Waukivory Pilot Project

Request to vary the approved activity

Prepared for AGL Upstream Investments Pty Ltd
April 2015

AGL Energy in action.

EMM
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Final

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Position	Associate Director
Signature	
Date	15 April 2015

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1 Introduction

1.1 Background

AGL Upstream Investments Pty Ltd (AGL) submitted a request to the NSW Office of Coal Seam Gas (OCSG) to vary an approved activity known as the Waukivory Pilot Project (the Project) on 25 February 2015. The variation related to the onsite storage and management of flowback water prior to its offsite disposal.

Since the request was submitted to OCSG, AGL undertook further reviews and risk assessments of the Project with respect to obtaining greater certainty and security of the management of flowback water. As a result of this process, AGL is seeking to vary the existing approved activity as described in this report (refer to Section 1.3). This report supercedes and replaces the request submitted to OCSG on 25 February 2015.

The proposed variation will provide operational benefits to the Project with additional security of storage and the management of flowback water as it will enable the flowback activities to recommence, and flowback water to be contained within Tiedmans East Dam (TED) with a double-liner and leak detection system constructed by the NSW Government's Soil Conservation Service.

The proposed variation also allows for the potential reduction in offsite impacts through reduced offsite transportation of flowback water with tankers should flowback water continue to be securely stored within TED and be treated by the water treatment facility to be constructed as part of the project approval for the Stage 1 of the Gloucester Gas Project (GGP).

If this request to vary the approved activity is approved, it also affords the Project greater certainty and continuity in achieving its overarching objectives to further assess the gas reserves as required by AGL's obligations under Petroleum Exploration Lease (PEL) 285.

1.2 The approved activity

The Project was approved on 6 August 2014 following lodgement of the application on 30 September 2013 under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) supported by a review of environmental factors (REF) (EMM 2013a) and supporting documents.

The components of the current approved activity are set out below in Table 1.1 together with the status of each component.

Table 1.1 Project components and their status

Component	Status
Conversion of four existing exploration wells (WK11, WK12, WK13 and WK14) to pilot wells using perforation and fracture stimulation techniques	Completed
Pilot testing of the four wells	Commenced and currently suspended
Construction of a water storage area at WK13 for flowback and produced water, called the 'water staging point'	Completed
Construction of a buried water pipeline and water and gas gathering lines	Completed and also the part of the approved activity to be varied in this request
Construction of an enclosed central gas flare at WK12	Completed

Table 1.1 Project components and their status

Component	Status
Delivery of equipment (and water) to undertake the activity; lawful disposal of flowback water	Commenced
Lawful re-use or disposal of produced water	Not commenced
Suspension of exploration wells following completion of pilot testing	Not commenced
Site rehabilitation of disturbed land including construction laydown areas, access tracks and gas gathering pipelines verges	Commenced

The Project is also subject to an environment protection licence (EPL) which was issued by the NSW Environment Protection Authority (EPA) on 6 August 2014 (EPL 20358) and contains requirements for the management and reporting of noise, air and water monitoring during the Project.

Prior to and during the Project, AGL engaged two third party contractors to lawfully transport, treat and dispose of flowback water. On separate occasions, each of the contractors subsequently notified AGL it could no longer take the flowback water. Since that time, AGL has been actively attempting to engage another contractor, and will continue to do so.

1.3 Proposed variation

The overall objective of the Project's flowback stage is to promptly pump flowback water from the wells to maximise the recovery of fluids injected as part of the activity, and to manage the flowback water to ensure that risks to health, safety and the environment are maintained at acceptable levels (see *Code of Practice for Coal Seam Gas: Fracture Stimulation Activities* (DRE 2012)).

As described above in Section 1.2, AGL secured a third party contractor to lawfully transport, treat and dispose of its flowback water prior to commencing the Project. That contractor advised AGL on 22 December 2014 it could no longer take the flowback water due to an investigation which is currently being undertaken by Hunter Water Corporation.

A second contractor was secured to lawfully transport, treat and recycle flowback water from 5 January 2015 until 13 January 2015 when AGL was informed that they could no longer accept flowback water. Both of the contractors engaged by AGL have advised that the transportation, treatment and disposal or recycling of flowback water was undertaken in accordance with each facility's EPL and Trade Waste Agreement that were in place at the time. Since 13 January 2015, AGL has been actively attempting to engage another contractor, and will continue to do so.

In order to ensure the overall objective of the Project's flowback stage is met, and to further enhance certainty and security of the management of flowback water for its lawful disposal, AGL proposes to vary the approved activity as set out below. Key components of the proposed variation are shown in Figure 1 and flow chart shown in Appendix A.

The current activity is proposed to be varied as follows:

- **Additional pressure test on existing (approved) pipeline**: Carry out further pressure test to existing approved water flow line from AST 2 to TED. Record results of pressure test.
- **Existing stored flowback water**: Pump existing stored and tested flowback water from AST 2 to the TED at the Tiedmans site through the existing approved pipeline (approximately 600,000 litres).

- **Flowback water in wells**: When Waukivory (WK) 11, 12, 13 and 14 pumps are re-commissioned, pump remaining flowback water to AST 2 and then to the TED until the final of the wells reaches the produced water stage (in accordance with the Surface water and Groundwater Management Plan (SGMP) AGL 2014a). Note that the TED has a capacity of 20 ML. A maximum of 3.0 to 3.5 ML of flowback water is anticipated to be pumped via the pipeline to the TED.

- **Monitoring**: When WK11, 12, 13 and 14 pumps are re-commissioned, in addition to the monitoring requirements specified in EPL 20358 and the SGMP (AGL 2014a), take daily samples of flowback water from each well and AST 2 for a period of four weeks from recommissioning. These samples will be analysed for benzene, toluene, ethylbenzene and xylenes (collectively known as BTEX). Results will be provided by the laboratory to AGL within 24 hours (Monday to Friday only excluding public holidays). If requested, an analysis of these results will be promptly provided to OCSG once they have gone through an internal quality control process.

- **Temporary storage of flowback water**: Temporary storage of flowback water in the TED. Ongoing maintenance of the TED to ensure the quality of the TED's integrity and leakage detection system (see further detail in Section 2.3.1).

- **Rehabilitation of AST 2 area (already approved)**: For completeness, following completion of the flowback water stage of all four Project wells, AST 2 will be removed from the WK13 site and the area rehabilitated in accordance with the approved activity.

- **New loading facility at TED**: Installation of a temporary tanker loading facility consisting of two enclosed topped, bunded tanks (57,000 L capacity each) and associated pumps and pipe infrastructure at TED for transportation of flowback water by road tankers from the TED to a lawful offsite disposal facility.

    - The road tankers would utilise Tiedmans Lane and Fairbairns Road to access The Bucketts Way and in accordance with the *Traffic Management Plan for the Transportation of Flowback Water* (AGL 2013).

    - As per the existing activity approval, approximately three tankers per day would be anticipated.

    - The two enclosed water tanks will be stored in a bund with 110% capacity of the volume of the largest tank.

    - The bunded tanks would be positioned adjacent to the dams (refer to Figure 1) to facilitate pumping from the dam into tankers.

    - Flowback water would be characterised prior to lawful disposal. When pumping to TED is occurring, characterisation would occur in the enclosed tanks. However when pumping to TED is not occurring, this characterisation would occur within the TED (refer to Section 2.1 for further detail).

- **Flowback water may be treated via Stage 1 Extracted Water Management Strategy (AGL 2014b)**: If Stage 1 GGP has commenced by 22 February 2016 in accordance with the Stage 1 Project Approval, and lawful offsite disposal of flowback water from the TED is still required and not available (or commercially viable) for AGL despite all reasonable and practicable efforts, flowback water will continue to be securely stored in TED until the Stage 1 GGP water treatment facility is constructed and then treated as per the Stage 1 Project Approval.

Note that as required in the Stage 1 Project Approval, AGL has prepared a draft *Extracted Water Management Strategy* (AGL 2014b) (EWMS) in consultation with the OCSG, NSW Office of Water (NOW), Hunter Local Land Services, EPA and relevant Councils. The draft EWMS identifies the final suite of water (**inclusive of flowback water**) disposal and re-use option(s) to be implemented to manage groundwater extracted from gas wells (refer to condition 3.12(a)) as well as an assessment of the need for control measures to be implemented at the extracted water dams (refer to condition 3.12(h)). The EWMS is required to be approved by the Secretary for the Department of Planning and Environment prior to commencement of construction.

- **Ongoing efforts for offsite disposal**: Continue to exert all reasonable and practicable efforts to engage a contractor for the lawful offsite disposal of flowback water from the TED. AGL will provide OCSG with bi-monthly updates of progress until a contractor has been engaged.

- **Contingency**: If Stage 1 GGP has not commenced by 22 February 2016, and lawful offsite disposal of the flowback water is still required and not available (or commercially viable) for AGL despite all reasonable and practicable efforts, then AGL will seek approval for a mobile containerised water treatment unit to be located at the Tiedmans site. Water quality from the mobile containerised water treatment unit will meet the requirements of the approved EWMS.

  Should the mobile containerised water treatment unit be installed, the treated water will be pumped into Tiedmans South Dam for use in accordance with the approved EWMS and a 1.5ML AST (similar to the existing ASTs at WK13) will be installed for the storage of wastewater from the temporary water treatment unit. This AST would be adjacent to the existing dams on the existing hard standing area and would require no ground disturbance activities. Should this contingency option be required, AGL will liaise with OCSG and obtain approvals (as required) to operate the mobile containerised water treatment unit.

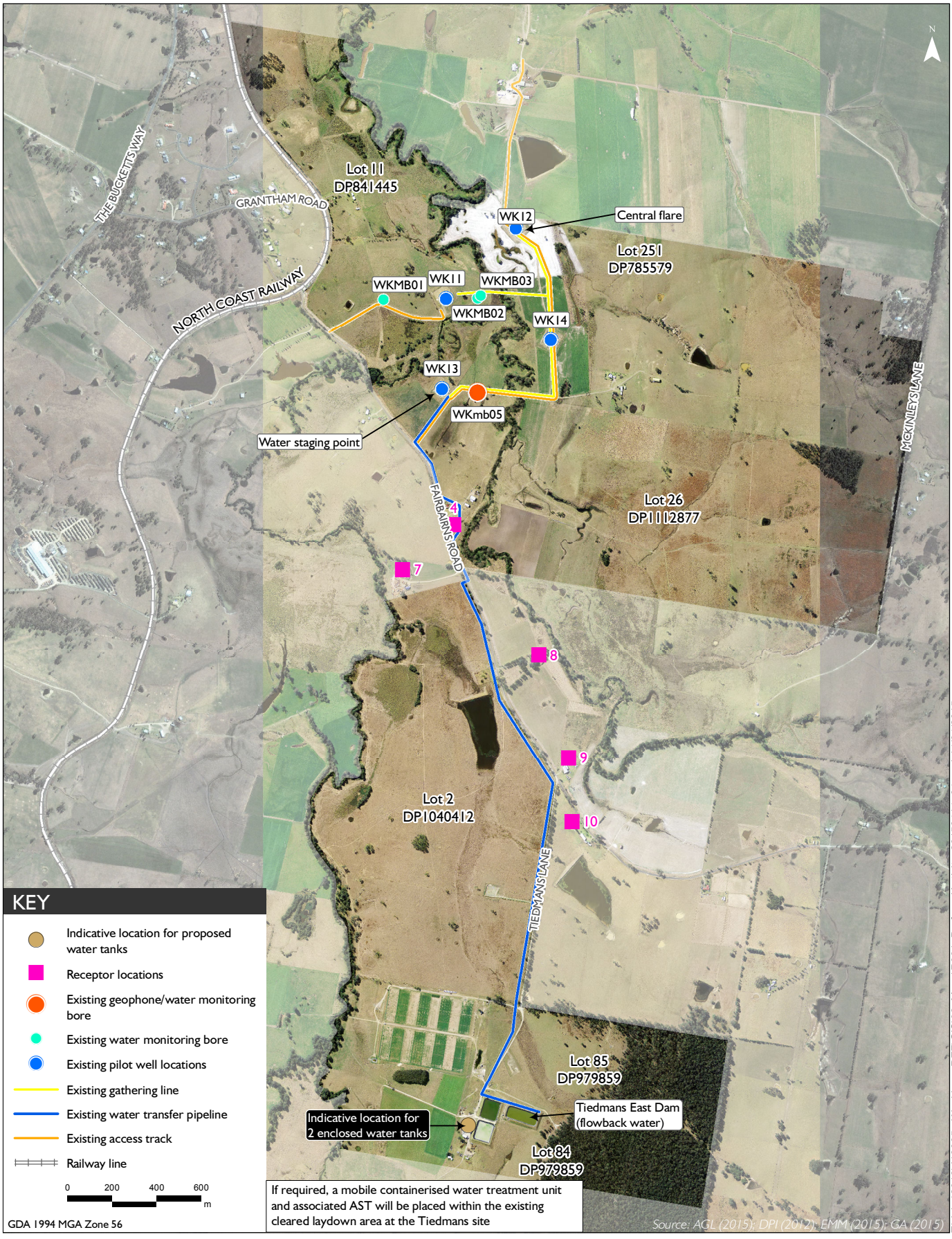
With the exception of the two enclosed water tanks adjacent to the dams (loading facility), no new infrastructure is required to facilitate this proposed variation to the approved activity.

As described in Section 1.1, the proposed variation described above will provide operational benefits to the Project as it enhances the robustness of the SGMP with additional security of storage and the management of flowback water as it will allow the flowback activities to safely recommence, and flowback water to be contained within a dam constructed by the NSW Government's Soil Conservation Service.

The dam is double-lined and complies with ASTM D4437-99 (*Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymer Sheet Geomembranes*), which is the industry and regulator recognised standard for liner construction. The dam has a leak detection system which will be frequently monitored when storing flowback water (see Section 2.3.1).

These measures will provide further security and certainty regarding the quality of the flowback water temporarily stored at TED for use in Stage 1 GGP as per the approved EWMS. Should this occur, it would result in a reduction in offsite traffic movements required for the disposal of flowback water.

Lawful offsite disposal of flowback water consistent with the existing activity approval will continue to occur from the Tiedmans site if available (and commercially viable) for AGL.



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Request to vary approved activity

Waukivory Pilot Project

Figure 1

1.4 Current status of the Project

The Project has completed its construction and hydraulic fracture stimulation phases and is currently in the production testing phase.

On 27 January 2015, AGL voluntarily suspended the Project.

At the time of this report, the flowback operations are suspended and shut in with no water currently being produced. Flowback water is currently stored within AST 2 (ie a 1.5 mega litre (ML) tank) which is used for the receipt of flowback water prior to offsite disposal. The flowback water is currently awaiting offsite disposal to an appropriately licensed facility via road tanker when flowback operations recommence. AGL is currently in negotiations with third party contractors for the offsite disposal, however seeks to recommence flowback operations in the immediate future in accordance with clauses 8.2 and 8.3 of the *NSW Code of Practice for Coal Seam Gas - Fracture Stimulation Activities* (DRE 2012).

In addition, AGL can only recommence the Project, including dewatering operations, if both the EPA and OCSG issue their approval.

As described in the approved SGMP, the flowback water period is deemed to be finished when 100% of the volume of the hydraulic fracture stimulation fluids injected at each well is recovered and a salinity trigger of 5,000 µS/cm is reached (and maintained) for the return waters at which point the water is then classified as produced water.

1.5 OCSG considerations

Following lodgement of AGL's previous request to vary the approved activity (dated 25 February 2015), the OCSG requested clarification on 17 March 2015 regarding the following matters:

- description around the need for the batching approach to flowback water storage and disposal;
- description of measures to ensure disposal of flowback water is undertaken as the primary objective;
- ensure that freeboard contingencies are included in flowback water management measures;
- minimisation of flowback water volumes held on site during the flowback water phase;
- description of the removal of above-ground storage tank 2 (AST 2) (in accordance with the existing approval) following completion of the flowback water phase; and
- inclusion of appropriate trigger/response mechanisms and notifications to the OCSG, particularly if lawful disposal of flowback water is not available.

As noted in Section 1.1, AGL undertook further reviews and risk assessments of the Project with respect to obtaining greater certainty and security of the management of flowback water. AGL is seeking to vary the existing approved activity as described in this report (refer to Sec tion 1.3). This report supercedes and replaces the request submitted to OCSG on 25 February 2015.

This report also considers the OCSG matters for clarification OCSG where relevant. A summary of these is presented in Section 5.

1.6 Purpose of the report

The report assesses the proposal to pump flowback water from AST 2 to the Tiedmans site into the existing TED, its management and disposal from the Tiedmans site and the activities set out in Section 1.3 above.

The request to vary the activity provides enhanced certainty and security of flowback water management and disposal with the inclusion of treatment of flowback water in accordance with the approved EWMS required in the project approval of Stage 1 GGP.

It should be noted that this document does not provide an assessment of the treatment process required under the EWMS as it is part of the Stage 1 GGP project approval.

2 Description of the variation

2.1 Water management infrastructure components and flowback water storage

i Tiedmans East Dam

The proposed variation involves the pumping of flowback water from AST 2 to the Tiedmans site into the existing TED via the existing approved pipeline (refer to Figure 1) following an additional pressure test on the existing approved pipeline between AST 2 and the TED. The TED is double-lined with HDPE and was constructed by NSW Government's Soil Conservation Service in 2013.

The TED has been used to temporarily store produced water. The dam has a capacity of 20 ML (allowing for the required freeboard) and it is envisaged that the remaining flowback water to be pumped to the TED until the final well reaches the produced water stage would be 3 to 3.5 ML. Flowback water will be temporarily and securely stored in TED with the dam's existing leakage detection system frequently monitored as outlined in Section 2.3 below.

If flowback water is no longer being pumped to TED (ie the contents of TED is 'static'), then representative samples of TED will be analysed in advance of any offsite disposal.

ii Enclosed water tanks

Two enclosed and bunded tanks with a capacity of approximately 57,000 litres each (accommodating 110% secondary containment capacity within the duck pond) would be installed adjacent to the TED within an existing cleared laydown area (refer to Figure 1). The tanks would be managed to ensure the capacity of 57,000 litres is not exceeded, ensuring the duck pond can capture 110% of the contents of one tank.

Prior to lawful transportation of flowback water to a licensed offsite disposal facility (if available and commercially viable), AGL will undertake sampling and analysis of the flowback water to characterise the water quality. If flowback water is being pumped from AST 2 to the TED (ie the content of TED is 'dynamic') and if AGL is able to engage a third party contractor for lawful offsite disposal of flowback water, batches of flowback water will be decanted from the TED into the two enclosed and bunded tanks (ie Batch tank 1 and Batch tank 2) for sampling and analysis in advance of offsite disposal.

iii Mobile containerised water treatment unit

If Stage 1 of the GGP has not commenced by 22 February 2016, and lawful offsite disposal of flowback water is still required and not available (or commercially viable) for AGL despite all reasonable and practicable efforts, AGL will seek approval for a mobile containerised water treatment unit to be located at Tiedmans. Water quality from the mobile containerised water treatment unit will meet the EWMS requirements.

The wastewater stream would then be transported for lawful disposal at an appropriate destination via truck consistent with the approved activity. Due to the treatment process to separate the wastewater stream it can be expected that the volumes requiring offsite disposal would be significantly less than those assessed as part of the approved activity. Should this contingency option be required, AGL commits to liaising with OCSG and obtain any outstanding necessary approvals required to operate the mobile containerised water treatment unit.

2.2 Flowback water quality

Prior to the Project's suspension, flowback water was received in AST 2 from WK 12 and 13 following completion of hydraulic fracture stimulation activities at each of the four wells. This water has been routinely sampled and analysed.

A review of available water quality results of samples from the flowback AST (December 2014 to February 2015) was undertaken by Environmental Risk Services Pty Ltd (EnRiskS) and is provided in Appendix B. Relevant guidelines used in the review were:

- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000) – guidelines which determine the trigger value concentrations for 95% protection of freshwater aquatic ecosystems. It should be noted that the 'trigger values' indicate the concentration below which no effects would be expected and the concentration above which investigations should occur to determine if effects are actually occurring; and

- *NSW Liquid Trade Waste Guidelines* (DWE 2009) – guidelines for local water utilities to accept water being discharged into the sewer system prior to treatment. It should be noted that local water utilities may choose to adjust the limits according to their circumstances.

The review of the water quality data noted the following:

- *NSW Liquid Trade Waste Guidelines* – concentrations of analytes present in the flowback water stored in AST 2 are present at concentrations that would be acceptable to allow discharge of this waste water into the sewerage system except for boron. Boron was reported at concentrations in the flowback water that would be acceptable to the Sydney Water system but may not be for some regional sewerage systems.

- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* – the maximum concentrations reported are higher than the guidelines for the 95% protection of freshwater ecosystems for aluminium, boron, cadmium, cobalt, copper, molybdenum, lead, zinc, iron, total nitrogen and total phosphorus. However, all of these are naturally occurring elements that may be in aquatic environments, particularly groundwater systems. The salt contained in the coal seam groundwater comes from the salts being dissolved over the millennia from the sedimentary rocks.

  This has been observed by AGL continuous loggers in nearby local rivers with elevated salinity levels recorded in excess of 1,000 µS/cm in the first flush from stormwaters. Occasional exceedances of water quality guidelines are unlikely to cause significant impacts especially given that these salts may have limited availability to organisms due to reactions with humic acids and other organic matter present in aquatic environments from the degradation of plants and animals.

When WK11, 12, 13 and 14 pumps are re-commissioned, in addition to the monitoring specified within EPL 20358 and the SGMP (AGL 2014a), for an initial four week period, daily samples of flowback water will be taken from each well and AST 2. These samples will be analysed for BTEX. BTEX analyses will be provided by the laboratory to AGL within 24 hours (Monday to Friday only excluding public holidays). If requested, an analysis of these results will be promptly provided to OCSG once they have gone through an internal quality control process.

Prior to transportation of flowback water for lawful disposal, AGL will assess the water quality to meet regulatory requirements including *Protection of the Environment Operations (Waste) Regulation 2014.*

2.3 Water storage management and monitoring

2.3.1 Tiedmans East Dam

Subject to OCSG and EPA approval, operations to pump flowback water from the wells will recommence and the flowback water from the wells will continue to be pumped to AST 2. This flowback water inclusive of the existing approximately 600,000 litres (L) of flowback water which was pumped from the four pilot wells until AGL suspended operations on 27 January 2015, will then be pumped to TED via the existing approved pipeline.

The TED was constructed in accordance with relevant standards with leak detection mechanisms and complies with ASTM D4437-99 (*Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymer Sheet Geomembranes*); a recognised industry standard.

The following regime will be incorporated into the SGMP and implemented to monitor water levels and quality of the TED's integrity and leakage detection system:

- weekly visual check of the liner;
- weekly sample of sump water level and field parameters (ie electrical conductivity);
- monthly (basic as defined in the SGMP) water samples plus BTEX taken from both the dam and the inspection sump during the flowback water pumping period;
- if flowback water is being pumped from AST 2 to TED (ie the contents of TED is 'dynamic') and a third party contractor for lawful offsite disposal of flowback water is available and commercially viable, batches of flowback water will be decanted from the TED into the two enclosed and bunded tanks at Tiedmans for sampling and analysis in advance of lawful offsite disposal.

In addition, AGL commits to the following expanded water monitoring requirements:

- quarterly (comprehensive) sampling from the TED during the produced water pumping period; and
- quarterly (comprehensive) sampling of the two seepage monitoring bores (TMB04 and TMB05).

2.3.2 Continuation of sampling and analysis at Waukivory – enhanced monitoring program

When WK11, 12, 13 and 14 pumps are re-commissioned, in addition to the monitoring specified within EPL 20358 and the SGMP (AGL 2014a), for an initial four week period, daily samples of flowback water will be taken from each well and AST 2. These samples will be analysed for BTEX. BTEX analyses will be provided by the laboratory to AGL within 24 hours (Monday to Friday only excluding public holidays). If requested, an analysis of these results will be promptly provided to OCSG once they have gone through an internal quality control process.

It should be noted that should a well experience a pump failure or other operational issue where water cannot be brought back to surface, then the four week testing period for the well with the operational issue, will be extended so that the four week sampling is captured for each well.

2.4 Lawful offsite disposal via Tiedmans Lane and Fairbairns Road

Offsite lawful disposal of flowback water by road tanker from the Tiedmans site will utilise Tiedmans Lane (unsealed) and Fairbairns Road to access The Bucketts Way and to an appropriate destination. This transport route includes a 2.6 km section of Tiedmans Lane and Fairbairns Road not previously assessed as part of the Project. There are four residential properties (R7 to R10) in proximity to this section of the transport route as shown in Figure 1 with an additional residence unoccupied (R4). These residences along with other existing stakeholders would be notified prior to recommencement of offsite disposal. Offsite disposal will be undertaken in accordance with the *Traffic Management Plan for the Transportation of Flowback Water* (AGL 2013) which requires the implementation of appropriate management measures to minimise potential noise and dust emissions from Project-related traffic movements, including vehicles accessing the unsealed section of Tiedmans Lane.

Offsite flowback water disposal would continue at a rate of up to approximately three tankers per day (up to 75,000 L/d) within the assessed period of Monday to Friday, 7.00 am to 6.00 pm and Saturday, 8.00 am to 1.00 pm. This is consistent with the approved activity as per the original REF (EMM 2013a) and Addendum to the REF (EMM 2013b). The transportation of flowback water offsite will continue to be managed in accordance with the *Traffic Management Plan for the Transportation of Flowback Water* (AGL 2013).

2.5 Mitigation strategy

The temporary storage of flowback water at the TED will be managed in accordance with the requirements of the REF (as amended) and subsequent management plans (such as the SGMP) prepared and/or updated by AGL and approved by OCSG. Specific additional measures to manage the proposed variation to the approved activity include:

- flowback water levels and volumes will be metered at AST 2;
- regular inspections of the leakage detection system of TED will be undertaken in accordance with the requirements of the SGMP (and as outlined in Section 2.3.1);
- when WK11, 12, 13 and 14 pumps are re-commissioned, in addition to the monitoring specified within EPL 20358 and the SGMP (AGL 2014a), for an initial four week period, daily samples of flowback water will be taken from each well and AST 2. These samples will be analysed for BTEX. BTEX analyses will be provided by the laboratory to AGL within 24 hours (Monday to Friday only excluding public holidays). If requested, an analysis of these results will be promptly provided to OCSG once they have gone through an internal quality control process;
- sampling procedures for water quality sampling from the Project's well surface facilities and the flowback ASTs will be undertaken in accordance with AGL's procedure document (Ref Number: DCS-GLO-SOP_WE-001);
- characterisation of flowback water prior to lawful offsite disposal to an appropriate destination; and
- Water Sampling Plan for the Project outlining the water sampling and monitoring procedures and schedule, required analytical suite and reporting schedules (Ref Number: DCS-GLO-HSE-WSP-001_Gloucester Water Sampling Plan).

In summary, this request to vary the approved activity further reduces operational and environmental risks. The SGMP and PWMP will be updated immediately to take into account this variation, if approved.

The updated SGMP will incorporate those parts of the *Waukivory Flowback Above Ground Storage Tank Management Plan* (AGL 2015) (lodged with the previous variation dated 25 February 2015) which are relevant to this proposed variation.

Flowback water will continue to be stored securely with greater certainty provided for methods of its safe and secure management and disposal. These proposed methods for the management and disposal of the flowback water are consistent with this primary objective of the flowback water stage of the Project.

If this request to vary the approved activity is approved, it also affords the Project greater certainty and continuity in achieving its overarching objectives to further assess the gas reserves as required by AGL's obligations under PEL 285.

2.6 Summary of triggers/responses to OCSG

Should offsite lawful disposal of flowback water not be available (or commercially viable) for AGL despite its reasonable efforts, the following trigger/ response mechanisms will be implemented and notifications made to OCSG for the Project:

- **Promptly after each daily sample for first four weeks** – Samples from WK11, 12, 13 and 14 and AST 2 will be taken and analysed for BTEX. BTEX analyses will be provided by the laboratory to AGL within 24 hours (Monday to Friday only excluding public holidays). If requested, an analysis of these results will be promptly provided to OCSG once they have gone through an internal quality control process.

- **Every two weeks** AGL will provide an updated report to OCSG outlining the reasonable and practicable endeavours to secure a third party contractor for lawful transportation, treatment and disposal of flowback water offsite to a licensed and appropriate facility.

- **Commencement of Stage 1 GGP (up to 22 February 2016) –** If the flowback water has not been transported to an offsite licensed facility for lawful treatment and disposal, then on commencement of Stage 1 GGP, the flowback water will be managed via the approved EWMS.

- **22 February 2016** - If the flowback water has not been transported to an offsite licensed facility for lawful treatment and disposal and Stage 1 GGP has not commenced, AGL commits to a mobile containerised water treatment unit to be located at the Tiedmans site. AGL will apply for all necessary approvals to do so.

2.7 Consultation and stakeholder engagement

AGL proposes a comprehensive and timely community engagement program to support the approval of this application and ensure stakeholder awareness and understanding of the variation.

This will include:

- consultation with landholders and tenants;

- consultation with the additional residences along the proposed flowback water transportation route and notification prior to commencement;

- a letter of notification to any other affected residents and residents of Fairbairns Road and Forbesdale;

- an AGL update to:
    - Gloucester Community Consultative Committee;
    - Gloucester Shire Council (General Manager and Mayor);
    - Gloucester Dialogue;
    - Gloucester Business Chamber, Advance Gloucester; and
    - Government regulators.
- publication of an article on AGL's community information portal, www.YourSayAGL.com.au and the AGL website update;
- social media updates via AGL's community relations Twitter account;
- a media release to local, regional and metro media;
- an E-news update via email newsletter to subscribers within the Gloucester area;
- an update at the following Gloucester Community Consultative Committee meeting;
- inclusion in AGL's regular community update in the Gloucester Advocate;
- direct stakeholder engagement by AGL's local Gloucester team, Gloucester Community Relations and Government relations teams; and
- ongoing communication updates to all stakeholders identified.

2.8 Other approvals

A minor variation will be required to the Gloucester Gas Project EPL to refer to this variation, if approved.

It should be noted that no referral to the Commonwealth Department of Environment (DoE) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* is required. The proposed request to vary the approved activity will not impact upon water resources as defined within the *Significant Impact Guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources* (DoE 2013) or any other matter of national environmental significance.

3 Impact assessment

The assessment of the proposed variation to the approved activity has adopted a risk-based approach. The basis of this approach was to review the assessment outcomes of the approved activity which used the *ESG2: Environmental impact assessment guidelines* (ESG2 guidelines) impact criteria and apply these same criteria to the environmental aspects relevant to the proposed variation.

As described in Section 1.1, a risk assessment was undertaken by AGL of the Project with respect to obtaining greater certainty and security of the management of flowback water and the Project. This is provided in Appendix C.

An impact assessment using the ESG2 guidelines with consideration of the outcomes of the AGL risk assessment is provided in Table 3.2.

Impacts are categorised as negligible, low adverse, medium adverse, high adverse or positive as per the ESG2 guidelines. The extent and nature of the impact will assist OCSG in determining whether or not significant impacts are likely.

Table 3.1 describes the method for characterising the extent of negative impacts provided in the ESG2 guidelines (ie from low adverse to high adverse).

Table 3.1 Guide to categorising the extent of impact

Analysis of impact	Low adverse	High adverse
Size	Small scale size/volume	Large scale/volume
Scope	Localised	Extensive
Intensity	Small impact dispersed over a long period	Large impact over a short or long period
Duration	Short term	Long term
Level of confidence in predicting impacts	High confidence/knowledge and past experience	Low confidence, numerous uncertainties and unknowns
Level of reversibility of impacts	Impacts are reversible and rehabilitation likely to be successful	Reversibility impossible or unlikely due to cost or other factors
Ability to manage or mitigate impacts	Effective mitigation measures available	Mitigation measures untested or unavailable
Ability of the impacts to comply with standards, plans or policies	Total compliance	Uncertain or part compliance
Level of public interest	Low interest and predictable impacts on community	High interest and uncertain impacts on community
Requirement for further information on the impacts of the activity or mitigation	High level of understanding and information on the impact	Low level of information and understanding of key issues

Table 3.2 Summary of impacts

Environmental aspects	Assessed level of impact for approved activity[1]	Impact assessment	Revised level of impact
Physical and chemical	Negligible to low adverse	There will not be any soil impacts additional to those predicted in the previous assessments as the disturbance footprint is not proposed to be increased. Potential surface water, groundwater, flooding and noise impacts are considered below. **Surface water and groundwater** The water quality of local waterways and shallow aquifers could be impacted if flowback water escapes the site, via either TED, the two enclosed water tanks or the mobile containerised water treatment unit (and associated AST) and enters the waterways. **Size:** the disturbance footprint is not proposed to be increased, nor is the volume of flowback water now to be temporarily stored at TED. Flowback water will be pumped via the existing approved pipeline from AST 2 to the Tiedmans site for temporary storage in the TED. The flowback water will be temporarily stored in this dam prior to lawful offsite transportation, treatment and disposal, or use treatment in accordance with the EWMS prepared in accordance with the requirements of the project approval for Stage 1 GGP. This document is being prepared in consultation with OCSG, NOW, Hunter Local Land Services, EPA and relevant Councils. The TED is double-lined. The dam has also undergone testing and complies with AST D4437-99 ((*Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymer Sheet Geomembranes*); a recognised industry standard for liner construction. The dam has a comprehensive leak detection monitoring system which will be monitored weekly. These measures will provide further security and certainty regarding the quality of the flowback water stored at TED for use in Stage 1 GGP as per the EWMS. Lawful disposal of flowback water may occur from the Tiedmans site if available (and commercially viable) for AGL. Water would be transferred to tankers from TED via two enclosed water tanks to be installed within a duck pond near the dams (refer to Figure 1). In the event that Stage 1 GGP has not commenced by 22 February 2016 and offsite disposal of flowback water is not available (or commercially viable) for AGL, a mobile containerised water treatment unit will be installed at the Tiedmans site. The containerised unit would be placed within an existing cleared laydown area next to the dams along with an AST similar to those at WK13. The treated water would be pumped into available storage at the Tiedmans site for use in accordance with the project approval of Stage 1 GGP and the wastewater stream stored in the AST prior to lawful disposal via truck to an appropriate destination consistent with the approved activity. **Scope:** impacts of any spills or leaks of flowback water will be localised unless all water storages fail simultaneously and all stored flowback water is released into the environment at the same time. This is highly unlikely as multiple storages would have to fail simultaneously. **Intensity:** impacts of any spills or leaks of flowback water through either transport, pumping or storage will be small in size and short in duration, unless the highly unlikely flowback water storage failure described above occurs. **Duration:** the pumping of flowback water will be short term with the duration similar to the four to 16 week flowback period nominated in the REF. If offsite flowback water disposal ceases in this time, flowback water will continue to be pumped to TED and temporarily stored. The flowback water will remain in place for either disposal offsite or treatment in accordance with the project approval of the Stage 1 GGP. In the event that Stage 1 GGP has not commenced by 22 February 2016 and offsite disposal of flowback water is not available (or commercially viable) for AGL, a mobile containerised water treatment unit will be installed at the Tiedmans site.	Negligible to low adverse

Table 3.2 Summary of impacts

Environmental aspects	Assessed level of impact for approved activity[1]	Impact assessment	Revised level of impact
		Level of confidence in predicting impacts: AGL has high confidence in the predicted impacts as it has successfully carried out these activities and associated management measures at this site during this approved activity as well as at other locations over many years. **Level of reversibility of impacts:** samples of flowback water have been taken and analysed in accordance with the requirements of Project's EPL. The review of flowback water quality results (EnRiskS 2015 provided as Appendix B indicated that reported occasional exceedances of ANZECC's guideline trigger levels for the 95% protection of freshwater ecosystems are unlikely to cause significant impacts should it be encountered. **Ability to manage or mitigate impacts:** the following measures will be in place to prevent leaks and spills of flowback water from entering the environment: • TED has a double liner system consisting of a HDPE primary liner and a linear low density polyethylene secondary liner for leak detection and collection. • The area in which the enclosed water tanks are to be used for transfer of flowback water is bunded to 110% capacity of one of the tanks in accordance with the requirements of the EPL. **Ability of the impacts to comply with standards, plans or policies:** Section 120 of the NSW *Protection of the Environment Operations Act 1997* (POEO Act) is unlikely to be breached if the management measures are implemented. Further, continued characterisation of the flowback water will continue in accordance with the requirements of the POEO (Waste) Regulation prior to its lawful disposal offsite at a licensed facility. **Level of public interest:** water management is one of the public's main concerns in relation to coal seam gas testing and production. However, impacts are unlikely if the management measures are implemented. **Requirement for further information on the impacts of the activity or mitigation:** When WK11, 12, 13 and 14 pumps are re-commissioned, in addition to the monitoring specified within EPL 20358 and the SGMP (AGL 2014), for an initial four week period, daily samples of flowback water will be taken from each well and AST 2. These samples will be analysed for BTEX. BTEX analyses will be provided by the laboratory to AGL within 24 hours (Monday to Friday only excluding public holidays). If requested, an analysis of these results will be promptly provided to OCSG once they have gone through an internal quality control process. AGL will also implement its *Procedure for water sampling from pilot gas wells WK11, 12, 13, 14 and above ground flowback water storage tank* on an ongoing basis to understand potential impacts if flowback water enters the environment. Further, continued characterisation of the flowback water will continue in accordance with the requirements of the POEO (Waste) Regulation prior to its lawful disposal offsite at a licensed facility. **Flooding** Capacity of the TED is approximately 25 ML (allowing for freeboard). There is currently less than 1 ML (600,000 L) in existing storage within this dam with the amount of flowback water anticipated to be received from the Project approximately 3 to 3.5 ML. This represents approximately 20% of the freeboard capacity of the dam, therefore risk of overtopping of dam is negligible. As previously described in Section 2, the TED is double lined, with leak detection and is positioned at a high point within the Tiedmans site. Water management infrastructure at the Tiedmans site (ie TED and the proposed two enclosed water tanks) is outside the probable maximum flood area for the Avon River (refer to Figure 2).	

Table 3.2 Summary of impacts

Environmental aspects	Assessed level of impact for approved activity[1]	Impact assessment	Revised level of impact
		Given this, it is highly unlikely that flood waters could mix with flowback water if the enclosed water tanks are dislodged and damaged by flood waters or there is a catastrophic failure of the TED. The continued implementation of the mitigation strategy outlined in the REF (EMM 2013a), the Addendum to the REF (EMM 2013b) and the Further Addendum (EMM 2014a) is appropriate to manage and minimise impacts from flooding to the Project. **Noise and vibration** The pumping of flowback water to the Tiedmans site via the existing approved pipeline is consistent with the existing approved activity and additional impacts are not anticipated from this activity. Emissions from the installation of the two enclosed water tanks (and AST, if the mobile containerised water treatment unit is required), pumping of water from TED into the enclosed tanks and additional pressure test on the existing approved pipeline between AST 2 and TED are considered to be negligible given the activities are temporary and result in low emissions. It should be noted that the nearest sensitive receptor to TED is over 1.4 km away and the Tiedmans site currently operates water infrastructure equipment. Further, the operation of the mobile containerised water treatment plant within the Tiedmans site (should this contingency measure method of disposal be required) is also considered to be negligible as the unit is housed entirely within a container. However, emissions from the transport of flowback water from the Tiedmans site using Tiedmans Lane and Fairbairns Road to access The Bucketts Way introduces potential traffic noise impacts to four residential receptors (R7 to R10 – see Figure 1) not previously assessed. **Size:** the size of the impact is anticipated to be minimal with up to three tankers per day anticipated to transport flowback water offsite to an appropriate destination consistent with the existing approval. **Scope:** the impacts of traffic noise from trucks transporting flowback water to these four nearby residential receptors (R7 to R10 – see Figure 1) will be intermittent and short-term. If offsite disposal is available (and commercially viable) for AGL, up to three trucks per day will be used to transport flowback water from the Tiedmans site to an appropriate destination. These four residences would be notified prior to the recommencement of offsite disposal, which would be undertaken in accordance with the *Traffic Management Plan for the Transportation of Flowback Water* (AGL 2013). **Intensity:** no traffic noise impacts above established criteria are predicted at these four residential receptors (R7 to R10 – see Figure 1). Table 6.9 from the REF displayed the calculated noise levels for flowback water transportation at nominal setback distances for receptors along local roads, such as Tiedmans Lane and Fairbairns Road. Residential receptors R7 (100 m setback), R8 (200 m setback), R9 (100 m setback) and R10 (100 m setback) are predicted to experience noise levels of a maximum of 42 dB(A) Leq, 1hr compared to the criteria of 50 dBA. Therefore, the potential impact of traffic noise on these receptors is considered to be negligible.	

Table 3.2 Summary of impacts

Environmental aspects	Assessed level of impact for approved activity[1]	Impact assessment	Revised level of impact
		Duration: transportation of flowback water from Tiedmans site to an appropriate destination for lawful disposal will occur during the flowback water stage if this method of disposal is available (and commercially viable) to AGL. The REF stated that the flowback water stage may be between 4 and 16 weeks in duration. However, due to the suspension of the Project and availability of (and commercial viability of) offsite disposal, the duration of flowback water transportation is likely to be over a longer period. However, the maximum of three trucks per day and associated short term and intermittent nature of traffic noise and traffic noise impacts will not change over this duration and are considered negligible. **Level of confidence in predicting impacts:** AGL has high confidence in the predicted impacts as it has successfully carried out these activities and associated management measures at other locations over many years. **Level of reversibility of impacts:** the impacts are completely reversible given they are short term in nature. **Ability to manage or mitigate impacts:** the continued implementation of the *Traffic Management Plan for the Transportation of Flowback Water* (AGL 2013) will minimise noise impacts from trucks disposing of flowback water from the Tiedmans site. No further management measures are necessary. **Level of public interest:** public interest in noise impacts from the project is moderately high and generally focussed on activities at the Waukivory site. However, the proposed variation to the approved activity does not result in additional adverse noise impacts to the community. **Requirement for further information on the impacts of the activity or mitigation:** AGL has a high level of understanding of this impact and further information is not required.	
Biological	Negligible	None of the impact categories apply to this environmental aspect as no land will be disturbed from the proposed request to vary the approved activity. The continued implementation of the mitigation strategy outlined in the REF (EMM 2013a), the Addendum to the REF (EMM 2013b) and the Further Addendum (EMM 2014a) is appropriate to manage and minimise impacts to biological values of the project area.	Negligible
Community	Low adverse	**Visual amenity** Visual amenity is a potential community impact associated with offsite disposal along Tiedmans Lane and Fairbairns Road by trucks past four residential properties (R7 to R10) with a further residence (R4) unoccupied (refer to Figure 1). Visual impacts are assessed against the impact criteria below. The installation of two enclosed water tanks and, if required, the mobile containerised water treatment unit and associated AST within the Tiedmans site will not be visible from surrounding receptors. **Size:** the size of the impact will be small as it will be limited to the four residential receptors (R7 to R10 – see Figure 1) along the transport route of Tiedmans Lane and Fairbairns Road not previously assessed. **Scope:** the impact will be localised. **Intensity:** the size of the impact will be small and intermittent as up to three trucks per day will transport flowback water offsite. If there is a cessation of disposal offsite, flowback water will continue to be stored onsite at the Tiedmans site to be either used in Stage 1 GGP, disposed offsite when available (and commercially viable) to AGL or treated with a mobile containerised water treatment unit.	Low adverse

Table 3.2 Summary of impacts

Environmental aspects	Assessed level of impact for approved activity[1]	Impact assessment	Revised level of impact
		Duration: the impact of offsite disposal is anticipated to be short term given the small number of vehicles, unless, as described above, flowback water disposal decreases in frequency or ceases. If offsite flowback water disposal ceases, flowback water will continue to be stored onsite at the Tiedmans site to be either used in Stage 1 GGP, disposed offsite when available (and commercially viable) to AGL or treated with a mobile containerised water treatment unit. **Level of confidence in predicting impacts:** AGL has high confidence in the predicted impacts as it has successfully carried out these activities and associated management measures at other locations over many years. **Level of reversibility of impacts:** the impacts are completely reversible. There are no proposed changes to the rehabilitation of AST 2 outlined in the REF (EMM 2013a), the Addendum to the REF (EMM 2013b) and the Further Addendum (EMM 2014a). These rehabilitation techniques have a high degree of confidence as they have been successfully carried out at other locations over many years. **Ability to manage or mitigate impacts:** the continued implementation of the *Traffic Management Plan for the Transportation of Flowback Water* (AGL 2013) will minimise visual disruption from trucks disposing of flowback water from the Tiedmans site. The proposed installation of two enclosed water tanks (and mobile containerised water treatment unit and associated AST, if required) at Tiedmans site will not be visible to surrounding receptors. The additional four residences along the transportation route (together with other stakeholders) would be notified prior to the recommencement of offsite disposal of flowback water. No further management measures are necessary. **Level of public interest:** public interest in visual impacts from the project is focussed on the visibility of flaring and not visual effects from the transportation of flowback water. **Requirement for further information on the impacts of the activity or mitigation:** AGL has a high level of understanding of this impact and further information is not required. **Traffic** The proposed variation will not increase the number of truck movements from the approved Project. Flowback water would be continued to be lawfully disposed of offsite to an appropriate destination if available (and commercially viable) to AGL. Trucks would transport flowback water from the Tiedmans site by using Tiedmans Lane and Fairbairns Road to access The Bucketts Way. Approximately 2.6 km of this route (between Tiedmans site gate and WK13 access gate) has not been assessed previously. There are an additional four residential receptors along this route (refer to Figure 1) with one additional property unoccupied. As a contingency measure in the event that Stage 1 GGP does not commence by 22 February 2016 and offsite disposal is not available (or commercially viable) for AGL, a mobile containerised water treatment unit would be installed at the Tiedmans site. The wastewater stream from this process would be stored in an AST and then transported offsite to an appropriate destination. It is anticipated that the volume of this wastewater stream would be significantly reduced from assessed volumes in the REF and minimal truck movements required for its disposal. **Size:** the size of the impact will be small as it will be limited to a maximum of three trucks per day to remove the flowback water from the Tiedmans site. Should offsite disposal not be available (or commercially viable) for AGL, flowback water will continue to be secured within the TED for use in the Stage 1 GGP as per the project approval.	

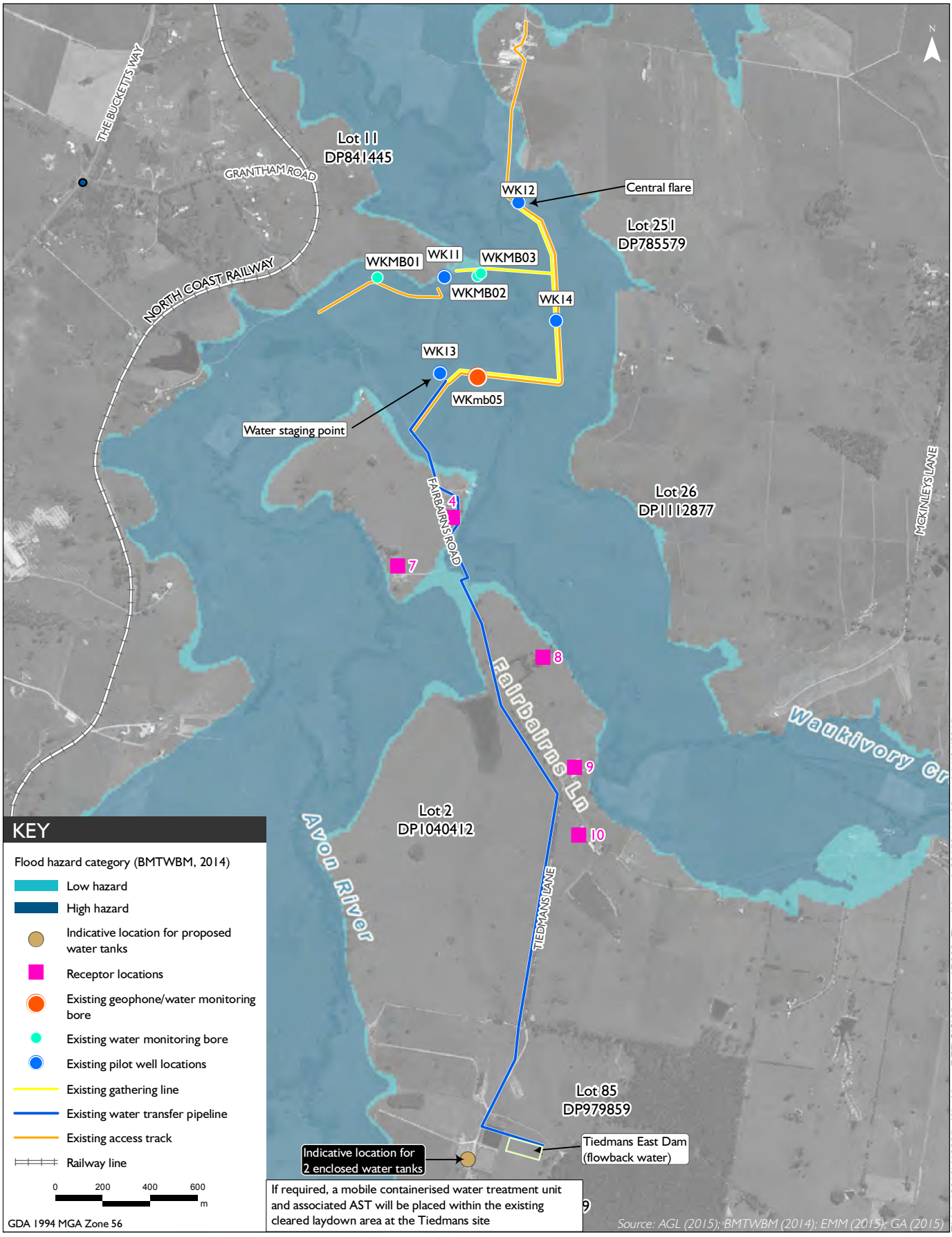
Table 3.2 Summary of impacts

Environmental aspects	Assessed level of impact for approved activity[1]	Impact assessment	Revised level of impact
		Scope: the impact will be localised along the transport route past an additional four residential properties along Tiedmans Lane and Fairbairns Road. **Intensity:** Transportation of flowback water will continue to be managed through the implementation of the existing *Traffic Management Plan for the Transportation of Flowback Water* (AGL 2013). Offsite disposal of flowback water will continue with up to the assessed three semi-trailer tankers (EMM 2014a). The implementation of the mitigation strategy outlined in the REF (EMM 2013a), the Addendum to the REF (EMM 2013b) and the Further Addendum (EMM 2014a) is appropriate to manage and minimise traffic impacts to the community surrounding the Project area. **Duration:** transportation of flowback water from Tiedmans site to an appropriate destination for lawful disposal will occur during the flowback water stage if available (and commercially viable) to AGL. The REF stated that the flowback water stage may be between 4 and 16 weeks in duration. However, due to the suspension of the Project and the availability of (and commercial feasibility of) offsite disposal, the duration of flowback water transportation is likely to be over a longer period. However, the maximum number of trucks per day will not change and additional impacts are not expected given the continued implementation of the *Traffic Management Plan for the Transportation of Flowback Water* (AGL 2013). **Level of confidence in predicting impacts:** AGL has high confidence in the predicted impacts as it has successfully carried out these activities and associated management measures at other locations over many years. **Level of reversibility of impacts:** the impacts are completely reversible. **Ability to manage or mitigate impacts:** the continued implementation of the *Traffic Management Plan for the Transportation of Flowback Water* (AGL 2013) will minimise traffic network disruption from trucks disposing of flowback water from the Tiedmans site. **Level of public interest:** public interest in traffic impacts from the project is high given the perceived characterisation of flowback water relative to the analysed volumes stored onsite (refer to Section 2.3). **Requirement for further information on the impacts of the activity or mitigation:** AGL has a high level of understanding of this impact and further information is not required.	
Natural resource	Negligible to low adverse	None of the impact categories apply to this environmental aspect as planned rehabilitation activities will be implemented as approved. Following completion of the flowback water stage, AST 2 will be removed and the area rehabilitated. The installation of two enclosed water tanks (and mobile containerised water treatment unit and associated AST, if required) adjacent the existing dams at the Tiedmans site will occur on an existing cleared laydown area (refer to Figure 1). The implementation of the mitigation strategy outlined in the REF (EMM 2013a), the Addendum to the REF (EMM 2013b) and the Further Addendum (EMM 2014a) is appropriate to manage and minimise impacts to the Aboriginal heritage values of the Project area.	Negligible to low adverse
Aboriginal heritage	Negligible	None of the impact categories apply to this environmental aspect as no land will be disturbed as part of the proposed request to vary the approved activity. The installation of two enclosed water tanks (and mobile containerised water treatment unit and associated AST, if required) adjacent the existing dams at the Tiedmans site will occur on an existing cleared laydown area (refer to Figure 1). The implementation of the mitigation strategy outlined in the REF (EMM 2013a), the Addendum to the REF (EMM 2013b) and the Further Addendum (EMM 2014a) is appropriate to manage and minimise impacts to the Aboriginal heritage values of the Project area.	Negligible

Table 3.2 Summary of impacts

Environmental aspects	Assessed level of impact for approved activity[1]	Impact assessment	Revised level of impact
Historic cultural heritage	Low adverse	None of the impact categories apply to this environmental aspect as no land will be disturbed as part of the proposed request to vary the approved activity. The installation of two enclosed water tanks (and mobile containerised water treatment unit and associated AST, if required) adjacent the existing dams at the Tiedmans site will occur on an existing cleared laydown area (refer to Figure 1). The implementation of the mitigation strategy outlined in the REF (EMM 2013a), the Addendum to the REF (EMM 2013b) and the Further Addendum (EMM 2014a) is appropriate to manage and minimise impacts to the cultural heritage values of the Project area.	Low adverse
Cumulative	Negligible	The proposed use of flowback water for Stage 1 GGP is consistent with its project approval and the Strategy which has been prepared in consultation with the OCSG, NOW, Hunter Local Land Services, EPA and relevant Councils. The draft EWMS identifies the final suite of water disposal and re-use option(s) to be implemented to manage groundwater extracted from gas wells (refer to condition 3.12(a)) as well as an assessment of the need for control measures to be implemented at the extracted water dams (refer to condition 3.12(h)).	Negligible

Note: 1. Addendum to the REF (EMM 2014a).



Avon River flood study probable maximum flood hazard

Waukivory Pilot Project

Figure 2

4 Summary of impacts

This report documents the assessment of the potential environmental impacts of the proposed variation of the approved activity in accordance with the ESG2 Guidelines.

Table 4.1 summarises the impacts of the approved activity and the extent of such impacts. The assessment did not identify any increase in the impact levels identified in the previous documentation regarding the proposed variation to the approved activity.

Table 4.1 Summary of impacts

Impacts	Level of impact[1] (EMM 2014a)	Level of impact for the proposed variation to the approved activity
Physical and chemical	Negligible to low adverse	Negligible to low adverse
Biological	Negligible	Negligible
Community	Low adverse	Low adverse
Natural resource	Negligible to low adverse	Negligible to low adverse
Aboriginal heritage	Negligible	Negligible
Historic cultural heritage	Low adverse	Low adverse
Cumulative	Negligible	Negligible

Notes: 1.Further Addendum to the REF (EMM 2014a).

The assessment outcomes of the Project have been updated to consider the factors described in clause 228 of the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation). These are shown in Table 4.2.

Table 4.2 Assessment outcomes with regards to clause 228 of the EP&A Regulation

Factors that must be taken into consideration	Assessment of the approved activity[1]	Assessment of the proposed variation to the approved activity
(1) For the purposes of Part 5 of the Act, the factors to be taken into account when consideration is being given to the likely impact of an activity on the environment include:		
(a) for activities of a kind for which specific guidelines are in force under this clause, the factors referred to in those guidelines, or	The activity is a petroleum prospecting (exploration) activity subject to assessment under Part 5 (and has not been approved under Parts 3A or 4). The activity has been assessed in accordance with ESG2 guidelines and its draft supplement for petroleum prospecting, as well as the Codes of Practice (CoPs) (fracture stimulation activities and well integrity).	No change.
(b) for any other kind of activity:	N/A	No change.
(i) the factors referred to in the general guidelines in force under this clause, or	N/A	No change.
(ii) if no such guidelines are in force, the factors referred to subclause (2)	The proposed activity has been assessed in accordance with the guidelines and the factors referred to in the subclause (2) as indicated below.	No change.
(2) The factors referred to in subclause (1) (b) (ii) are as follows:		
(a) any environmental impact on a community,	The proposed activity was assessed in the REF (EMM 2013a), the Addendum to the REF (EMM 2013b) and the Further Addendum (EMM 2014a) and found to result in low adverse to positive impacts. The proposed activity will be short-term and of limited extent.	No change.
(b) any transformation of a locality,	The proposed activity is complementary to the current landuse and is temporary. Section 2.8 describes proposed rehabilitation activities and rehabilitation objectives.	No change. Flowback water will be pumped to TED via the existing approved pipeline and two enclosed water tanks will be installed adjacent to the dams in an existing laydown area. If required, a mobile containerised water treatment unit and associated AST will also be within this existing laydown area. The completion of flowback water transportation may change if water disposal decreases in frequency or ceases to be available (or commercially viable) for AGL during the four to 16 week flowback period nominated in the REF. Rehabilitation activities will be implemented as per the approved activity.
(c) any environmental impact on the ecosystems of the locality,	Negligible biological impacts were assessed to result from the proposed activity.	No change. Negligible biological impacts were assessed to result from the proposed variation to the approved activity.

Table 4.2 Assessment outcomes with regards to clause 228 of the EP&A Regulation

Factors that must be taken into consideration	Assessment of the approved activity[1]	Assessment of the proposed variation to the approved activity
(d) any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality,	A visual and scenic assessment (Section 8.7) was undertaken and assessed the proposed activity would have low adverse impacts and be short term. Nature heritage assessment (Section 9.2) concluded that the Stroud Gloucester Valley would also not be significantly affected by the proposed short-term activity.	No change. No change if water disposal continues during the four to 16 week flowback period nominated in the REF. There will be a minor aesthetic change if water disposal decreases in frequency or ceases during this time as the transportation of flowback water may occur over a longer duration. However, if offsite disposal of flowback water is not available (or commercially viable) for AGL, it will continue to be stored in TED and used for Stage 1 GGP in accordance with the EWMS as per condition 3.12 of the project approval.
(e) any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations,	Aboriginal and cultural heritage impacts have been assessed in Chapter 10. The assessment found the proposed activity will result in negligible impacts on aboriginal cultural heritage and negligible impacts on places, buildings, landscapes or moveable historic heritage items.	No change.
(f) any impact on the habitat of protected fauna (within the meaning of the NPW Act),	The biological impacts of the proposed activity are assessed in Chapter 7. As the proposed activity will occur in previously disturbed or cleared areas negligible impacts are expected on the habitat of protected fauna. Negligible impacts are expected (if any) to any matters of national environmental significance including threatened species, populations, communities or Ramsar wetlands.	No change. No change as no land will be disturbed as a result of the request to vary the approved activity.
(g) any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air,	The proposed activity will include several security and safety measures (ie telemetry system and SDV geophone and VWP) with regard to the environment and community. Further, a HHERA was undertaken and in accordance with relevant risk assessment methodologies to inform the proposed activities. The implementation of these safeguards as well as the ERP will ensure the appropriate and necessary required levels of safety to the environment and community.	No change. No change as no land will be disturbed as a result of the request to vary the approved activity.
(h) any long-term effects on the environment,	Physical and chemical impacts of the proposed activity including soil quality and land stability, water bodies, coastal processes, flooding, chemical use, waste and emissions and noise and vibration were discussed and assessed in Chapter 6. The impact level was assessed as negligible to low adverse.	No change. Physical and chemical impacts of the request to vary the approved activity were assessed in Section 4.

Table 4.2 Assessment outcomes with regards to clause 228 of the EP&A Regulation

Factors that must be taken into consideration	Assessment of the approved activity[1]	Assessment of the proposed variation to the approved activity
(i) any degradation of the quality of the environment,	A visual and scenic assessment (Section 8.7) was undertaken and assessed the proposed activity would have low adverse impacts and be short term. Nature heritage assessment (Section 9.2) concluded that the Stroud Gloucester Valley would also not be significantly affected by the proposed short-term activity.	No change. No change if water disposal continues during the four to 16 week flowback period nominated in the REF. There will be a minor aesthetic change if a water disposal decreases in frequency or ceases to be available (or commercially viable) for AGL as the transportation of flowback water may occur over a longer duration. The following procedures and measures will continue to be implemented for the Project (as per Section 2.5) to maintain the quality of the environment: • flowback water levels and volumes will be metered at AST 2. Regular inspections of the leakage detection system of TED will be undertaken in accordance with the requirements of the SGMP; • when WK11, 12, 13 and 14 pumps are re-commissioned, in addition to the monitoring specified within EPL 20358 and the SGMP (AGL 2014a), for an initial four week period, daily samples of flowback water will be taken from each well and AST 2. These samples will be analysed for BTEX. BTEX analyses will be provided by the laboratory to AGL within 24 hours (Monday to Friday only excluding public holidays. If requested, an analysis of these results will be promptly provided to OCSG once they have gone through an internal quality control process; • sampling procedures for water quality sampling from the Project's well surface facilities and the flowback ASTs will be undertaken in accordance with AGL's procedure document (Ref Number: DCS-GLO-SOP_WE-001); • characterisation of flowback water prior to lawful offsite disposal to an appropriate destination; and • Water Sampling Plan for the Project outlining the water sampling and monitoring procedures and schedule, required analytical suite and reporting schedules (Ref Number: DCS-GLO-HSE-WSP-001_Gloucester Water Sampling Plan). In addition, characterisation of the flowback water will continue to be undertaken in accordance with the requirements of the POEO (Waste) Regulation prior to its lawful disposal offsite at a licensed facility.

Table 4.2 Assessment outcomes with regards to clause 228 of the EP&A Regulation

Factors that must be taken into consideration	Assessment of the approved activity[1]	Assessment of the proposed variation to the approved activity
(j) any risk to the safety of the environment,	The proposed activity will include several security and safety measures (ie telemetry system and SDV geophone and VWP) with regard to the environment and community. Further, a HHERA was undertaken and in accordance with relevant risk assessment methodologies to inform the proposed activities. The implementation of these safeguards as well as the ERP will ensure the appropriate and necessary required levels of safety to the environment and community.	No change. The proposed changes to the approved activity do not require any change to the security and safety measures in REF (EMM 2013a), the Addendum to the REF (EMM 2013b) and the Further Addendum (EMM 2014a).
(k) any reduction in the range of beneficial uses of the environment,	Community impacts including community services and infrastructure and visual and scenic impacts were assessed in Chapter 8. The proposed activity will have low adverse to positive impacts on beneficial uses of the environment by the community.	No change. No change if water disposal continues during the four to 16 week flowback period nominated in the REF. There will be a minor aesthetic change if water disposal decreases in frequency or ceases to be available (or commercially viable) for AGL as the transportation of flowback water may occur over a longer duration. The following procedures and measures will continue to be implemented for the Project (as per Section 2.5) to maintain the quality of the environment: • flowback water levels and volumes will be metered at AST 2. Regular inspections of the leakage detection system of TED in accordance with the requirements of the SGMP; • when WK11, 12, 13 and 14 pumps are re-commissioned, in addition to the monitoring specified within EPL 20358 and the SGMP (AGL 2014a), for an initial four week period, daily samples of flowback water will be taken from each well and AST 2. These samples will be analysed for BTEX. BTEX analyses will be provided by the laboratory to AGL within 24 hours (Monday to Friday only excluding public holidays). If requested, an analysis of these results will be promptly provided to OCSG once they have gone through an internal quality control process; • sampling procedures for water quality sampling from the Project's well surface facilities and the flowback ASTs will be undertaken in accordance with AGL's procedure document (Ref Number: DCS-GLO-SOP_WE-001); • characterisation of flowback water prior to lawful offsite disposal to an appropriate destination; and

Table 4.2 Assessment outcomes with regards to clause 228 of the EP&A Regulation

Factors that must be taken into consideration	Assessment of the approved activity[1]	Assessment of the proposed variation to the approved activity
		• Water Sampling Plan for the Project outlining the water sampling and monitoring procedures and schedule, required analytical suite and reporting schedules (Ref Number: DCS-GLO-HSE-WSP-001_Gloucester Water Sampling Plan). In addition, characterisation of the flowback water will continue to be undertaken in accordance with the requirements of the POEO (Waste) Regulation prior to its lawful disposal offsite at a licensed facility.
(l) any pollution of the environment,	The disposal of wastes and emissions including flowback water is addressed in Section 6.6 and Section 6.7 respectively. Risks to human health and the environment were considered to be negligible to low adverse.	No change. Temporary storage of flowback water in TED will not damage the environment provided the management measures outlined in the SGMP are implemented for the period flowback water is stored. Traffic noise impacts from the disposal of flowback water to residential receptors on Tiedmans Lane and Fairbairns Road not previously assessed is predicted to be well below prescribed noise criteria. In addition, characterisation of flowback water will continue to be undertaken water in accordance with the requirements of the POEO (Waste) Regulation prior to its lawful disposal offsite at a licensed facility. The proposed variation to the approved activity does not preclude the disposal of flowback water as it allows alternate methods which further reduce operational and environmental risks. Flowback water will continue to be stored securely with greater certainty provided for methods of its safe and secure management and disposal. These proposed methods for the management and disposal of the flowback water are consistent with this primary objective of this stage of the Project.
(m) any environmental problems associated with the disposal of waste,	As above.	No change, as above.
(n) any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply,	Impacts on community resource use is addressed in Section 9.2 and will have negligible adverse impacts on roads, power, water, drainage, waste management, or education, medical and social services.	No change. The proposed variation to the approved activity will not result in additional demand for community resources.
(o) any cumulative environmental effect with other existing or likely future activities.	Cumulative impacts have been addressed in Chapter 12 and were found to have a negligible to low adverse impact.	No change, refer to Section 4.

Notes: 1. Table 12.1 from the Further Addendum to the REF (EMM 2014a).

5 Conclusion

This report provides an assessment of the proposed variation to the approved Project. The environmental assessment concluded the proposed variation will not result in any change to the impacts already reported in the REF (EMM 2013a), the Addendum to the REF (EMM 2013b) and the Further Addendum (EMM 2014a). The proposed variations to the approved activity do not have and are not likely to have a significant impact on any matters of national environmental significance. No additional cumulative impacts were identified.

The environmental assessment determined the proposed variation to the approved activity does not change the assessment outcomes of the factors to be taken into consideration by the determining authority under clause 228 of the EP&A Regulation, nor the measures contained within the mitigation strategy.

Following the implementation of the mitigation strategy in the REF (EMM 2013a), the Addendum to the REF (EMM 2013b), the Further Addendum (EMM 2014a) and this report, all impacts for the proposed variation to the approved activity and the activity itself are expected to remain negligible to low adverse. The proposed variation will provide operational benefits to the Project with additional security of storage and the management of flowback water as it will allow the flowback activities to safely recommence, and flowback water to be contained within TED with a double-liner and leak detection system constructed by the NSW Government's Soil Conservation Service.

The proposed variation also allows for the potential reduction in off-site impacts through reduced offsite transportation of flowback water with tankers should flowback water continue to be securely stored within TED and treated by the water treatment facility to be constructed as part of the project approval for the Stage 1 GGP.

With the Project proceeding with these additional operational benefits, it also affords the Project greater certainty and continuity in achieving its overarching objectives to further assess the gas reserves as required by AGL's obligations under PEL 285.

In addition, Table 5.1 provides a considerations given to OCSG's matters of clarification in the request to vary the approved activity (refer to Section 1.5), where relevant.

Table 5.1 Summary of response to OCSG request for clarification

OCSG comment	Consideration given in response to vary approved activity
Justification that includes a suitable description around the need for the batching approach to flowback water storage and disposal	AGL has amended the request to vary the approved activity. Characterisation of flowback water will continue to be undertaken prior to its disposal consistent with the requirements of the POEO (Waste) Regulation.
Description of measures to ensure disposal of flowback water is undertaken as the primary objective	The request to vary the approved activity affords AGL with greater certainty and security in the management and disposal for flowback water. Pumping of flowback water directly to the AGL-owned Tiedmans site and into TED provides the Project with greater operational security as the dam has a larger storage capacity for flowback water than AST 2. Lawful disposal of flowback water offsite to an appropriate destination consistent with the approved activity will continue to be implemented from the Tiedmans site. If offsite disposal is not available (or commercially viable) for AGL, the flowback water would remain securely stored within the TED and used for Stage 1 GGP in accordance with the approved EWMS prepared under condition 3.12 of the project approval.

Table 5.1 Summary of response to OCSG request for clarification

OCSG comment	Consideration given in response to vary approved activity
	In the event that Stage 1 GGP does not commence before 22 February 2016 and offsite disposal is not available (or commercially viable), AGL would install a mobile containerised water treatment unit at the Tiedmans site. Treated water would be pumped into available remaining storage at the Tiedmans site with the wastewater stream pumped into an AST (similar to those installed at WK13). The wastewater stream will be considerably smaller in volume than that contemplated within the REF and would be transported offsite via truck as per the approved activity when available to do so. The above suite of measures described within this request to vary the approved activity provides greater certainty regarding the primary objective of this phase of the Project by enhancing the operational security of the management and disposal of flowback water.
Ensure that freeboard contingencies are included in flowback water management measures	There is no change to the operational freeboard within AST 2. The two enclosed water tanks to be installed at the Tiedmans site have a capacity of 70,000 litres. To ensure that the 110% secondary containment bunded area requirements are met, the capacity of these tanks will be limited to 57,000 litres. TED has an operational capacity of 20 ML which includes a large freeboard of 5 ML (for a total dam capacity of 25 ML). The transportation of flowback water will continue in accordance with the management measures outlined in the *Traffic Management Plan for the Transportation of Flowback Water* (AGL 2013).
Minimisation of flowback water volumes held on site during the flowback water phase	The request to vary the approved activity minimises the volumes of flowback water and the duration it is be stored at WK13 within AST 2. Flowback water would be pumped to the Tiedmans site and temporarily stored within TED. This dam has been constructed in accordance with relevant standards and is double-lined. The dam has also been routinely tested and complies with industry-recognised standards for liner construction. The Tiedmans site is also outside the probable maximum flood area of the Avon River (refer to Figure 2). AGL will continue to use all reasonable and practicable endeavours to secure a third party contractor for lawful transportation, offsite treatment and disposal of flowback water at a licensed facility. Where available (and commercially viable) lawful offsite disposal will continue consistent with the approved activity. However, should disposal cease to be available (or commercially viable), flowback water will be securely stored within TED and used in Stage 1 GGP in accordance with the EWMS under condition 3.12 of the project approval.
Description of the removal of AST2 (in accordance with the existing approval) following completion of the flowback water phase	Following completion of the flowback water stage, AST 2 will be dismantled on site and removed via truck and the site rehabilitated.
Inclusion of appropriate trigger/response mechanisms and notifications to the OCSG, particularly if lawful disposal of flowback water is not available	Should disposal cease to be available (or commercially viable), flowback water will be securely stored within TED and used in Stage 1 GGP in accordance with the EWMS under condition 3.12 of the project approval. In the event that Stage 1 GGP does not commence before 22 February 2016 and offsite disposal is not available (or commercially viable), AGL would install a mobile containerised water treatment unit at the Tiedmans site. Treated water would be pumped into available remaining storage at the Tiedmans site with the wastewater stream pumped into an AST (similar to those installed at WK13). The wastewater stream will be considerably smaller in volume than that contemplated within the REF and would be transported offsite via truck as per the approved activity when available to do so. The above suite of measures described within this request to vary the approved activity provides greater certainty regarding the primary objective of this phase of the Project by enhancing the operational security of the management and disposal of flowback water.

References

AGL (2013) *Traffic Management Plan for the Transportation of Flowback Water*, prepared for the Waukivory Pilot Project.

AGL (2014a) *Consultation Draft - Extracted Water Management Strategy*, prepared for Stage 1 of the Gloucester Gas Project.

AGL (2014b) *Surface and Groundwater Management Plan*, prepared for the Waukivory Pilot Project.

ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian Water Association, Artarmon.

ASTM D4437-99 (1999) *Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymer Sheet Geomembranes.*

DRE (2012) *Code of Practice for Coal Seam Gas: Fracture Stimulation Activities* published by NSW Trade and Investment.

DWE (2009) *Liquid Trade Waste Guidelines*, NSW Government, Sydney.

EMM (2013a) *Waukivory Pilot Project: Review of Environmental Factors*, prepared for AGL Upstream Investments Pty Ltd.

EMM (2013b) *Waukivory Pilot Project: Addendum to the Review of Environmental Factors*, prepared for AGL Upstream Investments Pty Ltd.

EMM (2014a) *Waukivory Pilot Project: Further Addendum to the Review of Environmental Factors*, prepared for AGL Upstream Investments Pty Ltd.

EMM (2014b) *Supplementary report to the Further Addendum to the Review of Environmental Factors*, prepared for AGL Upstream Investments Pty Ltd.

Environmental Risk Services (2015) *Water quality review for flowback water*, prepared for AGL Upstream Investments Pty Ltd.

Appendix A

Flow chart for proposed flowback water management

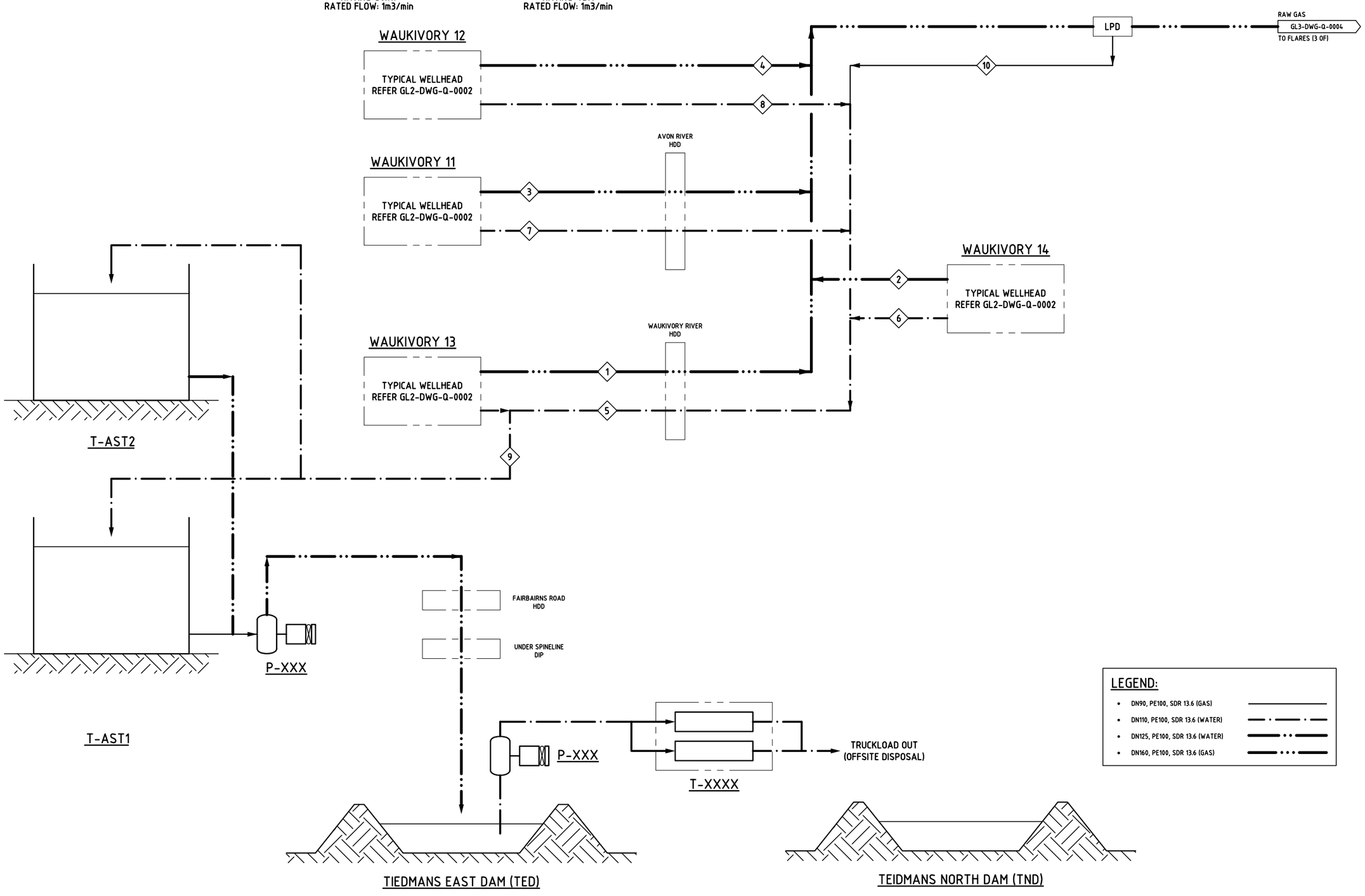
T-AST2
FLOWBACK WATER TANK
SIZE: 1500m3

T-AST1
WORKING WATER/PRODUCED WATER SOURCE TANK
SIZE: 1500m3

P-XXX
PRODUCED WATER/FLOWBACK WATER PUMP
SIZE: 80x50-315
RATING: 30kW
RATED FLOW: 1m3/min

P-XXX
TRUCKOUT WATER PUMP
SIZE: TBA
RATING: TBA
RATED FLOW: 1m3/min

T-XXXX
TRANSPORT DISPOSAL STAGING TANKS ENCLOSED
SIZE: 50,000L X 2



LEGEND:

- DN90, PE100, SDR 13.6 (GAS)
- DN110, PE100, SDR 13.6 (WATER)
- DN125, PE100, SDR 13.6 (WATER)
- DN160, PE100, SDR 13.6 (GAS)

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
A	13.04.15	ISSUED FOR PROPOSAL	BL	HWP	MB	RMD	MR			

A1 SHEET SCALE NTS

OneWay to zero harm

WORLEYPARSONS PROJECT No.
401015-00130

ENGINEERING AND PERMIT STAMPS (As Required)

CUSTOMER
AGL

WorleyParsons
resources & energy

WAUKIVORY PILOT PROJECT
GATHERING NETWORK
PROCESS FLOW DIAGRAM
WATER DISPOSAL OPTION A

DRG No GL3-DWG-Q-0002A

REV A

Appendix B

EnRiskS report

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20 February 2015

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Re: Water Quality Review for Flowback Water

1.0 Introduction

Environmental Risk Sciences Pty Ltd (enRiskS) has been commissioned by AGL Upstream Investment Pty Limited (AGL) to undertake a review of the water quality of flowback water that is currently stored in tanks associated with the Waukivory Coal Seam Gas (CSG) project in the Gloucester Basin in NSW. The flowback water requires disposal. Disposal of this water has not yet been finalised with an appropriate contractor, hence this water quality review is being undertaken to inform discussion of disposal options.

2.0 Background

AGL is currently operating the Waukivory CSG project within the Gloucester Basin in NSW. A number of pilot wells were drilled in 2014 and these wells are located approximately 5 km to the southeast of Gloucester. As part of normal operations for such a project, water from the target coal seams has been brought to the surface. Removal of water from the coal seam depressurises it allowing coal seam gas to flow and be brought to the surface for use as natural gas. Flowback water is water that is returned to the surface after fracture stimulation has been undertaken.

Flowback water was extracted from wells WK12 and WK13. This water flowed through a closed pipework system to a holding tank, where approximately 0.6 megalitres (ML) water is currently stored. During normal operations it is held in the holding tank for testing prior to disposal. AGL's Waukivory Pilot Project Review of Environmental Factors (AGL 2013) states that *the flowback water will be lawfully transported and disposed of at an appropriate facility.*

Testing of the flowback water stored within the holding tank was undertaken between December 2014 and February 2015. Testing of water quality involved analysis by a NATA accredited laboratory for a wide range of compounds and physico-chemical indicators that included the following:

- Inorganics (i.e. metals and other inorganic compounds)
- Physico-chemical indicators (i.e. pH, salinity, suspended solids)
- Nutrients (i.e. nitrogen and phosphorous)
- Anions and cations
- Oil and grease
- Hydrocarbon gases
- Phenolic compounds
- Petroleum hydrocarbons
- Benzene
- Toluene
- Ethylbenzene
- Xylenes

- Monocyclic aromatic hydrocarbons
- Oxygenated compounds
- Fumigants
- Halogenated aliphatic and aromatic compounds
- Trihalomethanes
- Polycyclic aromatic hydrocarbons, including naphthalene
- Ethanolamines
- THPS (Tetrakis (Hydroxymethyl)- Phosphonium Sulfate)

Most of these analyte groups may be present naturally in water from the coal seam. Ethanolamines and THPS may be present in flowback water due to their use in the drilling and hydraulic fracturing fluids.

3.0 Management of Flowback Water and Potential for Exposure

AGL store flowback water on-site at a well pad in a holding tank. The flowback water is tested to determine its quality. Once an appropriate disposal option is chosen, the relevant licensed liquid waste transporter then arrives at the site to pump the water in the holding tank into tanker trucks. These trucks then transport the waste to licensed waste facilities in accordance with NSW Government requirements. The trucks are unloaded into tanks at the designated liquid waste facility. These tanks then connect the flowback water into the treatment systems at the facility for processing. Given this process, the potential for people to be exposed to flowback water is low.

Exposure may occur in normal circumstances as follows:

- AGL staff – incidental exposure when touching wet surfaces or if water in the tank splashes while someone is at the top of the tank making observations or taking water samples for analysis
- Liquid waste transport staff – incidental exposure when they connect the hose from the tanker to the discharge valve on the holding tank (at the AGL site (loading truck) and at the liquid waste treatment facility (unloading truck))
- Liquid waste treatment plant staff – incidental exposure during the treatment process

In all these cases, exposure is described as incidental as it usually just involves occasionally touching a piece of equipment that might be wet or being splashed by the water as it is moved.

It is also possible that people or the environment might be exposed if a tanker truck transporting the flowback water were to have some sort of accident. Minor accidents are unlikely to result in any spillage or leaks as it is unlikely the tank will be ruptured. For more major incidents which may result in a spillage or leak of the flowback water, exposure of people would be incidental and small. Such exposure would also be a one off as it would not be expected that a truck would have multiple accidents in the one location. If a creek or stream were close to the site of such an accident it is possible that the flowback water could run off into the surface water. If so, the water would be diluted as it mixes with the water already present in the creek or stream. Again, such an exposure (should it occur) would be short term.

4.0 Liquid waste disposal

In urban areas liquid wastes are primarily disposed to the sewerage system. Liquid wastes that require management include domestic wastes (sewage, water used in showering and washing), commercial wastes (water from restaurants, shops and offices) and industrial wastes (water used in industrial processes which could range from vegetable washing and food preparation through to chemical manufacture). The sewerage system accepts a wide range of water based liquid wastes. Solvent based liquid wastes are not usually accepted into the sewerage system. The liquid wastes accepted into the sewerage system are collected and transported to a sewerage treatment plant. Sewerage treatment plants include a range of treatment processes which degrade or remove chemicals in water to enable the effluent from the plant to be reused or discharged into the environment. These plants have been designed to deal with a range of chemicals as well as bacteria, viruses and other microbiological contamination.

Water based liquid wastes that contain very high concentrations of chemicals or solvent based liquid wastes are usually dealt with by dedicated waste treatment facilities like the one located in Lidcombe in Sydney.

The NSW Government requires that liquid wastes be managed in a way that protects the environment and the community and have established a range of guidance documents and management processes that ensure appropriate control. Information is available from the NSW EPA at http://www.epa.nsw.gov.au/waste/liquid-wastes.htm .

5.0 Basis of water quality guidelines

Trade Waste Acceptance Criteria

Trade waste acceptance criteria are the limits on the concentration at which a chemical can be present in waste water that indicate it is acceptable for discharge into a sewerage system. Sydney Water has established acceptance criteria for discharges to their system (Sydney Water Corporation 2014). The NSW Department of Water and Energy has established acceptance criteria for sewerage systems across the rest of NSW (Department of Water and Energy 2009).

Development of these criteria includes consideration:

- safe levels for workers in and around the sewerage system and for public health
- whether a particular chemical is normally present in domestic waste and at what concentration it would normally be present
- if a chemical is not normally present in domestic waste, is it the sort of chemical that can be treated in a sewerage treatment plant
- whether the chemical can be readily removed or minimised by pre-treatment technologies that are installed prior to discharge to the sewerage system
- what sort of concentration of a chemical might cause damage to treatment processes (e.g. corrosion of pipes or other infrastructure or damage to the bacteria used in the treatment process)
- the licence limits and other requirements applied by the environmental regulator on the discharge of the sewerage treatment plant
- if the effluent from the sewerage treatment plant (or biosolids) is being reused for industrial purposes or for irrigation there may be some additional requirements for wastes.

Drinking water guidelines

The National Health and Medical Research Council (NHMRC) are responsible in Australia for developing and maintaining guidelines for drinking water (NHMRC 2011 Updated 2014). These guidelines are available online at http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/eh52_australian_drinking_water_guidelines_150108.pdf and provide guideline values for a wide range of chemicals. These guidelines indicate

acceptable quality for water used for drinking purposes. These guidelines are calculated assuming that everyone drinks 2 litres (L) of water per day every day of the year for their entire lifetime. Where guidelines are not available from the NHMRC, other guidelines for drinking water quality (derived on the same or similar basis as the Australian guidelines) can be considered.

Water stored in the flowback tanks is not used for drinking water. Nor is it proposed to be disposed to any location where the water may be used for drinking water. Hence these guidelines are not directly relevant for comparing with the flowback water quality, however, they have been included in this review to provide context in relation to human health exposure issues.

The type of incidental exposure to the flowback water that might occur during disposal is expected to result in occasional incidental consumption of less than 5 mLs of water (equivalent to a teaspoon of water that might be swallowed if splashed). The calculation to determine the drinking water guideline is directly proportional to the amount of water consumed so, if exposure was reduced to 5 mLs per day for a lifetime instead of 2 L of water per day, the guideline value becomes 400 times higher than those listed in the drinking water guidelines.

The NHMRC also note in their guidelines:

> *"Therefore, for most characteristics, occasional excursions beyond the guideline value are not necessarily an immediate threat to health. The amount by which and the duration for which any health-based guideline value can be exceeded without raising concerns for public health depends on the particular circumstances. Exceeding a guideline value should be a signal to investigate the cause and, if appropriate, to take remedial action."*

As a result, low level incidental exposures that could occur during regular operations to allow disposal of flowback water or one off exceedances of these guidelines should an accident occur could not have health effects given the quality of the water (refer to **Section 6**).

Ecological protection guidelines

The national guidelines for water quality protective of ecological systems were established by ANZECC in 2000 – the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ 2000). They are available at http://www.environment.gov.au/water/quality/publications/australian-and-new-zealand-guidelines-fresh-marine-water-quality-volume-1 and http://www.environment.gov.au/water/quality/publications/australian-and-new-zealand-guidelines-fresh-marine-water-quality-volume-2 .

These guidelines are based on results from ecotoxicity tests which determine the concentrations at which a chemical can cause impacts on aquatic organisms (fish, invertebrates, algae and plants). The tests and the calculations to determine the guidelines are based on determining what concentration can be present in water for the whole life of an organism without causing impacts. The guidelines are termed "trigger values" and they indicate the concentration below which no effects would be expected and the concentration above which investigations should occur to determine if effects are actually occurring. Exceedance of these trigger values does not indicate that effects will definitely occur as it depends on the nature of the environment, the types of organisms present, the season, whether other stressors are present etc.

Just like the drinking water guidelines minor short term exceedances of a trigger value are not likely to cause significant impacts on aquatic systems.

The guidelines relate to the quality of water in the environment, where the species are exposed (i.e. in the river, creek, dam or pond).

Water stored in the flowback tanks is not an environment where an aquatic ecosystem is present. Nor is it proposed to be disposed to any location where the water may enter an aquatic ecosystem without

appropriate treatment. Hence these guidelines are not directly relevant for comparing with the flowback water quality, however, they have been included in this review to provide context in relation to environmental issues.

6.0 Flowback water quality

Table 1 presents a summary of the minimum and maximum concentrations reported (from laboratory analysis) in the flowback water currently stored in the holding tanks. The table provides data for each analyte detected above the limit of reporting for the analytical method. It is noted that the table has not included the major cations that are present in all waters and are essential for life.

For the purpose of comparison the table also includes the guidelines discussed in **Section 5**, where the following can be noted:

Trade Waste

All chemicals present in the flowback water are present at concentrations that would be acceptable to allow discharge of this waste water into the sewerage system except for boron. Boron was reported at concentrations in the flowback water that would be acceptable for discharge to the Sydney Water system but may not be acceptable for discharge into some regional sewerage systems.

Overall, the flowback water is generally compliant with the requirements for acceptance for discharge into sewerage systems in NSW.

Drinking Water

Flowback water is not used as drinking water and any comparison with drinking water guidelines is for the purpose of discussion of the quality of the flowback water in relation to human health risk issues.

The flowback water is more salty than is normally allowed for drinking water. The salinity of drinking water is controlled as it affects taste and can cause corrosion of pipes and infrastructure.

The maximum concentrations of chloride, boron, barium, cadmium, manganese, lead, iron, bromine, THPS and benzene exceed the drinking water guidelines. The guidelines for chloride, manganese and iron are based on aesthetic requirements like changing the taste or odour of the water or the accumulation of scale in pipes or causing brown spots on clothes after washing. Health based guidelines for these chemicals are much higher.

If the drinking water guidelines are adjusted to account for incidental contact exposures with the water (as discussed in **Sections 3 and 5**), where a 400 fold adjustment factor can be applied, none of these chemicals are present at concentrations exceeding the adjusted guideline.

On this basis there is no potential for adverse health effects to occur to employees, contractors or the community during the routine activities required for the disposal of the flowback water.

Ecological Water Quality Guidelines

The maximum concentrations reported in the flowback water are higher than the water quality guidelines used to protect freshwater aquatic ecosystems for aluminium, boron, cadmium, cobalt, copper, molybdenum, lead, zinc, iron, total nitrogen and total phosphorus. All of these chemicals are naturally occurring elements that may be found in every aquatic environment. The water from the coal seam is more salty than freshwater. The saltiness comes from these metal salts being dissolved in the water found in the coal seam. The metal salts are present in the rocks surrounding the coal and in the coal in the coal seams. Over the millennia this water has been present in the coal seam, small amounts of these salts have dissolved from the rock into the water in the coal seam. Evidence of this has been monitored by AGL in continuous

loggers in the local rivers with elevated salinity levels recorded during the initial flush from stormwaters which exceed 1000 µS/cm in the first six hours.

As discussed, occasional exceedances of water quality guidelines are unlikely to cause significant impacts especially given that these salts may have limited availability to organisms due to reactions with humic acids and other organic matter present in aquatic environments from the degradation of plants and animals. Hence in the unlikely event of an accident where flowback water were spilled into an aquatic environment (e.g. during transport) no significant impacts are expected to occur.

Stormwater

In addition to the above, to provide some context as to the range of concentrations reported in flowback water, published data on stormwater quality has also been included for comparison.

The NSW Department of the Environment (http://www.environment.nsw.gov.au/stormwater/whatis/), notes that stormwater is another type of water that must be well managed. As rainwater falls on houses, roofs, driveways, roads and footpaths as well as natural surfaces it collects chemicals from these surfaces which can impact on the quality of the water. Rainwater also needs management to minimise/control flooding (which may result in damage to structures or people).

Stormwater is not treated and runs directly into creeks, streams, rivers and harbours where exposures to the public (including drinking and recreational exposures) and the aquatic environment may occur.

Information on the typical characteristics of stormwater has been reported in the Australian Guidelines for Water Recycling, Managing Health and Environmental Risks – Stormwater Harvesting and Reuse published in 2009 (NMMRC 2009).

Typical stormwater in Australia contains a range of chemicals that are washed from rocks and soil as well as human structures and activities (e.g. roads, houses, buildings, gardens, swimming pools, service stations, industrial facilities, car parks, etc.).

Comparison of the maximum concentrations found in flowback water with typical stormwater shows that the flowback water is mostly similar to or less contaminated than typical stormwater. Some elements like barium are present at higher levels than normally found in stormwater and the flowback water is more salty than stormwater.

While flowback water will not be discharged directly into the environment this comparison has been presented to demonstrate that the quality of flowback water is not significantly different to (or more contaminated than) the quality of water that discharges via stormwater directly (untreated) to the environment.

Table 1: Range of Concentrations Reported in Water in Flowback Tank with Comparison against Guidelines

			Range fo Concentrations Reported in Flowback Water Tank		Guidelines Relevant for Discharge as Trade Waste		Guidelines - For Water used as Drinking Water		Guidelines - For Water Discharged to Freshwater Environment	Concentrations Reported in Stormwater in Australia[N]
Analytes Detected in at least 1 sample	**LOR**	**Units**	**Minimum**	**Maximum**	**Liquid Trade Waste Regulation Guidelines (2009)**	**Sydney Water Trade Wastewater Acceptance Standards 2014-2015**	**Australian Drinking Water Guidelines 2011 (updated 2014) Health**	**Drinking Water Guidelines (other sources) Health**	**ANZECC (2000) Trigger Values for Freshwater (95%)**	
pH										
pH Value	0.01	pH unit	**8.38**	**9.19**	7-9	7-10	6.5-8.5		6.5-9*	5.5 - 7.27
Conductivity										
Electrical Conductivity @ 25°C	1	uS/cm	**4050**	**6370**					0.02-2.2*	
Total Dissolved Solids										
Total Dissolved Solids @180°C	10	mg/L	**2870**	**4900**	4000	500-10000	600[A]		*	112.89 - 169.60
Suspended Solids										
Suspended Solids (SS)	5	mg/L	**34**	**117**					6-50*	19.01 - 254.47
THPS and Sulfate as SO_4										
Sulfate	1	mg/L	**4**	**30**	500	2000	250			
THPS	50	ug/L	**61**	**210**				126[D]		
Chloride										
Chloride	1	mg/L	**390**	**540**			250[A]			9.75 - 13.2
Inorganics (dissolved)										
Aluminium	0.01	mg/L	**0.01**	**0.06**	100	100	0.2[A]		0.055	0.49 - 2.23
Arsenic	0.001	mg/L	**0.002**	**0.008**	1	1	0.01		0.013-0.024	0.006 - 0.011
Boron	0.02	mg/L	**7.57**	**11.8**	5	100	4		0.37	
Strontium	0.001	mg/L	**1.85**	**2.75**				12[R]		
Barium	0.001	mg/L	**2.15**	**3.68**		5	2			0.021 - 0.038
Cadmium	0.0001	mg/L	**0.0028**	**0.0028**	1	1	0.002		0.0002	0.0015 - 0.0606
Cobalt	0.001	mg/L	**0.002**	**0.002**	5	5		0.006[R]	0.001	
Chromium	0.001	mg/L	**0.001**	**0.002**	3	3	0.05		0.001 - 0.0033	0.002 - 0.017
Copper	0.001	mg/L	**0.002**	**0.046**	5	5	2		0.0014	0.012 - 0.141
Manganese	0.001	mg/L	**0.022**	**0.43**	10	10	0.1		1.7	0.054 - 0.197
Molybdenum	0.001	mg/L	**0.004**	**0.014**	5	100	0.05		0.034	
Nickel	0.001	mg/L	**0.003**	**0.008**	3	3	0.02		0.011	0.004 - 0.017
Lead	0.001	mg/L	**0.005**	**0.021**	1	2	0.01		0.0034	0.017 - 0.162
Antimony	0.001	mg/L	**0.001**	**0.002**			0.003		0.009	
Zinc	0.005	mg/L	**0.012**	**0.074**	5	5	3[A]		0.008	0.08 - 0.57
Iron	0.05	mg/L	**0.22**	**4.26**	100	50	0.3[A]		0.3	1.126 - 5.1
Bromine	0.1	mg/L	**0.6**	**0.8**		5	0.5			
Reactive Silica	0.05	mg/L	**15.8**	**21.4**			80[A]			
Fluoride	0.1	mg/L	**0.6**	**1**	20	20	1.5			
Ammonia as N	0.01	mg/L	**0.01**	**0.09**	50		0.5[A]		0.18-0.56 (pH 5.3-9)	0.102 - 3.281
Nitrate as N	0.01	mg/L	**0.01**	**0.08**			50		0.7	
Nitrogen and Phosphorous										
Total Nitrogen as N	0.1	mg/L	**3.6**	**7**	100	150			0.2-0.6*	0.62 - 7.46
Total Phosphorus as P	0.1	mg/L	**2.05**	**3.2**	20	50			0.02-0.05*	0.075 - 1.261
Oil and Grease (O&G)										
Oil and Grease	5	mg/L	**8**	**8**	100	110				3.43 - 28.25
C1 - C4 Hydrocarbon Gases										
Methane	10	mg/L	**0.403**	**1.52**				10[U]		
Ethane	10	mg/L	**0.014**	**0.108**						
Propane	10	mg/L	**0.012**	**0.014**						
Phenolic Compounds										
Phenol	1	mg/L	**0.0022**	**0.0036**	5	1		5.8[R]	0.32	
2-Methylphenol	1	mg/L	**0.0011**	**0.0021**				0.93[R]		
3- & 4-Methylphenol	2	mg/L	**0.0077**	**0.033**				1.4[R]		
Total Recoverable Hydrocarbons										
C6 - C10 Fraction minus BTEX (F1) - aliphatics	20	mg/L	**0.02**	**0.11**				15000[W]		
BTEXN										
Benzene	1	mg/L	**0.006**	**0.02**	0.04	0.1	0.001		0.95	0.006[P]
Toluene	2	mg/L	**0.006**	**0.025**	0.5	0.5	0.8		0.18	0.017[P]
Ethylbenzene	2	mg/L	**0.002**	**0.002**	1	1	0.3		0.08	0.0034[P]
Total Xylenes	2	mg/L	**0.003**	**0.004**	1	1	0.6		0.075-0.35	0.029[P]
Naphthalene	5	mg/L	**0.005**	**0.005**	5 (total PAHs)	5 (total PAHs)			0.016	0.017 - 0.811 (total PAHs) 0.0013 - 0.0064[P]
Ethanolamines										
Ethanolamine	1	mg/L	**0.005**	**0.143**						
Diethanolamine	1	mg/L	**0.002**	**0.02**				0.04[R]		
Methyl diethanolamine (MDEA)	1	mg/L	**0.001**	**0.013**						

A = aesthetic guideline - no health based guideline available

* = stressors where effects are associated with changes in an existing ecosystem, hence application of a specific guideline or trigger level is not specifically relevant. The changes relate to both the concentration and duration of change.

Other sources of drinking water guidelines:

W = WHO Guidelines for Drinking Water Quality (2011 and rolling revisions)

D = Derived based on the approach outlined in the Australian Drinking Water Guidelines and available toxicity data, as outlined in the HHERA for Hydraulic Stimulation Activities (enRiskS 2014)

U = US Department of the Interior (2001) action level for methane in drinking water, based on explosive issues. Value is the trigger for further investigation

R = Regional Screening Value for Tap Water available from USEPA (2015) - derived on the same basis as drinking water guidelines

N = National Water Quality Management Strategy, Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2), Stormwater Harvesting and Reuse, July 2009. Range of values detected listed unless referenced separately. Range of values reported reflect the 5th to 95th percentile.

P = WA Department of Water 2007. Contaminants in Stormwater Discharge, and Associated Sediments, at Perth's Marine Beaches, Beach Health Program 2004-06

7.0 Conclusions

The quality of the flowback water currently stored in the holding tank by AGL is similar to the typical quality of stormwater in Australia. Stormwater is allowed to discharge directly to aquatic ecosystems without additional treatment. The potential for exposures to the flowback water is very limited and would only be short term and incidental. The flowback water is unlikely to cause any health or environmental effects considering the limited potential for exposure. The flowback water is generally compliant with the requirements for acceptance for discharge into sewerage systems in NSW.

8.0 References

AGL 2013, Review of Environmental Factors, Volume 1 of 7: Waukivory Pilot Project, Executive Summary. Available from http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20and%20the%20Environment/Gloucester/Assessments%20and%20Reports/2013/October/REF%20Waukivory%20Pilot%20Project%20%20%20Executive%20Summary%20and%20Chapters%201%20to%2014.pdf

ANZECC/ARMCANZ 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand,

Department of Water and Energy 2009, *Liquid Trade Waste Regulation Guidelines*, Department of Water and Energy, NSW Government.

NHMRC 2011 Updated 2014, *Australian Drinking Water Guidelines, National Water Quality Management Strategy*, National Health and Medical Research Council and Natural Resource Management Ministerial Council, Commonwealth of Australia, Canberra.

NMMRC 2009, *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2). Stormwater harvesting and reuse*, National Water Quality Management Strategy, National Resource Management Ministerial Council, Environment Protection and Heritage Council, National Health and Medical Research Council. <http://www.environment.gov.au/system/files/resources/4c13655f-eb04-4c24-ac6e-bd01fd4af74a/files/water-recycling-guidelines-stormwater-23.pdf>.

Sydney Water Corporation 2014, *Industrial Customers - Acceptance standards and charging rates for 2014-15*, Sydney Water Corporation.

Appendix C

AGL risk assessment

		Consequence Descriptors						
Score	**Descriptor**	**Commercial / Profitability / Assets**	**Business Continuity**	**Customer**	**Regulatory / Legal & Government**	**Reputation & Community**	**Environment**	**People & Safety**
0.5	Level 1	Risk of one off event of less than $1M or recurrent adverse effect on expected future earnings of less than $1M.	Minor business interruption. Temporary delay in operations with little effect, business would return to normal immediately.	May impact or lose up to 10 Commercial & Industrial gas customers OR 50 Commercial & Industrial electricity customers OR 2,000 SME/multisite customers OR 2,000 residential customers.	Once off minor breach, no prior history of breach event. Notification of relevant authority may be required, but rare possibility of prosecution or breach of license.	Issue resolved in day to day management. Small local publicity. No/minor interest by local community.	Single event with negligible and short term environmental impact to localised area of negligible environmental value and no impact beyond AGL's operational area.	Injury or illness that may require medical treatment or first aid resulting in no lost time.
1	Level 2	Risk may exceed one off event of $1M to $25M or recurrent adverse effect on expected future earnings of $1M to $10M per annum.	Business interruption causes problems to either internal or external customers however business as usual achieved after several hours; AND / OR Growth options put off for up to 3 months.	Impact to or loss of between 10 and 20 Commercial & Industrial gas customers OR between 50 and 200 Commercial & Industrial electricity customers OR between 2,000 and 5,000 SME/multisite customers OR between 2,000 and 20,000 residential customers.	Multiple, but no more than 6 in any 12 months period, minor breaches. Regulator may express concern. Possible breach of licence or regulation requires notification to relevant authority / regulator, but unlikely to be associated with financial penalty.	Managed locally some publicity in local and state press for 2 - 5 days. Social media commentary limited to small interest groups May result in minor local community complaint(s).	Small scale and short term environmental impact to localised area of low environmental value and no impact beyond AGL's operational area. OR A repeated event which has occurred previously with negligible and short term environmental impact to localised area of negligible environmental value and no impact beyond AGL's operational area.	Injury or illness that temporarily impairs a person's life. Return to work with rehabilitation to same role.
1.5	Level 3	Risk may exceed one off event of $25M to $145M or recurrent adverse effect on expected future earnings of $10M to $25M per annum.	Business interruption causes impact to internal or external customers that last up to 5 business days; AND / OR Growth options are delayed for between 3 and 6 months.	Impact to or loss of between 20 and 50 Commercial & Industrial gas customers OR between 200 and 500 Commercial & Industrial electricity customers OR between 5,000 and 15,000 SME/multisite customers OR between 20,000 and 50,000 residential customers.	Systemic breaches small to medium breaches or 1 large breach. Breach of regulatory / license requirements with likely action by regulatory authorities, resulting in tightening of licence and permit conditions and financial penalties or fines. Enforceable undertakings possible. Unfavourable policy outcomes.	Regional and state and/or online negative publicity for a period approximately a week and social media commentary restricted to interest groups. Localised community complaints	Short to medium term environmental impact that may extend beyond AGL's operational area. OR A repeated event which has occurred previously with small scale and short term environmental impact to localised area of low environmental value and no impact beyond AGL's operational area.	Injury or illness that permanently impairs a person's life. Return to work with rehabilitation and alternate role.
4	Level 4	Risk may exceed one off event of $145M to $1 billion or recurrent adverse effect on expected future earnings of $25M to $100M per annum.	Business interruption causes impact to internal or external customers that last for between 1 and 2 weeks; AND / OR Growth options are delayed for between 6 months and 12 months.	Impact to or loss of between 50 and 100 Commercial & Industrial gas customers OR between 500 and 1,000 Commercial & Industrial electricity customers OR between 15,000 and 20,000 SME/multisite customers OR between 50,000 and 200,000 residential customers.	Civil prosecution Unfavourable tariff outcomes. Unfavourable policy outcomes impact commercial position. Unable to secure necessary permits for growth / developments. Incident could result in revocation of licence/permits, large fines and prosecutions.	National and/or online negative publicity for a period of greater than a week and/or online social media commentary extended to news and general public engagement Widespread community complaints.	Significant medium term impact on important environment/habitat OR A repeated event which has occurred previously with short to medium term environmental impact that may extend beyond AGL's operational area	Injury or illness that results in a fatality or permanently impairs a person's life. No return to work.
5	Level 5	Risk may exceed one off event of more than $1 billion or recurrent adverse effect on expected future earnings of more than $100M per annum.	Business interruption causes impact to internal or external customers that last for more than 2 weeks; AND / OR Growth options are delayed for more than 1 year.	Impact to, or long term loss of over 100 Commercial & Industrial gas customers OR 1,000 Commercial & Industrial electricity customers OR 20,000 SME/mutilsite customers OR more than 200,000 residential customers.	Criminal prosecution Loss of operating licences. Loss of licenses and possible. closure of facility, significant fines and/or jail penalties could result. Introduction or change to government policy which will likely prevent achievement of strategic priorities.	Sustained widespread community complaints over time leading to Government intervention. Repeated national or international negative publicity and/or online negative publicity and social media commentary extended to news and general public engagement	Long term damage to the environment. Any loss or damage to listed or protected environment/habitat. OR A repeated event which has occurred previously with medium term impact on important environment/habitat	Injury or illness that results in more than 1 fatality or permanently impairs more than 1 person's life. No return to work.

		Likelihood Description		
Score	**Descriptor**	**Complexity**	**Susceptibility/ Exposure**	**Probability**
5	Almost Certain	Can only be performed after specialist training and education, years of knowledge required, very advanced technology, extreme inter dependencies between tasks	Extremely susceptible – large numbers of new people and/or new to AGL, attractive to most people with ready access, newly implemented, a lot of changes, new system, untried processes	Knowledge/evidence either within AGL or externally suggests this event/risk occurs almost all of the time. The occurrence of this risk is common and expected - greater than 1 in 2 chance (greater than 50%)
4	Likely	Advanced training, education and specialist knowledge, a significant number of variables and interrelated tasks and dependencies	Highly susceptible - many new people, item is attractive, a lot of changes to the systems and procedures, the item is aging or otherwise becoming susceptible, the event is likely to occur sooner rather than later.	Knowledge/evidence either within AGL or externally suggests this event/risk occurs at regular intervals - between 1 in 10 and 1 in 2 chance (10% to 50%)
3	Possible	High level skill required, usually secondary studies necessary, detailed knowledge needed, advanced technology, a number variable tasks or steps	Quite a few people involved, audit trail difficult to follow, requires 'specialist' knowledge and skills, newly introduced staff and/or procedures, one would expect the event to occur at intervals	Occurs either within AGL or known environment on an irregular basis but frequently enough to be more than a remote possibility - between 1 in 100 and 1 in 10 chance (1% to 10%)
2	Unlikely	Requires basic training but can be quickly mastered by most people, few variations or steps involved	Recent changes, attractive but difficult to obtain, new people, some new processes or procedures, quite a few people involved, one would expect the risk to occur occasionally.	Aware that the event has occurred occasionally either within AGL or externally. However, it is not something that would be classed as a common occurrence and would only occur in certain remote circumstances - between 1 in 10000 and 1 in 100 (0.01% to 1%)
1	Rare	Straight forward singular tasks requiring little or no training	Has a minimum degree of susceptibility, been around for years, tried and true, well known and understood, can't conceive the risk occurring.	Either is not known to have occurred or has not occurred in many 'exposures' to the potential risk - greater than 1 in 10000 (less than 0.01%)

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Client:
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Risk Register Builder / Champion / Facilitator: Doug Ferry
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Last Review Date:

Review Team:

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RISK REGISTER
Transfer of Flowback water to TED

Risk / Administrative Detail						Raw Risk									
Ref	Category	Source	Due to...	There is a risk that...	Which may result in...	$	BC	Cust	Reg	R&C	E	H&S	Likelihood	Risk Score	Risk Level
1	Environment		PE transfer pipe and connectors may leak, spill or crack	lose containment of flowback and produced water	Significant medium term impact on important environment/habitat OR A repeated event which has occurred previously with short to medium term environmental impact that may extend beyond AGL's operational area						4		2	8	High
2	Environment		flowback water to be stored in TED.	Risk of loss of containment of flowback water in TED	Short to medium term environmental impact that may extend beyond AGL's operational area. OR A repeated event which has occurred previously with small scale and short term environmental impact to localised area of low environmental value and no impact beyond AGL's operational area.				1	1.5	1.5	1.5	2	3	Moderate

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Risk / Administrative Detail															
Ref	Category	Source	Due to...	There is a risk that...	Which may result in...	Current Controls / Mitigations	Control Effectiveness	$	BC	Cust	Reg	R&C	E	H&S	Likelihood
1	Environment		PE transfer pipe and connectors may leak, spill or crack	lose containment of flowback and produced water	Significant medium term impact on important environment/habitat OR A repeated event which has occurred previously with short to medium term environmental impact that may extend beyond AGL's operational area	1. Meter will be installed on discharge of the transfer pump to measure volume of water pumped to TED . 2. Pump transfer area at WK 13 to be bunded with an impermeable base 3. single hockey stick and foot valve to be shared between ASTs at WK 13, if required. 4. Hydro testing of water gathering line system to be conducted and compliant to Australian standard [AS3500 and AS4654] prior to use. 5.install pressure switch on transfer pump to protect water gathering line from over pressuring. 6. SOP for water transfer to be reviewed to follow best practice and containing any spills. 7. Visual weekly inspection of line between AST2 and Tiedmans - Environ check sheet							4		1
2	Environment		flowback water to be stored in TED.	Risk of loss of containment of flowback water in TED	Short to medium term environmental impact that may extend beyond AGL's operational area. OR A repeated event which has occurred previously with small scale and short term environmental impact to localised area of low environmental value and no impact beyond AGL's operational area.	1. SOP for water transfer to be reviewed to follow best practice and containing any spills. 2. TED has adequate capacity (freeboard) for heavy rain event, estimated only 15% of capacity to be used. 3. TED has double liner and leak detection system. 4. TED is a fully secured fenced site. 5. Daily inspections of the dam liner. 6. Weekly function test of leak detection system.					1	1.5	1.5	1.5	1

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Risk / Administrative Detail															
Ref	Category	Source	Due to...	There is a risk that...	Which may result in...	Calc. Risk	Risk Level	ALARP?	Escalation	Proposed Controls / Mitigations	$	BC	Cust	Reg	Rep
1	Environment		PE transfer pipe and connectors may leak, spill or crack	lose containment of flowback and produced water	Significant medium term impact on important environment/habitat OR A repeated event which has occurred previously with short to medium term environmental impact that may extend beyond AGL's operational area	4	Moderate	No	General Manager or approved delegate.						
2	Environment		flowback water to be stored in TED.	Risk of loss of containment of flowback water in TED	Short to medium term environmental impact that may extend beyond AGL's operational area. OR A repeated event which has occurred previously with small scale and short term environmental impact to localised area of low environmental value and no impact beyond AGL's operational area.	1.5	High								

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Risk / Administrative Detail																	
Ref	Category	Source	Due to...	There is a risk that...	Which may result in...	E&C	H&S	Likelihood	Calc. Risk	Risk Level	ALARP?	Action Owner	Implementation Cost	Control Accepted	Name of Approver	Due Date	Status
1	Environment		PE transfer pipe and connectors may leak, spill or crack	lose containment of flowback and produced water	Significant medium term impact on important environment/habitat OR A repeated event which has occurred previously with short to medium term environmental impact that may extend beyond AGL's operational area				0	#N/A							
2	Environment		flowback water to be stored in TED.	Risk of loss of containment of flowback water in TED	Short to medium term environmental impact that may extend beyond AGL's operational area. OR A repeated event which has occurred previously with small scale and short term environmental impact to localised area of low environmental value and no impact beyond AGL's operational area.												

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Risk / Administrative Detail						Action Tracking		
Ref	**Category**	**Source**	**Due to...**	**There is a risk that...**	**Which may result in...**	**Update**	**Dependency**	**Date Implemented**
1	Environment		PE transfer pipe and connectors may leak, spill or crack	lose containment of flowback and produced water	Significant medium term impact on important environment/habitat OR A repeated event which has occurred previously with short to medium term environmental impact that may extend beyond AGL's operational area			
2	Environment		flowback water to be stored in TED.	Risk of loss of containment of flowback water in TED	Short to medium term environmental impact that may extend beyond AGL's operational area. OR A repeated event which has occurred previously with small scale and short term environmental impact to localised area of low environmental value and no impact beyond AGL's operational area.			

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RISK REGISTER
Transfer of Flowback water to TED

Risk / Administrative Detail						Raw Risk									
Ref	Category	Source	Due to...	There is a risk that...	Which may result in...	$	BC	Cust	Reg	R&C	E	H&S	Likelihood	Risk Score	Risk Level
3	Environment		Transfer of flowback water to enclosed tanks from TED	loss of containment at enclosed tanks	Small scale and short term environmental impact to localised area of low environmental value and no impact beyond AGL's operational area.						1		3	3	Moderate
4	Environment/ Community		Due to illegal and unathourised entry on the site equipment may be sabotaged	Risk of loss of containment of flowback water, delays to operation, intended contamination of flowback water	Short to medium term environmental impact that may extend beyond AGL's operational area. Regional and state and/or online negative publicity for a period approximately a week and social media commentary restricted to interest groups. Localised community complaints		1			1.5	1.5	1	3	4.5	High
5	Business Continuity		Debris in pipeline	blockage of pipeline	Business interruption causes impact to internal or external customers that last up to 5 business days; AND / OR Growth options are delayed for between 3 and 6 months.		1.5						3	4.5	High

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Risk / Administrative Detail															
Ref	Category	Source	Due to...	There is a risk that...	Which may result in...	Current Controls / Mitigations	Control Effectiveness	$	BC	Cust	Reg	R&C	E	H&S	Likelihood
3	Environment		Transfer of flowback water to enclosed tanks from TED	loss of containment at enclosed tanks	Small scale and short term environmental impact to localised area of low environmental value and no impact beyond AGL's operational area.	1. Inspection report on enclosed tanks 2. Rain water to be vac sucked out of bund in the case of rain event 3. Bunds to have the capacity of 110% of volume of the largest tank 4. dedicated above ground line to enclosed tanks 5. transfer of water is to be supervised by operator -SOP 6. Tanks to be filled to the top of the sight glass only 7. Bunding and impermeable base for connection points 8. demarcated area to define enclosed tanks 9. enclosed tanks located in fully fenced operational area.						1		2
4	Environment/ Community		Due to illegal and unathourised entry on the site equipment may be sabotaged	Risk of loss of containment of flowback water, delays to operation, intended contamination of flowback water	Short to medium term environmental impact that may extend beyond AGL's operational area. Regional and state and/or online negative publicity for a period approximately a week and social media commentary restricted to interest groups. Localised community complaints	1. System access valves to be locked 2. Operational areas fully fences 3. Surveillience of operational areas 4. Mobile security patrols 5. Security Management Plan 6. Use of signage to inform general public that the site is "restricted" 7. Protester Protocols 8. Operational areas require keyed access for vehicles			1			1.5	1.5	1	2
5	Business Continuity		Debris in pipeline	blockage of pipeline	Business interruption causes impact to internal or external customers that last up to 5 business days; AND / OR Growth options are delayed for between 3 and 6 months.	1. Pressure switch to be installed on transfer pump to shut pump down if pressure reaches max working pressure of line. 2. History of pressure is monitored including baseline pressure at various rates. 3. Transfer of water from AST 2 to TED is attended. 4. If pressure increases in pipeline due to obstruction, flush with fresh water at tubulent flow rate, until pressure drops back to baseline pressure			1			1.5	1		2

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Risk / Administrative Detail																
Ref	Category	Source	Due to...	There is a risk that...	Which may result in...	Calc. Risk	Risk Level	ALARP?	Escalation	Proposed Controls / Mitigations	$	BC	Cust	Reg	Rep
3	Environment		Transfer of flowback water to enclosed tanks from TED	loss of containment at enclosed tanks	Small scale and short term environmental impact to localised area of low environmental value and no impact beyond AGL's operational area.	2	High								
4	Environment/ Community		Due to illegal and unathourised entry on the site equipment may be sabotaged	Risk of loss of containment of flowback water, delays to operation, intended contamination of flowback water	Short to medium term environmental impact that may extend beyond AGL's operational area. Regional and state and/or online negative publicity for a period approximately a week and social media commentary restricted to interest groups. Localised community complaints	3	Moderate		#REF!						
5	Business Continuity		Debris in pipeline	blockage of pipeline	Business interruption causes impact to internal or external customers that last up to 5 business days; AND / OR Growth options are delayed for between 3 and 6 months.	3	Moderate		General Manager or approved delegate.						

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Risk / Administrative Detail																	
Ref	Category	Source	Due to...	There is a risk that...	Which may result in...	E&C	H&S	Likelihood	Calc. Risk	Risk Level	ALARP?	Action Owner	Implementation Cost	Control Accepted	Name of Approver	Due Date	Status
3	Environment		Transfer of flowback water to enclosed tanks from TED	loss of containment at enclosed tanks	Small scale and short term environmental impact to localised area of low environmental value and no impact beyond AGL's operational area.												
4	Environment/ Community		Due to illegal and unathourised entry on the site equipment may be sabotaged	Risk of loss of containment of flowback water, delays to operation, intended contamination of flowback water	Short to medium term environmental impact that may extend beyond AGL's operational area. Regional and state and/or online negative publicity for a period approximately a week and social media commentary restricted to interest groups. Localised community complaints				0	#N/A							
5	Business Continuity		Debris in pipeline	blockage of pipeline	Business interruption causes impact to internal or external customers that last up to 5 business days; AND / OR Growth options are delayed for between 3 and 6 months.				0	#N/A							

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Risk / Administrative Detail						Action Tracking		
Ref	Category	Source	Due to...	There is a risk that...	Which may result in...	Update	Dependency	Date Implemented
3	Environment		Transfer of flowback water to enclosed tanks from TED	loss of containment at enclosed tanks	Small scale and short term environmental impact to localised area of low environmental value and no impact beyond AGL's operational area.			
4	Environment/ Community		Due to illegal and unathourised entry on the site equipment may be sabotaged	Risk of loss of containment of flowback water, delays to operation, intended contamination of flowback water	Short to medium term environmental impact that may extend beyond AGL's operational area. Regional and state and/or online negative publicity for a period approximately a week and social media commentary restricted to interest groups. Localised community complaints			
5	Business Continuity		Debris in pipeline	blockage of pipeline	Business interruption causes impact to internal or external customers that last up to 5 business days; AND / OR Growth options are delayed for between 3 and 6 months.			

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