Appendix BB Constraints Mapping

The Bowen Gas Project (the Project) constraints analysis has been developed to support the environmental framework approach as detailed in the Environmental Impact Statement (EIS) (Environmental Framework chapter (Section 7)). The constraints analysis is to be used for planning, decision making and to align design objectives with commitments and conditions identified within the EIS. The constraints mapping provides a guideline for determining the types of development and Project related activities that can and cannot occur within particular areas. The constraints mapping aims to provide direction for planning and development decision making within the Project area, and is the basis for the optimisation of infrastructure locations.

This section outlines the methodology and rationale behind the constraints analysis and mapping for the Project. Further detail on the Impact assessment methodology employed for the EIS is provided in Section 6 of the EIS.

BB.1 Objectives

The objectives of the constraints mapping activity are to: develop a broad scale, desktop assessment tool to guide the planning of site and route selection within the Project area. Constraints mapping does not provide a comprehensive list of all activities associated with the Project and their associated development constraints; its intent is to guide Project planning and development activities, and as a result protect the integrity and the long term viability of environmental values within the Project area through avoidance and impact minimisation.

BB.2 Method

The constraints analysis mapping was performed as a desktop analysis using multiple datasets and layers within a Geographic Information System (GIS). Existing datasets were coupled with information and data collected from site visits and ground verification of data. Where existing datasets did not correlate with ground verified information, the ground verified data was used to overrule information obtained from desktop data.

The accuracy of the maps produced is restricted to the scale at which the existing data is provided. For example, vegetation mapping (which is used to derive aspects of the Environmentally Sensitive Areas (ESA) categories) provided by the Department of Environment and Heritage Protection (EHP) is produced at a scale of 1:100,000 within the Brigalow Belt Bioregion. At this scale, the minimum mappable area size for discrete vegetation communities is five hectares and the minimum width for linear features is 75 m. At this scale, a distance of 1 mm on a map is equal to 100 m on the ground. It is for this reason that ground verification activities are undertaken and that the ground verified data overrides the existing dataset.

Recent state government and federal government approvals granted for coal seam gas (CSG) projects within the region were reviewed to understand the values and conditions that have been of consideration to regulatory bodies.
Appendix BB Constraints Mapping

In recent CSG project approvals, petroleum activities as defined in the *Environmental Protection Act 1999 (EP Act)*, have been separated into three categories:

- Limited petroleum activities;
- Low impact petroleum activities; and
- Other petroleum activities.

The separation of the categories is performed by defining ‘limited petroleum activities’ and ‘low impact petroleum activities’, with remaining activities falling under the generic ‘petroleum activities’ definition.

Limited petroleum activities are generally listed as a restricted set of activities that may include:

- Well sites less than 1 hectare (ha) (and the infrastructure located on the well site);
- Geophysical surveys;
- Gathering / flow pipelines from a well head to the initial compression facility;
- Supporting access tracks; and
- Communication and power lines necessary for the undertaking of petroleum activities.

Limited petroleum activities generally do not include (but are not limited to):

- Dams;
- Borrow pits;
- Compressor stations; and
- Workforce accommodation / campsites.

Low impact petroleum activities have been defined as limited petroleum activities which do not result in the clearing of native vegetation, cause disruption to soil profiles through earthworks or excavation or result in significant disturbance to land. For example, soil surveys, topographic surveys, cadastral surveys, ecological surveys and traversing land by car or foot via existing access track or routes or in such a way that does not result in permanent damage to vegetation.

Using these definitions, a matrix of constraint level with associated petroleum activities and mitigation / control measures was developed to govern broad decision making and planning processes (see Table BB-1).

### Table BB-1 Project Activities based on Level of Constraint

<table>
<thead>
<tr>
<th>Level of Constraint</th>
<th>Controls and Mitigation</th>
<th>Project Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Impact Petroleum Activities</td>
<td>Limited Petroleum Activities</td>
</tr>
<tr>
<td>No go</td>
<td>Site-specific environmental management measures</td>
<td>Yes</td>
</tr>
<tr>
<td>High</td>
<td>Site-specific environmental management measures</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Appendix BB Constraints Mapping

<table>
<thead>
<tr>
<th>Level of Constraint</th>
<th>Controls and Mitigation</th>
<th>Project Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Low Impact Petroleum Activities</td>
</tr>
<tr>
<td>Moderate</td>
<td>Specific environmental management measures</td>
<td>Yes</td>
</tr>
<tr>
<td>Low</td>
<td>Standard environmental management measures</td>
<td>Yes</td>
</tr>
</tbody>
</table>

This matrix is to be used as a guide for preferentially locating Project activities within low (or no) constraint areas and moving up constraint levels when it is not possible or feasible to locate activities within the preceding constraint level.

The level of constraint will determine the type of activity that can take place within the mapped constraint area. The constraint categories provide an indication on the level of approval or assessment that may be required in addition to extra expenses that may result from developing within that area (for example, additional management activities, providing offsets or the clearing of vegetation). An explanation on the categories and some of the additional work that may be required is found below:

**No go areas:** Development within no go areas is prohibited and Arrow has made a commitment to avoid development within these areas. The only activities permitted in these areas are low impact petroleum activities, as defined above. Examples of these areas would include; nature refuge areas, national parks, towns, residences etc. No go areas within the project area include:

- Indigenous and non-indigenous cultural heritage sites;
- Homevale National Park;
- The towns of Coppabella, Middlemount and Blackwater; and
- Sensitive receptor sites.

**High constraint areas:** In addition to the mapped constraint, development within these areas would most likely require additional approval processes. Such processes might include flora or fauna surveys, and rehabilitation or relocation programs. Consultation with stakeholders is probable. Arrow has made a commitment that production facilities (such as workers accommodation sites, gas processing facilities or water treatment facilities) will not be located within highly constrained areas. Extra conditions may be imposed (such as limiting the width of right-of-ways, limiting road widths or development footprint areas). Offsets may be required. Costs of development in these areas will probably be higher than in non-constrained areas. Examples of these areas would include: endangered regional ecosystems, sensitive receptor buffers and buffer zones of no-go areas.

**Moderate constraint areas:** In addition to the mapped constraint, development within these areas may require additional approval processes. Such processes may include flora or fauna surveys and rehabilitation or relocation programs. Consultation with stakeholders might be required. Certain types of infrastructure might require site specific mitigation measures and if possible, be required to be...
Appendix BB Constraints Mapping

located elsewhere. Offsets might be required. Costs of development in these areas may be higher than in non-constrained areas. Examples of these areas might include least concern remnant vegetation or areas with visual amenity values.

Low constraint areas: In addition to the mapped constraint, development within these areas may require additional approval processes. Such activities might include mitigation activities or implementation of management plan activities. Offsets are unlikely. Costs of development in these areas may be slightly higher than in non-constrained areas.

Using various datasets and input from specialist desktop and field technical studies, values within the following categories were identified and mapped:

- Natural Environment / Ecology;
- Surface water;
- Land tenure;
- Land use;
- Cultural heritage (indigenous and non-indigenous);
- Landscape and visual amenity;
- Engineering; and
- Roads.

**BB.2.1 Natural Environment / Ecology and Surface Water**

Constraints mapping for natural environment / ecology and surface water is based upon the ESA mapping categories identified by EHP. Two ESA categories are defined under the *Environmental Protection regulation 2008* (Categories A and B) with a third category defined within the *Code of environmental compliance for mining lease projects* (Category C). The breakdown of the ESA categories in conjunction with the constraint matrix has been used to determine the level of activity within the constraints mapping. The ESA categories and restrictions can be found in Table BB-2.

<table>
<thead>
<tr>
<th>ESA Category</th>
<th>Within the ESA</th>
<th>ESA Buffer Zone (500 m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category A ESAs</td>
<td>No petroleum activities permitted</td>
<td>Only limited petroleum activities permitted</td>
</tr>
<tr>
<td>Category B ESAs</td>
<td>Only limited petroleum activities permitted</td>
<td>Petroleum activities permitted*</td>
</tr>
<tr>
<td>Category C ESAs</td>
<td>Only limited petroleum activities permitted</td>
<td>Petroleum activities permitted*</td>
</tr>
</tbody>
</table>

1 Buffer is indicative based on the current regulatory conditions, however these may be subject to change in future. The buffers that will be implemented for the project will be in line with the regulatory requirements at the time of implementation.

2 Permitted limited petroleum activities still need to meet additional reporting and decision making conditions defined by the State Government before commencing construction.

Surface water constraints differ depending on the value being impacted. For the purpose of this Project, The buffers outlined below are indicative based on the current regulatory conditions, however these may be subject to change in future. The buffers that will be implemented for the Project will be
in line with the regulatory requirements at the time of implementation. Indicative buffers at this time include:

- In areas mapped as high constraint, a buffer of 100 m measured from the high bank edge, will be adopted during all phases of the Project, with a further 100 m constrained to low impact activities;
- For areas mapped as moderate constraint, the following buffer zones, measured from the high bank edge, will be adopted during all phases of the Project:
  - a riparian buffer of 50 m width on either side of first and second order streams; and
  - a riparian buffer of 100 m width on either side of third, fourth, fifth and higher order streams;
- Referable Wetlands – 200 m buffer; and
- Springs – 100 m buffer.

### BB.2.2 Land Tenure and Landuse

The land tenure and land use constraints maps have been developed to identify potentially conflicting land uses with the Project area. Areas identified as no go areas are sensitive receptors (such as homesteads, schools, towns and hospitals). These areas have been identified as being incompatible with CSG activities. Other areas have been identified as high, moderate and low constraint areas and may require specific management or mitigation measures. Significant areas mapped as no go areas include:

- Blackwater;
- Middlemount; and
- Coppabella.

Land use constraints have been developed in accordance with the analysis and information contained in the Landuse and Tenure chapter (Section 19) of the EIS. The land use constraints are based upon Good Quality Agricultural Land (GQAL) Categories A and B; and Strategic Cropping Land (SCL) mapping provided by EHP. It is Arrow’s intention to avoid locating the central gas processing facilities and integrated processing facilities on intensively farmed land and SCL. Other petroleum activities are not excluded from these areas.

Land use constraints were compiled also using the Queensland Land Use Mapping Project (QLUMP) data produced by EHP. Due to the inability for the data to distinguish between “grazing natural vegetation” and “grazing exotic vegetation” categories, which would result in the entire petroleum lease area being under high constraint, the categories were excluded from the constraints mapping.

### BB.2.3 Cultural Heritage and Landscape / Visual Amenity

Visual amenity constraints have been identified in conjunction with the Landscape and Visual Amenity chapter (Section 20) of the EIS. Sensitive receptors (such as urban areas and homesteads) have been identified and have been constrained as no go areas. This report has identified landscape and visual constraints that reflect the capacity of existing environmental values to adjust to impacts arising from the key Project activities.

Following a determination of visual and landscape significance, constraints have been assigned on the following basis:
Appendix BB Constraints Mapping

- **‘No Go’**: the Project activities could cause significant adverse landscape and visual impacts. Project activities will not be permitted to disturb existing environmental values.
- **High Constraint**: key landscape and visual values will be at risk from key Project activities. Only certain types of Project activities might be permitted under stringent environmental controls.
- **Moderate Constraint**: key landscape and visual values will be at risk from key Project activities but the application of standard environmental procedures in conjunction with site-specific controls will ensure likely impacts will not exacerbate threatening processes.
- **Low Constraint**: no specific landscape or visual values have been identified and the application of standard operating procedures will ensure minimal impact as a result of the key Project activities.

Table BB-3 identifies visual sensitivity areas (as identified in Table 20-12 of the EIS) and their constraint category for that sensitive area.

<table>
<thead>
<tr>
<th>Visual Sensitivity Rating</th>
<th>Constraint Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>High sensitivity</td>
<td>No go</td>
</tr>
<tr>
<td>High sensitivity buffer (1 km)</td>
<td>High</td>
</tr>
<tr>
<td>Medium sensitivity</td>
<td>Moderate</td>
</tr>
<tr>
<td>Low sensitivity</td>
<td>Low</td>
</tr>
</tbody>
</table>

**BB.3 Results**

The development of the constraint framework allows for preliminary assessment of values and constraints throughout the Project area. As a result of the constraints analysis, eight maps have been produced to guide planning and development within the lease area. These maps can be found in Appendix B of this report.

- Map 1: Natural environment / ecological constraints;
- Map 2: Surface water constraints;
- Map 3: Land tenure constraints;
- Map 4: Land use constraints;
- Map 5: Cultural heritage constraints;
- Map 6: Landscape amenity constraints;
- Map 7: Roads constraints; and
- Map 8: Overview of constraints.
BB.4 Definitions

“Category A Environmentally sensitive area” means any area listed in Section 25 of the Environmental Protection Regulation 2008

“Category B Environmentally sensitive area” means any area listed in Section 26 of the Environmental Protection Regulation 2008

“Category C Environmentally sensitive area” means any of the following areas:

- Nature Refuges as defined under the Nature Conservation Act 1992;
- Koala Habitat areas as defined in the Nature Conservation (Koala) Conservation Plan 2006;
- State Forests or Timber Reserves as defined under the Forestry Act 1959;
- Declared catchment areas under the Water Act 2000;
- Resources reserves under the Nature Conservation Act 1992;
- An area identified as “Essential habitat” or “Essential Regrowth Habitat” under the Vegetation Management Act 1999 for a species of wildlife listed as endangered, vulnerable, rare or near threatened under the Nature Conservation Act 1992; or
- Of Concern Region Ecosystems identified in the database maintained by the Department of Environment and Heritage Protection called ‘RE description database’ containing Regional Ecosystem numbers and descriptions.

“Primary protection zone” means an area within a 200 m buffer from the boundary of any category A, B or C Environmentally sensitive area.

“Secondary protection zone” means an area within a 300 m buffer from the boundary of the primary protection zone of any category A, B or C Environmentally sensitive area.

“Low impact petroleum activities” means limited petroleum activities which do not result in the clearing of native vegetation, cause disruption to soil profiles through earthworks or excavation or result in significant disturbance to land. Examples of such activities include but are not necessarily limited to soil surveys, topographic surveys, cadastral surveys and ecological surveys and traversing land by car or foot via existing access tracks or routes or in such a way that does not result in permanent damage to vegetation. This definition is based on current regulatory conditions at the time of writing, however these may be subject to change in future.

“Limited petroleum activities” mean only the following activities outlined below, which are indicative based on current regulatory conditions, however these may be subject to change in future and will be in line with the regulatory requirements at the time of implementation:

- Well sites not exceeding 1 ha disturbance and multi-well sites not exceeding 1.5 ha disturbance. Well sites may include the following infrastructure:
  - well pads;
  - water pumps and generators associated with well operations;
  - sumps for storing drilling muds;
  - flare pits;
  - ponds used to contain and/or store stimulation fluid;
- Geophysical surveys (including seismic petroleum activities);
Appendix BB Constraints Mapping

- Ecological geological surveys (including seismic petroleum activities);
- Gathering / flow pipelines from a well head to the initial compression facility;
- Supporting access tracks; and
- Communication and power lines that are necessary for the undertaking of petroleum activities and that are located within well sites, well pads and pipeline right of ways without increasing the disturbance area of petroleum activities.

For clarity, limited petroleum activities currently exclude, but are not necessarily limited to the following exclusions:

- The construction of infrastructure for processing or storing petroleum or by-products;
- Low hazard dams (that do not meet the limitations prescribed above);
- Regulated dams;
- Borrow pits;
- Compressor stations;
- Campsites / workforce accommodation;
- Pipelines which are used to transport gas after the initial compression facility (e.g. trunk pipelines, transmission pipelines or pipelines that require a pipeline licence) except for those pipelines authorised under the conditions of a valid environmental Authority;
- Waste disposal; or
- Other supporting infrastructure for the project (e.g. sewage treatment plants).
Appendix BB Constraints Mapping

**BB.5 Limitations**

URS Australia Pty. Ltd. (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Arrow Energy Pty Ltd and only those third parties who have been authorised in writing by URS to rely on this Report.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this Report.

It is prepared in accordance with the scope of work and for the purpose outlined in the contract dated January 2012.

Where this Report indicates that information has been provided to URS by third parties, URS has made no independent verification of this information except as expressly stated in the Report. URS assumes no liability for any inaccuracies in or omissions to that information.

This Report was prepared between February and October 2012 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

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It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the site.

Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.
Appendix BB Constraints Mapping

**Appendix A**

**Table BB-4 Natural Environment, Ecology and Surface Water**

<table>
<thead>
<tr>
<th>Natural Environment / Ecology</th>
<th>Surface Water</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No Go Zone</strong></td>
<td></td>
</tr>
<tr>
<td>Significant conservation areas</td>
<td>Within Springs</td>
</tr>
<tr>
<td>ESA category A</td>
<td>Within mapped Wetlands</td>
</tr>
<tr>
<td>ESA category B</td>
<td>Within Lakes</td>
</tr>
<tr>
<td>ESA category C</td>
<td></td>
</tr>
<tr>
<td>EPBC species habitat</td>
<td></td>
</tr>
<tr>
<td><strong>High</strong></td>
<td></td>
</tr>
<tr>
<td>ESA category A buffer zone</td>
<td>Within Watercourses</td>
</tr>
<tr>
<td>ESA category B</td>
<td>Within Waterways</td>
</tr>
<tr>
<td>ESA category C</td>
<td></td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td></td>
</tr>
<tr>
<td>High Value Regrowth</td>
<td>Within 100 m springs *</td>
</tr>
<tr>
<td>ESA category B buffer zone</td>
<td>Within 200 m mapped wetlands *</td>
</tr>
<tr>
<td>ESA category C buffer zone</td>
<td>Within 200 m lakes *</td>
</tr>
<tr>
<td>Other remnant vegetation</td>
<td>Within 50 m of 1st and 2nd order waterways and watercourses *</td>
</tr>
<tr>
<td></td>
<td>Within 100 m of 3rd and 4th order waterways and watercourses *</td>
</tr>
<tr>
<td></td>
<td>Within 100 m of 5th order and above waterways and watercourses *</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td></td>
</tr>
</tbody>
</table>

* Buffer is indicative based on the current regulatory conditions, however these may be subject to change in future. The buffers that will be implemented for the project will be in line with the regulatory requirements at the time of implementation.

**Table BB-5 Landuse and Tenure**

<table>
<thead>
<tr>
<th>Land Tenure</th>
<th>Landuse</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No Go Zone</strong></td>
<td>Sensitive receptors</td>
</tr>
<tr>
<td></td>
<td>Sensitive receptor buffers (200 m)</td>
</tr>
<tr>
<td><strong>High</strong></td>
<td>Mining leases granted within the project development area</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>Easements</td>
</tr>
<tr>
<td></td>
<td>GQAL A &amp; B</td>
</tr>
<tr>
<td></td>
<td>Water resources</td>
</tr>
<tr>
<td></td>
<td>Strategic cropping land</td>
</tr>
<tr>
<td></td>
<td>Railways</td>
</tr>
<tr>
<td></td>
<td>Contaminated land</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>Other areas</td>
</tr>
<tr>
<td></td>
<td>Other areas</td>
</tr>
</tbody>
</table>
Appendix BB Constraints Mapping

### Table BB-6  Cultural Heritage and Landscape Amenity

<table>
<thead>
<tr>
<th></th>
<th>Cultural Heritage</th>
<th>Landscape and Visual Amenity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No Go Zone</strong></td>
<td>Indigenous cultural heritage</td>
<td>Sensitive receptors</td>
</tr>
<tr>
<td></td>
<td>Non-indigenous cultural heritage</td>
<td>High visual sensitivity areas</td>
</tr>
<tr>
<td></td>
<td>National heritage register</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Qld cultural heritage register</td>
<td></td>
</tr>
<tr>
<td><strong>High</strong></td>
<td></td>
<td>Sensitive receptor buffers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium visual sensitivity areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High visual sensitivity areas buffers (1 km)</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td></td>
<td>Low visual sensitivity areas</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>Other areas</td>
<td>Other areas</td>
</tr>
</tbody>
</table>

### Table BB-7  Engineering and Roads

<table>
<thead>
<tr>
<th></th>
<th>Engineering</th>
<th>Roads</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No Go Zone</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>High</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>Road Reserves</td>
<td>Stock routes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Railway crossings</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>Other areas</td>
<td>Other areas</td>
</tr>
</tbody>
</table>
Appendix BB Constraints Mapping

Appendix B
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The Bowen Gas Project tenements are shown in red, and the Moderate Constraint Area is shown in yellow. The map is generated using Geographic (GDA94) projection.

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CULTURAL HERITAGE
CONSTRAINT ANALYSIS

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Approved: DS
Date: 18-10-2012
Rev. A

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