological and physical hazards which could affect the quality of water and impact public health.

To assist in the compilation of a potential hazards list, the responsible entity should use:

- the list of potential contaminants of concern in section 9 (Appendix 1) of this guideline
- where applicable, any additional parameters identified both in the source water and verification monitoring programs
- expert or specific knowledge of the scheme identified by a member(s) of the risk management team.

Criteria for all schemes

- The hazards, and the source of the hazards, which could adversely affect water quality must be documented in the plan.
- Hazards should be referenced to the source water characterisation and monitoring program and include those found from section 9 (Appendix 1) of this guideline.
- Where possible, all hazards must have their seasonal, spatial and temporal variability assessed to ensure intermittent hazards are also identified.

Criteria specific to CSG (aquifer) recycled water schemes

- Hazard identification should consider the results from the baseline aquifer monitoring program (as specified in section 5.1 of this guideline).

5.2.4 Hazardous event identification

For each identified hazard, a list of hazardous events which may lead to its exposure should be identified.

Criteria for all schemes

- The RWMP must document all potential hazardous events which may affect the quality of water.
- Hazardous events and the source of hazardous events likely to affect public health must be identified at each management and process step (source to the supply point) in the scheme.
- Hazardous events must specify which hazard they expose.

Criteria specific to CSG (aquifer) recycled water schemes

- The responsible entity should consider and document the potential for any or all the following hazardous events:
  - Adverse chemical reactions within the aquifer due to the supply with CSG water.
  - Adverse effect(s) (such as accelerated weathering and/or connectedness to other aquifers) on the formation stability of an aquifer, if it supplies a drinking water source, due to the supply of CSG water.
  - Decreased porosity of the drinking water aquifer due to mechanical, chemical and/or biological clogging caused by the supply of CSG water resulting in decreased availability of groundwater.
  - An unexpected increase in aquifer permeability or flow rate of CSG water through the aquifer causing contamination of a drinking water source.
  - Depletion of the aquifer's storage capacity resulting in decreased supply of groundwater.
  - Change in reservoir pressure resulting in decreased supply of groundwater.
  - Contamination of an aquifer(s) that supplies a drinking water supply source.
  - Treatment failure resulting in contaminants being supplied into the aquifer.
  - Any contaminant that may possibly precipitate out of solution post treatment (for example, metals, silicates) and contaminate an aquifer.

5.2.5 Risk assessment

Risk assessment is a process which allows the responsible entity, to identify the level of management or control for the hazards, or hazardous events, required.

Each identified unmitigated hazard, or hazardous event, must be assessed and given a risk rating or category. Depending on the methodology used, this assessment may be quantitative (for example providing numbers for each likelihood and impact), semi-quantitative (for example using numbers and descriptions for each likelihood and impact) or qualitative where descriptions are used to assess the magnitude of risks posed by hazards, or hazardous events.

Not all risks posed by hazards or hazardous events can be mitigated to an acceptable level so it is important that the risk management team agree on and document a 'significant risk' cut-off. This agreement should occur before the risks are assessed so as to minimise bias in the assessment process, but may be reviewed after the process is complete for applicability. In quantitative risk management methodologies this may equate to a number in a rank, in semi-quantitative it may equate to a category (for example 'medium'), whilst in qualitative risk management methodologies this may be a description of acceptable versus unacceptable risk levels. The methodology used should however aim to ensure all significant risks are correctly identified and should not result in all hazards, or hazardous events, being identified as significant risks.

Criteria for all schemes

- The risk management team should decide upon and document, the cut-off threshold for significant risks.
- The likelihood and impact of each unmitigated hazard, or hazardous event, must be assessed in order to determine the risk for that hazard, or hazardous event.
- The risk assessment should highlight all significant unmitigated risks that require additional management or controls measures.
- The risk assessment should document uncertainty levels for each risk rating given for each hazard or hazardous event. Uncertainty relates to the level of confidence that is placed in the risk assessment and arises from issues such as:
    - lack of complete knowledge
    - variability of information.
- The plan should recognise any uncertainties surrounding the risk assessment and factor these into the preventive measures adopted.

Criteria specific to multiple-entity schemes

- The scheme manager plan for a multiple-entity scheme must contain a risk assessment that considers the risks to the entire scheme.
- Each scheme provider plan in a multiple-entity scheme must document the risks that are present in their part of the scheme, regardless of whether they control that risk, or pass it on as an unmitigated risk to the next entity.
- The risk assessment should include a consideration of the cumulative risks arising from other recycled water, or drinking water service, providers' systems or activities. This information should be obtained from any other entity(s) and evaluated in the context of the measures in place by related providers and the risk assessment methodology adopted for the specific plan.

5.2.6 Control measure identification and residual risks

The risk assessment of unmitigated risks should have demonstrated the maximum risk posed by each hazard or hazardous event. The next step in the risk management process is to identify all existing control measures for all identified hazards, or hazardous events. Significant risks should be considered in more detail to ensure their management.

A control measure is defined as any action or activity that can be used to prevent, eliminate or reduce a hazard to an acceptable level. Examples of control measures may include treatment processes, alarming systems, management protocols or procedures and the use of personal protective equipment.

Monitoring schedules are not control measures, but an indicator of the efficacy of the control measure. For example, in a reverse osmosis (RO) system, the monitoring of conductivity is not a control measure, but an indication that the control measure (membranes) are working effectively.

Once all control measures have been identified, an assessment of the residual risk for each identified hazard, or hazardous event should occur. The use of control measures should reduce the risk rating or category to an acceptable level. Some hazards, or hazardous events, may remain a significant risk and require further controls or management.

Additional or improved management or control measures must be identified for all significant residual risks.

Criteria for all schemes

- All unmitigated risks should have an associated control measure to ensure the hazard, or hazardous event, is removed or reduced to an acceptable level.
- The unmitigated risks should be assessed, including the likelihood, impact and risk ranking for each hazard, or hazardous event, to provide a rated or categorised residual risk.
- A list of further management and control measures should be identified for each significant residual risk.
- A risk management table must be provided in the RWMP summarising the process. This table should include:
    - identified steps in the scheme and/or sources of hazards
    - hazards
    - hazardous events
    - unmitigated risk assessment
    - control measures
    - residual risk assessment
    - additional controls
    - comments or justification regarding degrees of uncertainties or assumptions used throughout the process.

Criteria specific to multiple-entity schemes

- Risks should be attributed to the relevant entity where the risk is best controlled and must be documented in their scheme provider plan.

Criteria specific to CSG (aquifer) recycled water schemes

- The control measures identified should specifically demonstrate and document the method(s) of controlling risks prior to supply and within the aquifer if supply occurs.
- The responsiveness of control measures to groundwater monitoring should be demonstrated and documented.
- To protect public health, all possible corrective actions available for remediation of groundwater within the aquifer must be documented.
- Due to the enclosed nature of aquifers and difficulty in taking corrective actions in the event of contamination from a hazard or the detrimental impact of a hazardous event, the risk assessment should investigate, and document, the possibility of alternate sources for drinking water, should a contamination event occur.

Criteria specific to schemes proposing the direct supply of CSG water to a drinking water service provider as a source of drinking water[28]

- The RWMP must describe the management measures proposed for each significant residual risk.
- The process for providing the relevant information to the regulator must also be described. The description must include:
    - measures, actions, strategies or process(s)
    - priority for implementation
    - timeframe
    - other factors, for example, responsibilities between the provider and third parties and/or other stakeholders.

5.3 Critical control points, critical limits and alert levels

Upon completion of the risk assessment, the risk management team should identify and document the scheme's critical control points and their operational limits. This identification should occur as a lead-on from the identification of significant risks in the previous section.

[28] Schemes proposing the direct supply of CSG water to a drinking water service provider as a source of drinking water cannot apply for an interim RWMP but must provide this additional information when applying for a full RWMP.

5.3.1 Critical control points and quality control points

A critical control point (CCP) is a process point, step or procedure where control can be applied, and which is essential to prevent, eliminate or reduce a hazard to an acceptable level. It is essential that CCPs be monitored in a timely manner (online monitoring) as they are critical to ensuring that water quality is met. A CCP decision tree or identification flowchart is often used to determine CCPs.

Other points, steps or procedures not identified as a CCP may still be important, but not essential, to ensuring water quality. These may be called quality control points (QCPs). Generally there are more QCPs than CCPs; this is recommended as too many CCPs can result in a loss of operational focus and diminish the importance of CCPs.

For example the normalised salt passage of a RO treatment plant has been identified as a CCP, and the flux through the RO membrane is the QCP.

Criteria for all schemes

- Each process step in the process flowchart (or similar) should be assessed to determine if it is a CCP or a QCP.
- CCPs and QCPs should be correctly and separately identified using a documented and consistent process.
- If a flowchart is not used, the alternative method used to determine CCPs and QCPs needs to be consistent, logical and documented in the RWMP.

Criteria specific to multiple-entity schemes

- All CCPs should be summarised in the scheme manager plan and detailed in each relevant service provider plan.

5.3.2 Critical limits

After all CCPs are identified, critical limits are used to define the value(s) at which a process step can be operated to ensure the required water quality is produced. They define the cut-off point between acceptable and unacceptable and provide assurance to the responsible entity that the control measure is working. Critical limits can be established from expert advice, technical literature or manufacturer's information.

Critical limits should be monitored continuously to provide a real time measure of the performance of a CCP. This monitoring will be included in the operational monitoring program for the scheme.

For any exceedence of a critical limit there should be a documented corrective action, as the critical limit exceedence demonstrates a hazard is no longer under control.

Criteria for all schemes

- Every CCP should have a critical limit associated with it.
- For each critical limit, the RWMP should document:
    - the location of all monitoring points
    - the values of the critical limits - these should be exact values, not a range. This does not preclude a CCP from having two distinct critical limits, an upper and a lower limit. This may be appropriate when too little of a substance may be as hazardous as too much
    - the frequency, where preference should be given to online monitoring with real-time alarming systems
    - what online equipment is used
    - how samples will be taken and analysed
    - who is responsible for taking samples and analysing them
    - who is responsible for quality assurance of results
    - how and where sampling and analysis results will be recorded
    - a response for any breaches of critical limits including prescribed corrective actions (note these should link to the incident and emergency response plan).
- Corrective actions should be documented in a format which allows for ease of understanding by the different levels of personnel identified who will be managing any breaches of critical limits.
- The corrective action should document communication protocols between the relevant stakeholders.

5.3.3 Alert levels

For each CCP and critical limit there should be a set alert level. Alert levels are more conservative than critical limits and allow for early warning to be given prior to exceedences of critical limits. This allows the responsible entity, to implement corrective actions before the critical limit is exceeded.

Criteria for all schemes

- Every CCP and critical limit should have an alert level associated with it.
- For each alert level, the RWMP should document:
    - the location of all monitoring points
    - the values of the alert levels, which should be exact values and be set to ensure that sufficient time is given to allow appropriate corrective actions to be implemented before critical limits are reached
    - the monitoring frequency, where preference should be given to online monitoring with real-time alarming systems
    - what online equipment is used
    - how samples will be taken and analysed
    - who is responsible for taking samples and analysing them
    - who is responsible for quality assurance of results
    - how and where sampling and analysis results will be recorded
    - a response for any exceedence of alert levels including prescribed corrective or preventative actions which prevent the critical limit from being reached.

The final output of the CCP identification process can be documented in a table with all identified CCPs and their critical and alert limits. For an example of a table, refer to section 11 (Appendix 3 - Example table for CCP and operational monitoring.

5.4 Validation

Once the risk assessment has been undertaken, and CCPs have been established, it is important to undertake validation to ensure the operation of the scheme is able to achieve the desired water quality.

5.4.1 What is validation?

Validation is the process of assessing the effectiveness of control measures in reducing the risks posed by hazards, or hazardous events, indentified during the risk assessment process. A validation program is documented and demonstrates how the system components of a recycled water scheme will be tested to prove the recycled water can consistently achieve the water quality criteria.

There are several distinct phases of validation which are covered by this guideline:

- Pre-commissioning validation (section 5.4.5) is generally performed as part of a feasibility study during the design stage to determine the treatment processes required to meet the desired water quality. Individual components of the system may be validated during the pre-commissioning phase, but will also be re-validated as part of the whole system validation after construction is completed.
- Commissioning validation (section 5.4.6) is performed to ensure that system components are correctly constructed and installed and able to operate in accordance with their design specification(s). During commissioning validation, control measures are tested to ensure they reduce hazards to the expected level when used in conjunction with the other components in the treatment process.
- Commissioning verification, or monitoring of final water quality (section 5.4.7), is a type of validation distinct from other methods because it is performed by testing the end product water. This is performed to prove that the expected water quality can be produced consistently over time. Commissioning verification should not be confused with verification monitoring, which is the on-going monitoring of the final recycled water quality.

5.4.2 Existing schemes

Existing schemes may not have undertaken pre-commissioning or commissioning validation prior to commencing supply. In these instances, the responsible entity, may supply sufficient information by way of water quality results obtained from the verification monitoring program submitted in the interim RWMP stage.

However, if the responsible entity, is unable to supply sufficient water quality results, they should contact the regulator to discuss an acceptable alternative. Examples of this may include:

- a targeted monitoring program to provide further information in addition to available data, which the recycled water provider is able to provide
- testing of a specific control measure to ensure its hazard reduction capability.

The criteria for existing schemes are included in section 5.4.7 (commissioning verification) of this guideline.

5.4.3 Who should prepare a validation program?

If the scheme is a single-entity recycled water scheme, the recycled water provider must prepare the validation program.

If the scheme is a multiple-entity scheme, the scheme manager and each recycled water provider must prepare a validation program. In this case the scheme manager is responsible for submitting the whole of scheme validation program (comprising the scheme manager validation program and the individual provider validation programs) for approval by the regulator.

5.4.4 Validation program requirements

The outcomes of the validation program should be reflected in the RWMP. For example if the validation program reveals a need for additional monitoring or a specific alert level, this should be incorporated into the RWMP.

Criteria for all schemes

- The RWMP should include a documented validation program.
- The validation program should consist of a report that, for each item being validated, details:
    - the aim of the validation
    - the methodology(s) used
    - the results of the validation
    - the conclusion of the validation, with a discussion on whether the aim of the validation was met
    - a summary of recommendations made from the validation program.
- The RWMP should reflect that the recommendations from the validation program have been incorporated in the RWMP and all relevant procedures.

Validation methodologies

The validation program should be designed to meet the requirements of the specific scheme. The methodologies outlined below are broadly categorised and should be considered by the responsible entity when designing their validation program.

More than one method should be used to validate individual treatment components. Methods used to validate may include:

- pre-commissioning validation
    - historical data (for example from other schemes)
    - scientific literature
    - manufacturers specifications and challenge studies.
- commissioning validation
    - pilot plant
    - specific challenge testing
    - on-site tracer studies
    - direct integrity testing
    - continuous indirect integrity testing.
- commissioning verification
    - monitoring of final water quality.

The validation methods chosen should be appropriate to the scheme type, the technology used and the hazards identified. Advice on appropriate validation methods can be sought from the regulator.

Recycled water providers should consider ways in which their validation methodologies can be buffered from statistical errors.

It is unlikely that any single validation methodology can ensure the performance of a complex treatment system to provide a specified water quality, so a comprehensive validation program should be used.

Recycled water providers, or scheme managers, should use Table 1 to identify a way of meeting a minimum of 14 points for their validation program. This is the case regardless of how many times that methodology is used for different CCPs. This does not preclude the need to validate all CCPs, critical limits, surrogates and indicators.

Table 1: Typical approach for validation

	Methodology	Points
Pre-commissioning validation	Historical data, for example, from other schemes	✓ (1)
	Scientific literature	✓ (1)
	Manufacturer's specifications	✓ (1)
Commissioning validation	Pilot plant	✓ (3)
	Specific challenge testing	✓ (3)
	On–site tracer studies	✓ (3)
	Direct integrity testing	✓ (3)
	Continuous indirect integrity testing	✓ (3)
Commissioning verification	Monitoring of final water quality	✓ (5)

The points referred to in Table 1 are indicative only. For example, the weighting and awarding of points for each of the validation methodologies may vary depending on the regulator's assessment of the quality and relevance of the material supplied by the recycled water provider in the validation report.

CSG (aquifer) recycled water schemes must also validate the methodology used for supply.

Criteria for all schemes

- Where using the points system, the validation report should demonstrate a minimum of 14 points from the chosen methodologies.
- If the points system is not adopted, the responsible entity, should indicate how an appropriate spread of methodologies were used or how they have taken steps to guard against statistical errors or other issues in using their validation methodology.

Criteria specific to CSG (aquifer) recycled water schemes

- The interim RWMP must contain a validation program.
- The method proposed to be used for supply must be validated as a step in the treatment train, as it is the last physical point of control within the system.
- If attenuation of any parameters within the aquifer is to be claimed, then documented evidence is required.

5.4.5 Pre-commissioning validation

Pre–commissioning validation is generally undertaken as part of a feasibility study to determine what treatment processes are required to meet the desired water quality, based on the:

- source water characterisation
- risk management process and the identification of control measures
- identification of CCPs and their critical limits and alerts.

The design of the scheme may be achieved through the use of expert knowledge, literature reviews or challenge testing (of a pilot plant). Individual components of a treatment system may be validated during the pre-commissioning phase, even though they will also need to be re-validated as part of the whole system once construction is complete.

Criteria for all schemes

- The responsible entity should demonstrate how pre-commissioning validation has been considered in the planning or design stage of the scheme.
- At least one of the three methodologies (historical data, scientific literature or manufacturer's specification) should have been used for pre-commissioning validation.

Historical data

Historical data from similar schemes can be used to support the pre-commissioning validation process. Historical data can be used as evidence to support the effectiveness of similar, or comparable, treatment systems to remove contaminants under similar, or comparable, operating conditions. The historical data should be critically reviewed to ensure that it is directly applicable to the treatment process and its operating conditions. For example, different temperatures, volumes and pressures will have an affect on a system's ability to remove contaminants.

The validation report should include an assessment of whether treatment processes have been assessed in accordance with existing protocols, for example, the United States Environmental Protection Agency Membrane Filtration Guidance Manual 2005.

Criteria for all schemes

- The validation report should include evidence that historical data is directly applicable to the treatment process and its operating conditions for the scheme.
- The validation report should compile all historical data including:
    - information on the source of the data. For example, reports to regulators, trade waste data or research data
    - a summary of the results
    - a rationale for the data included
    - relevance to the source water characterisation.

Scientific literature

Peer-reviewed literature can be used to support the validation process. Scientific literature can be used as evidence to support the effectiveness of similar, or comparable, treatment systems to remove contaminants under similar, or comparable, operating conditions. When using scientific literature, it should be critically reviewed to ensure it is directly applicable to the treatment process and its operating conditions.

Criteria for all schemes

- The validation report should reference any peer-reviewed literature used to support the pre-commissioning validation process.
- The validation report should include evidence that scientific literature is directly applicable to the treatment process and its operating conditions for the scheme.

Manufacturer's specifications

Manufacturer's specifications can be used to support the validation process. Any contaminant removal rates provided by a manufacturer should be confirmed by commissioning validation. When using manufacturer's specifications and data (for example manufacturer's challenge studies) the responsible entity, should ensure that the information is directly applicable to the installation and operating conditions for the scheme. Conditions under which experiments were performed should be confirmed as being appropriate for the conditions under which the full-scale plant will operate.

Criteria for all schemes

- The validation report should include all manufacturers' specifications (and a reference list of operation manuals) for each treatment component in the scheme.
- The validation report should include details of any manufacturer data or scientific results including the methodology used, and the operating conditions under which the testing was performed.
- The validation report should include details of all monitoring or testing undertaken to confirm that the manufacturer's specifications, including methodology and results, will directly apply to the scheme.

5.4.6 Commissioning validation

Commissioning validation is performed to ensure that all system components are correctly constructed and installed, and will be able to operate in accordance with their design specification(s). This will test control measures to ensure they reduce hazards to the expected level when used in conjunction with the other components in the treatment process.

For each treatment process, the commissioning validation should include the parameters that the system component was designed to remove and/or inactivate (for example hazards and indicators (refer to section 9 (Appendix 1)) or surrogates (refer to section 12 (Appendix 4)). Frequency of monitoring should be set to provide statistical evidence to prove the effectiveness of the process against target parameters.

Note: For schemes with multiple treatment processes, at a minimum, all identified CCPs must be validated.

When validating critical limits, the responsible entity should demonstrate that operating within the critical limits will result in the desired water quality. This ensures that the critical limits have been set at an appropriate level.

When validating alert levels, the responsible entity should conduct tests to ensure that alarms have been set at appropriate levels and that they are functional.

When validating control measures other than treatment systems or alarms, the responsible entity must ensure that the control measures are in place and are able to reduce the hazards as stated in the risk management process.

Criteria for all schemes

- The commissioning validation report should include details of how and when validation of the following occurred:
    - control measures
    - each treatment system - at least all CCPs (to prove their effectiveness against the hazard they control, or that the surrogate or indicator shows that the hazard would be controlled)
    - critical limits (to prove performance below critical limits can be consistently achieved)
    - alert levels
    - surrogates and indicators used for monitoring, to prove that they accurately predict the level of hazard(s) they represent.
- The report should include the results and any recommendations of the commissioning validation.

Pilot plant studies

A pilot plant is a small scale treatment plant that is directly comparable to the full-scale plant. Pilot plant studies can be used to support the validation process. When using a pilot plant to validate any individual treatment component, evidence should be provided to show its performance is comparable to a full-scale plant.

Criteria for all schemes

- The validation report should include evidence that the pilot plant is comparable to a full scale plant by, for example, comparison of volumes, pressure, size of treatment component and types of treatment components.

Specific challenge testing

Challenge testing is designed to demonstrate the ability of a treatment process to remove a specific target contaminant. It involves inoculating influent to a treatment process with a known concentration of a chemical and then testing the treated water to determine how much has been removed.

The United States Environmental Protection Agency Membrane Filtration Guidance Manual 2005 provides detailed information on using challenge testing for the validation of a membrane filtration process for micro-organisms. This manual is designed for surface water and therefore uses Cryptosporidium as the indicator micro-organism. It is located online on the US EPA website at <www.epa.gov>.

Chemicals chosen for challenge testing should include key indicators based on chemical type, molecular structure and shape, molecular weight and having particular health concern.

Ideally, challenge testing should be performed and/or verified by an independent third party. The methods used for challenge testing should be documented. Samples of inoculated influent and the treated water should be taken in triplicate, that is, three samples individually tested. Challenge testing should be repeated under varying conditions which account for operational extremes (for example, concentrations, volumes, pressure and temperature) that the full scale plant may be exposed to.

If an independent third party is not engaged to perform and/or verify the challenge testing, a detailed description of the methodology and rationale behind the chosen methodology should be supplied to the regulator. Information on the conditions under which challenge testing was performed, results of analysis performed and an analysis of the data collected, including assessment of equipment performance, should also be provided.

Criteria for all schemes

- The validation report should include a detailed description of the challenge test methodology used.
- The validation report should include a rationale for the chosen challenge test methodology, including parameters chosen and conditions under which challenge testing was performed.
- The validation report should include contact details and qualifications of the independent assessor, if used.
- The validation report should include the results of analysis performed for the challenge test.
- The validation report should include an analysis of data collected, including an assessment of the performance of the equipment under the challenge test.

On-site tracer studies

On-site tracer studies may be used to demonstrate retention time in disinfection systems, lagoon treatment systems and reservoirs. If on-site tracer studies are used, the methodology should be documented and substantiated. All data collected as part of the on-site tracer study should be collated, reviewed and critically assessed by the responsible entity.

One example is the use of rhodamine dye studies. Rhodamine dye can be used for measuring, mapping and monitoring water systems, including studying and modelling surface and ground water systems, tracing contaminants, detecting leaks and measuring retention times.

Further information can be found in the United States Environmental Protection Agency Membrane Filtration Guidance Manual 2005.

Criteria for all schemes

- The validation report should include a detailed description of the tracer study methodology used.
- The validation report should include a rationale for the chosen tracer study methodology, including type of tracer and conditions under which the study was performed.
- The validation report should include the results achieved and the analysis of data collected during the tracer study.

Direct integrity testing

A direct integrity test is a physical test applied to a membrane unit in order to identify and isolate integrity breaches. Integrity breaches can develop in the membrane during routine operation that could allow the passage of chemicals and micro-organisms.

There are two general classes of direct integrity tests that are commonly used in membrane filtration facilities, namely pressure-based tests and marker-based tests. The pressure-based tests are based on bubble point theory, described in Appendix B, United States Environmental Protection Agency Membrane Filtration Guidance Manual 2005. Bubble point theory involves applying a pressure or vacuum that is, negative pressure to one side of a membrane barrier and monitoring for parameters such as pressure loss or the displacement of air or water in order to establish whether an integrity breach is present.

Marker-based tests use either a spiked particulate or molecular marker to verify membrane integrity by directly assessing removal of the marker, similar to a challenge test. Chapter 4, United States Environmental Protection Agency Membrane Filtration Guidance Manual 2005, describes direct integrity testing in detail.

Manufacturer's instructions will be available on the direct integrity testing that is applicable to the membrane type. Most microfiltration and ultrafiltration membranes have a direct integrity testing system; however, not all reverse osmosis membranes do.

Note: This methodology can also be utilised as part of an operational monitoring program.

Criteria for all schemes

- The validation report should include a description of the type of direct integrity test(s) used.
- The validation report should include a rationale for the direct integrity test(s) chosen.
- The validation report should include results of direct integrity testing, including information on the conditions under which tests were performed, and the analysis of data collected.

Continuous indirect integrity testing

Continuous indirect integrity testing is not a physical test applied to a membrane module or membrane unit, but instead involves monitoring some aspect of filtrate water quality as a surrogate measure of membrane integrity. Quality of membrane filtrate is very consistent and largely independent of fluctuations in feed water turbidity or particle levels. A marked decline in filtrate quality may indicate an integrity problem. Continuous indirect integrity testing is not as sensitive as direct testing for detecting integrity breaches. However, it offers some benefits including the ability to be operated in a continuous, online mode and its applicability to any membrane filtration system independent of manufacturer or system parameters.

Measurements of online parameters such as turbidity, particle counts and conductivity can be used pre- and post- treatment to provide removal information for the particular treatment barrier. For example, manufacturer's data may indicate a 95 per cent sodium chloride removal rate for a particular reverse osmosis membrane. Online monitoring of conductivity, as a surrogate, pre- and post-reverse osmosis filtration can provide information on whether the membranes, as installed in the treatment plant, are achieving this.

Note: This methodology can also be utilised as part of an operational monitoring program. Further information can be found in the United States Environmental Protection Agency Membrane Filtration Guidance Manual 2005.

Criteria for all schemes

- The validation report should include a description of the type of continuous indirect integrity testing used.
- The validation report should include a rationale for this type of testing.
- The validation report should include results of continuous indirect integrity testing, including information on the conditions under which tests were performed, and the analysis of data collected.

5.4.7 Commissioning verification

Commissioning verification will confirm that the final water quality consistently complies with the required water quality criteria. For schemes with an approved interim RWMP the commissioning verification will equate to the commissioning monitoring program. For CSG (aquifer) recycled water schemes and CSG recycled water schemes proposing the direct supply of CSG water to a drinking water service provider, as a source of drinking water, commissioning verification must occur prior to commencing supply.

The responsible entity should submit a report documenting the water quality monitoring program (and its results) carried out to demonstrate that the scheme is able to consistently achieve the required water quality. Refer to sections 4.2 and 9 of this guideline for further information on the required water quality.

The recycled water provider should provide a statistical analysis of the data collected to determine the confidence level for meeting the water quality criteria. If statistical validity cannot be gained from the data set, further testing may be required. The frequency of sampling during the commissioning verification period should be sufficient to give statistical confidence that the final water quality consistently achieves the required water quality criteria. A minimum of three months of weekly testing is required for all schemes but recycled water providers, or scheme managers, may choose to go beyond this. The regulator has the discretion to alter the duration of the verification period on a case by case basis.

If, during commissioning verification, any of the water quality criteria are exceeded, the responsible entity must contact the regulator to discuss what action, if any, should be taken. The cause of the exceedence should be thoroughly investigated as it may result in changes to design or operational parameters for the scheme. These changes will have to be mirrored in the relevant sections of the RWMP and may negate any previous validation program(s) (for example commissioning validation). Exceedences may therefore require amendment of the entire validation program and re-commencement of the commissioning verification process. If a responsible entity is unsure about the necessity for amending a validation program, advice should be sought from the regulator.

Criteria for all schemes

- Commissioning verification must include the required water quality criteria specified in sections 4.2 and 9 (Appendix 1) of this guideline.
- Commissioning verification must be conducted as close as possible to the point where recycled water is supplied.
- The responsible entity, must submit a commissioning verification report that:
    - demonstrates the treatment system is reliable and robust and that the scheme is able to consistently provide the required water quality prior to supply of recycled water
    - documents the frequency of sampling for each parameter
    - provides details on the sampling point(s) and method of sampling for each parameter

- includes the result of analysis, compiled and presented in a format that includes the following details:
  - parameter
  - unit of measurement
  - guideline value
  - limit of reporting/detection
  - laboratory (and appropriate accreditation)
  - analytical method used
  - total number of samples
  - minimum and maximum concentrations
  - trend analysis
  - assessment of the data reliability
  - justification of any gaps in data.

5.4.8 Receiving water source

The receiving water source must be an effective barrier that allows for sufficient management of any risk to the health of the public associated with potential incidents relating to recycled water quality. The recycled water provider should provide evidence of the effectiveness of the barrier at the time of submitting their validation program. A regulator approved drinking water quality management plan that addresses the ongoing management of the barrier, including the ability to manage potential incidents, will be developed by the entity responsible for the receiving water source.

To be an effective barrier, storage conditions should be appropriate to ensure that substantial safety margins are in place to account for any and all possible delays in completing monitoring, communicating results and responding to results where necessary. This could be demonstrated through:

- water quality monitoring
- tracer studies
- hydrodynamic modelling of the storage
- various management options to control storage conditions.

Criteria for all schemes

- The responsible entity, must submit evidence demonstrating that the receiving water source is an effective barrier.

5.4.9 Revalidation of an RWMP

Revalidation should occur following a significant change within the scheme. Triggers for revalidation may include:

- the introduction of new processes or equipment
- changes to the source water or product water quality
- increases in hazard concentrations
- identification of new or emerging hazard(s)
- detection of repeated systematic failures
- catchment inputs increasing beyond the maximum flow tested during validation
- the addition of new a influent source
- variation in process configuration, operational parameters or mode of operation
- new membrane specification
- new chemical used in treatment processes
- any unscheduled suspension to supply or operation
- changes to the receiving water source, for example supply into a different aquifer.

Revalidation methods should be based on the criteria in sections 5.4.6 and 5.4.7.

Depending on the scope of the revalidation, a full validation program may not be required. In some instances the validation period may be shortened, or only a specific system component may require validation. The revalidation requirements will be dependant upon the type and magnitude of alterations to the scheme. Guidance should be sought from the regulator on proposed revalidation.

Revalidation will require the interim or full, RWMP to be amended. Similarly, the responsible entity, will be required to revalidate the scheme when they wish to resume supply following a suspension of an RWMP. Refer to section 7.3 of this guideline for details on amending an RWMP.

Criteria for all schemes

- The triggers for revalidation should be documented in the RWMP.

6 Full RWMPs

The information required to be submitted in a full RWMP is in addition to, and includes, all the information supplied in an interim RWMP, for that particular CSG recycled water scheme (sections 4 and 5 of this guideline). If no interim RWMP was submitted to the regulator, it is the responsibility of the responsible entity to prepare and submit a full RWMP.

Note: The criteria from sections 5.2, 5.3, 5.4 and 5.5 in this guideline also form part of the full RWMP requirements for CSG recycled water schemes proposing the supply of CSG water to a water source, and for CSG recycled water schemes proposing the direct supply of CSG water to a drinking water service provider as a source of drinking water.

When preparing a full RWMP the responsible entity must review their interim RWMP (if they submitted one), and include the reviewed sections in the full RWMP.

This section provides information on the contents of a full RWMP. According to section 201(5) and 201A of the Act, a full RWMP must include:

- a detailed scheme description to which the plan relates
- details of the infrastructure[29] for the production or supply of the CSG water and how the infrastructure is to be maintained for the scheme
- the pre-supply water quality data
- the water quality criteria for recycled water for the plan
- a demonstration showing how any risks associated with variations in the quality of the source water will be managed
- details of the incident and emergency response plan for the scheme, including preventative and corrective actions and communication protocols
- the identification of the hazards and hazardous events that may affect the quality of the recycled water
- an assessment of the risks posed by the relevant hazards and hazardous events
- a demonstration of how the risks posed by the relevant hazards and hazardous events are proposed to be managed
- a documented validation program
- details of the operational and verification monitoring programs under the plan, including the parameters to be used for indicating compliance with the plan and the water quality criteria for recycled water
- scheme management procedures and supporting documents.

A number of these requirements should have been approved if an interim RWMP has been submitted to the regulator. The results of the interim RWMPs aquifer baseline (if applicable), source water quality, operational and verification monitoring programs should also be included in the full RWMP.

Recycled water providers, or scheme managers, should ensure that the full RWMP contains information to address all the applicable criteria from the interim RWMPs (refer to sections 4 and 5 of this guideline). In addition to these sections, a full RWMP should include the management framework for the scheme. This includes:

- a recycled water policy statement
- a list of all the supporting programs for the scheme
- a list of the management procedures for the scheme including:
  - documentation, record keeping and internal reporting arrangements;
  - management review and continuous improvement procedures
  - internal auditing procedures.

Due to the uncertainties and the changing environment inherent in the CSG industry it is essential that the scheme management framework is designed in a way that is adaptive. While procedures and policies should allow for reactive responses to the changing environment, the management framework should provide a stable platform for scheme management and protection of public health.

[29] Examples of infrastructure for the production or supply of CSG water includes feed ponds, petroleum wells, storage and distribution infrastructure, treatment plants

Figure 5 below shows the process to developing a full RWMP.

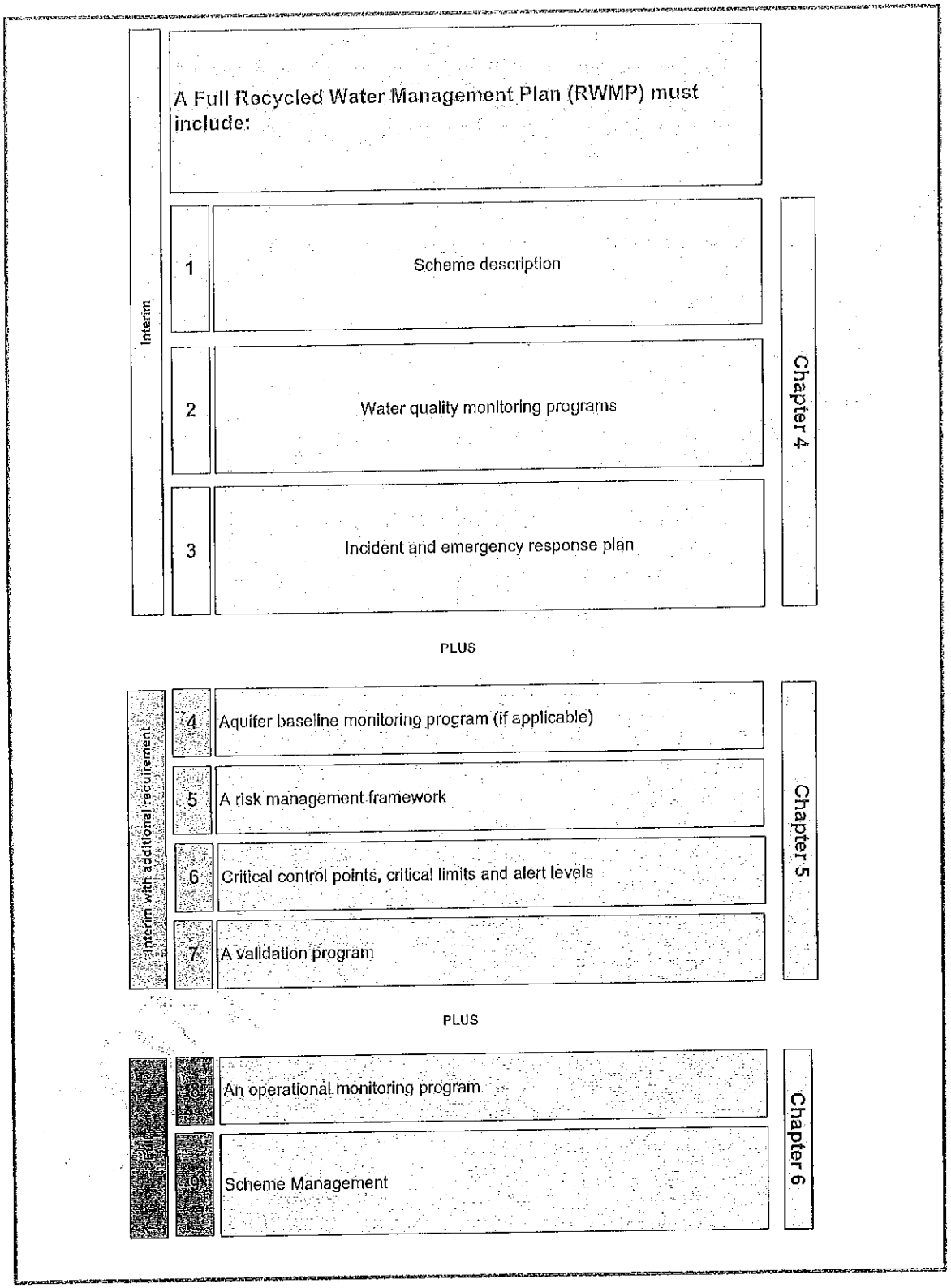

Figure 5: Components in a full RWMP

6.1 Operational monitoring program

Operational monitoring is required to ensure that the production and supply of recycled water is occurring as per the scheme's design and operational plans. It can also be used to assess whether control measures and limits are set appropriately.

Parameters selected for operational monitoring should be indicative of infrastructure performance and therefore be monitored on a continuous basis. For example, turbidity is used as a measure of filtration efficiency, and pressure decay testing is used as a measure of membrane treatment performance. The selection of surrogates or indicators is appropriate providing they are properly validated and the treatment system is operating according to the validated limits.

Continuous monitoring, including alarm systems, can provide real time management and response to operational issues. Monitoring is part of a feedback loop; it is vitally important that operational monitoring results are analysed and any non-conformance (from source to supply point) is immediately responded to. The monitoring management system should be flexible and responsive to the results and analysis as well as allow for new monitoring methodology and/or scientific advancement(s).

The operational monitoring program should be linked and responsive to the source water monitoring program. This will allow new hazards identified in the source water to be managed and, if necessary, the treatment system to be altered.

The operational monitoring program should include a table similar to the one presented in section 11 (Appendix 3 - Example table for CCP and operational monitoring).

Criteria for all schemes

- A documented operational monitoring program must be included in the RWMP.
- The operational monitoring parameters must be identified and should, at a minimum, include all critical and alert limits identified in sections 5.3.2 and 5.3.3 of this guideline.
- The frequency of monitoring should be responsive to non-conformances. For example, if a sample fails, the monitoring frequency is increased until three successive compliant results have been achieved.
- The operational monitoring program should establish a process for checking performance and implementing control measures.
- The operational monitoring program should include keeping a calibration record and schedule for all monitoring equipment in accordance with manufacturer's specifications.

6.2 Scheme management

An RWMP is a management plan for the scheme. A portion of the plan should include documentation on how all the elements come together to ensure adequate management of the scheme, and therefore consistently achieve the prescribed water quality to protect public health.

Having documented management procedures will help ensure that activities are performed correctly and consistently across the scheme. The scheme management section of an RWMP must contain:

- source water and verification monitoring programs (refer to section 4.3 of this guideline)
- a recycled water policy statement
- maintenance and operational procedures
- quality assurance and quality control procedure
- document and record keeping procedures
- internal reporting procedures
- supporting programs.

Criteria for all schemes

- The RWMP must include documented management procedures for every activity that ensures the correct operation of the scheme in order to ensure that the water quality criteria are met.
- All management procedures should be version controlled documents, stored in a way to promote easy access by all relevant staff.
- All management procedures included in the RWMP must contain:
    - the objective of the procedure

- the levels of responsibility associated with the procedure (for example, who is responsible for updating it, training on it, following it or auditing it)
- at what frequency the tasks are to be performed (including training)
- record keeping requirements
- internal and external reporting requirements
- reviewing and continuous improvement requirements.

6.2.1 Recycled water policy statement

A CSG recycled water policy statement should be included in the RWMP. This statement is used to formalise the commitment to responsible, safe and sustainable use of CSG water. The policy statement should be clear and succinct and should address broad issues and requirements, such as:

- commitment to the application of a risk management approach
- recognition and compliance with relevant regulations and other requirements
- partnership arrangements with agencies and relevant expertise
- communication and engagement with employees, contractors, stakeholders and the public
- commitment to continuously improve management of CSG recycled water.

Criteria for all schemes

- A recycled water policy statement must be included in the RWMP.

6.2.2 Quality assurance and quality control

A quality control (QC) and quality assurance (QA) procedure should establish a framework for managing the different activities in the scheme. QC generally involves performing a task according to established controls (or procedures), for example, sampling according to sampling procedures or guidelines. QA involves checking the QC activities, analysing their results and auditing their efficacy/efficiency.

In managing a CSG recycled water scheme, all source water, operational and verification monitoring programs should be undertaken within a QA/QC framework. Operational staff generally conduct QC, but the same staff should not also be responsible for QA, as there needs to be independent verification of the QC activities.

Criteria for all schemes

- There should be a separate documented procedure for QA and QC.
- All monitoring activities should be undertaken within the QA and QC framework.
- Responsibility for QA and QC activities should be documented and differentiated.
- The staff undertaking the QC should not be responsible for QA.

6.2.3 Documentation control

All documents, management procedures or supporting programs referred to in the RWMP, should be current and controlled. Where these documents are relevant to the production or supply of recycled water, they should be submitted to the regulator as attachments or appendices to the RWMP. Any referenced document not included, may be requested by the regulator for submission and assessment as part of the RWMP approval process (section 203 of the Act).

Criteria for all schemes

- There should be a procedure for document control to ensure that all copies of documents referenced in the RWMP are current and controlled.
- All relevant referenced documents should be attached to the RWMP.

6.2.4 Record keeping

Record keeping is fundamental in demonstrating compliance with legislative requirements and auditing needs. Records range from management decisions and human resources practices to water quality and operational monitoring results.

The record keeping procedure should establish document retention times, having regard to frequency of audits and reporting. For example, if a recycled water provider is required to audit the scheme every five years, it is integral that records are kept for at least those five years.

The record keeping procedure should be linked to the QA/QC procedure so that responsibilities for keeping records and checking records are appropriately kept and documented.

Criteria for all schemes

- There should be a procedure for record keeping.
- The procedure should ensure that records are maintained for all operations of the scheme.
- The procedure should outline document retention times based on any relevant regulatory requirements and satisfy auditing needs.
- There should, where practicable, be a standardised system (for example templates, online databases) for recording information, especially for source water, operational and verification monitoring records.
- The procedure should be linked to the QA/QC procedure to identify levels of responsibility to ensure records are appropriately stored and maintained.

6.2.5 Internal reporting

An internal reporting procedure should document the levels of information to be reported to the correct staff. Internal reporting procedures should be linked to the incident and emergency response plan. It should ensure that the appropriate information is communicated to all relevant staff within a recycled water scheme.

Criteria for all schemes

- The RWMP should include an internal reporting procedure outlining how internal reporting will be conducted, specifying the timeframes within which information should be passed on.
- The procedure should ensure that monitoring and audit results are communicated to all relevant staff.

6.2.6 Audits and reviews

To ensure continuous improvement of the management of the scheme, the Act (section 206) prescribes three separate review and audit requirements:

- Regular reviews - conducted by the recycled water provider or scheme manager.
- Internal audits - conducted by the recycled water provider or scheme manager.
- Regular audits - conducted by external parties.

The RWMP should contain procedures, or alternatively a commitment to undertake the two audits and regular review.

Regular review

A regular review of the RWMP is required to ensure that it continues to accurately reflect the scheme and allows for continuous improvement of it. Under section 258 of the Act, the purpose of a regular review is to ensure the RWMP remains relevant with regard to:

- the operation of the scheme
- the water quality criteria for recycled water relevant to the scheme
- best practice industry standards for the production and supply of recycled water.

The frequency with which the regular review must be undertaken will be set out in the information notice or notice of decision at the time the RWMP is approved. Due to the current limited information available regarding the water quality of CSG recycled water, and the emerging technology available to manage that water, it is expected that the RWMP will be required to be reviewed at least on an annual basis.

The responsible entity should have a review procedure. It should outline all triggers to review, including those outlined in the Act. Appropriate triggers for undertaking internal reviews may include significant scheme changes, an incident, emergency or an unscheduled stoppage of production. They may wish to undertake more frequent internal reviews of the full RWMP, or parts of the scheme. The procedure should document the review schedule.

Criteria for all schemes

- The RWMP should have a procedure outlining the process for undertaking a regular review and any additional reviews.
- The procedure should include triggers for reviews, including linkages to the incident and emergency response plan, situations where the provider becomes aware of changes to the water quality criteria, significant scheme changes, unscheduled stoppages of production or supply.
- The regular review process should include a review of all the components in the RWMP including the scheme description, risk management and monitoring programs.
- Where practical, the risk assessment team should form the basis of the RWMP review team.

Internal and regular audits

Auditing is a form of verification of the performance of the scheme and is essential to ensure that compliance with the RWMP is maintained. The RWMP should include a procedure that outlines triggers for internal audits, and the process for internal auditing requirements.

Under the Act (sections 260 and 261) the responsible entity is required to conduct two types of audits of the RWMP and of the conditions of the plan: internal and regular (external) audits.

The intervals of internal and regular (external) audits will be stated in the information notice or notice of decision at the time the RWMP is approved. Under the Act, the frequency for an internal audit can be set at a minimum of one year, and the regulator has discretion when setting the frequency for regular (external) audits. The regulator will consider the times for the internal and regular audits when setting regular auditing frequency.

Criteria for all schemes

- The RWMP should include a procedure for internal auditing. This procedure should outline:
    - scheduling for internal systems, processes or procedures audits
    - how audit results will be documented and recorded (linking to the document control and record keeping procedures)
    - what will trigger an internal audit (linking, at a minimum, to the incident and emergency response plan)
    - who is responsible for conducting audits, preparing audit reports, preparing recommendations, briefing staff on outcomes and ensuring recommendations are pursued.

Criteria specific to multiple–entity schemes

- The scheme provider plan should have a procedure for internally auditing the scheme as a whole (in addition to each entity's auditing requirements).

6.2.7 Supporting programs

Supporting programs contribute to the safe production and supply of recycled water. Some will have been developed and put in place before the RWMP is completed, while others will be developed in conjunction with the RWMP.

Possible supporting programs are outlined in the paragraphs below. This is not an exhaustive list; supporting programs will change with the scope of the recycled water scheme.

Maintenance and calibration: detailed descriptions, schedules and results for all plant equipment maintenance should be recorded and documented. Instrument calibration should be performed in a similar manner. Any external testing or maintenance of plant equipment and/or instrumentation should be performed by an accredited organisation and be documented.

Training and awareness programs: ongoing training programs should be available to improve and maintain staff proficiency through increased awareness, hygiene and safety. Programs should link to the recycled water policy, operational and maintenance procedures, incident and the emergency response program and review audit procedures. Separate training packages should be provided for site visitors and contractors, which include hygiene and safety.

Existing risk management programs: if existing programs are already in place they should form the basis of, and link with, any new programs being developed within the RWMP.

Agreements: these may be for example, agreements with users, suppliers or entities in a multiple-entity scheme. The responsible entity may wish to have individual agreements with each user (for example each drinking water service provider) for required water quality to be discharged. Contractual arrangements may also assist to facilitate the relationship between entities in a multiple-entity scheme.

Information on the content for agreements can be found in the Manual for Recycled Water Agreements in Queensland on the DERM website at <www.derm.qld.gov.au>.

Community involvement and awareness, media protocols and community information program: engagement with stakeholders such as local communities and other parties that are either affected by, or hold an interest in, a water recycling scheme is important to ensure their continued support. This program should identify all stakeholders and state the commitment of the organisation to appropriately engage these stakeholders. This should include evidence that stakeholders were appropriately engaged during the planning stages of the project. There should be a documented process for appropriately engaging stakeholders throughout the life of the recycled water scheme. This should link to the incident and emergency response plan when communication to stakeholders is required.

Communications protocol: should incorporate how notification will be made to the regulator and other entities in the case of a noncompliance with water quality criteria or production or supply stoppages, and be linked to the incident and emergency response plan.

Research and development: programs focussed on research and development may assist the responsible entity to identify unknown hazards and assess risks, ensuring their RWMP and treatment process remains as up to date as possible.

Criteria for all schemes

- The RWMP should include all the supporting programs for the scheme and list the associated documentation for each supporting program.
- The training and awareness program should document the existing skills and qualifications of operators or positions which have responsibility for a particular process.
- The maintenance and calibration program should be signed off by an appropriately qualified person such as a registered engineer.

7 Process for approval of an RWMP

7.1 What must be submitted to the regulator?

When preparing an RWMP to be submitted to the regulator, one of three approaches will need to be implemented based on the method of supply of CSG water to the water source:

- RWMPs for CSG recycled water schemes proposing the direct or indirect supply of CSG water to a water source (excluding aquifers) will require either an interim RWMP (section 4 of this guideline) or full RWMP (section 6 of this guideline). If an interim RWMP is approved a full RWMP must be submitted and approved within 12 months of supply.
- RWMPs for CSG (aquifer) recycled water schemes proposing the direct or indirect supply of CSG water to an aquifer will require either an interim RWMP including additional requirements (section 4 and 5 respectively, of this guideline) or full RWMP with the additional requirements included (section 6 of this guideline). If an interim RWMP is approved a full RWMP must be submitted and approved within 12 months of supply.
- RWMPs for CSG recycled water schemes proposing the direct supply of CSG water to a drinking water service provider as a source of drinking water will require a full RWMP (section 6 of this guideline).

An application for approval of an interim or full RWMP must be in the approved form accompanied by a copy of the RWMP and the fee prescribed under regulation (section 202 of the Act).

Note: For CSG recycled water schemes proposing the direct supply of CSG water to a drinking water service provider as a source of drinking water, the drinking water service provider for the relevant drinking water service will be required to hold an approved Drinking Water Quality Management Plan (DWQMP), for the part of the drinking water service that uses CSG water, prior to the commencement of supply of CSG water by the CSG recycled water scheme.

7.2 The assessment process for an RWMP

7.2.1 Regulator considerations

In accordance with sections 205 and 329E of the Act, when considering the RWMP the regulator must have regard to the following:

- the interim or full RWMP
- additional information supplied by the responsible entity, to the regulator under section 203 of the Act[30]
- this guideline
- the relevant water quality criteria
- information obtained under section 204, of the Act by the regulator from an advisory council or any other entity that the regulator considers appropriate.

The regulator may also have regard to other matters that advance the public health objectives of the Water *Supply (Safety and Reliability) Act 2008*.

The timeframes for a decision by the regulator about an application made to approve a properly made interim or full RWMP are as follows:

- if a request for additional information has not been made in relation to the RWMP—within 80 business days of receiving the RWMP
- if a request for additional information is made in relation to the RWMP—within 80 business days after the information has been provided.

[30] The regulator may request additional information where needed to make a decision regarding the application. This may include information about the criteria outlined in these guidelines. Any information requested by the regulator under section 203 of the Act may be subject to a request to be verified by statutory declaration.

7.2.2 Regulator's decisions

After consideration of the application, the regulator must make a decision about the application under sections 206(1) of the Act to:

- approve an interim or full RWMP, with or without regulator conditions; or
- refuse to approve an interim or full RWMP.

The regulator must provide the responsible entity, with a notice of the regulator's decision within 10 business days of making the decision. If the RWMP is approved without regulator conditions, the regulator must give the responsible entity a written notice of the decision. If the RWMP is approved with regulator conditions, or the regulator refuses to approve the plan, the regulator must give the responsible entity an information notice.

If an RWMP is approved by the regulator, the notice of the decision or information notice will state for the RWMP for the scheme the intervals at which:

- regular reviews of the RWMP must be conducted (not less than one year)
- internal audits must be conducted (not less than one year)
- regular audits (conducted by an external third party) must be conducted (as determined by the regulator).

If the RWMP is refused by the regulator or the applicant disagrees with the regulator conditions stated on an information notice, the applicant may seek review then appeal the decision. Refer to Chapter 7, Parts 1, 2 and 3 of the Act for further details about internal reviews and appeals of the regulator's decision.

Note: All approved RWMPs will be subject to certain statutory conditions (section 208 of the Act) requiring that notice be given to the regulator as soon as practicable by the recycled water provider or other declared entity (or scheme manager where applicable), if production or supply of recycled water under the recycled water scheme stops, or is intended to be stopped, other than as provided for under the approved RWMP for the scheme.

7.3 Can an approved RWMP be amended?

There are different types of amendments to an RWMP including:

- **amendments requested by the recycled water provider (single scheme) or scheme manager (multiple-entity scheme)** (section 212 of the Act). This type of amendment is subject to the detailed considerations undertaken by the regulator outlined in section 7.2 of this guideline. For example, the regulator can seek additional information, seek advice from another entity or consider compliance with relevant guidelines or water quality criteria when assessing amendment applications.
- **minor amendments by agreement** (section 209 of the Act). Under this section, the relevant entity may, with the regulator's agreement, amend the approved RWMP for the relevant scheme, if the amendment is to:
  - correct a minor error in the plan
  - make another change that is not a change of substance
  - record a change of name or change of ownership in an entity that is part of a scheme.

Note: A minor amendment of an RWMP is not subject to the detailed consideration undertaken by the regulator for assessing an RWMP, as outlined in section 7.2 of this guideline.

- **amendments instigated by the regulator to an approved RWMP for a single-entity recycled water scheme** (section 210 of the Act). The regulator may require an RWMP to be amended if the scheme is a critical scheme:
  - to protect public health
  - to ensure the continuity of the scheme.

Otherwise if the scheme is not a critical scheme:

  - to protect public health.

- **amendments instigated by the regulator to an approved RWMP for a multiple-entity critical recycled water scheme** (section 211 of the Act). The regulator has the ability to instigate an amendment to an approved RWMP for a multiple-entity recycled water scheme if the scheme is a critical recycled water scheme:
  - to protect public health

- to ensure the continuity of the scheme.

Otherwise if the scheme is not a critical recycled water scheme:

- to protect public health.

Note: Regulator instigated amendments under sections 210 and 211 of the Act, are subject to a show cause process before the regulator's amendment(s) to the plan is required. This allows the responsible entity, to make submissions to the regulator about the proposed amendments. If, after considering properly made submissions, the regulator is still satisfied that the amendments should be made, the regulator will give the responsible entity a notice requiring them to amend the plan in a stated way and within a stated timeframe. This summary does not contain all of the Act requirements and providers should refer to sections 210 and 211 of the Act for full details.

7.4 How long does an approved RWMP last?

Interim RWMPs will be valid for a 12 month period[31], after which the responsible entity will be required to submit a full RWMP. Full RWMPs do not have a specified expiry date.

For both interim and full RWMPs other provisions may apply. For example, the regulator may suspend or cancel an RWMP if the regulator is satisfied, or reasonably believes, the responsible entity for a recycled water scheme has not complied with the RWMP, or the conditions of the RWMP, or a compliance notice (refer to section 213 of the Act).

If the regulator intends to suspend or cancel an RWMP, the regulator must give the proponent an opportunity to rebut the proposed action. This opportunity will come in the form of a show cause notice. Copies of the show cause notice must be given to each of the entities in the scheme. The regulator must consider all properly made submissions before making a decision to either suspend or cancel the RWMP. A responsible entity that receives a copy of a show cause notice may make a submission in relation to the notice.

If, after giving a show cause notice about suspending or cancelling an RWMP and after considering all properly made submissions, the regulator decides to suspend or cancel the RWMP, the regulator must, within 10 business days of making the decision, give an information notice to the responsible entity.

If, after considering any properly made submissions, the regulator decides not to suspend or cancel an RWMP, the regulator must, within 10 business days of making the decision, give a notice to responsible entity that the suspension or cancellation will not take place.

Note: If an RWMP is suspended, the suspension ends only when the resumption of supply of recycled water under the recycled water scheme to which the plan relates is taken to be approved by the regulator. Applications for resumption of supply are made under section 215 of the Act.

The regulator may also suspend an RWMP for a scheme if the regulator has received a notice that the production or supply of recycled water under the scheme has temporarily stopped (section 214 of the Act).

The Act requires that a notice be given to the regulator when unplanned or unscheduled stoppages not covered under the approved RWMP occur. Notice of the unplanned stoppage gives the regulator the option of suspending the plan if appropriate in the circumstances. It is likely that an RWMP would be suspended if, for example, both production and supply of recycled water were stopped for an extended period. If supply of the recycled water ceased because of the loss of a major customer, but the treatment plant continued to operate, it is unlikely that the full RWMP for the scheme would need to be suspended.

Suspending a full RWMP enables the regulator to require that the scheme be validated before approving the resumption of supply of recycled water under the scheme.

7.5 If an RWMP is suspended, what process is followed to recommence supply?

If an RWMP is suspended, the responsible entity must obtain approval from the regulator to recommence supply. The regulator may give approval for the resumption of supply of recycled water under the scheme following an application to the regulator (section 215 of the Act). The application must be in the approved form, be accompanied by enough information to enable the regulator to decide the application and be accompanied by the fee prescribed under a regulation.

[31] Or a shorter period if the regulator reasonably believes a shorter period is required to protect public health.

After considering an application and any information the regulator considers relevant to the application, the regulator must, as soon as practicable, decide to:

- approve the application without conditions
- approve the application on the condition that:
    - the scheme be 'validated' by undertaking the validation program for the scheme
    - testing of the plant and equipment under the program shows the quality of the scheme's recycled water consistently meets the relevant water quality criteria for the scheme – and that the relevant entity for the scheme (that is, a recycled water provider in a single entity scheme, or a scheme manager for a multiple entity scheme) gives evidence satisfactory to the regulator
- refuse to approve the application and direct the responsible entity to amend the full RWMP, scheme manager plan or any of the scheme provider plans, in the way the regulator considers appropriate, and to apply to the regulator for approval of the amendment
- refuse to approve the application.

The regulator must notify the responsible entity of the decision within 10 business days after deciding the application. If an application is approved without conditions, the regulator must give a notice of the decision. If an application is approved with conditions or refused, the regulator must give an information notice.

The resumption of supply of recycled water under the recycled water scheme is taken to be approved at one of the following stated times:

- when the notice of the decision is given
- when the regulator gives the relevant entity a notice that it is satisfied with the evidence provided, where the application was approved on the condition that:
    - the validation program be undertaken
    - the testing of any treatment component under the program shows that the quality of the scheme's recycled water consistently meets the water quality criteria relevant to the scheme
    - the responsible entity, gives the regulator satisfactory evidence of the previously mentioned testing
- when the amended full RWMP is approved – where the application was refused under the circumstances where the regulator directed an entity under section 215(4)(d) of the Act, or directed a recycled water provider under section 215(4)(c) of the Act to amend a plan and to apply for approval of the amended plan.

7.6 What happens if the supply of the recycled water needs to cease permanently?

The recycled water provider, scheme manager and other declared entities have an obligation to give the regulator notice if they propose to permanently stop the supply of recycled water under the scheme, and there is no other entity willing to take over the operation of all or part of the scheme (refer to section 230 of the Act).

For critical recycled water schemes, the notice to the regulator must be given at least 60 days before supply of the recycled water is proposed to stop, unless the recycled water provider for a single-entity scheme or the scheme manager for a multiple-entity scheme has a reasonable excuse for not giving notice. There is a significant maximum penalty for non-compliance.

Additionally, if a post supply obligation has been imposed on a CSG (aquifer) recycled water scheme and supply of recycled water from the scheme has stopped the following applies:

- The entities and infrastructure that comprised the scheme immediately before the supply of recycled water ceased are still considered to comprise the scheme.
- An entity that was a responsible entity for the scheme immediately before the supply of recycled water ceased is still the responsible entity for the scheme.
- The specific post supply obligation conditions for the approved RWMP continue to have effect despite the supply of recycled water having stopped, and whether or not the RWMP for the scheme has been suspended or cancelled.

The above three points will apply until all post supply obligations in relation to the CSG (aquifer) water recycled scheme have been complied with.

Notice of the entity's intention to cease supply must be submitted in the approved form and state the date by which supply of recycled water is proposed to stop. The regulator may request additional information about the notice, or require any information in the notice or additional information, to be verified by statutory declaration. Failure to supply the additional information or verification of information without a reasonable excuse, and within the reasonable timeframe stated in the notice, renders the notice given by the entity void, that is, the notice ceases to have effect. Additionally, if supply continues after the date stated in the notice by the entity, the notice of intention to cease supply ceases to have effect.

Once supply under the scheme actually stops, the entity must give the regulator notice of the stoppage within five days. This notice must be in the approved form and state the day on which the supply of recycled water ceased. The regulator may cancel an RWMP if the regulator has received a notice that the supply of recycled water under a scheme has permanently stopped.

7.7 Operation under an approved plan

Once an interim or full RWMP is approved, section 270 of the Act requires a recycled water provider, scheme manager or other declared entity, to undertake certain notifications to the regulator where they become aware of a noncompliance.

Noncompliance refers to the water quality criteria set, and approved by the regulator, for the scheme. Notification must be given to the regulator in the approved form which provides the details of:

- the noncompliance and the circumstances that give rise to the noncompliance
- any action taken, or to be taken, by the entity to correct the noncompliance
- the measures the entity will take to prevent the noncompliance in the future.

The notification must be made to the regulator immediately unless there is a reasonable excuse. There is a significant penalty for noncompliance with this requirement of the Act. If the notice is given orally, the recycled water provider, scheme manager, or other declared entity, should give the regulator notice of the information in the approved form as soon as practicable. This form is available online at <www.derm.qld.gov.au>.

It is not a reasonable excuse for the recycled water provider, scheme manager, or other declared entity, to fail to give the relevant information to the regulator on the grounds that notification might tend to incriminate them. However, if the responsible entity is an individual, evidence of, or evidence directly or indirectly derived from, the relevant information that might tend to incriminate the entity is not admissible in evidence against the entity in a civil or criminal proceeding, other than a proceeding for an offence about the falsity of the information.

8 Glossary

Term	Meaning
AGWR	The Australian Guidelines for Water Recycling.
Approved recycled water management plan	A recycled water management plan approved by the regulator and not suspended or cancelled, under Chapter 3 of the *Water Supply (Safety and Reliability) Act 2008*.
AS/NZS	Australian Standards/New Zealand Standards.
Attenuation zone	The area surrounding the zone of recharge where natural attenuation takes place. All the pre-existing environmental values of the aquifer are continually met beyond this zone. After any managed aquifer recharge project ceases, the attenuation zone will shrink and disappear as all groundwater conforms to pre-existing environmental values. Verification monitoring would normally be undertaken on the perimeter of the attenuation zone, and in the recharge zone when the operation ceases. (source: AGWR)
Audit Reporting Guideline	The guidelines issued by the regulator under section 571(1)(l) of the *Water Supply (Safety and Reliability) Act 2008*.
Annual Reporting Guideline	The guideline issued by the regulator under section 571(1)(m) of the *Water Supply (Safety and Reliability) Act 2008*.
Business day	A day that is not- (a) a Saturday or Sunday; or (b) a public holiday, special holiday or bank holiday in the place in which any relevant act is to be or may be done.
Cavitation	The process of collapsing the coal to create a down-hole cavern and distressed area at the well bore to enhance production, usually using compressed air.
Coal seam gas	Petroleum (in any state) occurring naturally in association with coal or oil shale, or in strata associated with coal or shale mining.
Coal seam gas water	Coal seam gas water means underground water brought to the surface of the earth in connection with exploring for or producing CSG, and includes CSG water: (a) whether it is treated or untreated; or (b) that is mixed with other water.
Commissioning verification	A type of validation that is distinct from other validation methods, because it is done by testing the end product water. This is performed to prove that the expected water quality is being consistently produced.
Compliance period	(a) three months from the day notice of the revocation of the exclusion decision is given to the original applicant; or (b) if the regulator gives the relevant parties a notice stating that the compliance period is a period that is more than three months, but not more than six months, from the day mentioned in paragraph (a) – that period.

Term	Meaning
Conditions	(a) of an approved recycled water management plan, means— (i) any regulator conditions for the plan; or (ii) a condition mentioned in section 208(2), (3), (5) or (6) of the *Water Supply (Safety and Reliability) Act 2008* that applies to the plan; and (b) of an exclusion decision, means— (i) any condition mentioned in section 327 of the *Water Supply (Safety and Reliability) Act 2008*.
Control measure	Any action or activity that can be used to prevent, eliminate or reduce a hazard to an acceptable level.
Corrective actions	Corrective actions are those taken immediately to prevent hazards from reaching end users for example, actions taken following noncompliance with water quality criteria.
Critical Control Point (CCP)	A point, step or procedure at which control can be applied and which is essential to prevent or eliminate a hazard or reduce it to an acceptable level.
Critical recycled water scheme	A recycled water scheme declared to be a critical recycled water scheme under Chapter 3 of the *Water Supply (Safety and Reliability) Act 2008*. All CSG recycled water schemes will be declared critical.
CSG (aquifer) recycled water scheme	A CSG recycled water scheme under which recycled water is supplied by its release, directly or indirectly, into an aquifer.
CSG recycled water scheme	A recycled water scheme under which recycled water that is coal seam gas water is supplied, or produced and supplied.
DERM	The Department of Environment and Resource Management.
Drinking water service provider	A water service provider for a drinking water service.
Event	(a) means anything that has happened or is likely to happen, in relation to a recycled water scheme or drinking water service, that may have an adverse effect on public health; and (b) if a post supply obligation is imposed in relation to a CSG (aquifer) recycled water scheme-subject to section 329I(3), includes anything that happens or is likely to happen after the supply of recycled water under the scheme has stopped, whether or not the approved recycled water management plan for the scheme has been suspended or cancelled.
Exceedence	Water quality that goes outside identified limits. These limits may include alert levels, critical limits or water quality criteria.
Exclusion decision	An exclusion decision made under Chapter 3 Part 9A of the *Water Supply (Safety and Reliability) Act 2008*.

Term	Meaning
Extraction zone	The area surrounding the point at which groundwater is removed from an aquifer. The extent of this zone will be determined by the rate of extraction from, and the physical characteristics of, the aquifer. Contaminants found within this zone may be included in the extracted groundwater.
Fraccing	The process of fracturing and propping open the coal with hydraulic pressure and sand to enhance production and it excludes cavitation.
HACCP	Hazard Analysis and Critical Control Point.
Hazard	A biological, chemical or physical agent in, or condition of, recycled water with the potential to cause an adverse health effect.
Hazardous event	A hazardous event is the result of a hazard or one that can lead to the presence of a hazard.
Hydraulic impact zone	From the release of recycled water that is coal seam gas water into an aquifer, means the zone in which there is an attributable change in hydraulic head within the aquifer.
Incident and emergency response plan	For a recycled water scheme, means a documented plan about the procedures to be followed for incidents or emergencies that affect or may affect the quality of recycled water under the scheme, including- (a) the preventative and corrective actions to be taken; and (b) protocols for communication between entities that are part of the recycled water scheme, the regulator and any other stakeholders.
Industry code or best practice management document	A published standard by a body that the regulator considers to be a recognised industry body.
Influent	Liquid waste flowing into a recycled water provider's treatment facility.
Multiple-entity recycled water scheme	1) A multiple-entity recycled water scheme means a scheme involving: (a) the production and supply of recycled water other than coal seam gas water; or (b) the production and supply, or supply only, of recycled water that is coal seam gas water; by more than 1 recycled water provider, or at least 1 recycled water provider and another entity. 2) A multiple-entity scheme is made up of : (a) each recycled water provider and other entity declared to be part of the scheme under a declaration for the scheme made under chapter 3, part 8; and (b) the infrastructure for (i) the production and supply of the recycled water; or (ii) if the recycled water is coal seam gas water , the production and supply, or the supply only, of the recycled water that is stated to be part of the scheme under tbe declaration
NATA	National Association of Testing Authorities.

Term	Meaning
Non–conformance	An internal situation (from source water to supply point) whereby a deviation from the acceptable criteria has occurred.
Operational monitoring	The act of conducting a planned sequence of observations or measurements of parameters to assess whether a critical control point (CCP) is reliable and robust.
Point of supply	In relation to water quality criteria the discharge point, where possible. There are instances where this is not practical and will not accurately represent the water quality of the scheme. In these instances the responsible entity, should discuss with the regulator options for monitoring points including the final recycled water monitoring point.
Preventive actions	Actions taken to investigate the cause of a non-conformance or non-compliance and prevent it from happening again.
Receiving water source	Means any of the following- (a) a watercourse or lake, including a dam or weir across the watercourse or lake (b) an aquifer (c) a dam or weir that is not located across a watercourse or lake (d) another source of water prescribed under a regulation.
Recharge zone	The area of the aquifer surrounding the recharge site that is impacted by the supply of water into the aquifer.
Recycled water	Means- (a) any of the following that are intended to be reused: (i) sewage or effluent sourced from a service provider's sewerage (ii) wastewater, other than water mentioned in the subparagraph i); or (b) coal seam gas water that augments a supply of drinking water.
Recycled Water Management Plan (RWMP)	For a single-entity recycled water scheme a plan about: • the production and supply of recycled water other than coal seam gas water under the scheme by the recycled water provider for the scheme; or • the production and supply, or supply only, of recycled water that is coal seam gas water under the scheme by the recycled water provider for the scheme. For a multiple-entity recycled water scheme a plan about: • the production and supply of recycled water other than coal seam gas water under the scheme; or • the production and supply, or supply only of recycled water that is coal seam gas water under the scheme; consisting of a scheme manager plan and a scheme provider plan for each declared entity in the scheme.
Recycled Water Management Plan and	The guidelines issued by the regulator under section 571(1)(i) and (j)

Term	Meaning
Validation Guideline	of the *Water Supply (Safety and Reliability) Act 2008*.
Recycled water provider	An entity that owns infrastructure for: • the production and supply of recycled water other than CSG water; or • the production and supply, or the supply only of recycled water that is CSG water.
Recycled water scheme	A single-entity or a multiple-entity recycled water scheme.
Regulator	The chief executive of the Department of Environment and Resource Management (DERM).
Regulator conditions	(a) for an approved recycled water management plan—see section 205(1) of the *Water Supply (Safety and Reliability) Act 2008* (b) for an exclusion decision—see section 327 of the *Water Supply (Safety and Reliability) Act 2008*.
Relevant location	For chapter 3, pt 9A, for a drinking water service provider, is the location at which the drinking water service provider is authorised, under the Water Act, to take water that is, or is intended to be, supplied as drinking water.
Relevant plan	Under section 329B(6): (a) for a CSG (pt 9A, div 3) scheme that is a single-entity recycled water scheme-a recycled water management plan for the scheme; or (b) for a CSG (pt 9A, div 3) scheme that is a multiple-entity recycled water scheme- (i) if the responsible entity to whom a notice is given under subsection 329B(2)(b) is the scheme manager for the scheme-a scheme manager plan for the scheme; or (ii) otherwise – a scheme provider plan for the scheme.
Relevant water	For a CSG (aquifer) recycled water scheme referred to in section 201A means each of the following: (a) the recycled water supplied under the scheme; (b) the water in the aquifer after the recycled water has been released into it; (c) the water in the aquifer at the relevant location for a drinking water service provider.
Responsible entity	(a) for a CSG recycled water scheme, means- (i) if the CSG recycled water scheme is a single-entity recycled water scheme-the recycled water provider for the scheme; or (ii) if the CSG recycled water scheme is a multiple-entity recycled water scheme-the scheme manager and each recycled water provider or other declared entity for the scheme; or (b) for chapter 8, pt 1, div 1 – see section 530(3); or (c) for chapter 8, pt 1, div 2 – see section 535(1)(a).
Reused	Includes being treated to improve the water's quality, but does not include merely being discharged into, or disposed of in, the

Term	Meaning
	environment.
Risk	The likelihood that identified hazards will cause harm in exposed populations including the magnitude of that harm (risk = likelihood x impact).
Scheme manager	The scheme manager for a multiple-entity recycled water scheme is the entity: (a) the recycled water providers and other entities declared to be part of the scheme agree is the scheme manager for the scheme; and (b) either— (i) stated in the declaration under Chapter 3, Part 8 of the *Water Supply (Safety and Reliability) Act 2008* for the scheme to be the scheme manager; or (ii) stated in the notice given under section 307(2) of the *Water Supply (Safety and Reliability) Act 2008.*
Scheme manager plan	For a multiple-entity recycled water scheme, means a plan about the how the scheme manager for the scheme is to coordinate management of the scheme to ensure the continued operation of the scheme.
Scheme provider plan	For a multiple-entity recycled water scheme, means a plan about the production or supply of recycled water under the scheme by a recycled water provider or other declared entity for the scheme.
Single–entity recycled water scheme	(a) means a scheme involving: (i) the production and supply of recycled water, other than coal seam gas water, by only 1 recycled water provider; or (ii) the production and supply, or supply only, of recycled water that is coal seam gas water by only 1 recycled water provider; and (b) includes the infrastructure, owned by the provider, for the production and supply, or the supply only, of the water.
Source water	Coal seam gas water produced under the CSG recycled water scheme, including coal seam gas water from a petroleum well or in a feed pond.
Statutory condition	Any conditions imposed under section 208 of the *Water Supply (Safety and Reliability) Act 2008* for a recycled water management plan or section 256 of that Act for an exemption.
Supply	For coal seam gas water that is recycled water: (a) release of the recycled water, directly or indirectly into a water source, if the recycled water is used by a drinking water service provider in a drinking water service; or (b) delivery of the recycled water by an entity, other than a drinking water service provider who uses the recycled water in a drinking water service, to another entity, if the recycled water is used by a drinking water service provider in a drinking water service.
Supporting programs	The many actions that contribute to the safe production and supply of recycled water but do not in themselves constitute control measures.
Transitional period	For chapter 10, part 4 see section 642(2)

Term	Meaning
Validate	To carry out testing of the plant or equipment used for the treatment of recycled water under the scheme to show the quality of the recycled water consistently meets the water quality criteria for recycled water relevant to the scheme.
Validation program	A documented program about how the plant and/or equipment used for the treatment of recycled water under the scheme are to be tested to show the quality of the recycled water consistently meets the water quality criteria for the scheme.
Verification program	For a CSG (pt 9A) scheme means a documented program about how the recycled water produced or supplied under the scheme will be tested to show the quality of the recycled water consistently meets the water quality criteria for recycled water relevant to the plan.
Wastewater	Wastewater as defined in the *Water Supply (Safety and Reliability) Act 2008* as the spent or used water generated on premises from industrial, commercial or manufacturing activities, or animal husbandry activities prescribed under a regulation, other than spent or used water generated from an agricultural activity or a mining activity or petroleum activity.
Water quality monitoring and reporting program	For a CSG (pt 9A) scheme, means a documented program about: (a) how the quality of recycled water under the scheme is to be monitored, including: (i) the frequency of monitoring (ii) the parameters to be used for indicating compliance with the plan and the water quality criteria for recycled relevant to the plan (b) the giving of periodic reports about the monitoring to the regulator.
Water service provider	A person registered under Chapter 2, Part 3, of the *Water Supply (Safety and Reliability) Act 2008*, as a service provider for a water service.
Watercourse	A river, creek or other stream, including a stream in the form of an anabranch or a tributary, in which water flows permanently or intermittently, regardless of the frequency of flow events: (a) in a natural channel, whether artificially modified or not; or (b) in an artificial channel that has changed the course of the stream. It also includes weirs, lakes and dams.
Water source	Means any of the following- (a) a watercourse or lake, including a dam or weir across the watercourse or lake; or (b) an aquifer; or (c) a dam or weir that is not located across a watercourse or lake; or (d) another source of water prescribed under a regulation.

Term	Meaning
Weir	(a) means a barrier constructed across a watercourse below the banks of the watercourse that hinders or obstructs the flow of water in the watercourse; and (b) for the definition of water source – includes a barrier constructed across or within a lake that interferes with water in the lake.

9 Appendix 1 - CSG water quality requirements

The pre-supply water quality data collection program, aquifer baseline, source water, operational and verification monitoring programs should be developed in accordance with the parameters listed below in Table 2.

Table 2: CSG water quality requirements

Chloroform (DB)	Naphthalene	Copper
Bromodichloromethane (DB)	PAH (as B(a)P PEF)	Dysprosium
Dibromochloromethane (DB)	Benzene	Erbium
Bromoform (DB)	Toluene	Europium
THM (DB)	Ethylbenzene	Gadolinium
2,2-Dichloropropionic acid (DB)	Xylenes (all isomers)	Gallium
Monochloroacetic acid (DB)	Nonylphenol	Germanium
Monobromoacetic acid (DB)	Bisphenol A	Gold
Dichloroacetic acid (DB)	Phenol	Hafnium
Dibromoacetic acid (DB)	2-Chlorophenol	Holmium
Bromochloroacetic acid (DB)	2-Methylphenol	Indium
Bromodichloroacetic acid (DB)	4-Methylphenol	Iodine
Chlorodibromoacetic acid (DB)	2-Nitrophenol	Iridium
Trichloroacetic acid (DB)	2,4-Dimethylphenol	Iron
Tribromoacetic acid (DB)	2,4-Dichlorophenol	Lanthanum
HAA6 (DB)	2,6-Dichlorophenol	Lead
Monochloroacetonitrile (DB)	4-Chloro-3-methylphenol	Lithium
Dichloroacetonitrile (DB)	2,4,6-Trichlorophenol	Lutetium
Trichloro-acetonitrile (DB)	2,4,5-Trichlorophenol	Magnesium
Monobromoacetonitrile (DB)	2,4-Dinitrophenol	Manganese
Dibromoacetonitrile (DB)	4-Nitrophenol	Mercury
Bromochloro-acetonitrile (DB)	2,3,4,6-Tetrachlorophenol	Molybdenum
Total organic halogen (TOX) (DB)	2-Methyl-4,6-dinitrophenol	Neodymium
Chlorite (DB)	Pentachlorophenol	Nickel
Chlorate (DB)	Cyanide	Niobium
Chlorine dioxide (DB)	Chloride	Osmium

Bromate (DB)	Fluoride	Palladium
N-Nitrosodimethylamine (NDMA) (DB)	Nitrate	Platinum
Total Petroleum Hydrocarbons	Sulphate	Potassium
Benzo[ghi]perylene	Aluminium	Praseodymium
Dibenz[a,h]anthracene	Antimony	Rhenium
Indeno[1,2,3-cd]pyrene	Arsenic	Rhodium
Benzo[a]pyrene	Barium	Rubidium
Benzo[b+k]fluoranthene	Beryllium	Ruthenium
Chrysene	Bismuth	Samarium
Benz[a]anthracene	Boron	Scandium
Pyrene	Bromine	Selenium
Fluoranthene	Cadmium	Silver
Anthracene	Calcium	Sodium
Phenanthrene	Cerium	Strontium
Fluorene	Cesium	Tantalum
Acenaphthene	Chromium	Tellurium
Acenaphthylene	Cobalt	Terbium
Thallium	Titanium	Ytterbium
Thorium	Tungsten	Yttrium
Thulium	Uranium	Zinc
Tin	Vanadium	Zirconium
Alpha Emitters		
Beta Emitters		
radiological compounds (total radionuclide exposure)		

DB indicates the parameter is a disinfection by-product.

Any additional monitoring requirements have been specified in the relevant sections of this guideline. The parameters outlined above are likely to change significantly once a robust water quality dataset has been developed by industry.

10 Appendix 2 - Example table for risk management

Process step	Source of hazard	Hazard	Hazardous event	L	C	U risk	Control measure	Monitoring of control measure	L	C	R risk	Follow-up ac

Where L = likelihood, C = consequence, U risk = unmitigated risk and R risk = residual risk

11 Appendix 3 - Example table for CCP and operational monitoring

Process step	CCP or QCP	Operational monitoring		Corrective actions		Additional control measures/preventative measures
		Alert limit	Critical limit	Alert limit	Critical limit	
		Parameter: Limit: Where: How: When: Who:	Parameter: Limit: Where: How: When: Who:	Responsible:	Responsible:	
		Parameter: Limit: Where: How: When: Who:	Parameter: Limit: Where: How: When: Who:	Responsible:	Responsible:	

12 Appendix 4 - Surrogate parameters identified for different treatment processes

Mechanism	Treatment Process	Surrogate for performance assessment
Chemical Oxidation	Ozone	ΔUVA; Δcolour; 3-D fluorescence; Δformate; Δassimilable organic carbon (ΔAOC); integral contact time (CT)
	Advanced oxidation (ozone/H2O2; ozone/UV; UV/H2O2)	ΔUVA; Δcolour; 3-D fluorescence; Δformate; Δoxalate; Δaldehyde; ΔAOC
	Chlorination	Integral contact time (CT)
	Chloramination	Not a viable process to remove organic contaminants
UV Disinfection	Low and medium pressure UV	Not a viable process to remove organic contaminants unless UV intensity and dose is higher than that used for disinfection
Adsorption	PAC	ΔUVA; 3-D fluorescence
	GAC	ΔUVA; 3-D fluorescence; ΔTOC
Physical separation	Reverse Osmosis	Δconductivity
	Nanofiltration	Δcalcium; Δmagnesium

Modified from Khan S, Quantitative Chemical Exposure Assessment for Water RecyclingSschemes, National Water Commission Waterlines Report Series No 27, March 2010

On-going monitoring list from QH – schemes to include other parameters found from risk assessments (surface water discharge)

Chemical	Standard (ug/L)
THM (Total)	200
dichloroacetonitrile	2
bromochloro-acetonitrile	200
N-Nitrosodimethylamine (NDMA)	0.1
Total Petroleum Hydrocarbons	200
PAH (as B(a)P PEF)	0.01
Benzene	1
Toluene	800
Ethylbenzene	300
Xylenes (all isomers)	600
Nonylphenol	500
Bisphenol A	200
Cyanide	80
Fluoride	1500
Aluminium	200
Antimony	3
Arsenic	7
Barium	700
Boron	4000
Bromine	7000
Cadmium	2
Chromium	50
Copper	2000
Iodide	500
Lead	10
Manganese	500
Mercury	1
Molybdenum	50
Nickel	20
Selenium	10
Silver	100
Strontium	4000
Uranium	20
Vanadium	50
Zinc	3000
radiological compounds (total radionuclide exp.)	0.5 mSv/year

[redacted]

From: Ben McMahon
Sent: Wednesday, 6 April 2011 4:39 PM
To: [redacted]
Cc: Environment Mailbox; [redacted]
Subject: MGP discharge result notification
Attachments: ENV11-054_Notification of release exceedence - MGP TEP.pdf; TEP Results-6 April 2011.xls

[redacted]

Please find attached advice regarding recent test results from the MGP TEP.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T: [redacted]
F:
M
www.arrowenergy.com.au

6 April 2011

arrowenergy
go further

Ref: ENV11-054

[redacted]
Manager, Petroleum and Gas Unit
Department of Environment & Resource Management
(sent via email 6 April 2011)

RE: Notification of release event exceedence

Dear [redacted]

I am writing on the behalf of Arrow Energy Limited (Arrow) to provide notification of a release event exceedence in relation to the MGP TEP discharge.

Date:
26 March 2011

Location:
Moranbah

Description:
Recent sampling has identified elevated downstream concentrations of Fluoride. Concentrations of 0.1 mg/L were reported for the upstream monitoring site (MP3), and a concentration of 9.0 mg/L was reported at the downstream monitoring site (MP2) on the 26th March 2011. The remainder of the analytical results appear to be consistent with historical data. Based on the historical reported concentrations of fluoride at the discharge location, and in Dams 1, 2, 5 and 10, and the results of sampling conducted on 26 March 2011 (i.e. the highest reported fluoride concentration of 2.4 mg/L), it is considered highly unlikely that the elevated concentration of fluoride at the downstream location is the result of Arrow's activities. All available data has been tabulated and made available for DERM to review.

Potential Impact:
Based on review of the historical data, it is considered highly unlikely that the elevated concentration of fluoride at the downstream location is the result of Arrow's activities. The accuracy of the 9 mg/L result is currently being queried with the analysing laboratory.

Immediate Actions:
- Query the analysing laboratory as to the accuracy of the reported data. Provide additional analytical data to DERM as it becomes available.
- Arrow is to continue discharging as per the requirements of the TEP.

Further advice and actions regarding this notification will be provided to DERM as information becomes available.

Regards,

[redacted]

Ben McMahon
Manager Compliance & Reporting

T +61 7 3012 4000 ARROW ENERGY LTD LEVEL 19, AM-60, 42-60 ALBERT STREET GPO BOX 5262 BRISBANE QLD 4001 info@arrowenergy.com.au
F +61 7 3012 4001 ABN 73 078 521 936 BRISBANE QLD 4000 ASX CODE AOE arrowenergy.com.au

[redacted]

From: Ben McMahon
Sent: Thursday, 7 April 2011 4:08 PM
To: [redacted]
Cc: [redacted] Environment Mailbox
Subject: ENV11-055 Information request flooding incidents
Attachments: ENV11-055 Information request flooding incidents.pdf

Hi [redacted]

Please find attached a letter to follow up on our conversation and the information request made earlier this year in relation to the incidents that occurred during the flooding in January.

Best regards

Ben McMahon
Manager Compliance & Reporting

Arrow Energy Pty Ltd
Level 19, AM-60, 42-60 Albert St, Brisbane QLD 4000
GPO Box 5262, Brisbane QLD 4001, Australia
T [redacted]
F
M
www.arrowenergy.com.au

6 April 2011

arrowenergy
go further

Ref: ENV11-054

[redacted]
Manager, Petroleum and Gas Unit
Department of Environment & Resource Management
(sent via email 6 April 2011)

RE: Notification of release event exceedence

Dear [redacted]

I am writing on the behalf of Arrow Energy Limited (Arrow) to provide notification of a release event exceedence in relation to the MGP TEP discharge.

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Potential Impact:
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Further advice and actions regarding this notification will be provided to DERM as information becomes available.

Regards,

[redacted]

Ben McMahon
Manager Compliance & Reporting

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F +61 7 3012 4001 ABN 73 078 521 936 BRISBANE QLD 4000 ASX CODE AOE arrowenergy.com.au

Annexure Annexure-GDC-16 Not Used

DOC NO: ENV11-132

REV 0

STATUS: IFU

Review Date: December 2013

DOC OWNER: ASSET NORTH

Coal Seam Gas Water Management Plan

Bowen Basin

REV	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
A	26/07/11	ISSUED FOR COMMENT	BW		
B	27/7/11	ISSUED FOR REVIEW	BW/AP		
0	29/7/11	ISSUED TO DERM	AP/BW		

Contents

1. INTRODUCTION

1.1. PURPOSE AND SCOPE

The purpose of this Coal Seam Gas (CSG) Water Management Plan (the Plan) is to define and communicate Arrow Energy's strategy for the current and future management of CSG water in the Bowen Basin. Bowen Basin activities addressed by this plan include gas exploration, appraisal, and production interests for the domestic market.

This document has been developed in accordance with relevant legislation, government guidelines and Policy (further discussed in Section 2, below).

Under the *Environmental Protection Act 1994*, a revised (CSG) environmental management plan is required for environmental authorities (EA) in force prior to 5 July 2010. This revised (CSG) environmental management plan (the Plan) has been submitted to fulfil this requirement and addresses the following Level 1 EAs within the Bowen Basin.

Table 1: EA's addressed in the plan

EA	Applicable Tenures
PEN100015907	PL191, PL196
PEN100251408	PL224
PEN100317009	PL223

1.2. OBJECTIVES

In addition to fulfilling relevant legislative and policy requirements, the objectives of this Plan are to:

- Define the hierarchy of options for the disposal of CSG water from appraisal and production activities;
- Establish a management framework for each CSG water disposal option;
- Identify the environmental values potentially affected by activities addressed by the Plan as well as mechanisms for protection (e.g. established procedures);
- Ensure salt will be disposed of in accordance with the Plan; and

- Ensure action is taken, if any of the measurement criteria are not satisfied.

This plan is to be utilised in conjunction with Arrow's CSG Water Management Strategy.

1.3. Report Structure

The main body of this report describes existing activities, water characteristics, and Arrow's water management strategies in a basin wide context. Specific information with respect to infrastructure, water characteristics and management on each Bowen Basin tenement (and associated EA) is provided in the attached Appendices.

2. Legislative and Policy Requirements

This Plan has been developed in accordance with relevant provisions of the *Environmental Protection Act 1994* (EP Act) (including Section 310 D), as well as the *Queensland Government's CSG Water Management Policy 2010*[1]. The plan has also considered the Department of Environment and Resource Management (DERM) guideline *Preparing an environmental management plan for coal seam gas activities*[2] (The Guideline), as well as requirements specified in correspondence received by Arrow from DERM on 20 May 2011, with respect to associated obligations under the EP Act.

Table 1 provides a list of key information requirements (as specified in the Guideline and addressing Section 310D of the EP Act), with reference to where this information is addressed in the Plan.

[1] http://www.derm.qld.gov.au/environmental_management/coal-seam-gas/pdf/water-management-policy.pdf
[2] http://www.derm.qld.gov.au/environmental_management/land/documents/csg-environmental-management-plan.pdf

Table 2: Key information requirements and corresponding sections of the Plan where addressed.

REQUIREMENT	SECTION
Provide an estimate of the quantity of CSG water produced annually over the life of the project.	5 and Appendix 1
Provide an estimate of the flow rate at which the CSG water will be generated.	5 and Appendix 1
Describe the quality of CSG water, including changes in the water quality that may be reasonably expected to occur whilst conducting the activity.	5.3
Describe how and where the CSG water will be produced, aggregated, stored and kept separate from other waters until it is used, treated, distributed or disposed of.	6, 7.3
Describe how the CSG water will be dealt with in accordance with the CSG water management hierarchy, including a description of the estimated amount of CSG water that will be dealt with under the preferred water management options in category 1 and the water management options that are not preferred in category 2.	7.1
Where CSG water is to be treated, describe: • The treatment process; • How and where the treated water will be stored and used; and • How and where the waste generated by the treatment process will be stored, used and/or disposed of.	0, 7.3
If any CSG water is proposed for direct disposal as waste, provide information sufficient to demonstrate that legislative, environmental, technological, economic and social requirements have all been evaluated and taken into consideration in deciding that disposal as waste is the only feasible option.	Table 5
Describe the detail of any pilot programs or trials for CSG water solutions, including: • Objectives of project; • Quantity and quality of CSG water applied; • Location/area; and • Duration of activity.	4.2,, 6.2 and 7.5
Describe the characteristics of any receiving environment.	7.6
Describe the control measures that will be implemented for each water management option (aggregation, storage, treatment, use, or disposal) to prevent or control the release of a contaminant or waste to the environment.	7.7, 7.8

Describe the measurable criteria against which the performance of the CSG water management practices will be assessed. Criteria must include: • The quantity and quality of water used, treated, stored or disposed of; • Protection of the environmental values affected by the relevant CSG activity; • The disposal of waste, including for example, salt, generated from the management of the water.	7.9
Describe a monitoring program sufficient for the prediction and early detection of any detrimental impacts on the receiving environment from CSG water management practices.	7.8
Describe the procedures that will be adopted to regularly review the monitoring program and to report to management and DERM should unforeseen or non-compliant monitoring results be recorded.	7.8
Describe the procedures that will be implemented to prevent unauthorised environmental harm from unforeseen or non-compliant monitoring results.	7.7
Describe procedures for dealing with accidents, spills, failure of containment structures, and other incidents that may arise in the course of the CSG water management practices and result in the unexpected release of contaminants or waste to the environment.	7.7, 7.9
Describe the procedures used to identify and implement strategies that minimise the quantity of CSG water generated at the surface of the land, promote efficiency in the use of CSG water as a resource through direct use and treatment, improve the water management practices employed where non preferred management options are being used, and minimise the total area of land disturbed by water aggregation and storage structures.	7.8 and 7.10

3. BOWEN BASIN TENEMENTS

Arrow's gas exploration and production acreage in the Bowen Basin is centred around the town of Moranbah, approximately 400 km south of Townsville and 170 km west of Mackay (Figure 1). Bowen Basin tenements are shown in Table 3.

Table 3: Bowen Basin Tenements

Current Tenements	
Authority to Prospect (ATP)	**Petroleum Lease (PL)**
716	191
748	196
751	223
753	224
759	
787	
831	
1103	

The development of tenements within the Bowen Basin primarily involves drilling wells and constructing the required infrastructure to extract, compress and transport gas, and to transport, store and treat associated water.

Production and appraisal activities currently undertaken on the above tenures are further described below.

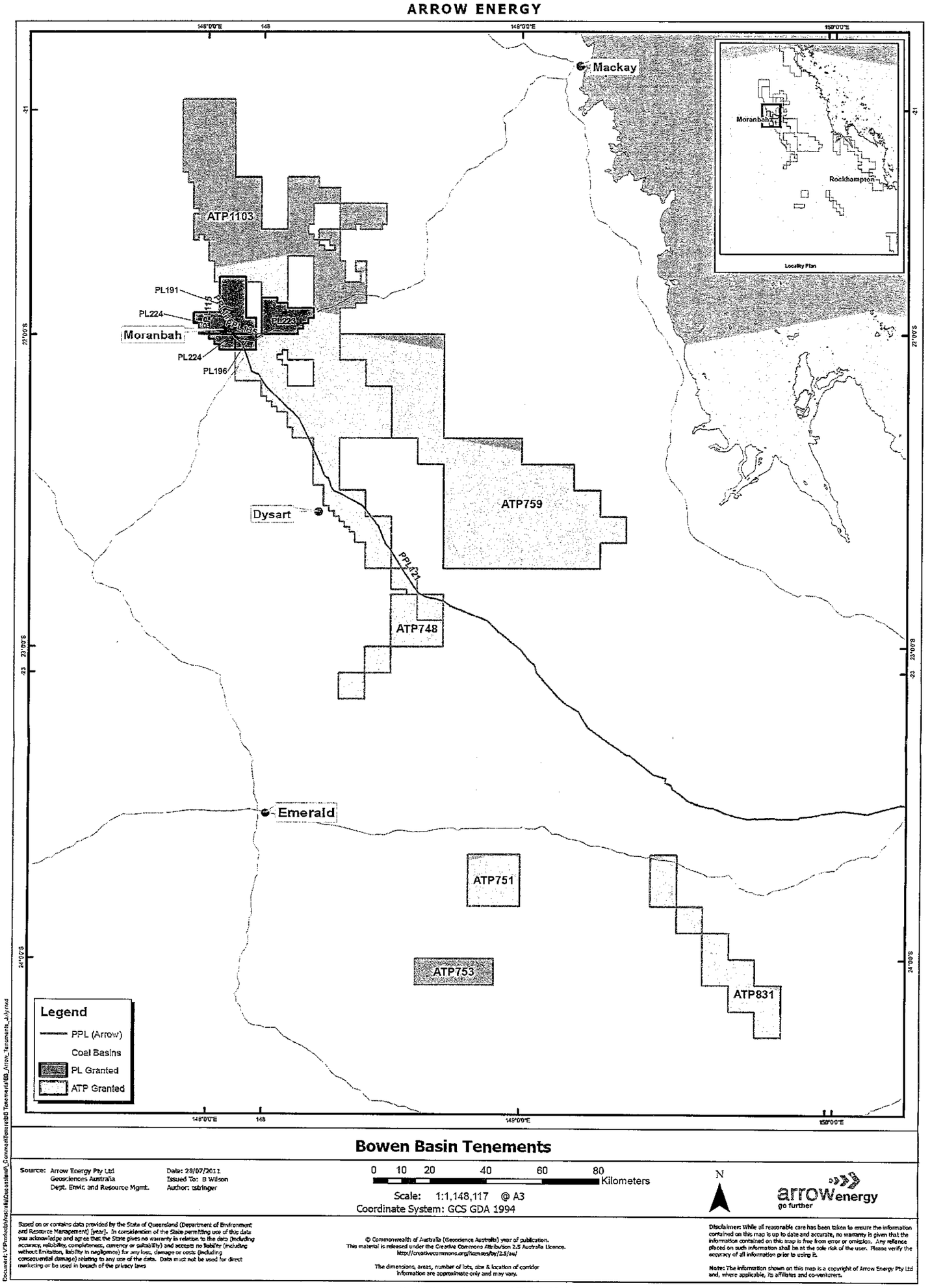


Figure 1: Bowen Basin Tenements

4. BOWEN BASIN ACTIVITIES

4.1. PRODUCTION

The Moranbah Gas Project (MGP), constitutes the majority of Arrow production activities in the Bowen Basin. The MGP produces from 169 production wells across three production leases (PL191, PL196 and PL224.) with a current production capacity of 40 TJ/d.

Production is set due to increase significantly by year end 2011, increasing the total MGP production target to 77 TJ/d. This production target includes a longer term plan to increase utilisation of the Townsville Power Station. Expansion to this production capacity will involve drilling of over 160 additional production wells between 2011 and 2016 and will incorporate associated gas compression and water treatment facilities. Arrow plans to consolidate many of its Bowen Basin tenures (including PL191, PL196, PL223 and PL224) under a single MGP project EA, to achieve consistency in approval conditions and associated management regimes.

A key component of Arrow's production water treatment infrastructure is the establishment of a reverse osmosis (RO) water treatment facility on PL191 (The RO Plant). The RO plant will have a maximum output of 580 ML/yr and will facilitate the treatment and beneficial use of a significant proportion of Arrow's production water in the MGP. The RO plant is use is further described in Section 7.2.2, while other specific Bowen Basin production infrastructure is described in the Environmental Management Plan (EM Plan) associated with each tenure. The production water characteristics for each PL (where known) are described in the attached Appendices.

4.2. EXPLORATION AND APPRAISAL

The exploration and appraisal program being undertaken by Arrow across the Bowen Basin will reduce the uncertainty in subsurface parameters that underpin the modelled rate of gas and expected water volumes. Exploration wells are being drilled to increase certainty in coal depth, thickness and data quality across the basin.

The appraisal program comprises a number of pilot production tests, conducted across the basin, to give a better understanding of dynamic behaviour on a large scale. Each pilot test

consists of four to six wells spaced approximately 200m apart in a diamond shaped layout. The pilot tests generally run for three to six months. The exploration and appraisal data will provide the basis for field development planning work.

Arrow's CSG water management activities covered by this plan will incorporate the current production and field development scheduled to meet domestic gas contracts. Specific exploration and appraisal infrastructure is further described in the EM Plan associated with each tenure.

5. Estimated Water Generation Characteristics

5.1. Production Water Volumes

Water volumes and quality vary considerably with location, well spacing and coal seam depth. Table 1 shows the cumulative water generation forecast for current domestic contracts. The water production will peak at over 3ML/day, with an average (over current forecast) of approximately 2.0ML/day. Figure 2 shows the MGP production volumes over five years.

5.2. Estimated pilot volumes

An Authority to Prospect (ATP) is granted under the Petroleum and Gas (Production and Safety) Act 2004 or Petroleum Act 1923 and authorises the holder to explore for petroleum (including coal seam gas) in Queensland. The purpose of exploration is to obtain information about the coal seam including the volume of water that may be produced.

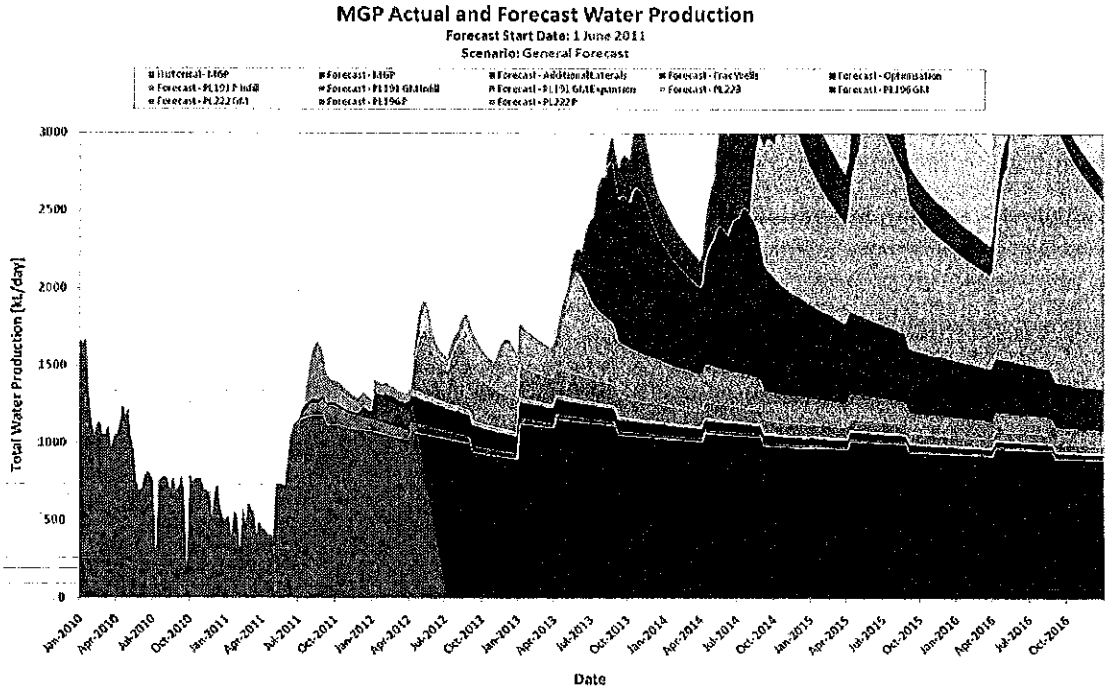


Figure 2: Moranbah Gas Project Water Production

Due to the nature of exploration, the water quantity and quality that will be generated is uncertain and to a large extent unpredictable. However, in some circumstances it is possible to estimate the quantity from previous experience and to extrapolate from exploration activities in close proximity. The CSG water generation curve over time for a typical pilot in the Bowen Basin is illustrated in

Figure **3.**

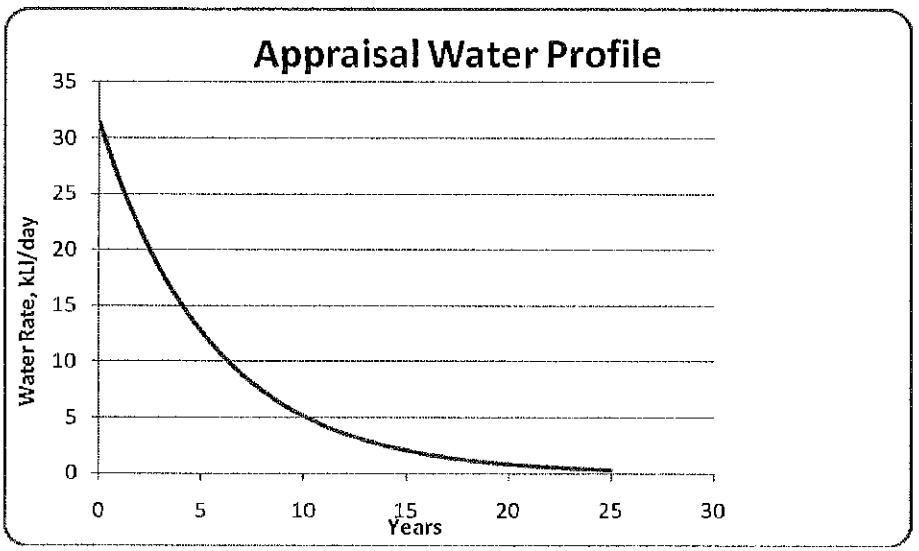


Figure 3 Predicted CSG water production rate over time for a typical pilot

At this stage in exploration Arrow has assumed that all production pilots in the Bowen exploration acreage will produce a similar quantity of water. This translates to an average production of approximately 5 -10 kL/day per site with an anticipated peak production of 30 kL/day at each location in the early dewatering phase.

5.3. Water Quality Characteristics

CSG water extracted from most seams in Australia is saline with Total Dissolved Solids (TDS) typically falling in the range 2,500-8,500 mg/l. Previous exploration in this region indicates a range of 1000 – 11000 mg/l TDS (EC 4000-14000 µs/cm) is a reasonable expectation. The CSG water quality range across Arrow's Bowen Basin tenements is shown in Table 4.

Table 4: Water quality values for Arrow Northern tenements

Bowen Basin Wells						
Parameter	Unit	Min	P10	Median	P90	Max
pH		7.2	7.7	8.1	8.5	8.8
TDS	mg/L	115	2740	4300	7758	10700
Conductivity	uS/cm	4500	5270	9930	12520	13900
TSS	mg/L	9	11	99	381	466
Turbidity	NTU	19	26	55	83	90
Alkalinity (BiCarb)	mg/L	26	291	873	1738	2860
Alkalinity (Carb)	mg/L	1	13	104	440	540
Alkalinity (Hyd)	mg/L	<1	<1	<1	<1	<1
Alkalinity (Total)	mg/L	26	293	951	1877	2860
SO4	mg/L	1	1	1	2	2
Cl	mg/L	15	649.2	1690	4218	5360
Ca	mg/L	1	3.1	11.5	61.9	275
Mg	mg/L	1	2	5	27	72
Na	mg/L	15	1110	1655	2898	3620
K	mg/L	3	4	8	25	59
Al	mg/L	0.01	0.02	0.1	0.32	0.69
Fe	mg/L	0.07	0.79	3.31	14.60	35.50
F	mg/L	0.1	0.6	1.55	2.64	3.1
Ba	mg/L	0.6	0.7	1.1	1.9	2.4
Sr	mg/L	2.2	2.2	2.4	5.3	6.4
Si	mg/L	6.2	7.0	7.9	9.2	9.4
SiO2	mg/L	13.2	15.0	17.0	19.7	20.2

6. Process Flow of CSG Water Generation, Aggregation and Storage

CSG water[3] is water extracted from coal seams in order to release CSG from the coal.

Water produced from all wells is aggregated and stored in CSG water aggregation dams designed and constructed in accordance with the *DERM Guideline for Regulated Dams in Environmentally Relevant Activities*[4] and *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams*.

The following subsections describe the process of water generation aggregation and storage associated with production and appraisal wells.

6.1. PRODUCTION WELLS

CSG water produced from individual production wells within a field is transferred by gathering lines to water management facilities through high density polyethylene (HDPE) gathering lines. Following aggregation in a dam, water undergoes a treatment process to allow the removal of any suspended solids and dissolved ions.

The current treatment process employed by Arrow incorporates micro filtration and reverse osmosis (RO). The RO process produces a high quality permeate (treated water) and a concentrated salt stream (brine). These two product streams, permeate and concentrate, are stored in fit for purpose water storage facilities in line with EA requirements.

The water collection and treatment process is an integral part of the water management and gas production strategy, and is illustrated below in Figure 4.

[3] http://www.derm.qld.gov.au/factsheets/pdf/water/w195.pdf
[4] NB: This guideline and has yet to be finalised or published.

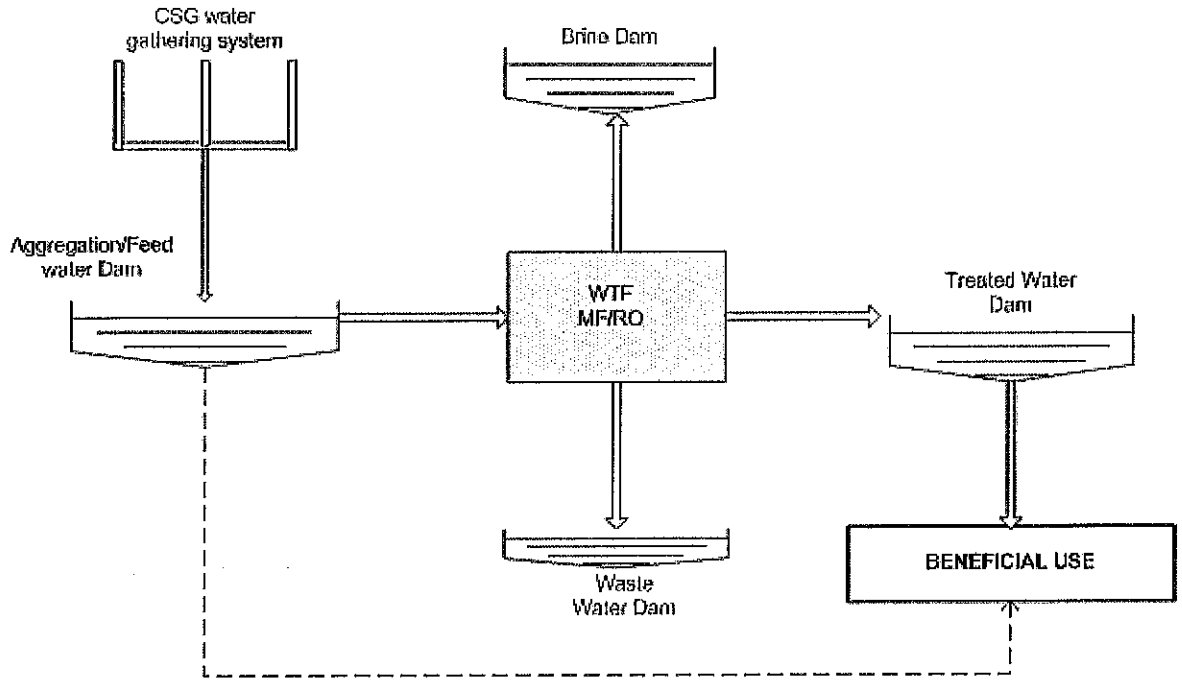


Figure 4: Bowen Basin CSG water management scheme

A third stream is also created through the cleaning and backwash operations of the treatment plant. The volumes associated with this waste are minimal and are accumulated in a suitably designed utility dam and periodically transported to a regulated waste facility when required.

6.2. Exploration/Pilot Wells

Pilot wells assist in determining the viability of the CSG resource. Until the appraisal project phase is complete it remains uncertain as to whether each area will be developed to production stage. Therefore, a key determinant of appropriate water management practices for pilot wells is proximity to existing water infrastructure.

Arrow considers that the construction of small aggregation dams (2 – 10 ML) is preferable to pre-development investment in pipelines and the construction of larger centralised water storages, each of which would create a larger environmental footprint than is necessary. However, such dams will be connected to a water gathering network where possible during the exploration/appraisal phase of field development.

The conceptual strategy for the treatment of CSG water for exploration is as follows:-

- Water produced from the pilot program will be aggregated in local associated water dams;
- If pilots are successful and the project moves into the production phase (following an EIS process), dams will be connected to the northern water treatment network. This will involve:
  - Construction of pipelines connecting dams to Reverse Osmosis (RO) Facilities (e.g. the RO facility to be situated on PL191);
  - Transport of water to where it will be treated to a quality enabling beneficial reuse for industrial, agricultural and urban purposes (refer to Section 7.4 for Arrow BU processes currently approved or under investigation). The decision tree in Figure 6 will be applied when determining the most appropriate beneficial use or disposal option for the CSG water;
  - Relevant land access and approval processes (including route assessments, ecological surveys, compensation agreements, development approvals and Beneficial use applications) as required, prior to undertaking the above;
  - Current investigations into mobile treatment units are progressing. This will potentially facilitate the decreased reliance on dams and treatment of all pilot and appraisal generated water for beneficial reuse. Viability is yet to be determined; and
  - The associated water dams may become part of the long term Northern domestic operations.

- In the event that any of the pilots deem an area not viable (and a production phase is not pursued), Arrow will decommission and rehabilitate dams as per Arrow's decommissioning and rehabilitation plan (which will accompany the specific dam operating plan). Arrow considers that the rehabilitation of individual dam sites will have a less significant environmental and social impact than rehabilitation of a network of pipelines over large distances.

7. CSG WATER MANAGEMENT

7.1. COAL SEAM WATER MANAGEMENT HIERARCHY

The EP Act provides for the *Environmental Protection (Waste Management) Policy 2000*[5] (EPP Waste) to deal specifically with environmental values relating to waste management. It does this by establishing a preferred waste management hierarchy and various principles as the basis for waste management. The environmental values to be enhanced or protected under this policy includes human health and safety, more effective use of resources and avoiding remediation costs.

In accordance with the EPP (Waste), waste management (including CSG water from exploration) will be based on the following hierarchy:

- Waste avoidance- Preventing the generation of waste or reducing the amount of waste generated- Re-using waste, without first substantially changing its form;
- Waste re-use- Treating waste that is no longer useable in its present form and using it to produce new products;
- Waste recycling;
- Energy recovery- Recovering and using energy generated from waste; and
- Waste disposal- Disposing of waste, or treating and disposing of waste, in a way that causes the least harm to the environment.

DERM have adopted two categories of preferred options for management of CSG water. With regard to DERM's CSG water management hierarchy and preferred options, Arrow's approach is shown in Table 5.

[5] http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/E/EnvProtWaMP00.pdf

Table 5: Water management hierarchy of preferred options

DERM CSG Water Management Preferred Options			Arrow's Approach[6]
Category	**Option**	**Description**	**Option implemented / investigated**
1	Injection where detrimental impact is unlikely	Involves injecting either treated CSG water, untreated CSG water or brine into a natural underground reservoir, or aquifer, where the injection is unlikely to have a detrimental impact on the identified environmental values and water quality objectives of the waters in the target formation or surrounding environment	To determine the feasibility of CSG injection, Arrow's commitments, actions and milestones include the following: ***Commitments***: • To further investigate the potential for CSG injection as part of a risk managed portfolio of CSG water options for the Bowen Basin • To work in close collaboration with other CSG operators and in conjunction with Regulatory agencies to assess injection options ***Actions:*** • Establishment of a targeted water injection specialist role within Arrow (position filled May 2011) • Currently investigating opportunities for site based injection trials in the Bowen Basin through a targeted scoping study • Ongoing discussions with local irrigators and government with respect to a substitution allocation or BU schemes ***Milestones*** (and anticipated dates) • Clarification of approval requirements with DERM to facilitate injection **(Nov. 2011)** • Relevant approvals secured to undertake injection trials **(June 2012)** • Completion of approved aquifer injection trials **(June 2013)** • Development of an internal water injection strategy on satisfactory completion of investigations and trials **(Nov. 2013)** (refer to section 7.5 for further details regarding scoping study)
1	Untreated Use	Involves using the CSG water without	Arrow is currently investigating a range of

[6] Refer to section 2.2 for period of implementation of management scheme.

DERM CSG Water Management Preferred Options			Arrow's Approach[6]
Category	**Option**	**Description**	**Option Implemented / investigated**
		first substantially changing its composition. Under a Specific Beneficial Use[7] or General Beneficial Use[8] approval issued by DERM the following uses are considered as an option for untreated CSG water: • - Irrigation and general use • - Livestock drinking water • - Dust suppression • - Landscaping and revegetation • - Power station cooling • - Coal washing • - Feedlots • - Urban use	options for untreated use, and has an existing water supply licence for mine site beneficial use (refer to section 7.4) Arrow will identify further beneficial reuse opportunities through continued community and surrounding stakeholder engagement Arrow will actively develop practicable agreements with the relevant entity/s.
1	Treatment and Use	Includes treatment of CSG water through a process to remove or reduce contaminants to make the water suitable for a desired end use. Under a Specific Beneficial Use[9] or General Beneficial Use[10] approval issued by DERM the following uses are considered as an option for treated CSG water management under this plan: • aquaculture and human consumption of aquatic foods • coal washing • dust suppression • industrial use • irrigation • livestock watering	Arrow is currently investigating a range of BU options for irrigation and industrial use of treated water (refer to Section 7.4 for details). Arrow is constructing a 2ML/day MF/RO plant in PL 191 to facilitate BUs and sustainable discharge in emergency scenarios. Containerised RO treatment facilities have been investigated for the purpose of treating the CSG water produced by pilot wells. Currently, this option has been deemed to possess an increased environmental impact compared to the current strategy of aggregating water for future linkage to the treatment system. This is associated with the generation of brine and additional footprint related to the infrastructure requirements of the RO facility and brine and treated water dams.

[7] http://www.derm.qld.gov.au/environmental_management/land/documents/csg-water-beneficial-use-approval.pdf
[8] http://www.derm.qld.gov.au/register/p02281aa.pdf
[9] http://www.derm.qld.gov.au/environmental_management/land/documents/csg-water-beneficial-use-approval.pdf
[10] http://www.derm.qld.gov.au/register/p02281aa.pdf

DERM CSG Water Management Preferred Options			Arrow's Approach[5]
Category	**Option**	**Description**	**Option implemented / investigated**
			Similarly, pumping CSG water to the nearest treatment facility by the installation of pipeline, involves substantial environmental (~15m easement for construction) and financial implications, and is best undertaken in the production stage.
1	Direct supply via pipeline to a water supply dam managed by a water service provider[11]	This option involves the supply of water of a suitable quality via a pipeline to a water supply dam managed by a water service provider	This option has not been considered under this plan, as Arrow's preference is for the CSG water to remain within the area it is produced. Further, no service providers operate practicable infrastructure within the tenement area and Arrow does not hold approvals to construct pipelines off lease. Issues associated with the transport of regulated waste off tenement (including approval requirements and potential environmental impacts) are an additional impediment to this approach.
2	Disposal via evaporation dams	Evaporation dams are no longer to be used as the primary method for disposal of CSG water. In some circumstances, where a company can demonstrate that there is no feasible alternative for using, treating, storing or disposing of CSG water, evaporation dams may be authorised on application to DERM.	Arrow may propose to use evaporation dams for the exploration phase, where there is no feasible alternative for managing CSG water. An approval will be sought from DERM for specific instances. Arrow is currently constructing the MGP UF/RO plant concurrently with developing and investigating all possible BU options as an alternative to evaporation dam usage.
2	Disposal via injection where a detrimental impact is likely	This option involves injection of CSG water.	This has not been considered as an option for CSG water management under this plan. Arrow's injection studies will initially focus on outcomes which will not result in detrimental impact
2	Disposal to surface waters	The disposal of any CSG water (treated or untreated) directly to surface waters.	Continuous or long term discharge has not been considered as an option for CSG water management under this plan. Arrow will actively pursue opportunities for beneficial use, but will seek to retain approvals for emergency wet weather discharge when the

[11] http://www.derm.qld.gov.au/water/regulation/service_provider_list.html

DERM CSG Water Management Preferred Options			Arrow's Approach[6]
Category	**Option**	**Description**	**Option implemented / investigated**
			water may not be able to be used. This approval will be sought through the relevant EA.
2	Disposal to land	The disposal of any CSG water (treated or untreated) directly to land.	This has not been considered as an option for CSG water management under this plan.

7.2. Water Treatment

7.2.1. Treatment process

Arrow currently treats CSG water through a process of micro filtration (MF) and reverse osmosis (RO). MF is a microporous membrane separation process with selectivity on the basis of size. Most MF membranes are screen filters with the feed inlet pressure serving as the driving force for filtration. The membranes allow the removal of turbidity, bacteria, cysts and particulates from the water to sizes of 0.1 to 3 µm. Following MF, water is treated using RO to remove dissolved salts. RO is significantly more complex than MF and involves the separation of salts from solution through a semi permeable microporous membrane under elevated hydrostatic pressure.

7.2.2. Treatment infrastructure

As described in Section 4.1, Arrow plans to construct a water treatment (RO) facility on PL191. The facility will have a treatment capability of 2ML/day, with a maximum output of approximately 580 ML/yr, based on actual recovery and availability rates. The plant will operate at a recovery between 75 – 85% (dependent on feed source). Pre-treatment will consist of activated carbon filtration to remove the residual organics that have been identified in the feed supply. The RO facility is scheduled to commence construction in October 2011.

Arrow initially installed RO plants in the Surat Basin at Daandine (12ML/day) and a trial plant at Glenelg for aquifer injection trials (on PL230). Additionally, the Tipton West MF/RO plant (12ML/day) on PL 198, is due for commissioning in early 2012. Through the design and operation of these plants (and associated 'lessons learnt'), Arrow has significantly bolstered its experience and capabilities in water treatment and waste reduction

technologies. Arrow will continue its investigations into long-term industry-wide solutions and alternative technologies for efficient water treatment and waste management.

7.2.3. TREATED WATER QUALITY

Table 6 shows predicted parameters for the water treatment facility on PL191, as an indicator of likely water qualities achieved through the RO Process. Due to the significant presence of sodium and low levels of calcium and magnesium in the treated water, ionic amendment will be required to lower the sodium absorption ratio (SAR) to make beneficial use possible. The amendment facility will utilise calcium chloride for SAR adjustment and will be designed and constructed in accordance with the beneficial use quality requirements for each use.

Treated water quality (permeate) will be continuously monitored for the available in situ parameters (pH, EC), and the remaining parameters sampled frequently to ensure compliance with the relevant approval conditions, supply agreements and process stability.

Table 6: RO treated water stream water qualities[12]

RO Pass Streams (mg/l)			
Parameter	**Feed**	**Concentrate**	**Permeate**
TDS	6734	44084	72.22
pH	8.6	7.65	5.99
Na	2100	13879	21.65
Mg	20	133	0.05
Ca	17	113	0.05
Sr	6	39	0.02
Ba	4	26	0.01
CO3	55	1000	0.00
HCO3	2989	18491	31.66
NO3	0.00	0.00	0.00
Cl	1500.	10139	15.40
F	2	13	0.03
SO4	2	13	0.00
SiO2	17	115	0.29
Boron	1	8	0.51
CO2	6	213	49.65

[12] Projected parameters taken from ROSA (*Dow Water and Process Solutions*) modelling for MGP WTF

7.3. STORAGE, USE AND / OR DISPOSAL OF TREATED CSG WATER AND BRINE

As described in section 6, prior to usage and /or disposal, treated CSG water and brine will be segregated and stored in purpose built dams, designed and constructed in accordance with the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dam,* and relevant EA conditions. Refer to Appendix 1 for specific details provided regarding Bowen Basin Dams.

Treated CSG water will be used according to the management hierarchy described in Section 7.1, of which BU approvals are a current focus, pending the realisation of injection opportunities.

With respect to brine and residual solid salts through the water treatment and evaporation process, the following hierarchy will be used to determine appropriate management strategies:

1. Waste reuse/recycling through chemically processing/treating brine or salt residues to create useable/saleable products such as soda ash;
2. Waste disposal through:
    - disposal of brine to an ocean/estuarine environment, then
    - disposal of salt into an existing licensed regulated waste disposal facility, then
    - disposal of salt into a purpose built regulated waste disposal facility (landfill mono cell) on freehold land owned by the tenure holder;
3. Injection of brine if the target formation is:
    - a single geological unit that is not regionally consistent and extensive.
    - isolated above and below by an aquitard or aquicludes within the hydraulic impact zone; and
    - not an aquifer that does or could supply water for potable, agricultural, industrial and commercial purposes.

Currently, the brine disposal strategy relies on evaporation and concentration until technologies for crystallisation have been fully investigated and trialled over the next two years. The proposed solution will potentially create marketable salts such as soda ash and sodium chloride. Arrow is currently collaborating with other CSG proponents to take advantage of economies of scale and reduce infrastructure requirements and footprints for brine management. Alternatively, as a last report, salt will be concentrated, dried and transported to a licensed and regulated landfill (Figure 5).

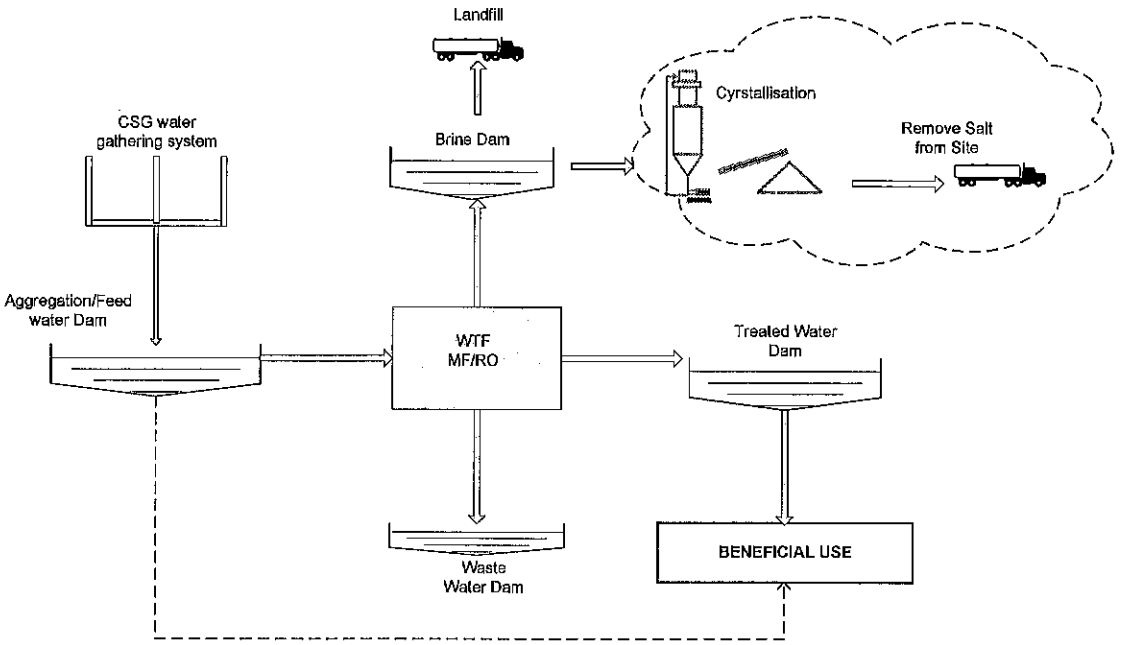


Figure 5: Bowen Water and Salt Management Strategy

7.4. Current and Proposed Beneficial Use

Arrow currently possesses a water supply licence (under renewal) for the use of untreated water for industrial beneficial use at Millenium Mine. The water is planned for use in coal washing activities in the approved quantity of 500 ML/yr. Due to the recent protracted wet season, and higher than average rainfall, this agreement has been under utilised.

Arrow is currently investigating a range of additional beneficial use options, in accordance with the following prescribed activities specified in DERM's guideline for beneficial use:[13]:

- irrigation
- industrial use

[13] http://www.derm.qld.gov.au/environmental_management/land/documents/csg-water-beneficial-use-approval.pdf

- dust suppression
- aquaculture and human consumption of aquatic foods
- livestock watering
- coal washing

The decision tree in Figure 6 shows Arrow's process for determining the most appropriate beneficial use or disposal option for CSG water.

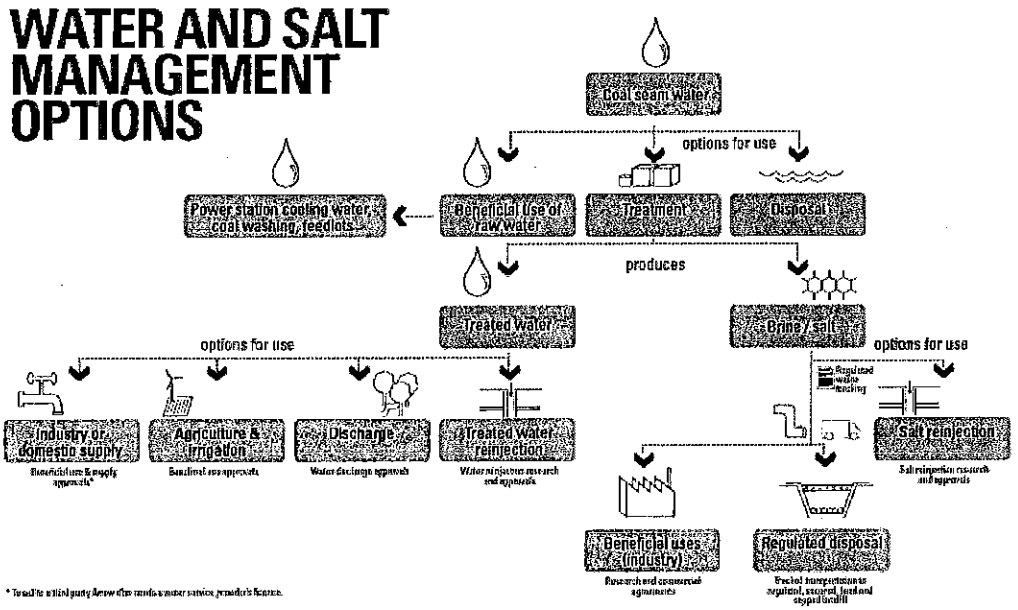


Figure 6: Decision tree for determining beneficial use or disposal options[14].

Due to the uncertainty of industrial off-takes, Arrow is currently preparing a BU application for an irrigation scheme on PL224 (refer to Section 7.5 for further information regarding BU trials on PL224). Investigations and assessment of the suitability of the nominated field are nearing completion. Submission of the BU application is scheduled to occur by late 2011, with project implementation expected by late 2012 (given anticipated approval and contractual timeframes).

Further negotiations are also currently progressing for additional industrial use, coinciding with the commissioning of the MGP water treatment facility. The overall BU scheme for the

[14] http://www.arrowenergy.com.au/icms_docs/73090_Water_and_salt_management_brochure.pdf

MGP will aim to encompass numerous off-take options and contingencies, to ensure water disposal balances or exceeds water generation, removing the reliance on evaporation.

Error! Reference source not found. shows the current Bowen Basin water disposal profile in comparison to the proposed off-takes that are being developed for the beneficial use scheme. It clearly reveals the diminishing reliance on evaporation to maintain the site's water balance.

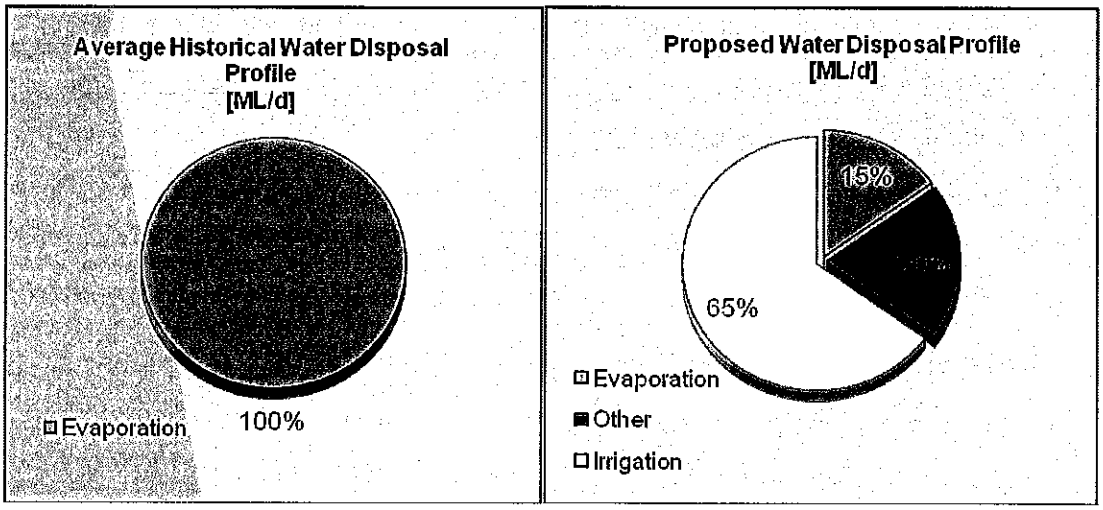


Figure 7 **Bowen Basin Water Disposal Profile**

7.5. INVESTIGATIONS INTO CSG WATER MANAGEMENT

Arrow is currently undertaking the following investigations to further develop options for management of CSG water:

- **Injection feasibility study (scheduled to commence late 2011);**
  - Objective is to assess the feasibility of injection in the Bowen basin as part of a risk managed portfolio of CSG water options for the Bowen Basin;
  - The study will involve:
    - A review of technical water characteristics and basin properties (both geophysical and chemical);
    - Identification of target aquifers and estimation of injectibility and containment;

- Quantification of predicted water generation volumes and water quality;
- Data gap analysis (including literature review);
- Generation of an initial static model (identifying all geological formations);
- Environmental risk assessment activities with respect to identified water quality and geological formation characteristics; and
- Assessment of non technical risks and issues (including approvals implications, stakeholder management, land access and cost implications).

o Further to the scoping study and depending on the outcomes, Arrow will undertake a data acquisition program to increase certainty around the feasibility of the aquifer injection which may include drilling (core, log), well testing, seismic and possibly injection/production tests;

o The aquifer injection investigation will be undertaken in conjunction with Arrow's groundwater monitoring and modelling program. Arrow is also committed to work in close relationship with the other CSG proponents and in conjunction with interested government agencies; and

o A targeted water injection specialist role has been created and filled within Arrow to manage the injection investigation and implementation process;

- **Brine crystallisation trial:**
  - o Arrow is currently in negotiations with other CSG proponents to commence brine management pilot trials early 2012. This will incorporate brine concentration and preferential crystallisation to obtain marketable salt products; and
  - o Additionally, Arrow will (as part of the LNG project) conduct separate brine concentration and salt production trials as a base case for salt management, moving towards the Arrow LNG project.

- **PL224 Irrigation Trial**
  - o The objective of this trial is to assess the viability of long term crop irrigation in the area;
  - o The trail will involve irrigation of a 92 hectare plot under a BU approval;
  - o Technical investigations are nearing completion and the BU application is planned for submission in late 2011; and

- If successful, the irrigation project is expected to operate indefinitely and will form an integral part of the BU scheme for the Bowen Basin.

7.6. Receiving Environment

The receiving environment, relevant to each CSG water management activity in the Bowen Basin, will be documented in the associated approval applications and management plans that are generated under specific conditions of the respective approvals (e.g. EAs, discharges approved under the EA, BUs and recycled water management plans).

7.7. Control Measures and Procedures

Arrow has clearly defined environmental management responsibilities as required under relevant approvals (including EAs and BU approvals) that govern the undertaking of petroleum activities on Arrow tenures.

As part of these environmental management responsibilities, Arrow implements a range of control measures and procedures, which include (but are not limited to) the following:

7.7.1. Control Measures

Aggregation and Storage

Key control measures include:

- All wells have the ability to be 'shut in' to cease water flow if required;
- All aggregation gathering systems are designed, constructed and tested to industry standard as a minimum;
- Gathering systems are frequently monitored and automated process control allows for prompt identification of any imminent issue; and
- Storage dams will be engineered and constructed to a standard that meets all legislative and EA requirements (as described in Section 8). All dams will be inclusive of leak detection systems and monitoring programs (as described in each specific dam operating plans) to ensure unacceptable seepage and/or contaminant release is identified and promptly actioned.

Treatment

Any water treatment facility constructed and operated by Arrow will incorporate best practice design and process controls. This will include:

- civil structures that will not allow any spill or contaminant to be released from the water treatment bunded areas;
- process controls that will trigger level shutdown and/or diversions for out of specification water quality;
- sufficient number of process monitoring points to enable additional sampling and analysis by third party laboratories This will allow tighter process control, advanced operational analysis/optimisation and troubleshooting;
- development of standard operating procedures (SOP) to ensure safe and robust procedures are standardised to reduce risk of operating error; and
- regular monitoring to assess functionality and performance.

Use/Disposal

Arrow will comply with all requirements specified in BU and EA approval conditions as a minimum. All delivery networks and/or equipment will be designed and constructed to industry standards in conjunction with Arrow emergency procedures for any operational incident response and recovery.

7.7.2. PROCEDURES

A range of procedures have been developed by Arrow to prevent or to control the release of a contaminant or waste to the environment. These include:

- 99-H-PR-0010 (5) Incident Reporting Recording and Investigation Procedure
- 99-H-PR-0016 (1) Chemical Management Procedure
- 99-V-PR-0018 (1) Waste Management Procedure
- 99-V-PR-0019 (1) Water Management Procedure

In addition, targeted environmental management and control measures, specific to relevant water infrastructure, are described in a range of documents including:

- Dam Operating Plans,

- Standard Operating Procedures for water treatment facilities, and
- Sampling and monitoring plans

Furthermore, all wells have the ability to be shut if water flow prevention was required. The dams are also operated and designed to have the capability to contain any contaminant of concern and redirected to supplementary treatment or disposal.

7.8. MONITORING PROGRAMS

7.8.1. GROUNDWATER

Monitoring sufficient for the prediction and early detection of any detrimental impacts on the receiving environment from CSG water management practices includes a Groundwater Monitoring Program and Annual Water Monitoring Report, as per the requirements of the relevant EA.

The groundwater monitoring network will detect any detrimental impacts on the receiving environment resulting from activities regulated by an Environmental Authority or BU through:

- regular monitoring of groundwater quality in the immediate vicinity of regulated dams,
- monitoring of background sites,
- monitoring of dam water quality,
- establishment of site-specific environmental values for the shallow groundwater system,
- development of site-specific trigger values,
- ongoing monitoring of groundwater to identify environmental impacts, and
- implementation of management actions in the event of environmental impact.

The Groundwater Monitoring Program required under the EA includes monitoring bores installed in close proximity to the dam. The exact location of these bores is guided by geotechnical investigations to identify the direction in which in groundwater impact is likely

to travel. Background sites are also installed at distances of 500m to 1,500m (where access allows) both up and down gradient of the dams.

Samples are collected to establish background conditions (i.e. un-impacted by regulated activities) prior to commissioning of the dam, and over a 12 month period (from background bores). This data is used to establish what the environmental values (including current and maximum beneficial use) of the shallow groundwater resource area.

Site-specific trigger levels are developed by considering the background groundwater quality, established trigger levels (such as ANZECC water quality criteria), and the potential impacts of seepage from regulated dams. Ongoing monitoring is then used to identify whether, and to what extent, environmental impacts, with reference to the aforementioned criteria, are occurring. Where unacceptable impacts have occurred, management actions are initiated to remedy these.

7.8.2. SURFACE WATER AND TREATMENT

The surface water monitoring program will detect any detrimental impacts on the receiving environment resulting from water discharge activities regulated by EAs through:

- regular monitoring of dam water quality,
- regular monitoring of treatment performance and process parameters,
- monitoring of any potential receiving waters,
- development of specific trigger values, and
- implementation of management actions in the event of environmental impact.

Arrow is currently undertaking a Bowen Basin water characterisation study to establish CSG water quality and to understand any geographical variations associated with the well distribution across the basin. This will facilitate the prediction and any additional management preferences necessary for treatment requirements/optimisation and/or preventative operation to allow for varying water quality. On site monitoring programs are also being developed to monitor chemical parameters and document any seasonal, operational variations.

Baseline data will then be established to create site-specific trigger levels by considering the water quality, treatment parameters and reporting requirements. Ongoing monitoring will then be utilised to identify whether, and to what extent, any environmental or treatment impacts may occur.

7.8.3. Reporting

If any contaminant levels are identified as having caused, or have the potential to cause environmental harm, this will be reported to DERM as per the EP Act and EA requirements. An annual monitoring report will be developed and made available to the administering authority upon request. Subsequent to the annual submission of the monitoring report, a review of the procedures, assets and sampling frequencies will be undertaken to ensure all relevant requirements are being met.

7.9. Measurable criteria for key CSG water management activities

The following table describes measurable criteria for the management of key CSG water infrastructure and processes in the Bowen Basin. Criteria described in this table are not exhaustive but provide an indication of the currently anticipated measurable management techniques to be employed by Arrow. These will be further refined and documented through an iterative process as Arrow's development planning progresses and water management requirements are further defined.

Table 7: Measurable Criteria for Key CSG Water Activities

Objectives	Environmental value to be protected	Task / Action	Key Performance Indicators
Transmission of CSG water via pipelines			
• Effective containment of water throughout transmission activities (i.e. from source to point of storage, treatment, usage or disposal)	• Surface and groundwater quality to sustain surrounding agricultural and domestic use, and ecological processes • Soil quality (including structure and chemical properties) of surrounding areas able to support pre existing land use and ecological processes	• Maintain shut in capability of wells • Regular monitoring in accordance with relevant procedures and programs (including groundwater monitoring program, field infrastructure inspections and audits) • Regular maintenance in accordance with set programs and schedules • Effective planning and clearance activities to site flowlines in areas of low impact and in accordance with EA conditions	• Recommendations for any repairs or remediation are closed out appropriately • Any complaints from landholders received with respect to flowline leakage are resolved • No evidence of soil erosion from flowline construction activities • No evidence of weed proliferation from flowline maintenance activities
Storage of untreated and treated CSG water in dams			
• Effective storage and containment of CSG water in relevant dams • The quality and quantities of stored water are maintained within relevant approval thresholds	• Surface and groundwater quality to sustain surrounding land for agricultural and domestic uses, and ecological processes • Soil quality of surrounding areas able to support pre existing land use and ecological processes	• Regular dam integrity inspections (annually) • Regular monitoring in accordance with relevant procedures and programs (including groundwater monitoring programs) • Maintenance of infrastructure and facilities necessary to effectively contain water and monitor leakage	• Records indicate regular inspections and maintenance as per planned schedules • Where dam levels reach mandatory reporting levels, appropriate actions are implemented within required timeframes (as per relevant EA conditions and dam operating plans) • Recommendations for any repairs or remediation are closed out appropriately
Beneficial use			
• Maximise use of CSG water (generated and treated through petroleum activities) for beneficial use • Undertake BU	• Surface and groundwater quality to sustain surrounding agricultural and domestic uses, and ecological processes • Soil quality of	• Regular monitoring of water quality and quantities in accordance with BU and EA conditions of approval • Regular inspections of BU infrastructure to	• Inspection reports indicate compliance with relevant EA and BU approval conditions (including water quality) • Records indicate that all required maintenance has

Objectives	Environmental value to be protected	Task / Action	Key Performance Indicators
activities that aim to return water to the source catchment or basin • Water quality and quantities, as specified under relevant BU Approvals, are maintained	surrounding areas able to support pre existing land use and ecological processes	ensure optimum operability	been actioned in a timely manner • Any complaints with respect to BU stakeholders are appropriately actioned
Management and disposal of any wastes (including brine and salt)			
• Waste materials are managed in accordance with relevant hierarchies, legislation and policies • The community is not adversely affected by Arrow's waste generation and management	• Human health and safety • Land use capability, having regard to economic considerations • Surface and ground water quality to sustain surrounding land for agricultural and domestic uses, and ecological processes • Soil quality of surrounding areas able to support pre existing land use	• Relevant control measures to detect leakages of brine from containment dams are regularly inspected and maintained • Storage of Hazardous wastes in is undertaken in accordance with relevant legislation and standards (including AS 1940). • Regular inspections of waste storage and transport infrastructure are undertaken to ensure optimum operability	• Any complaints with respect to waste management are appropriately actioned • Records indicate that all required maintenance has been actioned in a timely manner • No changes to baseline water quality remains unchanged

Should any of the above criteria not be met, actions to enable the criteria to be satisfied in future include:

- evaluation (including route cause analysis) of the underlying cause of the criteria not being met;
- implementation of corrective actions to address underlying cause (including engineering solutions and amendments to plans and procedures as required);
- review of relevant procedures, protocols and management plans to determine actions necessary to prevent further non conformance;
- implementation of training and awareness programs to prevent further non conformance.

7.10. RELEASE REDUCTION STRATEGY

Arrow is currently developing a Release Reduction Strategy which will be a continual initiative to realise and execute opportunities to minimise CSG water generated at the surface, maximise reuse and minimise ground disturbance through the establishment of CSG infrastructure. Specific activities that will be addressed by the Strategy include:

- A market analysis study to identify existing and future water management technologies;
- A feasibility assessment of BU opportunities for CSG water;
- On-going review of drilling technologies to minimise water generation; and
- optimisation of existing transport and treatment processes.

8. DAMS

All Arrow dams (treated, untreated and brine) associated with the management of CSG water will be designed, constructed, operated and authorised in accordance with legislative requirements[15]. This includes completing a hazard assessment for all dams that hold CSG water to determine if they are a Low, Significant or High hazard dam in accordance with DERMs *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams*.

Dams that are assessed as being in the low hazard category will be designed and operated in accordance with accepted engineering standards and for dams that are assessed as being in the significant or high hazard category, Arrow will lodge a third party certified *Dam Design Report* to DERM for review prior to construction. Details of significant or high hazard dams will be maintained in Arrow's *Regulated Dam Register*.

All MGP water networks and storage facilities are located on PL191, PL223 and PL224. A list of tenure related dams are listed in the Appendices.

Arrow has implemented a dam upgrade project (currently being undertaken by specialist consultants) to identify any upgrade requirements for existing regulated dams to comply with current EA conditions and DERM water management guidelines. This will be

[15] http://203.210.126.185/dsdweb/v4/apps/web/secure/docs/4382.pdf

completed by 1 October 2011, and will include detailed design plans and recommendations to address any upgrades required to meet legislated standards.

9. APPENDIX 1

Water management infrastructure of producing Bowen Basin tenures

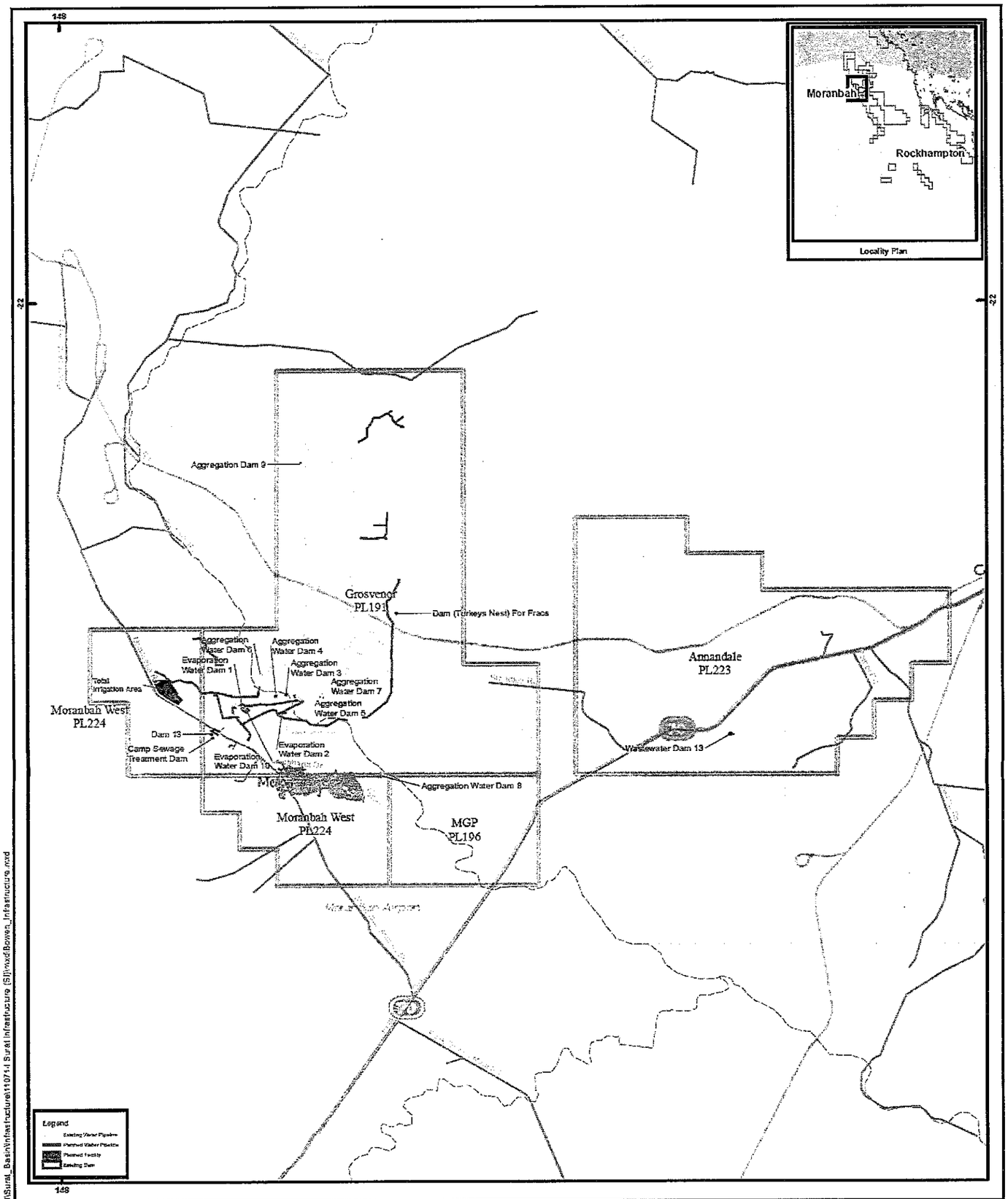
<table>
<tr><th>Tenure</th><th colspan="5">Water Management Strategy and Infrastructure Characteristics</th></tr>
<tr><td>PL191</td><td colspan="5">Beneficial use of CSG water will be realised through the treatment of all produced water and use for farm irrigation, industrial use and stock watering.

Piping and pumping station infrastructure will be installed to allow for compliance upgrades and/or the decommissioning and rehabilitation of existing evaporation dams. All CSG water gathered from PL191, PL196, PL223 and PL224 will be treated at the MGP water treatment facility where the water (after any amendment requirements) will be made available for beneficial reuse.</td></tr>
<tr><td></td><td>Activity</td><td>Size/Capacity</td><td>Status</td><td>Purpose</td><td>Description</td></tr>
<tr><td></td><td>Water Treatment Facility</td><td>2ML/day</td><td>Under Construction</td><td>Water Treatment</td><td>UF/RO</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>Evaporation</td><td>Moranbah Dam 1</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>Evaporation</td><td>Moranbah Dam 2</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>Aggregation</td><td>Moranbah Dam 3</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>Aggregation</td><td>Moranbah Dam 4</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>Aggregation</td><td>Moranbah Dam 5</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>Aggregation</td><td>Moranbah Dam 6</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>Aggregation</td><td>Moranbah Dam 7</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>Aggregation</td><td>Moranbah Dam 9</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>Evaporation</td><td>Moranbah Dam 10</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>WTF Brine Storage</td><td>Moranbah Brine Dam 11</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>Condensate Storage</td><td>MGP CGPF Oily Water Dam</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Planned</td><td>WTF Treated Water Storage</td><td>Moranbah Dam 14</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>Sewage Storage</td><td>MGP Camp Sewage Treatment Dam</td></tr>
<tr><td></td><td>Water Licences</td><td>500ML/ys</td><td>Granted</td><td>Industrial</td><td>Millenium Coal</td></tr>
</table>

<table>
<tr><th>Tenure</th><th colspan="5">Water Management Strategy and Infrastructure Characteristics</th></tr>
<tr><td>PL 196</td><td colspan="5">All CSG water from PL 196 will be gathered and transported to MGP WTF for treatment and beneficial reuse.</td></tr>
<tr><td rowspan="3">PL 223</td><td colspan="5">Currently, PL223 is in development with construction of a nodal compressor and associated oily water dam. All CSG water from PL 223 will be gathered and transported to MGP WTF for treatment and beneficial reuse.</td></tr>
<tr><td>Activity</td><td>Size/Capacity</td><td>Status</td><td>Purpose</td><td>Description</td></tr>
<tr><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>Containment</td><td>Oily Water Dam</td></tr>
<tr><td rowspan="3">PL224</td><td colspan="5">The reuse of all CSG water will be realised through the operation of a water treatment facility on PL191 to produce water that can be beneficially reused for irrigation, stock and industrial use such as coal washing.

PL224 is the planned location for the Moranbah Brine Dam 12, which will be transported from the WTF and will be designed in accordance with all relevant guidelines and legislation.</td></tr>
<tr><td>Activity No</td><td>Size/Capacity</td><td>Status</td><td>Purpose</td><td>Description</td></tr>
<tr><td>Regulated Dam</td><td><400ML</td><td>Active</td><td>Aggregation</td><td>Moranbah Dam 8</td></tr>
<tr><td></td><td>Regulated Dam</td><td><400ML</td><td>Scheduled</td><td>Brine</td><td>Moranbah Dam 12</td></tr>
</table>

ARROW ENERGY



Bowen Basin Infrastructure

Source:
Arrow Energy Pty Ltd
Geosciences Australia
Dept. Envir. and Resource Mgmt.

Date: 29/07/2011
Issued To: B Wilson
Author: tstringer

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Kilometres
Scale: 1:245,000 @ A4
Coordinate System: GCS GDA 1994

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Figure 8: Bowen Basin Water Infrastructure