Guidelines for the economic assessment of mining and coal seam gas proposals

DRAFT FOR CONSULTATION

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CIE were commissioned by the NSW Department of Planning and Environment to support the preparation of the CBA section, and Appraisal Guidelines for environmental, heritage, social and transport impacts and associated workbooks. Deloitte Access Economics were commissioned to support the preparation of the LEA section, and ACIL Allen Consulting the CBA workbook.
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1 Introduction

The NSW Department of Planning and Environment (the Department) has prepared these draft guidelines for broad consultation.

The purpose of these Guidelines is to assist proponents with providing the necessary information to meet some of the requirements of section 79C of the Environmental Planning and Assessment Act 1979 (EP&A Act). In particular these Guidelines focus on the following two matters the consent authority must take into consideration in determining a development application:

- The public interest\(^1\); and

- The likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality.

Consistent with NSW Treasury Guidelines for Economic Appraisal (2007)\(^2\), the public interest in these guidelines is the collective public interest of households in NSW.

Two components are used to provide the supporting information for the two considerations above. Firstly, cost benefit analysis (CBA) is used to assess the public interest by estimating the net present value of the project to the NSW community. Secondly, local effects analysis (LEA) is used to assess the likely impacts of the development in the locality.

The CBA and LEA provide a methodology to inform a consent authority about both the likely impacts of a proposal and public interest considerations raised by the proposal that the consent authority is to have regard to as part of its consideration of those matters and its broader statutory obligations under section 79C.

Economic assessment as an input to the development assessment process

Under section 78A of the EP&A Act, a development application for State Significant development must be accompanied by an Environmental Impact Statement (EIS). The Environmental Planning and Assessment Regulation 2000 requires a proponent to request any requirements for the EIS from the Secretary of the Department of Planning and Environment. These requirements are referred

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\(^1\) Clause 1 sub clause b and e of the Environmental Planning and Assessment Act 1979.

to as Secretary’s Environmental Assessment Requirements (SEARs) and require an economic assessment of the project in accordance with these guidelines, to support a triple bottom line assessment.

The economic assessment, comprising the CBA and LEA, forms part of the EIS. The economic assessment should consider all the issues covered in the SEARs and be integrated with the conclusions of the EIS.

Section 79C of the EP&A Act clearly states that in determining an application, the consent authority must evaluate a number of factors. Both the quantitative and qualitative findings of the CBA and the LEA are all factors for evaluation. They do not, in any way, influence the determination over and above other factors. Nor is any element of the economic appraisal necessarily given greater weight in the determination. These are matters for the consent authority to decide on the basis of the individual proposal and supporting arguments.

The economic assessment report will be reviewed as part of the full EIS and placed on public exhibition for community comment.

**Cost benefit analysis**

CBA estimates and compares, on a common basis, the total benefits and costs of a project or policy to the members of a specified community.

CBA provides a technique that allows a systematic treatment of trade-offs and provides a basis on which the Government can assess the net public benefits of decisions. It allows for quantification and valuation of the full range of potential impacts, economic, social or environmental (including human health) that might arise from a project. All costs and benefits should be quantified and monetised if feasible and material.

Impacts across the various types of costs and benefits are converted into a common unit. The preferred unit is the Australian dollar in current day prices.\(^3\) These values are then aggregated into a single metric – the expected present value of net benefits from a proposed project. Unquantified impacts should be reported where they are considered material to the decision making.

A CBA framework is focused on the benefits for a specified community, in this case the NSW community. The policy option that delivers the highest net social welfare is considered an important indicator of the best outcome for society, subject to considerations of any major unquantified effects and any major adverse impacts on particular groups in the community.

A CBA framework also considers the timing of each of the impacts, where future impacts are ‘converted’ into today’s terms so that all impacts can be meaningfully compared regardless of timing. A CBA, for example, will enable an evaluation of policies that deliver different streams of benefits and costs over time.

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\(^3\) This excludes future inflation in general prices. Changes in prices relative to inflation are included, such as real changes in coal prices.
The key steps to undertake a CBA are highlighted in box 1.1 and discussed in detail following.

### 1.1 Key steps in a CBA

| **Step 1:** Establish the base case | against which to assess the potential economic, social and environmental impacts of changes due to the project. |
| **Step 2:** Define the project | including all significant inputs required to achieve the project’s objectives. |
| **Step 3:** Quantify the changes | from the base case resulting from the project. This will focus on the incremental changes to a range of factors (for example, environmental, economic, social) resulting from the decision. |
| **Step 4:** Estimate the monetary value of these changes | and aggregate these values in a consistent manner to assess the outcomes. Where market prices exist, they are a starting point for valuations of both outputs and of inputs used for production. For non-market goods, as for many environmental impacts and some social impacts, the aim is to value them as they would be valued in money terms by the individuals who experience them. |
| **Step 5:** Estimate the Net Present Value (NPV) of the project’s future net benefits cash flow stream, using an appropriate discount rate, and deciding on the Decision Rule on which to assess the different options. |
| **Step 6:** Undertake sensitivity analysis | on the key range of variables, particularly given the uncertainties related to specific benefits and costs. |
| **Step 7:** Assess the distribution of costs and benefits across different groups. |
| **Step 8:** Report CBA results | and decide which option is better for society. In practice, additional information, aside from the CBA results, may also be utilised when deciding on the preferred option. |

**Key features of a CBA**

A CBA should have the following key features:

- **Scope** – A CBA should include all first round (primary) impacts both direct and indirect but not secondary impacts. Direct impacts reflect the revenues of the project less the opportunity cost of resources (such as land, labour and capital) used for the project. Indirect impacts are impacts on third parties and include all the environmental, social and health cost and benefits and associated public expenditure. The distribution of costs and benefits to the NSW community will reflect arrangements such as taxes and royalties applying to the project, and also impacts in related markets.
• **Discount rate** – A discount rate of 7 per cent per annum with sensitivity testing at 4 per cent and 10 per cent per annum should be used.\(^4\)

• **Timeframe** – the evaluation period should be long enough to capture all costs and benefits attributable to the project. In general the evaluation period should reflect the expected economic life of the principal asset. Where a project has environmental impacts (positive or negative), the impacts may continue well after the productive life of the project under consideration. It is recommended that long-term projects should use a 30 year time-frame post construction\(^5\), consistent with NSW Treasury Guidelines for Economic Appraisal, and where applicable a residual value for impacts beyond that time-period. However, where predictable and material, a longer time-frame can be adopted.

• **Risk and uncertainty** – A ‘risk neutral’ approach to expected costs and benefits, such that core estimates of costs and benefits reflect average (mean) estimates of the likely outcomes. Sensitivity testing should be conducted around key parameters.

• **Unquantified factors** – to provide information to the decision maker on any impacts that could not be quantified to be assessed in conjunction with the quantified expected net benefits.

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\(^5\) In the case of a mine, the CBA would need to cover 30 years from when the mine begins operating.
Local effects analysis (LEA)

LEA focuses on how local people will experience the changes incurred due to the project, with priority given to effects that are perceived to be material at the local level. An assessment of the consequences of the proposal in its “locality” is required by section 79C of the EP&A Act, which specifically requires an assessment of social and economic impacts.

The CBA conducted at the project and State level will already contain much of the information that is needed for the LEA. For example, the economic benefits to workers and suppliers that are considered in the CBA form a critical input for an LEA. In this sense, LEA is not a new approach and does not require significant additional analysis over and above the CBA.

The LEA is intended to be complementary to the CBA. What LEA does is translate the effects estimated at the State level to the impacts on the communities located near the project site. Local effects analysis can be seen as an identification and enumeration of local effects that have been incorporated into the CBA with the purpose of an LEA being to:

- Inform communities;
- Identify local impacts or change; and
- Aid a balanced assessment by providing some information that will assist in developing any mitigation plans and strategies that may be required.

The LEA also provides additional information to describe changes that are anticipated to occur within a locality, such as employment changes. These are intended to inform the scale of change rather than being a cost or benefit to the local community.

For the purposes of these draft Guidelines, the LEA defines the locality and the population group as the following:

- Locality - defined as the Statistical Area Level 3 (SA3) that contains the proposed project.  
  
- Population group - for practical reasons of measurement and identification, the analysis should include local effects that accrue to those people ordinarily resident in the locality at the time of the proposal.

In theory, a “full” LEA would capture the full range of effects experienced by local people as a result of the proposal. In practice, it is unlikely to be practical or cost effective to undertake a quantitative assessment of all local effects, and therefore it is necessary to propose some priorities, reflecting the legislation, local issues, the cost and complexity of assessment and the costs of obtaining the information required for quantitative assessment. The following local effects are therefore analysed in a local effects analysis:

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6 Statistical Areas are defined by the Australian Bureau of Statistics as part of the Australian Statistical Geography Standard. SA3s have been constructed to represent functional areas of regions and so are a good basis for analysing local effects from mining and coal seam gas projects.
- Local employment and income effects;
- Other local industry effects, for example on suppliers; and
- Environmental and social changes in the local community.
Using these Guidelines

The anticipated users of these Guidelines are proponents and relevant professionals employed by the proponent to assist in the development application for a proposal. The Guidelines will also be used to assess the adequacy of a proponent's economic assessment report.

Proponents may, at their discretion, also use alternative values, as a complement to, rather than a substitute for, the default parameters prescribed for application within the framework set out within these Guidelines. Proponents should offer a detailed justification for why the alternative parameters should be considered, including supporting research and analysis, in addition to the analysis set out in these Guidelines. The Guidelines are to be used in conjunction with the following Excel appraisal workbooks:

- Cost Benefit Analysis Workbook (CBAW); and the
- Environmental and Transport Impacts Valuation Workbooks (ETIVW):
  - Aboriginal Heritage Valuation Workbook;
  - Air Quality Valuation Workbook;
  - Greenhouse Gas Emissions Workbook;
  - Groundwater Impacts Evaluation Workbook
  - Non-Aboriginal Heritage Valuation Workbook;
  - Traffic Impact Valuation Workbook; and
  - Visual Amenity Valuation Workbook.
2 Establishing the base case and defining the project

Establish the base case

In a CBA, the costs and benefits of a project are compared to the costs and benefits ‘without’ the project. The without project case is termed the ‘base case’.

The base case should reflect the existing use of the land (based on current and committed policy settings) where the project is proposed. A clearly defined base case outlines the economic, environmental and social impacts associated with the existing use of land.

The purpose of establishing a clear base case is to focus on the incremental change in economic, environmental and social impacts caused by the project relative to the existing land use.

The base case should include existing and already approved (but not yet operational) projects that will interact with the mining or coal seam gas project. This will ensure the cost benefit analysis at the project level accounts for cumulative impacts and threshold effects to the extent possible.

Step 1 Existing land use on the project site

The proponent should outline the existing land use on the project site and assess its material economic, environmental and social impacts that would occur during the evaluation period. For example, this could assess the environmental impacts (e.g. greenhouse gas emissions) from continued agricultural production on the project site.

The CBA should estimate the forgone value of the existing land use. The value of output and residential amenity given up or forgone on the project site over time can be estimated as the market value of the land and properties.

Current land prices are generally an appropriate indicator of the ‘present value’ of future output, housing and lifestyle uses associated with land and properties in their current use. The proponent should estimate the current land and property price of the project site. This value should exclude any part of the price that may reflect the impact of mining, positive and negative:

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7 The base case should not include projects that may potentially be approved in the future. These projects will be subject to their own cost benefit analysis during the assessment process.

8 Cumulative impacts or threshold effects can occur where there are multiple projects in a given region. Cumulative impacts occur where the impact of two projects taken together is greater than the sum of the impacts of each undertaken individually. One example of cumulative impacts is if there are thresholds where impacts cannot be meaningfully ‘reversed’ or impacts significantly intensify (e.g. the extinction of a threatened species population).
Positive – it should exclude any element of mining profit that is capitalised into the land price, and which is therefore part of the net benefit of the project; and

Negative – it should exclude any discount on the land price that could be related to the threat of mining having a negative impact on amenity.

The existing use of the site may have third party impacts, such as environmental costs. In practice, not all third party impacts of the existing land use will be easily identifiable and quantifiable. Focus should be placed on impacts that are likely to be of material significance for the CBA. Where third party impacts of the existing land use are not quantified, a CBA of a mining or coal seam gas project implicitly assumes no third party impacts under the existing land use.

Step 2 Assess interactions with other projects in the surrounding area

Assess whether the proposed project interacts (complements or competes) with existing or approved projects in the surrounding area. This is required to evaluate possible cumulative impacts or threshold effects, as these projects will change base case environmental conditions.

Where interactions occur with other projects, identify the economic, environmental and/or social impacts that are likely to be of material relevance. For example, where the additional water take required by a new project may exceed the current availability of the resource, or where air or noise pollution contributes to higher base levels than could normally be expected.

These interactions would be part of the cost benefit analysis because other projects would be reflected in the base case set of environmental conditions that occur over the evaluation period.

Define project

Projects may be new mining or coal seam gas projects or extensions or modifications of existing projects. In any case, the proponent should describe the project in terms of land use, physical layout, proposed output, likely market(s), timing of the project and related infrastructure requirements. Where appropriate, the proponent should outline the mitigation or management strategies that will be undertaken as part of the project’s activities.

The definition of the project should include all significant inputs required to achieve the project’s objectives. The appraisal must focus on the whole proposed project for which approval is sought. Partitions of projects for administrative reasons are not appropriate for appraisal. The definition of the project should include options or scenarios for mitigation programs, as well as activities required by Governments because of the project.
3 Cost benefit analysis

This section sets out the requirements to complete the steps of a CBA of a mining or coal seam gas project, after the base case and project have been defined. The proponent may choose one of the following CBA options:

- Approach 1: Full cost benefit analysis for NSW – quantifies and attributes to NSW all the incremental costs and benefits of the project
- Approach 2: Minimum threshold analysis for NSW – quantifies and attributes to NSW a component of company income tax, royalty payments and all indirect costs and benefits of the project.

The first approach requires the proponent to provide information on revenues and financial costs in order to estimate the net producer surplus. The second approach does not require this information.

3.1 Components of net benefits (direct and indirect) attributed to NSW for the two approaches

<table>
<thead>
<tr>
<th>Component</th>
<th>Approach 1</th>
<th>Approach 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Royalties</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Company income tax</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Net producer surplus</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Economic benefit to existing landholders</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Economic benefit to workers</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Economic benefit to suppliers</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Net environmental, social and transport-related costs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Net public infrastructure costs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Cost benefit analysis for NSW

A CBA estimates and compares the total benefits and costs of a project to members of a specified community. These Guidelines consider the community of interest as NSW, requiring benefits and costs to be estimated where possible as those that accrue to the NSW community.

This section outlines how to report and quantify the incremental costs and benefits of a mining/coal seam gas proposal and estimate their monetary value for both approaches available to the proponent.

Task 1a Estimate royalties payable (both approaches)

The mineral royalty is the price charged by the State for the transfer of the right to extract a mineral resource. All royalties payable as a result of a project will be attributed to the NSW population.

The quantification of royalties payable (including allowable deductions) should be based on the NSW Government guidance documents and the royalty rates prescribed in legislation. 10

The two different types of royalties are:

- Ad Valorem royalty applied to high value to volume minerals and levied as a percentage of the total value of the mineral recovered (or the ex-mine value).
- Quantum royalty levied as a flat rate per unit of quantity.

The Ad Valorem royalty rates for coal are provided in table 3.2 and examples of royalty rates applied to different types of minerals are provided in table 3.3.

### 3.2 Ad Valorem royalty rates for coal

<table>
<thead>
<tr>
<th>Coal</th>
<th>Royalty rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open cut coal</td>
<td>8.2 per cent</td>
</tr>
<tr>
<td>Underground coal</td>
<td>7.2 per cent</td>
</tr>
<tr>
<td>Deep underground coal</td>
<td>6.2 percent</td>
</tr>
</tbody>
</table>


3.3 Types of royalty rates applied to selected minerals (excluding coal)

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Royalty rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos, Copper, Iron minerals, Nickel, Oil shale, Tungsten, Zinc</td>
<td>4 per cent ex-mine value (value less allowable deductions)</td>
</tr>
<tr>
<td>Agricultural lime, bauxite, gypsum</td>
<td>35 cents per tonne</td>
</tr>
<tr>
<td>Limestone, Magnesium salts, Potassium salts, Sodium salts</td>
<td>40 cents per tonne</td>
</tr>
<tr>
<td>Chlorite, Marble, Phosphates</td>
<td>70 cents per tonne</td>
</tr>
<tr>
<td>Petroleum</td>
<td>10 per cent of wellhead value (value less allowable deductions)</td>
</tr>
</tbody>
</table>


Task 1b Estimate company income tax (both approaches)

The proponent should estimate the total annual company income tax payable for each year of the evaluation period of the project. The proportion of company income tax attributable to NSW should be estimated by applying the proportion of Australia’s population based in NSW, equivalent to 32 per cent as of June 2014 (table 3.7).\(^\text{11}\)

Note that a new mine will also pay other taxes, such as payroll tax and personal income tax. The majority of these taxes will have been generated without the project, as people would have been employed elsewhere. Hence these should be included in costs.

3.4 Estimating ratio of NSW to Australian population

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSW population ('000)</td>
<td>7,519</td>
</tr>
<tr>
<td>Australian population ('000)</td>
<td>23,491</td>
</tr>
<tr>
<td>Ratio of NSW to Australian population</td>
<td>32 per cent</td>
</tr>
</tbody>
</table>


Task 1c Net Producer Surplus - Identify the direct costs and benefits to the producer (Approach 1 only)

The key difference between the two approaches is that Approach 1 estimates the net producer surplus attributable to the NSW community. Estimating net producer surplus requires information on the direct costs and benefits of the project. Table 3.5 outlines the direct benefits and costs of a mining or coal seam gas project that are typically considered.

\(^{11}\) This is based on population data from ABS, 2014, Australian Demographic Statistics, Cat. 3101.0 June 2014. This proportion should be updated to reflect updates to ABS population data.
The value of the direct benefits and costs will be estimated as part of the proponent’s financial assessment of the project. The annual values of all direct benefits and costs estimated by the proponent should be entered into the Cost Benefit Analysis Workbook.

The costs entered by the proponent will reflect their expected expenditures.

### 3.5 Direct benefits and costs of a project considered when estimating net producer surplus

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross mining revenue</td>
<td>Operating costs</td>
</tr>
<tr>
<td>Residual value of land at end of evaluation period</td>
<td>Capital costs</td>
</tr>
<tr>
<td>Residual value of capital at end of evaluation period</td>
<td>Decommissioning costs</td>
</tr>
<tr>
<td></td>
<td>Finance costs</td>
</tr>
<tr>
<td></td>
<td>Environmental mitigation costs</td>
</tr>
<tr>
<td></td>
<td>Transport management costs</td>
</tr>
<tr>
<td></td>
<td>Rehabilitation expenses</td>
</tr>
<tr>
<td></td>
<td>Purchase costs for land</td>
</tr>
<tr>
<td></td>
<td>Local contributions</td>
</tr>
<tr>
<td></td>
<td>All taxes (Australian, state and local)</td>
</tr>
</tbody>
</table>

*Note: The cost estimates should reflect expected expenditure by the proponent.*

**Task 1d Quantify direct benefits and direct costs to the producer and estimate the total direct net benefit to the producer (Approach 1 only)**

The total direct net benefit to the producer is the difference between the direct benefits (value of output, and residual value of land and capital) and the expected expenditure on inputs. It does not include indirect benefits and costs such as premiums for resources above their opportunity costs, the net environmental, social and transport costs or the net public infrastructure costs of the project.

The value of output will rely on projections of prices for outputs of the project. These prices would often be the same as the base case, as long as the project was small in the context of the relevant market. The relevant market would often be global.

**Task 1e Estimate net producer surplus attributable to NSW (Approach 1 only)**

The net producer surplus is the gain to the proponent excluding all opportunity costs of inputs and the economic benefits to all other parties.

The proponent should estimate the annual net producer surplus (for each year of the evaluation period) as follows:

\[
Net \text{ producer surplus} = Revenue - costs - tax - royalties
\]
Costs should include all costs incurred by the proponent including contributions to public infrastructure and costs for mitigating environmental impacts.

The proponent should attribute a proportion of net producer surplus to NSW as follows:

- Estimate the Australian share of the project’s ownership
- Apply the default proportion of 32 per cent\(^ {12}\) to estimate the NSW share of ownership (see example in table 3.6).

Note that where Approach 2 is used, the proponent would not include an estimate of net producer surplus.

### 3.6 Example of proportion of net producer surplus attributable to NSW

<table>
<thead>
<tr>
<th>Net producer surplus ($m)</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian share of project’s ownership</td>
<td>20 per cent</td>
</tr>
<tr>
<td>NSW share of Australia (^ a)</td>
<td>32 per cent</td>
</tr>
<tr>
<td>Value of net producer surplus attributable to NSW ($m)</td>
<td>6.4</td>
</tr>
</tbody>
</table>

\(^ a\) Based on NSW population relative to Australian population.

### Task 2a Estimate indirect benefits to NSW

Indirect benefits include economic benefit to existing landholders, workers, and suppliers and should be estimated in a cost benefit analysis for NSW as set out below. Indirect benefits should be attributed to NSW as set out in table 3.7.

### 3.7 Attribution of indirect benefits to NSW residents

<table>
<thead>
<tr>
<th>Benefit category</th>
<th>Attribution to NSW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic benefit to existing landholders</td>
<td>Full attribution to NSW (unless foreign ownership is identifiable)</td>
</tr>
<tr>
<td>Economic benefit to workers</td>
<td>Partial attribution to NSW (based on origin of labour)</td>
</tr>
<tr>
<td>Economic benefit to suppliers</td>
<td>Partial attribution to NSW (based on share of ownership of suppliers)</td>
</tr>
</tbody>
</table>

**Economic benefit to existing landholders**

A mining or coal seam gas proponent may need to purchase land or pay an access fee to an existing landholder(s) to undertake the project’s activities. Often these payments to existing landholders exceed the opportunity cost of land. The surplus is an economic benefit to existing landholders.\(^ {13}\)

---

\(^ {12}\) Based on NSW population relative to Australian population.

\(^ {13}\) The opportunity cost of land encompasses its value of future output, housing and lifestyle uses.
In the case where a proponent purchases land, the opportunity cost is equivalent to the forgone revenue less costs of the existing land use estimated as part of the base case. As noted above, current land prices are generally an appropriate indicator of the present value of the existing land uses’ future output, housing and lifestyle uses given that any negative or positive impacts of the mining project are excluded.

In the case where a proponent leases land, the economic benefit to landholders is the surplus between the value paid by the proponent less the present value of output, housing and lifestyle forgone on the leased area of land, assuming the mining or coal seam gas operation is compatible with a continuing mix of agricultural and residential land uses.

The total economic benefit to existing landholders should be attributed to NSW, unless there is sufficient evidence to allocate part of this to non-NSW land owners.

**Economic benefit to workers**

Workers in the mining project who would otherwise be unemployed, working part-time or working in other non-mining sectors may gain higher wages than they would without the project (a labour/wage premium).

The economic benefit to workers is the difference between the wage that he or she is paid in the mining project and the minimum (reservation) wage that they would accept for working elsewhere in the mining sector (chart 3.8). The minimum wage reflects the employment opportunity costs, skill level required and the relative disutility of an employment position. However in practice, minimum (reservation) wages are not observable.

A CBA for NSW should include the economic benefit to workers already residing in NSW prior to the project (the base case). The economic benefit to workers migrating to NSW should not be included in the CBA for NSW.

The proponent should estimate the proportion of NSW resident and non-NSW resident workers to be employed by the project for the purposes of attribution.

---

14 The reservation wage is the minimum wage a worker has to be paid to work in a particular industry. In view of the hours of work and working conditions, there is a reasonable possibility that workers’ reservation wages in mining are higher than in other industries, and take into account hours of work and working conditions.
3.8 Identifying the economic benefit to workers

Economic benefit to suppliers

Similar to the economic benefit gained by existing landholders and workers, local suppliers may also receive an economic benefit by achieving higher surpluses through supplying the mining/coal seam gas project. This economic benefit reflects producer surplus created for suppliers. This should be net of any producer surplus loss because of a reduction in an existing industry.

The value of economic benefit to suppliers attributed to NSW should reflect expected input-shares for NSW and non-NSW suppliers for the project.

Worked example

Table 3.9 outlines a worked example of how to attribute components of total net benefit to NSW under approach 1.

3.9 Worked example of attributing benefits to NSW under approach 1

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Example of total value ($m)</th>
<th>Proportion attributable to NSW (per cent)</th>
<th>Value for NSW CBA ($m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Royalties payable</td>
<td>50</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Company income tax</td>
<td>10</td>
<td>32</td>
<td>3.2</td>
</tr>
<tr>
<td>Economic benefit to existing landholders</td>
<td>10</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>Economic benefit to NSW workers</td>
<td>10</td>
<td>Determined by ratio of NSW workers to non-NSW workers</td>
<td></td>
</tr>
<tr>
<td>Economic benefit to NSW suppliers</td>
<td>10</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>Net producer surplus to NSW</td>
<td>100</td>
<td>Determined by Australian share of ownership. Apply default of 32 per cent NSW to Australia ratio</td>
<td></td>
</tr>
</tbody>
</table>
**Task 2b Estimate indirect costs to NSW**

The indirect impacts include the net environmental, social and transport costs, net public infrastructure costs and indirect costs to other industries.

**Net environmental, social and transport-related costs**

Mining and coal seam gas projects can cause environmental impacts to air quality, ambient noise, biodiversity, greenhouse gas emissions, groundwater, non-Aboriginal heritage, Aboriginal heritage, surface water and visual amenity. Transport related impacts also occur such as increased traffic congestion.

Guidance on how to identify and value the environmental and transport impacts of the project is provided in Chapter 5. The impacts detailed are Aboriginal heritage, air quality, greenhouse gas emissions, groundwater, heritage (not including Aboriginal heritage), noise, surface water, visual amenity and transport congestion. The proponent should identify and quantify environmental and transport related impacts using the guidelines in Chapter 5 and the corresponding Environmental and Transport Impacts Valuation Workbook.

In general the total net environmental, social and transport costs will be attributable to NSW. The proponent should include the total net environmental, social and transport costs in the NSW CBA, unless there are cases where these costs are not entirely attributable to the NSW community.

It is noted that multiple projects in a given region may cause cumulative environmental impacts whereby the total impact of two projects together is greater than the sum of the parts. Economic valuation of environmental impacts should take into account the cumulative effects of multiple projects on both marginal benefits and marginal costs.

**Net public infrastructure costs**

Net public infrastructure costs are those costs borne by government (local, state and Commonwealth) for providing public infrastructure. These should:

- Reflect incremental costs compared to costs incurred by governments for existing land use;
- Not include any portion of these costs paid for by the proponent and hence already included in direct costs section.

The incremental cost of public infrastructure (e.g. water, sewerage, drainage, power and communication expenditures) and transport infrastructure required due to a mining or coal seam gas project should be included in the CBA.

Mining and coal seam gas proponents contribute to the cost of incremental public infrastructure through payment of infrastructure charges, local contributions as part of development agreements or contributions made under planning agreements (PA) to provide or fund for additional public infrastructure.\(^{15}\)

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\(^{15}\) Where these services provide a community benefit to other users, the costs of provision should be pro-rated approximately with benefits provided.
The proponent should estimate the value of local contributions to be paid over the course of the project. The annual value of local contributions should be entered into the CBA Workbook for each year (where applicable) of the evaluation period.

The net public infrastructure cost is the difference between the incremental cost of public infrastructure and the local contributions paid by the proponent (table 3.10). The proponent should estimate the net public infrastructure cost for inclusion in the cost benefit analysis. In the case where local contributions paid by the proponent exceed the incremental public infrastructure cost, the residual is a net public infrastructure benefit to NSW.

The full net public infrastructure cost should be attributed to NSW.

### 3.10 Example of net public infrastructure cost

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incremental public infrastructure cost</td>
<td>50</td>
</tr>
<tr>
<td>Local contributions</td>
<td>40</td>
</tr>
<tr>
<td>Net public infrastructure cost</td>
<td>10</td>
</tr>
</tbody>
</table>

**Estimate loss of surplus to other industries**

A new mining project may impact on the surplus obtained from other industries, such as tourism or equine industries. It is preferable if these effects are measured through environmental impacts, where applicable. For example, tourism might be impacted by air pollution and then the most direct way to estimate this impact is to value it through the approach for air pollution.

There may be some unquantified residual impacts from this approach. These will in most cases not be material. Where they are likely to be significant, consideration should be given to the loss of surplus in these other industries. For example, a tourist facility might face a loss of revenue of $100,000 but would not incur costs of $60,000 then the loss of surplus is $40,000.

**Estimate the net present value of the project attributable to NSW**

The project’s net present value to the NSW community accounts for all direct and indirect costs and benefits. Simply it is the total direct net benefits (royalties, company tax and net producer surplus (Approach 1 only)), plus the indirect benefits minus the net environmental, social and transport related costs and the net public infrastructure costs.

All estimated costs and benefits occurring throughout the evaluation period should be converted into present values via the standard discounting process outlined in the CBA Workbook. The proponent should estimate the net present value by taking the difference between the present values of costs and benefits.
**Undertake sensitivity analysis**

Sensitivity analysis is standard practice in CBA to account for the uncertainty that commonly surrounds the value estimates of costs and benefits, particularly values inferred from market behaviour to approximate the ‘true’ value of non-market goods and services.

Sensitivity analysis provides decision makers with the potential range in the level of net benefits that could arise from the project. Where there is substantial uncertainty around key impacts, “threshold” testing should also form part of the sensitivity analysis to understand, for example, the magnitude of the costs that would be required to occur to offset the benefits of additional mining activities.

As part of the CBA, the proponent should undertake sensitivity analysis of a key range of variables and include these as part of the economic assessment report.

Sensitivity analysis scenarios will be built into the Cost Benefit Analysis Workbook for the proponent to select and define. The scenarios to be included relate to the discount rate and estimation of costs and benefits. The user will be provided flexibility in some cases to specify a proportional change in the estimates relative to the base case:

- discount rate (4 per cent and 10 per cent)
- royalties derived from project as a result of lower gross mining revenue (25 per cent lower or higher than primary case)
- company income tax from project (50 per cent lower or higher than the primary case)
- environmental cost (based on low and high estimates in Excel Workbooks)
- net public infrastructure cost (25 per cent lower or higher than primary case)
- There is also the ability for proponents to test scenarios of their own, using multiple sensitivities.
Report CBA results

The economic assessment report prepared by proponents should be transparent, include all important assumptions notably about output, and be comprehensive but not of excessive length. The report should contain sufficient discussion and information to allow the results of the CBA to be easily understood and replicable. The report should describe:

- The quantified costs and benefits;
- Estimated net present value of the quantified impact and sensitivity analysis conducted; and
- Major risks, unquantified impacts and distributional impacts.
4 Local effects analysis (LEA)

Introduction

This section sets out draft guidance for undertaking an LEA of mining and coal seam gas proposals. An assessment of the consequences of the proposal in its “locality” is required by section 79C of the EP&A Act, which specifically requires an assessment of employment effects.

The section is intended to support the development of a consistent, transparent and robust way of approaching the assessment of local effects related to coal mine and coal seam gas proposals. It aims to provide practical guidance that will allow analysts to capture the idea that local effects should be based around how local people will experience the proposal, with priority to be given to effects that are perceived to be material at the local level.

The CBA conducted at the project and State level will already contain much of the information that is needed for the LEA. For example, the economic benefits to workers and suppliers that are considered in the CBA form a critical input for an LEA. It is important to note that the information used in the LEA must be consistent with the values quantified at the State level CBA. In this sense, LEA is not a new approach and does not require significant additional analysis over and above the CBA.

The LEA is intended to be complementary to the CBA. What LEA does is translate the effects estimated at the State level to the impacts on the communities located near the mine site. LEA can be seen as an identification and enumeration of local effects that have been incorporated into the CBA with the purpose of an LEA being to:

- Inform communities;
- Identify local impacts and changes; and
- Provide information that will assist in developing mitigation plans and strategies.

It is not intended that the components of an LEA can be added together to provide a single summary measure or that an LEA measures economic welfare outcomes.

Definitions

This section covers some basic definitions that must be considered for an LEA to be undertaken, including:

- How to define the spatial area analysed in an LEA; and
- How to define the population groups to be included in an LEA.
Defining the spatial area

While the concept of a locality is enshrined in the EP&A Act, locality is not defined. It is acknowledged that a standardised approach may not be ideal for all potential proposals; however, for the purposes of conducting meaningful and comparable LEAs, a standard approach is required.

These draft guidelines propose that the locality should be defined as the Statistical Area Level 3 (SA3) that contains the proposed project. Statistical Areas are defined by the Australian Bureau of Statistics as part of the Australian Statistical Geography Standard. SA3s have been constructed to represent functional areas of regions and are therefore a good basis for analysing local effects from mining and coal seam gas projects.

Defining the population groups

For practical reasons of measurement and identification, the analysis should include local effects that accrue to those people ordinarily resident in the locality at the time of the proposal. This definition of the population will also assist in achieving one of the purposes of an LEA: informing local communities.

Local economic effects to be included in an LEA

The following local effects should be analysed in an LEA:

- Effects relating to local employment;
- Effects related to non-labour project expenditure; and
- Environmental and social impacts on the local community.

From an economic point of view, the mine or coal seam gas project creates two major effects in the locality: it employs people and it purchases goods and services. The project may also affect other industries through channels such as direct use of land. This section sets out the suggested approach to quantitatively and qualitatively analysing these effects.

In quantitatively and qualitatively analysing these effects, an LEA starts with information from the CBA and identifies the relevant local components. LEA also extends information within the CBA to account for effects which are important for people in the locality. In particular an LEA includes a consideration of employment effects as measured by full time equivalent employees (FTE).

These effects analyse the way in which the development impacts the local economy, both through the additional income it provides to local workers and through the impacts of increased demand on businesses in the locality. These impacts are not separate benefits and should not be added together. Instead, they should be regarded as different ways of identifying how the local community is economically impacted by the proposal.
Estimating effects related to local employment

Employment effects are important as they feature in the State Environmental Planning Policies, are of importance to local residents, and are a major way in which mining projects contribute to the local economy.

The estimation of employment effects should take into account the net benefits of the direct employment created by the project as well as the flow on employment that is created as these employees spend their increased income. In more detail, the flow of employment benefits through the economy can be summarised as:

- The project directly employs workers.
- A portion of these workers are ordinarily resident in the locality. These workers are likely to experience an increase in labour earnings due to the project. Some will experience larger increases than others. This is a local economic benefit of the project.
- The remainder of the workers will likely be temporary residents or commuting workers and the increase in their income does not create local economic benefits for the purpose of a LEA.
- For both groups of workers, some of the increased labour earnings will be spent in the local economy which could give rise to some flow on employment in the local economy. This is a local economic benefit of the project.

The approach to estimating employment effects therefore requires consideration of total direct employment, the proportion of workers that are local residents, the net increase in local workers’ income and the flow on employment that local expenditure of increased income will create.

Considering total direct employment and the proportion of workers that are local residents, the proponent needs to quantify its labour requirements for all of the construction and operations that form part of the proposal and attribute this to either local residents or non-local residents. The table below provides an example of how this data could be presented. The table shows a hypothetical project that will employ a total of 635 people a year, of which 185 are ordinarily resident in the locality.

4.1 Analysis of direct labour inputs

<table>
<thead>
<tr>
<th></th>
<th>Ordinarily resident in locality</th>
<th>Not ordinarily resident in locality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct employment</td>
<td>185</td>
<td>450</td>
<td>635</td>
</tr>
</tbody>
</table>

Note: this table shows hypothetical data

Turning to the increase in workers’ income, it is necessary to estimate the net benefits that can be attributed to the project. This issue is discussed in detail in the “Economic benefit to workers” in section 3. In essence, some of the employed workers may come from outside the labour force while others may already be working in the mining industry.
The recommended indicator of the net increase in income is the difference between incomes in the mining industry in the local area compared to the average level of income in the area – an example of this is shown in table 4.2. The best source for this data will be the most recent census adjusted for any known changes in income over the period since the census. Available income data is likely to be based on gross wages, but ultimately the increase needs to be estimated after tax and superannuation, to reflect the change in disposable incomes within the locality.

Once the increase in income (after tax and superannuation) has been calculated, it can be multiplied by the employment levels to give a total increase in income for local residents, this is shown in table 4.2. The increase in income for those ordinarily resident in the locality is a local economic benefit of the project.

### 4.2 Analysis of net income increase

<table>
<thead>
<tr>
<th></th>
<th>Ordinarily resident in locality</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Direct employment during operations phase</td>
<td>185</td>
</tr>
<tr>
<td>b) Average net income in mining industry ($/year)</td>
<td>$100,000</td>
</tr>
<tr>
<td>c) Average net income in other industries</td>
<td>$65,000</td>
</tr>
<tr>
<td>d) Average increase in net income per employee (b-c)</td>
<td>$35,000</td>
</tr>
<tr>
<td>e) Increase in net income per year due to direct employment ($m) (a*d)</td>
<td>$6,475,000</td>
</tr>
<tr>
<td>f) FTE equivalent (e/b)</td>
<td>64.75</td>
</tr>
</tbody>
</table>

*Note: this table shows hypothetical data*

This initial increase in local income and employment can then be translated to a total increase in employment in the locality by use of an appropriate multiplier. Detailed analysis of employment multipliers for SA3s within NSW is not readily available. The most thorough publicly available information on employment multipliers in the mining industry has been compiled by the Australian Urban Research Infrastructure Network (AURIN) in its ‘WISeR Economic Impact Analysis Tool’\(^\text{16}\). The tool provides estimates of Type I and Type II employment multipliers for all of Australia’s local government areas. Type II employment multipliers are most relevant for an LEA as Type II multipliers include industrial support effects. Industrial support effects capture the fact that the first round output from a new mining or coal seam gas project will induce extra output from all industries, and in turn, these will induce extra output in other industries. Type II employment multipliers for some LGAs in NSW with significant mining activity are shown in the following table:

---

\(^{16}\) AURIN is an initiative of the Australian Government under the National Collaborative Research Infrastructure Strategy and includes participants from across the Australian Public Sector (including the Australian Bureau of Statistics) and most of Australia’s major universities. AURIN, (2015): WISeR Economic Impact Analysis Tool (EIAT); accessed from [http://eiat.aurin.org.au/](http://eiat.aurin.org.au/) on 25 May 2015.
4.3 Type II Multipliers reported by AURIN

<table>
<thead>
<tr>
<th>Local Government Area</th>
<th>Type II Employment Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloucester</td>
<td>2.589</td>
</tr>
<tr>
<td>Lithgow</td>
<td>2.712</td>
</tr>
<tr>
<td>Maitland</td>
<td>3.180</td>
</tr>
<tr>
<td>Muswellbrook</td>
<td>1.978</td>
</tr>
<tr>
<td>Singleton</td>
<td>1.896</td>
</tr>
<tr>
<td>Upper Hunter Shire</td>
<td>2.723</td>
</tr>
<tr>
<td>Wollondilly</td>
<td>2.607</td>
</tr>
</tbody>
</table>

Based on these figures, a Type II employment multiplier in the range of 2-3 appears to be appropriate for most mining regions in NSW. For the purposes of an LEA, results for this range should be reported. An example of this calculation is shown in table 4.4. Should proponents wish to apply different multipliers, this should be done in addition to the range requested by the Guidelines and be accompanied by an appropriate discussion of the rationale and methodology used for calculating the additional multipliers.

4.4 Analysis of employment effects

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type II employment multiplier</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Total employment effect (FTE)</td>
<td>129.5</td>
<td>194.25</td>
</tr>
</tbody>
</table>

Note: this table shows hypothetical data

It should be noted that these estimated employment effects are for the purposes of providing information on the potential local effects of the proposal. Multipliers derived from Input-Output tables should be interpreted with care because they have the potential to overstate employment impacts, particularly when there is little spare local capacity. Multipliers derived from Input-Output analysis also give no indication of the timing of impacts. The overall results of this calculation are not intended to provide a precise measure of employment effects but, rather, an indication of the likely range of local effects.

Estimating effects related to non-labour project expenditure

In addition to employment, the other major economic effect of the proposal will be expenditure on other, non-labour inputs. Expenditure on other, non-labour inputs are a major way in which coal mining and coal seam gas projects contribute to the local economy.

As many of the flow on effects of other, non-labour expenditure by the project will already be captured in the employment multipliers discussed above, the estimation of effects related to other, non-labour expenditure in an LEA is restricted to the direct expenditure made by the project in the local area.
The approach to estimating effects related to other, non-labour expenditure therefore requires consideration of total direct, non-labour purchases by the project and the proportion of these purchases which are made in the locality.

The proponent will have to quantify its expenditure for all of the construction and operations activity that form part of the proposal and attribute this to geographical areas. Labour expenditure should be excluded. The table below provides an example of how this data could be presented. The table shows a hypothetical project that will spend a total $450 million a year during operations, of which $200 million is spent in the locality.

### 4.5 Analysis of direct expenditure (excluding labour)

<table>
<thead>
<tr>
<th></th>
<th>In locality</th>
<th>Outside locality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total direct expenditure ($m)</td>
<td>200</td>
<td>250</td>
<td>450</td>
</tr>
</tbody>
</table>

Note: this table shows hypothetical data

### Effects on other local industries

Even where there are no direct links, such as purchases of goods and services or through the spending of additional labour earnings, the development or extension of a mining project can have effects on other local industries. Some of the most important ways in which this can happen are:

- Displacement of a specific land use, where the mining project uses land that would otherwise be used for other purposes;
- Where the mining project affects choices by external parties, particularly tourism and business travel; or
- Where the mining project creates temporary effects on other industries that cause short run market adjustments in the cost of living for local residents, particularly in food and housing markets.

In some cases how a mining project could affect industries is quite clear, for example: where a land use is displaced. In other cases the mechanisms are less clear and are probably context specific. Nonetheless, these sorts of effects are often material to residents of the locality. Many of these effects will likely be covered, at least qualitatively, in either the global or state level CBA.

A qualitative discussion of these effects on other industries is required as part of an LEA. Where no or minimal impacts are claimed, evidence should be provided to support this assessment. Where possible, this discussion should specifically note who is being affected and what strategies might be possible to mitigate these impacts.
Environmental and social impacts on the local community (externalities)

Every LEA should assess positive and negative externalities created by the proposed project on the locality. Indeed, most externalities will be concentrated within the locality of the proposal and may impose significant costs or create benefits for local residents. For example, on the positive side, the local community may receive access to better quality infrastructure while on the negative side they may be exposed to noise from machinery.

Estimation of the externalities caused by a project is a required component of the CBA. The quantification of externalities is thoroughly covered in section 5 of these guidelines. The information on externalities required for an LEA can be sourced directly from the CBA.

An LEA should start with the externalities investigated in the CBA and identify those that create material, un-mitigated effects within the locality. The portion of the cost measured in the CBA that are incurred within the locality should be reported in an LEA. For externalities that are treated qualitatively in the CBA, the local effects should be discussed qualitatively in an LEA. It is recognised that there are some specific externalities that may not be able to be partitioned to those within and outside of the locality.

### 4.6 Analysis of externalities

<table>
<thead>
<tr>
<th>Externality benefit (cost)</th>
<th>In locality</th>
<th>Outside locality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise ($m)</td>
<td>(4.9)</td>
<td>(0.1)</td>
<td>(5.0)</td>
</tr>
<tr>
<td>Transport</td>
<td>(11.0)</td>
<td>(1.0)</td>
<td>(12.0)</td>
</tr>
</tbody>
</table>

*Note: this table shows hypothetical data*

**Presenting the LEA outputs**

An example table for summarising the output from an LEA is shown below. In practice, summary tables should show each of these measures throughout the project’s life. Summaries of results of an LEA should include:

- Employment effects;
- Other, non-labour expenditure effects; and
- Externality effects.

In the economic assessment report, the summary table should be accompanied by a detailed description of the results, an indicative timeline of when the costs and benefits are likely to occur, and the assumptions and methods used to arrive at them. It is important that sufficient supporting information is provided to allow the results to be replicable if required. This description should also include discussion of qualitative issues such as the effects on other local industries and residents.
### 4.7 Summary table

<table>
<thead>
<tr>
<th></th>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>(D)</th>
<th>(E)</th>
<th>(F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Project direct: Total</td>
<td>Project direct: Local</td>
<td>Net Effect: Local</td>
<td>Total Local Effects: Low</td>
<td>Total Local Effects: High</td>
</tr>
<tr>
<td>(1)</td>
<td>Employment related</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>FTE</td>
<td>635</td>
<td>185</td>
<td>65</td>
<td>130</td>
<td>194</td>
</tr>
<tr>
<td>(3)</td>
<td>Income ($m)</td>
<td></td>
<td></td>
<td></td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>Other, non-labour expenditure ($m)</td>
<td>450</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>Externality benefit/(cost)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td>Noise ($m)</td>
<td>(5.0)</td>
<td>(4.9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(7)</td>
<td>Transport ($m)</td>
<td>(12)</td>
<td>(11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8)</td>
<td>etc.</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: this table shows hypothetical data based on earlier examples. Items shaded in grey are likely to be directly sourced and reconcilable with the CBA. Items in the summary table should not be added to arrive at a total effect.
5 Appraisal guidelines for environmental, heritage, social and transport impacts

Introduction

Mining and coal seam gas (CSG) activities can impact on the environment in the following ways:

- Contribute to air and noise pollution;
- Release greenhouse gases;
- Alter the quality and quantity of groundwater and surface water resources;
- Alter and/or degrade ecosystems and their component species;
- Alter and/or degrade Aboriginal and non-Aboriginal heritage places or objects;
- Cause traffic impacts for the nearby community; and
- Alter the visual amenity of the surrounding area.

A CBA of a project should include an estimate of the economic value of these environmental impacts, where possible, or a qualitative analysis at a minimum.

The two key steps to estimate the economic value are:

- **Identify the physical change in environmental condition** — how do mining and CSG operations impact on the existing (status quo) environment (and how it is anticipated to change over time) and what is the nature of these impacts (e.g. the duration and extent of the impact, whether the change is temporary or permanent, irreversible).

- **Estimate the economic value associated with the physical change** — involves estimating the use and non-use values society holds for the impacted environmental attributes. Not all changes to environmental condition can be valued and some environmental attributes are more amenable to non-market valuation techniques (e.g. choice modelling and benefit transfer).

As part of the assessment process under the Environmental Planning and Assessment Act 1979, proponents are required to prepare and submit a comprehensive environmental assessment that addresses all potential impacts of the proposal, including potential impacts on water resources, air quality, noise, biodiversity and local communities.17

Environmental assessments outline the existing environmental condition and identify any physical changes to environmental attributes due to the activities of the proposed project. Information from the environmental assessment is critical for the economic valuation of environmental impacts. Throughout this section and in the accompanying workbooks, the information that is required from the respective environmental assessment is clearly outlined.

**Purpose**

The appraisal of environmental, heritage, social and transport impacts forms an input into the economic assessment of a proposed project. This section outlines a consistent framework for appraisal of environmental, heritage, social and transport impacts to improve the quality and transparency of appraisals conducted for economic assessment of mining and coal seam gas project proposals.

It is to be used in conjunction with the broader guidance provided in the earlier sections of this document.

The environmental impacts examined in this section and corresponding excel-based valuation workbooks (where applicable) are listed in table 5.1.

**5.1 Guidance modules developed for environmental impacts**

<table>
<thead>
<tr>
<th>Environmental impact</th>
<th>Type of appraisal</th>
<th>Corresponding Appraisal Workbook</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aboriginal heritage</td>
<td>Qualitative</td>
<td>Aboriginal Heritage Valuation Workbook (AHIVW)</td>
</tr>
<tr>
<td>Air quality</td>
<td>Quantitative</td>
<td>Air Quality Valuation Workbook (AQVW)</td>
</tr>
<tr>
<td>Ambient noise</td>
<td>Qualitative or Quantitative</td>
<td>Valuation workbook not developed for noise impacts*</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Qualitative or Quantitative</td>
<td>Valuation workbook not developed for biodiversity impacts*</td>
</tr>
<tr>
<td>Greenhouse gas emissions</td>
<td>Quantitative</td>
<td>Greenhouse Gas Valuation Workbook (GGVW)</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Qualitative</td>
<td>Groundwater Valuation Workbook (GVW)</td>
</tr>
<tr>
<td>Non-Aboriginal heritage</td>
<td>Qualitative</td>
<td>Non-Aboriginal Heritage Valuation Workbook</td>
</tr>
<tr>
<td>Surface water</td>
<td>Quantitative</td>
<td>Valuation workbook not developed for surface water impacts</td>
</tr>
<tr>
<td>Traffic impacts</td>
<td>Quantitative</td>
<td>Traffic Impact Valuation Workbook (TIVW)</td>
</tr>
<tr>
<td>Visual amenity</td>
<td>Quantitative</td>
<td>Visual Amenity Valuation Workbook (VAVW)</td>
</tr>
</tbody>
</table>

*Residual impacts (impacts not mitigated) may occur which should be quantitatively (or at a minimum qualitatively) appraised. A standardised valuation workbook has not been developed for the appraisal of residual biodiversity impacts and residual noise impacts because of the potential case-by-case nature of these impacts.
The key elements of economic valuation of environmental impacts include the following.

- Clear identification of the physical change in environmental attributes as a result of the project — the ‘with’ and ‘without’ scenarios.

- Any risks and uncertainties should be made explicit in the appraisal. Uncertainty of biophysical impacts and economic values for environmental impacts should be addressed through sensitivity analysis of key variables, with remaining uncertainties outlined.

- The economic value of environmental impacts should be quantified where possible, however where environmental impacts are not amenable to quantification a qualitative assessment should be completed at a minimum.

- Appraisal of environmental impacts should be proportionate to the project being assessed.

- Double counting of impacts is to be avoided by clearly outlining what the impacts are and who is impacted.

- Multiple projects in a given region may cause cumulative environmental impacts whereby the total impact of two projects together is greater than the sum of the parts. Economic valuation of environmental impacts should take account of the cumulative effects of multiple projects on both marginal benefits and marginal costs. In practical terms, this is achieved by one project forming part of the baseline for later projects.

Environmental impacts given management strategies put in place

Many potential environmental impacts are mitigated or managed by a proponent, often through action required by regulations. For example, biodiversity impacts are managed through a biodiversity offsets policy. The environmental assessment for a proposed project will outline the management strategies to be implemented, and any environmental impacts that may occur given these strategies are in place.

The focus of assessment is the economic value of the unmitigated environmental impacts, those impacts that will occur despite mitigation and management strategies implemented by proponent. The cost of mitigation and management strategies will be included in the project’s estimated capital and operating costs. To ensure that costs and benefits are measured on a consistent basis, it is not appropriate to include the value of environmental impacts that will be mitigated or managed by strategies implemented as part of the project’s operations.

Consistency of key parameters

The valuation workbooks for each environmental impact will be designed to be able to be used independently. However, it is critical that parameters and variables are used consistently across all environmental impact valuation workbooks and also within the broader cost benefit analysis framework. The following parameters must be kept consistent across all analyses:
• **Base year** – the year which future costs and benefits are discounted to.

• **Evaluation period** – encompasses the time period which impacts of the project occur.

• **Discount rate** – these appraisal guidelines use a central discount rate of 7 per cent, with sensitivity analysis conducted at 4 per cent and 10 per cent as per the current NSW Treasury Appraisal Guidelines. 18 These guidelines apply a discount factor to annual impacts using the method outlined in box 5.2.

5.2 Discounting

| Discount factor = \( \frac{1}{(1 + r)^t} \) |

When to undertake more detailed analysis

This section has been prepared using the best information currently available and no additional primary studies have been completed. In some cases values are not currently available to quantify impacts, or the available values may not be accurate for specific cases. More detailed analysis or completion of primary studies may be required where:

• The proposed project is likely to cause a significant environmental impact, the environmental impact is likely to be a decisive factor in the approval process or the environmental impacts may be irreversible and

• The site specific environmental impacts are not adequately captured by existing economic values.

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Aboriginal cultural heritage

Aboriginal objects and places can be damaged from various ground disturbance activities (e.g. land clearing and land subsidence) as a result of mining and coal seam gas activities.

Under the *National Parks and Wildlife Act 1974* (NPW Act), it is an offence to ‘harm’ an Aboriginal object or declared Aboriginal Place. The policy position for managing heritage is to avoid harm wherever possible. When avoidance is not feasible, impacts are to be minimised and mitigated, and only resort to impacting after all other options are exhausted. Where harm to an Aboriginal object or place cannot be avoided during a project, the NPW Act outlines steps for proponents to consider for the heritage they are managing. This includes investigating the site under the Code of Practice for Archaeological Investigation in NSW.

An Aboriginal cultural heritage impact assessment is required as part of the environmental assessment necessary for a project’s application. Anyone proposing to carry out an activity that may harm an Aboriginal object or a declared Aboriginal place must investigate, assess and report on the harm that may be caused by the activity they propose.

The Aboriginal cultural heritage impact assessment will determine whether Aboriginal heritage places or objects are present within the project area, the results of the assessment and recommendations for actions to be taken before, during and after an activity to avoid harm, manage and protect identified Aboriginal objects and declared Aboriginal places.

Appraisal of Aboriginal cultural heritage impacts

There are five steps in the appraisal of Aboriginal cultural heritage impacts:

1. Identify existing Aboriginal heritage objects and places within project site;
2. Scope the project’s impact on identified objects and places;
3. Assess the significance of impacted objects and places;
4. Assess the degree of impact from the project on the identified objects and places; and
5. Evaluate the overall significance of the potential impacts.

As noted an Aboriginal heritage impact assessment is usually required as part of the project’s environmental assessment. Relevant information from the Aboriginal heritage impact assessment will be relied upon to conduct the economic valuation.

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20 The regulated requirements for adhering to the Code of Practice for Archaeological Investigation can be found at the OEH website at [http://www.environment.nsw.gov.au/licences/archinvestigations.htm](http://www.environment.nsw.gov.au/licences/archinvestigations.htm)
Step 1: Identify existing Aboriginal cultural heritage objects and places

The Aboriginal heritage impact assessment will identify whether Aboriginal objects or places are present or likely to be present in the project area. A description of the existing Aboriginal heritage (including cultural and archaeological) in the area of the project and assessment of archaeological potential is developed through consulting with the Aboriginal community, using existing information sources (including previous archaeological studies in the area) and additional studies and field assessments.

In some cases Aboriginal heritage surveys and impact assessments have already been undertaken in the region of the project. Data and previous assessments of known heritage items in the project area can also be sourced from the Aboriginal Heritage Information Management System (AHIMS) database to support the Aboriginal heritage impact assessment.\(^{21}\)

Step 2: Scope the project’s impact on identified items

The Aboriginal heritage impact assessment will outline the various components and activities of the project and the associated potential impacts on identified Aboriginal heritage places and objects.

Heritage management plans are developed to manage and mitigate damage to Aboriginal cultural heritage items identified in the impact assessment process. Management strategies may include:

- Measures to isolate identified heritage places and objects from potential interference such as management systems, records maintenance, the establishment of no-go areas and awareness training; and
- Visual indicators and physical barriers established on the ground to prevent unauthorised or unintentionally access to heritage places and objects.\(^{22}\)

The Aboriginal heritage impact assessment should identify any Aboriginal heritage items that are at risk of harm from the project’s activities given the management strategies in place.

Inputs and tasks for the Aboriginal Heritage Valuation Workbook

Enter into the valuation workbook the Aboriginal cultural heritage items that will be impacted by the project after accounting for management strategies that will be implemented. These will be the Aboriginal heritage items that will be ‘harmed’ (either partially or totally).

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**Step 3: Identify and assess the significance of impacted items**

The significance of impacted items should be identified and assessed in consultation with the Aboriginal community by firstly identifying the range of values present across the study area and subsequently assessing why the identified values are important.

Consultation with Aboriginal people is an integral part of the process of investigating and assessing Aboriginal cultural heritage to determine what is the impact of this loss on Aboriginal cultural and the ability to practice culture. Aboriginal people who hold cultural knowledge about the area, objects and places that may be directly or indirectly affected by the proposed activity must be given the opportunity to be consulted.\(^{23}\)

The Aboriginal heritage impact assessment will identify the four values of the Burra Charter - social, historic, scientific and aesthetic (table 5.3) relevant for the impacted items.\(^{24}\)

### 5.3 Four values of the Burra Charter

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
<th>Key criteria to assess significance of value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social or cultural</td>
<td>Encompasses the spiritual, traditional, historical or contemporary associations and attachments the place or area has for Aboriginal people</td>
<td>Does the subject area have a strong or special association with a particular community or cultural group for social, cultural or spiritual reasons?</td>
</tr>
<tr>
<td>Historical</td>
<td>Refers to the associations of a place with a historically important person, event, phase or activity in an Aboriginal community</td>
<td>Is the subject area important to the cultural or natural history of the local area and/or region and/or state?</td>
</tr>
<tr>
<td>Scientific</td>
<td>This refers to the importance of a landscape, area, place or object because of its rarity, representativeness and the extent to which it may contribute to further understanding and information.</td>
<td>Does the subject area have potential to yield information that will contribute to an understanding of the cultural or natural history of the local area and/or region and/or state?</td>
</tr>
<tr>
<td>Aesthetic</td>
<td>Refers to the sensory scenic, architectural and creative aspects of the place.</td>
<td>Is the subject area important in demonstrating aesthetic characteristics in the local area and/or region and/or state?</td>
</tr>
</tbody>
</table>


---

\(^{23}\) For further information see OEH’s *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010.*

The assessment of the significance of the values identified is a discussion of what is significant and why.\footnote{Office of Environment and Heritage (2011) \textit{Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW}: \url{http://www.environment.nsw.gov.au/resources/cultureheritage/20110263ACHguide.pdf}} Assessment of significance is completed in the heritage impact assessment by consulting Aboriginal people and preparing a statement of significance.

Key criteria to consider in the assessment of the significance of the four values are outlined in table 5.3. In many instances the significance of these values will need to be identified and assessed through consultation with local Aboriginal people.

In order to grade the criteria in terms of high, moderate and low significance, the following questions should be considered:

- Research potential – does the evidence suggest any potential to contribute to an understanding of the area and/or region and/or state’s natural and cultural history?
- Representativeness – how much variability (outside and/or inside the subject area) exists, what is already conserved, how much connectivity is there?
- Rarity – is the subject area important in demonstrating a distinctive way of life, customs, process, land-use, function or design no longer practised? Is it in danger of being lost or of exceptional interest?
- Education potential – does the subject area contain teaching places or places that might have teaching potential?

The findings of the identification and assessment of significance will be summarised in a statement of significance.

\textit{Inputs and tasks for the Aboriginal Cultural Heritage Valuation Workbook}

Based on the findings in the statement of significance, the social/cultural, historical, scientific, and aesthetic values for each Aboriginal heritage item, need to be given a score between 0 and 2.

- A score of 0 reflects negligible importance
- A score of 1 represents medium importance
- A score of 2 reflects high importance
- Each of the four values must be independently valued and may reflect varying scores.
Step 4: Assess the degree of impact from the project on the identified items

The Aboriginal heritage impact assessment will assess the harm associated with the proposed project, examine its potential effects on Aboriginal objects and declared Aboriginal places and their associated heritage values. This will include assessment of both direct and indirect harm caused by the proposed project.26

The Aboriginal heritage impact assessment will also outline the practical measures to avoid harm (and minimise harm where necessary) that were identified in consultation with Aboriginal people that will be implemented as part of the project’s activities. Possible solutions may include reducing the area of a building footprint, changing its orientation, re-positioning built elements, re-routing infrastructure trenching or incorporating a no-development area in to the design of the proposed activity.27

After accounting for avoidance and minimisation strategies that will be put in place, the degree of harm on impacted heritage items needs to be outlined. It may vary from partial harm whereby only a section of the site is harmed whilst the remaining area of the site is preserved, or there may be total harm whereby a heritage item is harmed in its entirety. Information on the degree of harm to impacted heritage items should be sourced from the Aboriginal heritage impact assessment. Assessment of the degree of harm should also consider the cumulative impact of the project.

Inputs and tasks for the Aboriginal Cultural Heritage Valuation Workbook

In the ‘Heritage Impact’ worksheet assign the relevant degree of harm to each heritage item from the following:

- Minimal partial impact
- Medium partial impact
- High partial impact
- Total impact

Step 5: Evaluate the overall value of the potential impacts

By comparing the significance of the heritage items with the degree of potential impact of the proposed project, the overall value of the impact can be qualitatively assessed. Chart 5.4 demonstrates the relationship between significance of the impacted heritage items, the degree of the potential impact and the overall value of the project on the value of impacted heritage items.

26 Direct harm may result from ground disturbance activities such as site preparation, roadworks, or flood mitigation measures. Project activities may cause indirect harm to nearby sites or features such as destruction from increased erosion.

### Criteria for estimating the overall value of potential impacts

<table>
<thead>
<tr>
<th>Degree of potential impact on heritage item</th>
<th>Significance of heritage object or place</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very high</td>
</tr>
<tr>
<td>Total impact</td>
<td>Very high value</td>
</tr>
<tr>
<td>High partial impact</td>
<td>High value</td>
</tr>
<tr>
<td>Medium partial impact</td>
<td>Medium value</td>
</tr>
<tr>
<td>Minimal partial impact</td>
<td>Low value</td>
</tr>
</tbody>
</table>

*Data source: Adapted from UK Department of Transport, 2014, Transport Analysis Guidance*
Air quality

Air pollution can cause detrimental effects on human health and the environment. The dominant impact from air pollution is the negative effect on human health, most notably from emissions of coarse particulates (PM$_{10}$) and fine particulates (PM$_{2.5}$). Short and long term human exposure to air pollution can cause premature mortality, cardiovascular and respiratory disease, chronic and acute bronchitis, asthma attacks, restricted activity days, reduced lung function and reduced birth weights.

The health impacts of fine particulates (PM$_{2.5}$) are of notable health concern as they can reach the air sacs deep in the lungs causing greater damage. Segments of the community that are most susceptible are infants and children, elderly people, and people with existing respiratory conditions, heart disease or diabetes.

Mining and coal seam gas activities can contribute to air pollution during exploration, development, construction and operational project phases. Emission sources include wind erosion, vehicles using unsealed roads, blasting, bulldozing coal and loading coal stockpiles.

Dust from coal mines can also be of nuisance to nearby communities through reduced visibility and amenity. This impact on visual amenity is discussed in the relevant section.

Appraisal of air quality impacts

There are three steps in the appraisal of air quality impacts:

1. **Scope the impact**
2. **Measure the physical change**
3. **Estimate the economic value of impact and conduct sensitivity analysis of the discount rate and emissions**

These steps are explained in detail below. An Air Quality Valuation Workbook (AQVW) has been developed alongside this guidance module to facilitate the necessary steps for calculating the monetary values for air quality impacts.

**Step 1: Scope the impact**

This step is predominantly completed in preparation of an environmental assessment (or environmental impact statement). The environmental assessment will scope the:

- Key pollutants that are emitted by the project’s activities
- Time period for the appraisal (for example, number of years the mine is in operation or number of years the mine imposes impacts). The time period must be consistent across all appraisal modules.
- The location of the activity and the nearby area likely affected by the impact
• Impacts to human health and the environment from changes to air quality.

The appraisal of air pollution impacts should be proportional to the proposed impact identified in the environmental assessment.

**Selection of PM2.5 as the index pollutant**

The health impacts from PM$_{10}$ and PM$_{2.5}$ are highly correlated. It is very difficult to determine which impacts are attributable to which pollutant. To avoid double counting of human health impacts an index pollutant should be selected that is representative of the majority of human health impacts.

The health costs of air pollution are dominated by mortality and morbidity impacts resulting from PM$_{2.5}$. Therefore an appraisal of air quality impacts should apply PM$_{2.5}$ as the index pollutant.

There is no known threshold for health effects from particulate matter (PM$_{10}$ and PM$_{2.5}$). With a lack of evidence of a threshold for health effects, there are likely health benefits achievable above and below the NEPM Ambient Air Quality standard for PM$_{10}$ and goal for PM$_{2.5}$. In the absence of a threshold, an appraisal of air quality impacts should evaluate the impacts of the change in air pollution regardless of whether the national standards/goals are met.

**Accounting for other pollutants**

In some circumstances, other pollutants such as nitrous oxides or volatile organic compounds may be produced by a mine or coal seam gas project. The impacts of these other pollutants may not be captured by using PM$_{2.5}$ as the sole index pollutant. Where a project is expected to produce material amounts of other pollutants, the proponent should carry out additional valuations for the pollutants.

**Inputs and tasks for the Air Quality Valuation Workbook**

The following information on the scope of the appraisal should be entered into the Project Info & Parameters worksheet of the Air Quality Valuation Workbook:

- **Base Year** – the year which future costs and benefits are discounted back to. Often the base year is set the same year as the Project Start Year, however this does not need to be the case.

- **Project Start Year** – the year the project starts.

- **Project Final Year** – the year the project finishes.

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- **Location of Project** – select the most relevant Significant Urban Area (SUA) from the 35 SUAs located across NSW listed in the Air Quality Valuation Workbook. Where the project’s impacts occur across two SUAs, select both SUAs and detail the proportion of impact incurred in each SUA.

**Step 2: Measure the physical change**

This step involves estimating the change in air quality as a result of the project over the course of the appraisal period. The change in air quality is often estimated or modelled in the environmental assessment of a project. Information on the physical change in air quality available from environmental assessment should be used wherever possible.

The two metrics to measure physical changes in air quality are changes in pollutant emissions and changes in the ambient air quality.

- The relationship between emissions and ambient air quality is not direct and linear. Once emitted, pollutants can disperse over vast areas and undergo physical and chemical transformation. Complex dispersion models and chemical transport models are used to analyse the behaviour of emissions and the resultant ambient air quality.
- The change in pollutant emissions due to a project can be directly measured (in some cases) or estimated using emission factors.
- Negative human health impacts are directly linked to reduced ambient air quality. The most direct way to measure the change in human health impacts from air pollution is to measure the change in ambient air quality.

In 2013, PAEHolmes completed a study for NSW EPA outlining a methodology for valuing the health impacts of changes in particle emissions. In the study, PAEHolmes recommended appraisal of air quality impacts from projects be based on the change in pollutant emissions. Although impacts to human health and the environment is more closely linked to changes in ambient air quality, PAEHolmes recommend an emissions based approach for appraisal of projects due to lack of sufficient and readily available PM emission modelling information to undertake a full impact pathway process.³¹

**Estimating the physical change in emissions**

Direct measurement of emissions is not possible for environmental assessments conducted pre-operation. Direct measurement is also not suitable to measure fugitive emissions from mining and coal seam gas activities.

Emissions can be estimated using industry-standard emission factors. Industry-standard emission factors collated by the National Pollutant Inventory and the United States Environmental Protection Agency are available for different emission sources, for example, bulldozing coal, material transfer of coal by

Annual particulate emissions of different aerodynamic diameter (TSP, PM$_{10}$ and PM$_{2.5}$) are estimated by multiplying the relevant emission factor by the annual activity data for a given emission source.

Inputs and tasks for the Air Quality Valuation Workbook

As noted above, PM$_{2.5}$ should be selected as the index pollutant for appraisal purposes. The steps to incorporate estimated PM$_{2.5}$ emissions in the Air Quality Valuation Workbook are detailed below. Entries should be made into the Emission Inputs worksheet of the Air Quality Valuation Workbook.

Task 1. Enter the central estimate of annual PM$_{2.5}$ emissions for the Project Start Year, Project Final Year and interim years where changes in project activities alter PM$_{2.5}$ emissions.

Task 2. Low and high estimates of PM$_{2.5}$ emissions can also be entered for the Project Start Year, Project Final Year and interim years, where these estimates are available.

Task 3. The user will need to extrapolate emissions (based on a constant linear change) between years for which PM$_{2.5}$ emission estimates are available.

The AQVW allows for a maximum appraisal period of 50 years. The user should disregard additional years that are not included in the appraisal period.

Step 3: Estimate the economic value of the impact

The two approaches to estimate the economic value of changes in air quality are:

- **Damage cost approach** – values changes in emissions and is the approach selected for this guidance module.

- **Impact pathway approach** – values changes in ambient concentrations.

The ‘impact pathway’ approach is the most robust valuation approach following the pathway from emissions to cost via ambient air quality concentrations, population exposure, and morbidity and mortality health impacts.

Key elements of the impact pathway approach to value air quality impacts include an emissions inventory of key pollutants, dispersion and chemical transport models, detailed information on the current air quality sourced from air quality monitoring networks, and detailed population statistics used to determine the exposed population. The ‘impact pathway’ approach is resource intensive and mostly used for setting air quality standards.\(^{33}\)


The damage cost approach applies unit damage costs per tonne of emissions. This approach is less resource intensive than the full ‘impact pathway’ approach and as such has been used in Australia to evaluate policies and measures that change the quantity of emissions.\(^\text{34}\)

The full impact pathway approach can be used to estimate a robust set of unit damage costs, based on location-specific inputs and data, which are subsequently used to evaluate projects, policies and measures.\(^\text{35}\) This exercise has been undertaken in many countries and jurisdictions, but as noted by PAEHolmes (2013), damage costs based on the full impact pathway approach have not been estimated for Australian jurisdictions. Rather damage costs used for appraisal in Australia have been transferred from overseas studies.

The damage cost approach is appropriate in most cases. However, where robust full dispersion modelling is available and relevant, proponents should include this analysis in addition to the damage cost approach.

**Unit damage cost for PM\(_{2.5}\)**

PAEHolmes (2013) prepared unit damage costs per tonne of PM\(_{2.5}\) emissions by significant urban area (SUA) across NSW (table A.1). These unit damage costs were transferred from a UK study\(^\text{36}\) and adjusted to account for population density to estimate unit damage costs weighted for population exposure for each Significant Urban Area (SUA). Further detail on the construction of these damage costs is available in Appendix A.

**Inputs and tasks for the Air Quality Valuation Workbook**

The tasks to estimate the economic value of air quality impacts are detailed below.

**Task 1.** Confirm that the relevant Significant Urban Area(s) for the project location was selected in the *Project Info & Parameters* worksheet as part of Step 1. If the location(s) was not selected then choose the Significant Urban Area(s) from the drop down list that is most relevant to the project’s location. It is important the most relevant SUA for the project location is selected as this determines the unit damage cost of PM\(_{2.5}\) emissions that is used in the valuation.

**Task 2.** The unit damage costs prepared by PAEHolmes (2013) are based in 2011 prices. Adjust the unit damage cost to the relevant base year.


prices. The unit damage costs have been adjusted in the AQVW to 2015 prices using ABS Consumer Price Index data.\textsuperscript{37} The AQVW includes a CPI adjustment factor in the \textit{CPI Adjustment} worksheet. This CPI adjustment factor should be revised in cases where the base year is not 2015.

\textbf{Task 3.} The AQVW discounts the unit damage costs for each year of the appraisal period using a discount factor based on a 7 per cent discount rate.

\textbf{Task 4.} Calculate the discounted value of air quality impacts in each year by multiplying the discounted unit damage cost by the tonnes of PM\textsubscript{2.5} emissions.

a. The AQVW calculates the discounted value of air quality impacts in each year in the \textit{NPV Calculation} worksheet.

b. The total present value of air quality impacts over the appraisal period is the sum of the annual discounted values. The AQVW calculates the total present value in the \textit{Summary} worksheet.

\textbf{Task 5.} Sensitivity Analysis of the discount rate. Repeat Steps 3 and 4 using a 4 per cent (low) and 10 per cent (high) discount rate (as per NSW Treasury’s guidelines for economic appraisal\textsuperscript{38}). Sensitivity Analysis of the discount rate is completed in the \textit{SA Discount Rate} worksheet.

\textbf{Task 6.} Sensitivity Analysis of the quantity of PM\textsubscript{2.5} emissions. Where there is uncertainty about the quantity of emissions, estimates for a low and high emissions scenario might be available in the environmental assessment. Where estimates are available repeat Task 4 to calculate the present value of air quality impacts for the low emission and high emission scenario. Sensitivity analysis of the estimated PM\textsubscript{2.5} emissions is completed in the \textit{SA Emissions} worksheet of the AQVW.

\textsuperscript{37} ABS, 2014, \textit{6401.0 Consumer Price Index, Australia: Tables 1 and 2 CPI: All Groups, Index Numbers and Percentage Changes}.

Ambient noise

Mining projects are often a substantial source of noise affecting the surrounding community. Noise pollution from mining and coal seam gas projects is created by vehicle engines (dozers, scrapers, trucks and excavators), additional traffic, coal handling and processing, power generation, loading and unloading into dumpers, drilling, blasting and night time operations.

Ambient noise pollution can impact on the local community. Impacts can include increased annoyance and stress, with excess noise leading to sleep disturbance and other health impacts.

There are measures in place to regulate the noise and minimise the adverse impacts on the community, including the NSW Industrial Noise Policy which aims to balance the need for industrial activity with the desire for quiet in the community. The NSW Industrial Noise Policy applies two separate noise criteria to determine the project-specific noise level that meets environmental noise objectives:

- **Intrusiveness criterion** – requires the equivalent continuous (energy-average) noise level of the source (represented by the L_Aeq, 15 minute descriptor) to not exceed 5 decibels (dB) above the measured background level.

- **Amenity criterion** – relates only to industrial-type noise and is based on noise criteria specific to land use and associated activities (table 5.5) The existing noise level from industry is measured. If it approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion. See Table 2.2 in NSW EPA, 2014, *NSW Industrial Noise Policy* for information on modifications to acceptable noise levels to account for the existing level of industrial noise.

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40 See Table 2.2 in NSW EPA, 2014, *NSW Industrial Noise Policy* for information on modifications to acceptable noise levels to account for the existing level of industrial noise.
5.5 Amenity criteria for residential receivers from industrial noise sources

<table>
<thead>
<tr>
<th>Indicative noise amenity area</th>
<th>Time of day</th>
<th>Recommended $L_{Aeq}$ Noise Level , dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Acceptable</td>
</tr>
<tr>
<td>Rural</td>
<td>Day</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Evening</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>40</td>
</tr>
<tr>
<td>Suburban</td>
<td>Day</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>Evening</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>40</td>
</tr>
<tr>
<td>Urban</td>
<td>Day</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Evening</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>45</td>
</tr>
<tr>
<td>Urban/Industrial Interface – for existing situations only</td>
<td>Day</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Evening</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>50</td>
</tr>
</tbody>
</table>

Source: NSW EPA, 2000, NSW Industrial Noise Policy.

For a particular project, the more stringent of the two noise criteria sets the project-specific noise level for that project.

In certain cases a project may exceed the project-specific noise level after all reasonable and feasible avoidance and/or mitigation measures have been implemented. The NSW Voluntary Land Acquisition and Mitigation Policy enables these exceedances to be managed by the proponent through:

- negotiated agreements with affected landholders which may include a package of mitigation measures and/or compensatory benefits for landowners, or
- voluntary land acquisition.\(^1\)

The cost of mitigation measures, negotiated agreements or land acquisition should be specifically noted and included in the proponent’s operating and capital costs.

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Appraisal of noise impact

There are four steps in the appraisal of ambient noise impacts:

- Step 1. Outline the existing ambient noise levels
- Step 2. Scope the project’s impact
- Step 3. Measure the physical change in ambient noise levels
- Step 4. Estimate the economic value of the residual uncompensated impact

These steps are explained in detail below. A standardised workbook to appraise noise impacts will not be developed as part of this guidance because:

- In most cases noise levels will be limited to acceptable levels through the NSW Industrial Noise Policy and the Land and the NSW Voluntary Land Acquisition and Mitigation Policy; and
- Therefore cases of uncompensated noise impacts should only arise in rare and a limited number of cases where consideration of impacts will require a case-by-case analysis.

A noise impact assessment is required as part of a project’s environmental assessment. Information and data available in the noise impact assessment will be drawn on for the appraisal of noise impacts.

**Step 1: Outline the existing ambient noise levels**

The noise impact assessment will monitor the existing ambient noise levels from multiple locations within the project area and at different times during the day. This will include monitoring key weather variables, such as relative humidity, temperature and winds, which influence how noise travels and impacts on surrounding sites.

Table 5.6 details the different noise level descriptors used for modelling and measuring noise impacts.
5.6 Noise level descriptors

- **Maximum noise level (L\(_{A_{\text{max}}}\))**: The maximum noise level over a sample period is the maximum level, measures on fast response, during the sample period.
- **L\(_{A1}\)**: This is the level which is exceeded for 1 per cent of the sample period. During the sample period, the noise level is below this level for 99 per cent of the time.
- **L\(_{A10}\)**: This is the noise level which is exceeded for 10 per cent of the sample period. During the sample period, the noise level is below this for 90 per cent of the time.
- **L\(_{A_{\text{eq}}}\)**: The equivalent continuous sound level (L\(_{A_{\text{eq}}}\)) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment.
- **L\(_{A50}\)**: This is the level which is exceeded for 50 per cent of the sample period.
- **L\(_{A90}\)**: This is the noise level which is exceeded for 90 per cent of the sample period. This measure is commonly referred to as the background noise level.

**Source**: NSW Roads and Traffic Authority, Sapphire to Woolgoolga Environmental Assessment

The NSW Industrial Noise Policy is based on the L\(_{A_{\text{eq}}}\) noise metric and represents the equivalent continuous (energy average) A-weighted sound pressure level of the source.

**Step 2: Scope the project’s impact**

A noise impact assessment will assess changes to ambient noise levels due to the proposed project. Noise modelling is undertaken to estimate noise levels at nearby receivers during the day, evening and night in indicative years within the evaluation period. The noise modelling also takes into account the effects of meteorological effects such as wind and temperature inversion.

The noise modelling will identify households where ambient noise levels change due to the operational activities of the proposed project.\(^{42}\) The change in noise level that is modelled should be the change in noise level given the noise control and mitigation measures to be implemented, as outlined in the noise impact assessment.

The proponent should provide a physical description of the number of residents that may be affected by the change in the noise level and describe the impact on sleep and enjoyment of the indoor and outdoor environment.

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\(^{42}\) Noise from construction activities is not assessed due to the temporary nature of these noise impacts.
Step 3: Outline the residual change in noise level

The NSW Industrial Noise Policy specifies the project-specific noise level based on the more stringent of the Intrusiveness Criterion and the Amenity Criterion.

Management and mitigation measures will be undertaken by the proponent to meet the assessment criteria. This may involve negotiated agreements with landholders or land acquisition.

The proponent should identify the residual change in noise level over the appraisal period. The residual change in noise level is the noise impact that occurs after accounting for all management, mitigation and acquisition measures put in place.

Step 4: Economic valuation of uncompensated residual impact

In terms of economic valuation of noise impacts, there is a lack of conclusive evidence regarding impacts at noise levels below 45 decibels. The noise range above 45 decibels is rarely applicable in the case of industrial noise from mining and coal seam gas projects in low noise environments given:

- The requirement to meet the assessment criteria specified in the NSW Industrial Noise Policy, particularly the Intrusiveness Criterion which specifies that the noise level of the project should not exceed 5 decibels above the measured background level, and

- The provision for mitigation and acquisition under the NSW Voluntary Land Acquisition and Mitigation Policy.

As noted above, the cost of management, mitigation and acquisition provisions should be included in the proponent’s operating and capital costs.

In rare cases where noise impacts are discernible, an economic value of the residual impact should be estimated on a case-by-case basis.
Biodiversity

Land clearing and land subsidence involved in mining and coal seam gas activities can negatively affect the biodiversity of the region. Some impacts are short-term and confined to the mine site while other impacts may have longer term effects across the region. Nearby species can be impacted in the following ways:

- Land clearing and piling of mine wastes can disturb and destroy habitat, food sources, nesting and protection sites
- Spreading of weeds and exotic species
- Damage to habitat for threatened species and endangered ecological communities
- Soil and land contamination from chemical spills and residues
- Habitat loss and fragmentation, leading to cutting off of migratory routes and causing isolation for species.
- Soil erosion and dryland salinity.

The biodiversity management hierarchy is to avoid, minimise and then offset residual impacts. Where avoidance and mitigation are not possible, biodiversity offsets provide a means to compensate for residual impacts of a project that remain after avoidance and mitigation measures have been accounted for.

The NSW Biodiversity Offsets Policy for Major Projects clarifies and standardises biodiversity impact assessment and offsetting for major project approvals in NSW. The Policy requires assessment of biodiversity impacts resulting from a project (compiled in a Biodiversity Assessment Report) and development of a Biodiversity Offset Strategy outlining how the proponent intends to offset the identified impacts of the project. Under the Policy, proponents are required to determine the biodiversity offset requirement for the project using the Framework for Biodiversity Assessment. The Biodiversity Assessment Report quantifies the amount of biodiversity on a site in terms of the number of ‘biodiversity credits’.

The policy allows some flexibility around what is considered an appropriate offset if a proponent can demonstrate they cannot find a ‘like-for-like’ offset after undertaking all reasonable steps.

An offset is an area of land that is protected in perpetuity and managed by the project proponent, or a third party, to improve biodiversity values. In cases where it can be demonstrated that an offset site cannot be created, the NSW Biodiversity Offset Policy provides flexibility to project proponents through:

- Purchasing biodiversity credits from third parties (e.g. via biobanking agreements)

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43 For more information on the Framework for Biodiversity Assessment see NSW OEH, 2014, Framework for Biodiversity Assessment.
• Payment into a (yet to be established) Offsets Fund – based on the number and value of biodiversity credits reported in the Biodiversity Assessment Report.

• Supplementary measures – where proponents can provide funds for supplementary measures when offsets are not available. These are measures that benefit biodiversity but do not specifically involve protecting and managing a site.\(^\text{44}\)

• Mine site rehabilitation - ecological rehabilitation of mine sites will be recognised in calculation of offsets where there are good prospects of biodiversity being restored.

The cost to compensate for impacts to biodiversity should be included in the proponent’s operating and capital costs.

**Appraisal of biodiversity impacts**

There are four steps in the appraisal of biodiversity impacts:

1. Survey and assess existing biodiversity at project site
2. Scope and assess project’s impact on biodiversity
3. Develop a Biodiversity Offset Strategy
4. Economic valuation of residual uncompensated impact

These steps are explained in detail below. A standardised workbook to appraise biodiversity impacts has not been developed as part of this guidance because:

- Under the NSW Biodiversity Offset Strategy full compensation for any biodiversity losses is required;

- Therefore cases of uncompensated biodiversity impacts should only arise in rare and a limited number of cases where consideration of impacts will require a case-by-case analysis.

An environmental assessment is required as part of a project’s application. Two reports forming the environmental assessment regarding biodiversity impacts, the Biodiversity Assessment Report and the Biodiversity Offset Strategy will be heavily relied upon for the appraisal of Biodiversity Impacts.

**Step 1: Survey and assess existing biodiversity at project site**

This will be completed in accordance with the Framework for Biodiversity Assessment which sets out instructions on how to assess site vegetation, species and landscape context.

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\(^{44}\) The amount of money to be contributed to supplementary measures will be calculated so it is approximately equivalent to the cost of establishing an offset site. Ensuring the amount a proponent is required to contribute to supplementary measures is commensurate with the cost of establishing an offset site will prevent an artificial bias towards supplementary measures over offsets. (NSW OEH, 2014, *NSW Biodiversity Offsets Policy.*)
As part of a project’s environmental assessment, a Biodiversity Assessment Report will be completed for the project site, in accordance with the Framework for Biodiversity Assessment to:

- Identify and map landscape features, native vegetation and threatened species and population
- Determine the existing landscape value, biodiversity values of native vegetation and biodiversity values of threatened species.

**Step 2: Scope and assess a project’s impact on biodiversity**

The project’s Biodiversity Assessment Report will also identify the direct and indirect impacts on existing biodiversity values from the project’s activities. Measures and strategies available to avoid (in the first instance) and minimise the identified impacts will need to be identified.

The Biodiversity Assessment Report will:

- Estimate the change in landscape value score due to the project
- Estimate the direct impact of the development on the species credit determined to be present on the project site
- Calculate the total biodiversity credits for the project site
- Calculate the number of biodiversity credits retained as a result of avoidance and mitigation actions
- Calculate the offset requirement (number of credits required) for unmitigated and unavoidable impacts of the project on identified biodiversity values
- Calculate the offset requirement without and with rehabilitation

Remaining impacts (after avoidance and mitigation) on landscape features, native vegetation and threatened species will be aligned to the following specified impact thresholds:

- That require further consideration by the consent authority
- For which the assessor is required to determine an offset requirement
- For which the assessor is not required to determine an offset
- That do not require further assessment by the assessor

The requirement to assess and quantify impacts, and that an offset requirement is described in a ‘currency’ – a biodiversity credit – means that impacts on biodiversity have a direct and quantifiable economic cost to a project. Projects that have no (or very minimal) impacts on biodiversity and are therefore unlikely to require an offset, will be at a market advantage compared to projects with large biodiversity impacts and consequently offset requirements.
**Step 3: Develop a Biodiversity Offset Strategy**

Subsequent to the Biodiversity Assessment Report, the Biodiversity Offset Strategy will be completed outlining how the proponent intends to offset the unmitigated impacts of the project.

The Biodiversity Offset Strategy will outline whether:

- New offset sites will be created
- Existing biodiversity credits will be retired
- Supplementary measures are proposed
- Mine site rehabilitation is proposed.

Where a proponent is proposing to establish an offset site, the biobanking assessment methodology will be used to assess the biodiversity values of any offset site and identify the number and type of biodiversity credits that may be created on the offset site.

**Step 4: Economic valuation of uncompensated residual impact**

The current NSW Biodiversity Offset Policy requires project proponents to compensate for impacts to biodiversity through avoidance, mitigation, offsets or supplementary measures. As noted above, the cost to compensate for impacts to biodiversity as determined in the Biodiversity Offset Strategy should be included in the proponent’s operating and capital costs.

While it could be assumed that under the NSW Biodiversity Offset Policy, all biodiversity impacts are compensated, this may not always be the case.

Particularly severe impacts on biodiversity are identified under the Policy as ‘impacts for further consideration’. These impacts may require additional economic valuation, as the impact may not be able to be fully compensated through an offset. In these cases, an economic value of the residual impact can be estimated on a case-by-case basis using replacement cost valuation techniques.
Greenhouse gas emissions

Increasing GHG emissions can enhance the greenhouse effect, and lead to a rise in global temperatures - the environmental implications of which can include:

- Glacier retreat,
- Rising sea levels,
- Increased precipitation (rain and snowfall), and
- Changes in agricultural productivity.  

Appraisal of greenhouse gas emissions

There are three steps in the appraisal of GHG emissions:

Step 1. Scope the impact
Step 2. Measure the physical change
Step 3. Estimate the economic value of impact and conduct sensitivity analysis of discount rate and emissions.

These steps are explained in detail below. A Greenhouse Gas Emissions Valuation Workbook (GHGVW) has been developed alongside this guidance module to facilitate the necessary steps for calculating the monetary values for GHG emissions.

Step 1: Scope of impact from greenhouse gas emissions

As indicated in the previous section, a quantitative assessment of potential Scope 1, 2 and 3 GHG emissions will typically be completed in an environmental assessment. This taxonomy of GHG emissions is defined as:

- Scope 1: All direct GHG emissions.
- Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam.
- Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, non-production transport-related activities, electricity-related activities (e.g. T&D losses) not covered in Scope 2, outsourced activities, waste disposal, etc.

Both Scope 1 and 2 emissions should be included in the appraisal of greenhouse gas emissions. Being secondary effects, Scope 3 emissions are excluded from

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46 For more information, please see: [http://www.ghgprotocol.org/calculation-tools/faq](http://www.ghgprotocol.org/calculation-tools/faq)
47 Scope 1 emissions are direct emissions at the project site. Whilst Scope 2 emissions are indirect emissions, the electricity consumed by the project is directly determined by its operations.
the appraisal, consistent with the broader treatment of secondary impacts in CBA within these Guidelines.

_Carbon dioxide equivalent units_

The standard unit of measurement for GHG emissions is tonnes of carbon dioxide equivalent (tCO₂e).⁴⁸ That is, GHG emissions such as methane are converted to the volume of carbon dioxide that would trap the same amount of heat in the atmosphere.

_Inputs and tasks for the Greenhouse Gas Emissions Valuation Workbook_

The following information on the scope of the appraisal should be entered into the *Project Info & Parameters* worksheet of the GHGVW:

- **Base Year** – the year which future costs and benefits are discounted back to.
  - Often the base year is set the same year as the Project Start Year, however this does not need to be the case.
- **Project Start Year** – the year the project starts.
- **Project Final Year** – the year the project finishes.

_Step 2: Measure the physical change_

A quantitative assessment of Scope 1 and 2 carbon emissions in tonnes of carbon dioxide equivalent (tCO₂e) will be estimated in the environmental assessment. The assessment of greenhouse gas emissions should estimate the Scope 1 and 2 emissions over the duration of the project, capturing variations in annual emissions occurring in different stages of the project (construction, operation and rehabilitation) or where changes in the project’s activities change the project’s annual emission of greenhouse gases (e.g. changes in the production level).

_Inputs and tasks for the Greenhouse Gas Emissions Valuation Workbook_

The steps to incorporate estimated tCO₂e emissions in the GHGVW are detailed below. Entries should be made into the *Emission Inputs & Carbon Price* worksheet of the GHGVW.

**Task 1.** Enter the central estimate of annual tCO₂e emissions for each year of the appraisal period between the *Project Start Year* and *Project Final Year*, accounting for all project phases (e.g. construction, operation and rehabilitation).

**Task 2.** Low and high estimates of tCO₂e emissions can also be entered, where applicable.

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⁴⁸ UK Department for Transport, TAG unit A3 environmental impact appraisal, 2014.
Step 3: Estimate the economic value of the impact

- When estimating the economic value of environmental impacts, market data should be used where they exist. If significant environmental issues cannot be quantified by accepted methods, descriptive material should be provided.

This approach is consistent with the recent review of the NSW Energy Savings Scheme, which noted that:

In the absence of a locally appropriate study of the whole of economy cost of climate change impacts, the NSW Government preference is for market data to be used where it exists.49

The Review of the NSW Energy Savings Scheme determined the appropriate carbon price is the forecast European Union Emission Allowance Units price based on futures derivatives published by the European Energy Exchange.50 The Review noted this price forecast is considered to be a conservative value for the cost of carbon.

Given the uncertainty regarding the cost of carbon, the impact of greenhouse gases should also be estimated applying the following two carbon prices:

- Carbon price estimated by Australian Treasury for the Clean Energy Future Policy Scenario51

- US EPA Social Cost of Carbon (5 per cent discount rate scenario)52

All three of these projected carbon prices rely on assumptions that are not completely transferable to the current Australian context. As such the analysis using these three carbon prices provides a range of the potential cost of greenhouse gases.53

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52 The 5 per cent discount rate scenario reported in 2014 dollars sourced from US EPA Social Cost of Carbon, http://www.epa.gov/climatechange/EPAactivities/economics/scc.html
53 The three carbon prices outlined in this guidance module are subject to change reflecting revisions to forecasts and modelling and also to any changes to government policy.
The tasks to estimate the economic cost of GHG emissions are detailed below.

**Task 1.** The GGEVW contains three carbon price projections based in 2015 Australian dollars. If necessary, update the carbon price projections in the *Emission Inputs & Carbon Price* worksheet to account for base years different to 2015 and changes in the relevant exchange rates.  

**Task 2.** The GHGVW discounts the carbon price (per tCO$_2$e) for each year of the appraisal period using a discount factor based on a 7 per cent discount rate.

**Task 3.** Calculate the discounted cost of GHG emissions in each year by multiplying the discounted carbon price (per tCO$_2$e) by the tCO$_2$e of emissions.

a. The GHGVW calculates the discounted value of emissions in each year in the *NPV Calculation* worksheet.

b. The total present value of impacts from greenhouse gas emissions over the appraisal period is the sum of the annual discounted values. The GHGVW calculates the total present value in the *Summary* worksheet.

**Task 4.** Sensitivity Analysis of the discount rate. Repeat Steps 2 and 3 using a 4 per cent (low) and 10 per cent (high) discount rate. Sensitivity Analysis of the discount rate is completed in the *SA Discount Rate* worksheet.

**Task 5.** Sensitivity Analysis of the quantity of GHG emissions. Where there is uncertainty about the quantity of emissions, estimates for a low and high emissions scenario might be available in the environmental assessment. Where estimates are available repeat Task 3 to calculate the present value of impacts from greenhouse gas emissions for the low emission and high emission scenario. Sensitivity analysis of the estimated carbon emissions is completed in the *SA Emissions* worksheet of the GHGVW.

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54 Reserve Bank of Australia, *Exchange Rates*,  
Groundwater

Groundwater refers to the water contained within rocks and sediments below the ground’s surface in the saturated zone.

Maintenance of groundwater systems is important for the following reasons:

- Groundwater can be a vital source of drinking water in some locations around Australia. In many areas, it is the only reliable source of water.
- In some places, groundwater sites provide recreational opportunities and/or are culturally significant sites.
- The agricultural industry relies on groundwater systems to irrigate crops and pasture for livestock. In some arid areas, groundwater can be the only source of drinking water for livestock.
- Groundwater stocks can prevent land subsidence and be a barrier against seawater intrusion into aquifers. For this to be sustainable, it is pertinent to ensure that the groundwater levels are not severely depleted by extraction.
- The maintenance and support of groundwater-dependent ecosystems (GDEs) whose extent and life processes are dependent on groundwater.
- The importance of maintaining connected water sources and existing groundwater – surface water interactions.

Mining projects may impact on groundwater resources during exploration, development, reconstruction and operational phases. Mining has the potential to impact these resources by:

- Reducing or increasing the quantity of available water through extraction or dewatering\(^5\)
- Raising or lowering the water table around the mine
- Polluting or otherwise contaminating the water
- Changing aquifer structures leading to in-flow of saline water\(^5\)
- Causing subsidence
- Changes in water flow paths.


Environmental assessment of groundwater impacts

An environmental assessment of a project’s groundwater impacts will determine:

- The zone of influence of the project to groundwater resources
- Key groundwater resources that may be affected by the mining activity
- Significance of the resource to the area, including the community’s reliance of the groundwater
- The project’s total groundwater demand
- The potential impacts of the proposed project
- The scale of the impacts – including on the water table, water pressure and water quality.

Water sharing plans are being progressively developed for rivers and groundwater systems across New South Wales. Water sharing plans set annual extraction limits for water resources to protect the fundamental environmental health of the water source, ensure the water source is sustainable in the long-term and provide water users with a clear picture of when and how water will be available for extraction.\(^{57}\)

Proponents are required to hold a water licence for all water taken from a groundwater source during the life of the activity and after the activity has ceased. Water take includes:

- The removal of water from a water source
- The movement of water from one part of an aquifer to another part of an aquifer
- The movement of water from one water source to another water source\(^{58}\)

The NSW Aquifer Interference Policy requires assessment of potential impacts to groundwater against Minimal Impact Consideration for Aquifer Interference Activities.\(^{59}\) There are two levels of minimal impact considerations. The NSW Office of Water assesses the potential impacts to groundwater resources based on information provided in the proponent’s environmental assessment to determine if the predicted impacts are less than the Level 1 minimal impact considerations, and will therefore be considered acceptable. Mitigation, prevention or avoidance measures are required where Level 1 minimal impact considerations are not met.

In undertaking an appraisal of impacts of mining on groundwater resources, the environmental assessment will be heavily relied upon. Based on the findings from

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\(^{58}\) NSW Department of Primary Industries Office of Water, 2012, *NSW Aquifer Interference Policy*.

\(^{59}\) NSW Department of Primary Industries Office of Water, 2012, *NSW Aquifer Interference Policy*. Table 1 page 15.
the environmental assessment, the significance of the size of potential unforeseen impacts can be qualified.

When scoping the impact on groundwater resources, it is important to keep in mind that there may be potential cumulative impacts. From the information presented in the environmental assessment, any interactions with the existing activities and the proposed activities can be identified. This will provide an indication of the cumulative impacts to the immediate locality and the overall region.

**Estimating the value of the impact**

The value of groundwater is largely based on the service it provides rather than the good itself. Stakeholders also gain value from groundwater through capital investments in infrastructure for assessing, transporting and storing groundwater.

An analysis of the value of groundwater may be affected by some of the following characteristics of:  

- The uncertainty of the volumes available in different groundwater resources
- Connectivity between surface water and groundwater
- The relative scarcity of groundwater in many areas
- The difficulty in defining environmental impacts and therefore sustainable yields
- Differences in groundwater quality
- Ambiguity of property rights
- The temporal aspects of recharge, extraction and discharge

These characteristics can influence the significance of the groundwater supply to the region and therefore affect the value it provides to the community.

The impact of a significant adverse effect on groundwater resources may result in lower revenue to the industries affected, increased costs and reduced wetland use.

**Approach to evaluating impact on groundwater**

Proponents are required to hold a groundwater licence(s) with sufficient water allocation to account for the project’s take of water at all times during the project and after the activity has ceased (where required). The project must also meet the Level 1 minimal impact considerations set in the NSW Aquifer Interference Policy. The cost of water licences and any required mitigation measures is to be included in the proponent’s capital and operating costs.

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The purpose of this appraisal module is to qualitatively evaluate the project’s unmitigated impacts on groundwater resources. There are three steps pertinent in evaluating unforeseen impacts on groundwater resources:

- **Step 1**: Assess the importance of the groundwater resource to the region
- **Step 2**: Determine the potential magnitude of unforeseen impacts of the proposed project
- **Step 3**: Evaluate the overall significance of the potential impact of mining on the groundwater resources

These steps are explained in detail below. A Groundwater Impact Valuation Workbook has been developed alongside this guidance module to facilitate the necessary steps for determining the overall significance of the impacts. The Groundwater Impact Valuation Workbook makes provisions for up to four groundwater resources to be assessed. A significant level of professional judgement is required when using the workbook.

It is important to recognise that risk and uncertainty are major considerations in the appraisal of groundwater impacts. Mining risks associated with groundwater arise through the occurrence of unexpected events. Uncertainty is driven by the extent of understanding of groundwater systems and their interactions with other groundwater systems and surface water.

Even if there is a low chance of adverse impact on natural resources or if there is uncertainty around the potential impacts, as long as there is a risk of threat, it should be considered in the appraisal. Any uncertainties should be made explicit in the appraisal process.

**Step 1: Assess the importance of the groundwater resource to the region**

The groundwater resources that the mining project is expected to affect first need to be identified. Then, to determine the importance of the groundwater resource, the following factors should be considered:

- The degree to which the affected region relies on the groundwater resource for current or future consumptive uses
- Quality of groundwater\(^{61}\)
- Substitutability of groundwater resource
- Scale of the region affected by the groundwater resource
- Rarity of the resource\(^{62}\)

These attributes together provide an indication of the *importance* of the groundwater supplies to the region.

\(^{61}\) see Australian Drinking Water Guidelines 2011 (ADWG) for drinking water and Australian and New Zealand guidelines for fresh and marine water quality 2000 (ANZECC).

The ranking of the importance of groundwater resources are as follows:

- **Very high importance:**
  - The resource is of a high quality and is highly relied upon. It is of a regional scale with limited potential for substitutability.

- **High importance:**
  - The resource is of a high quality and highly relied upon. It is of a local scale and limited potential for substitution.

- **Medium importance:**
  - The resource is of medium quality and moderately relied upon, with a local scale and limited potential for substitution, or
  - the resource is of a low quality, with regional scale and limited potential for substitution.

- **Low importance:**
  - The resource is of a low quality, with a local scale and limited potential for substitution.

The following elaborate on the factors influencing the importance of groundwater resource.

**Quality of groundwater**

The quality of the groundwater refers to the physical condition of the feature. As per the NSW Government (Environment and Heritage)

> a healthy environment is one in which the water quality supports a rich and varied community of organisms and protects public health.\(^{63}\)

Table 5.7 following describes indicators that may be used to measure water quality.

A key indicator of quality of groundwater resources is how the groundwater resource is currently used, whether the resource is a water supply for potable, industrial or agricultural uses (for example, a high water quality is required for a resource to be used as potable water).

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5.7 Water quality indicators

<table>
<thead>
<tr>
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<td>• dissolved oxygen</td>
</tr>
<tr>
<td></td>
<td>• biological oxygen demand</td>
</tr>
<tr>
<td></td>
<td>• nutrients (including nitrogen and phosphorus)</td>
</tr>
<tr>
<td></td>
<td>• organic and inorganic compounds (including toxicants)</td>
</tr>
<tr>
<td>Aesthetic</td>
<td>• odours</td>
</tr>
<tr>
<td></td>
<td>• taints</td>
</tr>
<tr>
<td></td>
<td>• colour</td>
</tr>
<tr>
<td></td>
<td>• floating matter</td>
</tr>
<tr>
<td>Radioactive</td>
<td>• alpha, beta and gamma radiation emitters</td>
</tr>
</tbody>
</table>


Substitutability of groundwater resource

In locations where groundwater is a close substitute for surface water, the groundwater will be highly valued when surface water is scarce. This scarcity can be driven by factors such as droughts, policy and regulatory changes (such as changes to allocated surface and groundwater catchments through buy backs or changes to water allocation/sharing plans) and climate change.64

The substitutability of groundwater depends on the costs and availability of alternative sources. This also depends on the time frame required for replacement and uses of the groundwater resources. For example, if it is used for recreational purposes, a long time frame for alternative sources is acceptable. However, if it is primarily used as a supply of potable water, then it would need to be urgently substituted, making it more valuable.

The availability of alternative water sources and the associated costs of substitution are also pertinent. This depends on the location of use. Even if the groundwater resource can be readily substituted, if the transport costs are prohibitive, the groundwater resource would be considered to be of high value. Groundwater in a regional area near a major town will be of a higher value due to fewer alternatives available in addition to its value in use.

64 Deloitte Access Economics, 2013, Economic Value of Groundwater in Australia, prepared for the National Centre for Groundwater Research and Training
Scale of groundwater resource

It is pertinent to consider the scale of the impact that any changes to the groundwater reserves may have. Major aquifers are likely to be important at a regional level. The greater the scale at which the feature is valued, the higher its importance.

Rarity of the groundwater resource

The scarcity of a groundwater resource should also be evaluated on a scale basis, for example, even though groundwater may be abundant on a larger scale, locally it may be rare. In this case, it will be considered to be of a higher value due to its rarity if other water sources are not available.

Inputs and tasks for the Groundwater Impact Valuation Workbook

For each groundwater resource, the quality, substitutability and scale need to be given a score between 0 and 2.

- A score of 0 reflects the negligible importance
- A score of 1 represents medium importance
- A score of 2 reflects high importance

Therefore, a high score of 2 across all three categories refers to a groundwater resource that has high quality water, cannot be easily substituted and provides for a large region.

Each category must be independently valued and may reflect varying scores.

Step 2: Determine the magnitude of impact of the proposed project

When undertaking research for the environmental assessment, it will be assessed if the proposed project is likely to affect the community’s ability to use the groundwater resource. This involves a consideration of the impact on water quality or quantity especially where the community is reliant on the water supply. The environmental assessment will also outline instances of beneficial reuse of treated water.

The environmental assessment will estimate the potential importance of each likely impact. The nature of the impact will be analysed according to the following criteria:

- The level of confidence in predicting the impact
- The reversibility of the impact
- The effectiveness of the proposed methods to manage or mitigate the impact

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65 Mineral Resources Environmental Sustainability Unit, 2012, ESG2: Environmental Impact Assessment Guidelines, published by the Department of Trade, Investment, Regional Infrastructure and Services
66 Ibid.
• Compliance with any relevant policies or plans
• The extent of public interest
• Whether further information is required to confidently determine the impact of the activity.

The impact of a proposed mining project on groundwater supplies is likely to be either adverse or negligible. The magnitude can be determined by appraising the effects predicted on the groundwater. This is independent of the importance that the groundwater resource presents to the region.

The magnitude of the potential impacts on groundwater resources can be classified as follows:

• A large adverse impact
  – This is when the proposed project results in a complete loss of the groundwater resource or significant change in water quality

• A moderately adverse impact
  – This occurs when there is a partial loss of the groundwater resource or the integrity of the groundwater is compromised

• A slightly adverse impact
  – This happens when there is a minor adverse impact on the feature

• Negligible impact
  – This occurs when there is an impact but it is of insufficient magnitude to affect the use.

Table 5.8 sets out the indicators used in the preparation of the environmental assessment and how these relate to the magnitude ratings.

### 5.8 Guide to categorising the extent of the impact

<table>
<thead>
<tr>
<th>Analysis of impact</th>
<th>Slightly adverse</th>
<th>Large adverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Small scale size/volume</td>
<td>Large scale/volume</td>
</tr>
<tr>
<td>Scope</td>
<td>Localised</td>
<td>Extensive</td>
</tr>
<tr>
<td>Intensity</td>
<td>Small impact dispersed over a long period</td>
<td>Large impact over a short or long period</td>
</tr>
<tr>
<td>Duration</td>
<td>Short term</td>
<td>Long term</td>
</tr>
<tr>
<td>Level of confidence in predicting impacts</td>
<td>High confidence/knowledge and past experience</td>
<td>Low confidence, numerous uncertainties and unknowns</td>
</tr>
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<td>Level of reversibility of impacts</td>
<td>Impacts are reversible and rehabilitation likely to be successful</td>
<td>Reversibility impossible or unlikely due to cost or other factors</td>
</tr>
<tr>
<td>Ability to manage or mitigate the impacts</td>
<td>Effective mitigation measures available</td>
<td>Mitigation measures untested or unavailable</td>
</tr>
<tr>
<td>Ability of the impacts to comply with standards, plans or policies</td>
<td>Compliant</td>
<td>Not compliant</td>
</tr>
</tbody>
</table>

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Level of public interest | Low interest and predictable impacts on community | High interest and uncertain impacts on continuity
---|---|---
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 on and understanding of key issues


A high level of uncertainty around the type or magnitude of an impact should result in an increase in the severity ratings. Potential effects that may have a low probability, yet if they occur would have significant impacts, should be rated as large adverse.

**Inputs and tasks for the Groundwater Impact Valuation Workbook**

Based on findings from the environmental assessment, the magnitude of the impact proposed project must be assessed. For each groundwater resource assessed in the Groundwater Impact Valuation Workbook, assign the relevant magnitude of the impact from the following:

- Large adverse
- Moderately adverse
- Slightly adverse
- Negligible

**Step 3: Evaluate the significance of potential impacts on groundwater resources**

By comparing the importance of the groundwater supplies with the magnitude of the potential impact of the proposed project, the overall significance of the impact can be determined. Chart 5.9 demonstrates the relationship between importance of the groundwater feature, the magnitude of the potential impact and the overall significance of the project to the groundwater supplies.
### 5.9 Criteria for estimating the significance of potential impacts

<table>
<thead>
<tr>
<th>Importance of groundwater resource to region</th>
<th>Very high</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Large adverse</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very highly significant</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highly significant</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Significant</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Low significance</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Moderately adverse</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Highly significant</td>
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<tr>
<td>Highly significant</td>
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<tr>
<td>Significant</td>
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</tr>
<tr>
<td>Low significance</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Slightly adverse</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Significant</td>
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<tr>
<td>Significant</td>
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<td></td>
</tr>
<tr>
<td>Low significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimal significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Negligible</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Low significance</td>
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<tr>
<td>Low significance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimal significance</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*Data source: Adapted from UK Department of Transport, 2014, Transport Analysis Guidance*
Non-Aboriginal heritage

Heritage items can be individual places, buildings, trees, relics, works or objects identified as having significant value now and for future generations. The community places a positive value on keeping heritage items, objects and places.

The NSW Heritage Act 1977 defines environmental heritage as ‘those places, buildings, works, relics, moveable objects, and precincts, of State or local heritage significance’.

Mining and coal seam gas projects can impact on heritage items, objects and places through activities such as blasting causing subsidence, vibration impacts, land clearing and harm to aquifers. In NSW, the Environmental Planning and Assessment Act 1979 and the Heritage Act 1977 provide the legislative framework for managing heritage items, objects and places from impacts such as mining and coal seam gas projects. The NSW heritage management system adopts a three-step process for investigating, assessing and managing heritage resources (box 5.10).

5.10 NSW Heritage Management System

| Step 1 Investigate significance | Investigate the historical context of the item or study area |
| | Investigate the community’s understanding of the item |
| | Establish local historical themes and relate them to the State themes |
| | Investigate the history of the item |
| | Investigate the fabric of the item |

| Step 2 Assess and document significance | Summarise what you know about the item |
| | Describe the previous and current uses of the item, its associations with individuals or groups and its meaning for those people |
| | Assess significance using the NSW heritage assessment criteria |
| | Check whether you can make a sound analysis of the item’s heritage significance |
| | Determine the item’s level of significance |
| | Prepare a succinct statement of heritage significance |
| | Get feedback |
| | Write up all your information |

| Step 3 Manage significance | Analyse the management implications of the item’s level of significance |
| | Analyse the constraints and opportunities arising out of the item’s significance (including appropriate uses) |
| | Analyse owner and user requirements |
| | Prepare conservation and management recommendations |
| | If any obvious options are not suitable, explain why |
| | Request feedback from the community |
| | Analyse statutory controls and their relationship to the item’s significance |
| | Recommend a process for carrying out the conservation and management strategies |


67 For more information on the process for investigation, assessing and managing heritage resources see NSW Heritage Office, 2001, Assessing heritage significance.
Heritage items, objects and places provide use and non-use values to the community:

- **Use values** accrue to individuals, households, or firms through
  - *Direct use value*: the benefits associated with direct consumption of heritage services such as ownership of heritage assets, living or working in heritage buildings, or tourists visiting heritage sites. Reuse of heritage assets also provides a positive benefit to the environment as they do not require new construction or infrastructure materials.
  - *Indirect use value*: the benefit gained from indirectly consuming heritage services, such as when people gain benefit from observing aesthetic or historic qualities as they pass-by a heritage site

- **Non-use values** are intangible benefits experienced by individuals but are not reflected in market processes:
  - *Existence value*: the benefits associated with the knowledge of a heritage site even if a consumer does not intend to visit it themselves
  - *Option value*: the benefits derived from having the option to visit a heritage site in the future
  - *Bequest value*: the value gained from knowing that a heritage site can be bequeathed to future generations.

Primary non-market valuation studies such as hedonic pricing, choice modelling or travel cost method, can be undertaken to quantify the economic value of heritage items.

An alternative approach is to apply benefit transfer and transfer estimated economic values of heritage from a different context to the current project’s context. There are however limitations with this approach as well. Overall, the economic valuation of heritage is limited by a lack of a standard metric by which heritage value can be assessed.

Given the difficulty with quantifying the economic value of heritage, this guidance module provides a qualitative method to assess the overall impact of the mining and coal seam gas project on the heritage significance of the impacted heritage item, object or place.

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70 Including archaeological sites.
Appraisal of Heritage Impacts

There are five steps in the appraisal of heritage impacts.\(^71\)

- Step 1. Identify existing heritage sites and objects within project site
- Step 2. Assess heritage significance of identified items, objects or places
- Step 3. Scope the project’s impact on identified items, objects or places
- Step 4. Assess the degree of impact of the project on the identified items
- Step 5. Evaluate the potential impacts of the project on the heritage significance of the identified items, objects or places.

These steps are explained in detail below. A Heritage Valuation Workbook (HVW) has been developed alongside this guidance module to facilitate the necessary steps to qualitatively assess the project’s impact to heritage.

A heritage impact assessment\(^72\) is generally required as part of the environmental assessment necessary for a project’s application. The heritage impact assessment will determine whether heritage sites or objects are present within the project area. Relevant information from the heritage impact assessment will be relied upon to conduct the economic valuation.

**Step 1: Identify existing heritage items, objects and places**

The heritage impact assessment will determine whether heritage, items, objects or places are present or likely to be present in the project area through:

- Analysis of available documentation relating to the history and cultural heritage of the project area, including local environment plans
- Review of heritage registers and databases including State Heritage Register, Stage Heritage Inventory and the Register of the National Estate
- Historical background of the region and project site to provide context and understanding of the processes of settlement and land use development within the area
- Predictive modelling of the areas to assess the potential for heritage items to occur within the project area
- Field survey and ground inspections of the project area.

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\(^{71}\) Excluding Aboriginal heritage which is separately assessed.

\(^{72}\) A historical archaeological assessment may also be required. A heritage impact assessment is often referred to as a non-Aboriginal heritage impact assessment or European heritage impact assessment.
**Step 2: Assess heritage significance of identified items, objects or places**

The heritage significance of identified items, objects or places should be evaluated based on the NSW State Heritage Register criteria (box 5.11).

The heritage impact assessment will determine if the heritage item, object or place that will be impacted by the mining or coal seam gas project is of State/or local heritage significance according to the criteria.

### 5.11 NSW State Heritage Register criteria

An item will be considered to be of State (or local) heritage significance if, in the opinion of the Heritage Council of NSW, it meets one or more of the following criteria:

- **Criterion A**: an item is important in the course, or pattern, of NSW’s cultural or natural history (or the cultural or natural history of the local area)
- **Criterion B**: an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW’s cultural or natural history (or the cultural or natural history of the local area)
- **Criterion C**: an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area)
- **Criterion D**: an item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons
- **Criterion E**: an item has potential to yield information that will contribute to an understanding of NSW’s cultural or natural history (or the cultural or natural history of the local area);
- **Criterion F**: an item possesses uncommon, rare or endangered aspects of NSW’s cultural or natural history (or the cultural or natural history of the local area)
- **Criterion G**: an item is important in demonstrating the principal characteristics of a class of NSW’s (or the local area’s) cultural or natural places and environments.

**Inputs and tasks for the Heritage Valuation Workbook**

Select the assigned level of heritage significance for each heritage item as reported in the heritage impact assessment from the following:

- State heritage significance
- Local heritage significance
- No significance.
Step 3: Scope the project’s impact on identified items, objects or places

The heritage impact assessment will describe the various components and activities of the project and identify potential impacts on identified heritage items, objects and places.

A Heritage Management Plan should be prepared to manage and mitigate potential impacts from the mining and coal seam gas project on heritage items, objects or places identified in the project area. Strategies to manage or mitigate potential impacts may include:

- Avoidance of heritage items, archaeological sites, objects or places
- Implementation of procedures to minimise impacts on heritage items, objects or places
- Relocating heritage items, objects or places only as a last resort
- Demolishing heritage items, objects or places only as a last resort
- Archival recording of relocated or demolished heritage items, objects or places.

The heritage impact assessment should identify any heritage items, objects or places that remain at risk of impact from the project’s activities given the management strategies in place.

Inputs and tasks for the Heritage Valuation Workbook

Enter into the valuation workbook the heritage items, objects and places that will be impacted by the project after accounting for management strategies that will be implemented.

Step 4: Assess the degree of impact of the project on the identified items

The impact of the proposed mining or coal seam gas project on identified heritage items, objects or places needs to be identified and assessed. It may vary from partial impact whereby only a section of the site is impacted whilst the remaining area of the site is preserved, or there may be full impact where a heritage item is harmed in its entirety. The degree of impact may be influenced by the proximity of a heritage site to the project area. Information on the potential harm to identified heritage items and sites should be based on the assessment of the impact of the proposed project on the heritage significance of the item, object or place.

Inputs and tasks for the Heritage Valuation Workbook

In the ‘Heritage Impact’ worksheet assign the relevant degree of impact to each heritage item from the following:

- Minimal partial impact
- Medium partial impact
- High partial impact
• Total impact

*Step 5: Evaluate the overall significance of the potential impacts*

By comparing the heritage significance of the items with the degree of potential impact of the proposed project, the impact of the mining or coal seam gas project can be determined. Chart 5.12 demonstrates the relationship between the heritage significance of the impacted heritage items, the degree of the potential impact and the overall significance of the project on the value of impacted heritage items.

### 5.12 Criteria for estimating the overall significance of the project on the value of impacted heritage items

<table>
<thead>
<tr>
<th>Degree of potential impact on heritage item</th>
<th>State heritage significance</th>
<th>Local heritage significance</th>
<th>No significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full impact</td>
<td>Very high weight</td>
<td>High weight</td>
<td>No significance</td>
</tr>
<tr>
<td>High partial impact</td>
<td>High weight</td>
<td>Medium weight</td>
<td>No significance</td>
</tr>
<tr>
<td>Medium partial impact</td>
<td>Medium weight</td>
<td>Low weight</td>
<td>No significance</td>
</tr>
<tr>
<td>Minimal partial impact</td>
<td>Low weight</td>
<td>Minimal weight</td>
<td>No significance</td>
</tr>
</tbody>
</table>

*Data source: Adapted from the UK Department of Transport, 2014, Transport Analysis Guidance*
Surface water

Surface water comes from rivers, streams and lakes. Sustainable management of surface water resources is important because surface water:

- Is a vital source of drinking water
- Provides recreational opportunities
- Is a vital input for local industries such as agriculture, viticulture and mining
- Supports ecosystems and provides ecological services necessary for surrounding biodiversity.

Potential impacts to surface water from mining and coal seam gas activities that can occur during and post operation include:

- Reduced surface water quality and/or quantity
- Changes to natural water flows and probability of flood events
- Altered connectivity between surface water and groundwater systems
- Dryland salinity.

The regulatory framework for water resources seeks to avoid and minimise harm caused by surface water use. A water licence or other approval from the NSW Office of Water is generally required to extract water from rivers or aquifers to use for commercial purposes.73 It is an offence to take water when not authorised by a licence.

The NSW EPA regulates discharges to water through conditions it places on a premise’s environment protection licence. Water quality can still be impacted even when licence conditions are met. Exceedances above licence conditions should not occur or in the case they do proponents could face regulatory action.

The purpose of this guidance module is to appraise predicted impacts to surface water that may occur in response to the predicted or proposed discharge quality based on the requirements in the Standard Environmental Assessment Requirements issued to the proponent. The surface water assessment will model predicted impacts under the range of conditions that are likely to be encountered.

A surface water assessment is usually completed as part of a project’s environmental assessment and is heavily relied upon in this guidance module for an appraisal of impacts of mining and CSG projects on surface water resources.


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Appraisal of surface water impacts

The five steps to appraise the impacts of changes to surface water quality are:

- **Step 1**: Outline the existing surface water quality
- **Step 2**: Model predicted impacts on surface water quality
- **Step 3**: Identify surface water users downstream from project site
- **Step 4**: Identify indicators of cost from water quality impacts
- **Step 5**: Estimate the economic value of the impact

These steps are explained in detail below. A standardised workbook has not been developed for the appraisal of surface water quality impacts due to the complex nature and variability of these impacts. The steps for appraisal have been detailed below to guide the proponent through an economic evaluation of surface water impacts without restricting the analysis within a standardised workbook.

- It is important to recognise that risk and uncertainty are major considerations in the appraisal of impacts on surface water resources. Any uncertainties should be made explicit in the appraisal process.

**Step 1: Outline the existing surface water resource**

The surface water assessment will include a general description of the existing surface water resource at the site and the surrounding area that may be affected by the proposed activity. Key features of the existing surface water resource will be outlined, including:

- Sources of surface water within and adjacent to the mining area
- The local and regional water quality at appropriate locations within the surrounding area, including consideration of the relevant water quality objectives such as, for example aquatic ecosystems, drinking water, primary and secondary contact recreation, and agricultural uses
- The scale of the surface water resource determined by the local topography and natural water system of the area
- Key environmental features of the surface water resources in the project area including climate, rainfall and evaporation
- Key characteristics of the surface water resource including runoff, streamflow and flooding
- Existing local water storages
- Existing surface water users, including licence holders, local residents and recreational users, and whether the proposed activity is located within a drinking water catchment.
The surface water assessment should pay particular attention to features that may influence the magnitude of potential impacts resulting from the proposed activity. For example, drought events or high rainfall events may influence likely changes to water quality, water flows and level of pollution as a result of the proposed activity.

**Step 2: Model predicted impacts on surface water quality**

The surface water assessment will model predicted impacts to local and regional surface water resources from the project’s sources of pollution under the range of conditions likely to be encountered. Potential operational surface water impacts may include impacts to flow regime, of controlled release, of runoff from progressively rehabilitated landforms or impacts on local flood regime.

The surface water assessment will outline predicted impacts, extent of impacts and characteristics such as the change in water quality indicators, the duration over which the water quality is altered and the extent of the surface water resource that is impacted. Any appraisal of impacts on surface water must include consideration of the relevant NSW Water Quality Objectives for a catchment and address the National Water Quality Management Strategy policy principle of protecting and enhancing water quality to reserve the maximum opportunity for other present and future uses of a waterway.

Table 5.13 sets out the indicators that guide how impacts should be categorised in terms of extent.

### 5.13 Guide to categorising the extent of the impact

<table>
<thead>
<tr>
<th>Analysis of impact</th>
<th>Slightly adverse</th>
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<td>Long term</td>
</tr>
<tr>
<td>Level of confidence in predicting impacts</td>
<td>High confidence/knowledge and past experience</td>
<td>Low confidence, numerous uncertainties and unknowns</td>
</tr>
<tr>
<td>Level of reversibility of impacts</td>
<td>Impacts are reversible and rehabilitation likely to be successful</td>
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</tr>
<tr>
<td>Ability to manage or mitigate the impacts</td>
<td>Effective mitigation measures available</td>
<td>Mitigation measures untested or unavailable</td>
</tr>
<tr>
<td>Ability of the impacts to comply with standards, plans or policies</td>
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<td>Not compliant</td>
</tr>
<tr>
<td>Level of public interest</td>
<td>Low interest and predictable impacts on community</td>
<td>High interest and uncertain impacts on continuity</td>
</tr>
<tr>
<td>Requirement for further information on the impacts of the activity or mitigation</td>
<td>High level of understanding and information on the impact</td>
<td>Low level of information on and understanding of key issues</td>
</tr>
</tbody>
</table>

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Step 3: Identify surface water users downstream from project site

The surface water assessment should identify and characterise the potentially impacted downstream surface water uses and values (e.g. landholders with water access licences, recreational users, and aquatic ecosystems), including:

- The location of downstream user (relative to the project site) to determine if and when they will be impacted by water quality change events
- The water use (e.g. drinking water, agriculture, industrial purpose, recreational, aquatic ecosystems)
- Quantity extracted
- Reliability of water entitlement (whether general or high security)
- Whether treated or untreated water is used.

Step 4: Identify indicators of cost for the predicted change in water quality

The quantified value of predicted impacts on water quality will depend on the project’s activities, site-specific characteristics and the impacted water users. Due to this variability, this guidance module gives examples but does not specify the values to be used by proponents for surface water impacts. Key indicators of the cost borne by impacted parties include:

- The cost to treat water (per ML) to return water quality to pre-impact level (applicable to uses of treated water only)
- The cost of alternative water source (e.g. cost to replace water, source groundwater or the cost to transport water from local town)
- The value of lost production in cases where either the water cannot be treated or alternative water sources are not feasible.
- Estimates of use and non-use values for the surface water resource attained from non-market valuation studies including choice modelling, travel-cost surveys and benefit transfer.

The proponent should select the best available value estimates for the impacts identified and the site-specific characteristics and clearly document reasons why a particular value estimated was selected. Table 5.14 includes a range of available value estimates related to surface water impacts.

5.14 Examples of value estimates related to surface water impacts

<table>
<thead>
<tr>
<th>Impact</th>
<th>Value estimate range</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water prices</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use and non-use values from non-market valuation studies

| Waterway suitable for swimming | $0.93 per km per household per year for 10 years | Marsden Jacob Associates, 2013, Non-market valuation of river health benefits in the Hawkesbury-Nepean River, Final report prepared for the NSW Department of Finance and Services.

| Healthy waterways | $0.84 to $1.10 per household per year for 5 years for each kilometre of healthy waterways in the Hawkesbury Nepean | Mazur, K. and Bennett, J., 2009, Location differences in communities’ preference for environmental improvements in selected NSW catchments: A Choice Modelling approach. Environmental Economics Research Hub Research Reports.

| Increase in fish population | $0.5 to $5.1 per 1 per cent increase in fish populations for smaller to medium sized rivers/areas per household per year | Morrison, M. and Hatton MacDonald, D., 2010, Economic valuation of Environmental Benefits in the Murray-Darling Basin.

| Clear of non-native waterweeds | $0.85 to $1.12 per household per year for 10 years for each kilometre clear of non-native waterweeds | Marsden Jacob Associates, 2013, Non-market valuation of river health benefits in the Hawkesbury-Nepean River, Final report prepared for the NSW Department of Finance and Services.

\textsuperscript{a} Average water allocation prices is very dependent on seasonal factors and location. An average range has been taken on water allocation prices over the past 3-4 years. Source: Various sources as listed in table.

**Step 5: Estimate the economic value of the impact**

The total economic value of a predicted water quality change is the sum of costs borne by impacted water users over the duration in which the water quality is altered.
Traffic impacts

Mining and coal seam gas activities generate traffic. The amount of traffic generated will depend on the type, location and size of the project and the capacity of the existing road network. The additional traffic due to the project can impact on existing road users through:

- Increased travel time cost
- Decreased reliability (measured as increased variation in travel time)
- Increased vehicle operating cost – increased running costs (fixed and operating costs) due to fluctuations in speed and queuing.
- Accident costs - the cost of a crash to society is the value of the trauma, medical treatment costs, emergency services, property damage and third party impacts caused by the crash.

The value of travel time costs is the dominant traffic related impact to existing road users.

Transport activities of mining and coal seam gas projects also cause additional external impacts to the community through road damage, noise and air pollution, greenhouse gas emissions, and visual dis-amenity. These impacts are addressed in the corresponding sections of this guidance module as environmental impacts rather than traffic impacts.

Appraisal of transport related impacts

There are five steps in the appraisals of traffic impacts:

- **Step 1:** Outline project’s traffic generating activities
- **Step 2:** Define scope of traffic impact
- **Step 3:** Estimate the base case traffic conditions
- **Step 4:** Estimate the incremental change in traffic generated by the project
- **Step 5:** Estimate the economic value of the project’s traffic impact and conduct sensitivity analysis.

These steps are explained in detail below. A traffic impact valuation workbook (TIVW) has been developed alongside this guidance module to facilitate the necessary steps for appraising traffic impacts from mining and CSG activities.

This guidance module assists proponents to estimate the cost to existing road users of increased travel time due to road traffic generated by the project. A traffic impact assessment is completed as part of the proponent’s assessment.

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75 Existing road users includes existing and future road users under the base case (without the project) throughout the appraisal period.
Information and data available in the proponent’s traffic assessment is required for the appraisal of traffic impacts.

Step 1: Outline project’s traffic generating activities

The traffic impact assessment will outline the project’s direct traffic generating activities and local road closures (where applicable) for all phases of the project including construction, operation and rehabilitation. Traffic generating activities may include:

- Light vehicle traffic generated by construction and operational workforce travelling to and from the site at the start and end of shifts
- Delivery of construction equipment and materials to and from the site
- Delivery of consumables to the site
- Visitors to the project site
- Transport of product (e.g. coal haulage from the project site and coal reject haulage returning to the project site) to and from the site to a nearby intermediary facility, such as a coal handling and processing facility
- Traffic movements during the decommissioning stage of the project.

Step 2: Define scope of traffic impact

The scope of the project’s traffic impact needs to be defined in terms of the:

- Location of the project – either in a non-urban or urban location.
- Sections of the road network impacted – by identifying the traffic routes used by the project’s activities.
- The duration of impact – traffic impacts should be identified for all phases of the project (including construction, operation and rehabilitation phases).

Products from mining and coal seam gas activities are transported by various transport modes (rail, road, ship) over various distances from the mine to the market. This guidance module assesses the impact of traffic generated to directly undertake operations at the project site and includes traffic impacts caused by transportation of product from the project site to the next point in the supply chain (e.g. intermodal rail terminal, coal handling and processing facilities). Traffic impacts caused by transportation of product further down the supply chain to reach the market are not included in this economic appraisal. This is because transport activities further down the supply chain are not necessarily under the direct control of the proponent nor are the benefits of these activities included in the economic analysis.

Inputs and tasks in traffic impact valuation workbook

Task 1. The following information on the scope of the appraisal should be entered into the Project Info & Parameters worksheet of the traffic impact valuation workbook:
a. **Base Year** – the year which future costs and benefits are discounted back to. Often the base year is set the same year as the Project Start Year, however this does not need to be the case.

b. **Project Start Year** – the year the project starts.

c. **Project Final Year** – the year the project finishes.

**Task 2.** Select whether the project is located in a non-urban or urban region in the *Project Info & Parameters* worksheet of the TIVW.

**Step 3: Estimate the base case traffic conditions**

The traffic impact assessment will estimate the base case (without the project) traffic volumes for the section(s) of the nearby road network impacted by the project for different modelled years. The base case should estimate the:

- For private cars, business cars, light commercial vehicles and heavy rigid trucks
- Traffic volumes during AM peak, PM peak and non-peak periods
- Traffic impacts from activities within the nearby area, including existing and approved mining and coal seam gas activities that will become operational in the region during the evaluation period (to account for cumulative impacts).
- Background growth in traffic unrelated to the project or other developments but due to population and economic growth over the appraisal period
- The traffic volume generated by the existing land use at the project site.

The traffic impact assessment should estimate the base case annual vehicle-hours travelled by existing users on the impacted section(s) of the road network accounting for variations in AM peak, PM peak and non-peak time periods.

**Step 4: Estimate the incremental change in traffic generated by the project**

**Traffic generated by the project**

This guidance module is for the appraisal of impacts accounting for management and mitigation measures put in place by the proponent. Therefore, it is important the project’s traffic impact is net of any traffic mitigation measures or road improvements that will be implemented as a result of the proposed project. The cost of mitigation measures and road improvements should be included in the proponent’s capital and operating costs.

The traffic impact assessment will estimate traffic volumes on the road network for the “with project” scenario for different modelled years. This should include estimation of traffic volumes:

- For private cars, business cars, light commercial vehicles and heavy rigid trucks
• For different stages of the project (e.g. construction, operation and rehabilitation)

• Over different time periods during a given day to account for variations in peak periods.

The traffic impact assessment will estimate the vehicle-hours travelled for the “with project” scenario. This will capture the change in vehicle-hours travelled by existing users on the section of the road network identified as impacted by the project.

*Incremental change in vehicle-hours travelled due to the project*

The incremental change in vehicle-hours travelled by existing users, is the difference in vehicle-hours travelled between the ‘with project’ scenario and the base case. The incremental change in vehicle-hours travelled will depend on the traffic generated by the project, capacity of the existing road network and the current level of congestion on the road network.

The traffic volumes caused by the existing land use should be deducted from the base case traffic volumes where feasible and where the impact is likely to be material to the analysis (see box 5.15).
5.15 Deducting traffic impact of existing land use

The base case includes traffic volumes caused by the existing land use. The traffic volumes caused by the existing land use (located on the site of the proposed project) will not occur if the project goes ahead and therefore should be deducted when estimating the incremental traffic impact caused by the project.

As an example, assume traffic volumes per day are as follows:

- base case traffic volumes of 110 vehicle-hours travelled per day, which includes 10 vehicle-hours per day caused by the existing land use (e.g. agricultural production) on the proposed project site.
- estimated project traffic volumes of 50 vehicle-hours per day.

The incremental change in vehicle-hours travelled due to the project where the:

- impact of existing land use is deducted - 40 vehicle-hours per day
- impact of the existing land use is not deducted - 50 vehicle-hours per day.

Hence the traffic impact of the project will be overestimated if the traffic impact of the existing land use is not deducted.

<table>
<thead>
<tr>
<th>Traffic volume</th>
<th>Vehicle hours per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base case traffic volumes</td>
<td>110</td>
</tr>
<tr>
<td>Traffic volumes existing land use</td>
<td>10</td>
</tr>
<tr>
<td>Project traffic volume</td>
<td>50</td>
</tr>
<tr>
<td>Existing land use traffic volumes deduced from base case</td>
<td>100</td>
</tr>
<tr>
<td>With project traffic volumes</td>
<td>150</td>
</tr>
<tr>
<td>Incremental increase due to project</td>
<td>40</td>
</tr>
<tr>
<td>Existing land use traffic volumes not deducted from base case</td>
<td>110</td>
</tr>
<tr>
<td>With project traffic volumes</td>
<td>160</td>
</tr>
<tr>
<td>Incremental increase due to project</td>
<td>50</td>
</tr>
</tbody>
</table>

Inputs and tasks in traffic impact valuation workbook

The traffic impact assessment will model project case traffic volumes and corresponding vehicle-hours travelled by existing users for selected years.

**Task 1.** The proponent should manually enter the change in annual vehicle hours travelled for existing users for each of the four vehicle types for all modelled years in the *Annual VHT* worksheet. The proponent should then apply linear extrapolation between modelled traffic years to estimate the change in annual vehicle-hours travelled in all non-modelled years in the *Annual VHT* worksheet of the TIVW.
Step 5: Estimate the economic cost of the project’s traffic impact and conduct sensitivity analysis

The value of additional travel time for existing users due to the project’s traffic impact is estimated by multiplying the change in vehicle-hours travelled (for existing users only) by the value of time for each vehicle type and time period. The value of additional vehicle-hours travelled should be estimated for the following vehicle types:

- Private car
- Business car
- Light commercial vehicle
- Heavy rigid truck.

The value of travel time for light commercial vehicles and heavy rigid trucks includes the value of freight travel time (table 5.16).

5.16 Value of travel time, urban and rural roads - 2015 dollars

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Non-urban</th>
<th>Urban</th>
<th>Total value per vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value per vehicle</td>
<td>Freight</td>
<td>$/veh/hr</td>
</tr>
<tr>
<td>Cars - Private</td>
<td>26.37</td>
<td>0.00</td>
<td>26.37</td>
</tr>
<tr>
<td>Cars - Business</td>
<td>64.55</td>
<td>0.00</td>
<td>64.55</td>
</tr>
<tr>
<td>Light commercial</td>
<td>35.72</td>
<td>0.83</td>
<td>36.55</td>
</tr>
<tr>
<td>Heavy rigid truck</td>
<td>28.36</td>
<td>7.70</td>
<td>36.06</td>
</tr>
</tbody>
</table>

Value per vehicle estimated by multiplying occupancy rate and value per occupant.

Note: Assumptions include non-urban speed (km/hr): 90, Urban speed – cars and rigid trucks (km/hr): 50, Urban speed – articulated truck and combination vehicles (km/hr): 57.23. Value of travel time adjusted to 2015 dollars using ABS CPI data. Source: Transport for NSW (TfNSW), 2013, Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives.

Inputs and tasks in traffic impact valuation workbook

The tasks to estimate the economic value of traffic impacts are detailed below:

Task 1. The original value of travel time estimates are based on 2012 prices. The proponent should adjust the unit damage cost to the relevant base year prices. The costs have been adjusted in the TIVW to 2015 prices.

Existing road users includes existing and future road users under the base case (without the project) throughout the appraisal period.

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using ABS Consumer Price Index data.\textsuperscript{77} The CPI adjustment factor should be revised in cases where the base year is not 2015.

**Task 2.** Calculate the discounted annual value of traffic impacts by multiplying the discount factor by the undiscounted value of traffic impacts in each year.

a. The TIVW calculates the discounted value of traffic impacts in each year in the *NPV Calculation* worksheet.

b. The total present value of traffic impacts over the appraisal period is the sum of the annual discounted values. The TIVW calculates the total present value in the *Summary* worksheet.

**Task 3.** Sensitivity analysis of the discount rate. Repeat Task 2 using a 4 per cent (low) and 10 per cent (high) discount rate (as per NSW Treasury’s guidelines for economic appraisal\textsuperscript{78}). Sensitivity Analysis of the discount rate is completed in the *SA Discount Rate* worksheet.

The ‘Summary’ worksheet presents the estimated economic value of traffic impacts.

\textsuperscript{77} ABS, 2014, 6401.0 Consumer Price Index, Australia: Tables 1 and 2 CPI: All Groups, Index Numbers and Percentage Changes.

Visual amenity

Mining and coal seam gas activities can alter the visual amenity for nearby residents and the local community. The main causes of change to visual amenity include:

- Modification of topographic features including new and/or increased views of mine waste rock emplacements and/or open cut sections into the landscape
- Realignment of access roads and utilities (e.g. electricity)
- Additional vegetation clearance
- Temporary soil stockpiles
- Use of night-lighting during the operational phase
- Dust clouds following blasting and on windy days
- Construction of flood and earth bunds

Appraisal of visual amenity impacts

There are four steps in the appraisal of visual amenity impacts:

Step 1. Outline the existing landscape and visual setting
Step 2. Scope the project’s impact
Step 3. Outline the change to visual amenity, identifying affected sites
Step 4. Estimate the economic value of impact and conduct sensitivity analysis

These steps are explained in detail below. A Visual Amenity Valuation Workbook (VAVW) has been developed alongside this guidance module to facilitate the necessary steps for calculating the monetary values for visual amenity impacts (where possible).

A Visual Assessment is required as part of a project’s environmental assessment (or environmental impact statement). A Visual Assessment identifies properties and sites that are visually impacted by a project by assessing the:

- **Visual effect** - a measure of the level of visual contrast and integration of the project with the existing landscape.
- **Visual sensitivity** - the degree to which visual effects are visible and is dependent on visual screening, distance from site and general orientation of the landscape.

The **visual impact** of a project is a combination of the **visual effect** and the **visual sensitivity**.

Information from a Visual Assessment relevant to an appraisal of visual amenity impacts should be used where available.
**Step 1: Outline the existing landscape and visual setting**

The Visual Assessment will outline the:

- Existing landscape (topography, vegetation, hydrology and land use features) and visual setting
- Identify distinct land use types and landscape units of varying levels of landscape quality
- Assess visual impacts at different distances from the project site (e.g. greater than 5km, between 1km and 5 km, and less than 1km).
- Review short term and long term visual impacts
- Assess how the existing landscape is seen from various viewing locations.

**Step 2: Scope the project’s impact**

A Visual Assessment will identify the various components and activities of a project and the associated visual characteristics. The three key components of a project that alter the landscape and visual setting are:

- visual modification of topographic features and/or clearing of vegetation
- altered service lines and road networks
- Night-lighting for night time operations.

A Visual Assessment will assess how the project alters the landscape and visual setting at locations where people are likely to obtain a view of the project. In most cases, representative viewing locations are selected from which field assessment and detailed analysis of aerial photography and topographic plans are undertaken to determine the likely visibility of a project.

A Visual Assessment will also assess the impact of night-lighting from mobile machinery lights and operational lighting on nearby locations and dwellings.

**Step 3: Outline the change to visual amenity, identifying affected sites**

The change to the landscape and visual setting should be determined by assessing the visual characteristics of the project (identified in Step 2) against the existing landscape and visual setting (identified in Step 1).

**Visual effect**

Firstly, the *visual effect* of the project should be determined. The *visual effect* is a measure of the level of visual contrast and integration of the project with the existing landscape.\(^7\) The visual effect of a project is determined by the:

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• Level of contrast and integration of the project with its surrounding landscape

• Proportion of a view that includes the project, the lower the proportion of the view, the lower the level of visual effect will be and vice versa.

The visual effect increases as the contrast between the existing visual setting and the changed visual setting increases. For example, an open cut mine, which strongly contrasts with the existing landscape, increases the visual effect. Conversely, the greater the integration of the visual character of the project, the lower the visual effect will be as there is limited contrast. For example, greater visual integration occurs when a mine area is successfully rehabilitated.

**Visual sensitivity**

Visual sensitivity is assessed by identifying the number and type of sensitive viewing locations to determine the visual impact. For example, residential, tourist and/or recreation areas generally have a higher visual sensitivity than other land use areas including industrial, agricultural or transport corridors, because land uses, such as residential, use the scenic amenity values of the surrounding landscape and may be used as part of a leisure experience and often over extended viewing periods.

Visual sensitivity of impacted sites may range from high to low, depending on the following additional factors:

• Screening of any intervening topography, buildings or vegetation - residences with well screened views of the Project will have a lower visual sensitivity than those with open views.

• Viewing distance from the residence to visible areas of the Project – the longer the viewing distances, the lower the visual sensitivity.

• General orientation of residences to landscape areas affected by the project - residences with strong visual orientation towards the project – those with areas such as living rooms and/or verandas orientated towards it, will have a higher visual sensitivity that those not orientated towards the project and which do not make use of the views toward the project.

The visual impact of a project is the combined result of visual effect and visual sensitivity. The visual impact of a project is likely to differ spatially and change throughout the course of the project. Often mitigation measures are implemented to minimise negative visual impacts. The visual impact of the project should be assessed as the residual impact once management and mitigation measures have been taken into account.

**Inputs and tasks for the Visual Amenity Valuation Workbook**

A Visual Assessment will identify sites/properties where visual impact occurs. These sites need to be entered into the Visual Amenity Valuation Workbook (VAVW). The ‘Properties Impacted’ worksheet in the VAVW includes a matrix where the number of impacted sites should be entered according to average property value and degree of visual impact.
**Task 1.** Estimate the *average property per annum rental value* of the impacted sites.

- Where the property rental values of impacted sites are similar, a central estimate of the average property rental value can be entered into the ‘Key Assumptions’ worksheet.
- Where there is a substantial range in property rental values, group properties into low, central and high property value groups. Enter the average property rental value for the low, central and high property rental value groups into the ‘Key Assumptions’ worksheet.

**Task 2.** Assess the degree of visual impact for impacted sites. This information should be sourced from the Visual Assessment where available. As noted above, visual impact can range from high to low depending the visual effect and visual sensitivity ( Influenced by factors such as visual screening and viewing distance). Assign a low, medium or high visual impact rating for each impacted site.

**Task 3.** Enter the number of impacted sites into the matrix in the ‘Properties Impacted’ worksheet of the VAVW according to average property rental value and degree of visual impact.

**Task 4.** Enter the duration of the visual impact in number of years from the Project Start Year in the ‘Key Assumptions’ worksheet. This should be entered as the central estimate for the duration of impact. Sensitivity analysis of the duration of visual dis-amenity impact can be undertaken in Step 4 below.

**Step 4: Estimate the economic value of impact and conduct sensitivity analysis**

Visual dis-amenity impacts on nearby residents, the local community and visitors to the area. The lost economic value from visual dis-amenity can be estimated using non-market valuation techniques such as:

- **Hedonic pricing** – measures the value of non-market characteristics through changes in property rental values. For example, reduced visual amenity due to an open cut mine may reduce the market value of a nearby property. The decrease in market value for a property is an estimate of the economic cost of the visual impact borne by the property owner.

- **Travel cost** – measure the value of non-market characteristics by analysing people’s recreation expenditure and travel time. Theoretically, the cost of visual dis-amenity of a mine site for travellers to the area can be estimated using the travel cost method.

- **Choice modelling** – measures the value of a non-market attribute (e.g. visual amenity) through survey-based methods where respondents are asked to choose between various alternatives, with each different alternative being described by multiple attributes (including price/cost).
Both these non-market valuation techniques can be expensive and time consuming to complete. The opportunity to use benefit transfer is limited because:

- The implicit prices estimated in a hedonic pricing study are particular to the housing market being assessed and its particular circumstances of supply and demand.\(^80\)

- There is a lack of primary non-market valuation studies estimating the economic value of changes to visual amenity. This is particularly true in the case of visual amenity impacts from mining and CSG projects where previous cost benefit analyses in this area have included the cost of acquiring the property as a proxy for the cost of environmental impacts on nearby properties (including visual dis-amenity impacts).

This guidance module enables the proponent to choose one of two approaches to estimate the economic value of the visual impact:

- **Approach A:** Complete a hedonic pricing study to estimate the change in property rental value due to the presence of the mining or coal seam gas project.

- **Approach B:** Source information from local real estate agents or other property valuation sources on the change in property rental values due to the presence of the project. The likely change in property rental values should be specific to the local property market.

Regardless of which approach is chosen it is critical to avoid double counting the economic value of other impacts (e.g. noise pollution) that may also be reflected in changes in property prices. The economic value of impacts from changes in noise levels is valued separately in the guidance module (see Section 5) and should be deducted from the change in economic value estimated based on the change in property values due to the presence of the mining or coal seam gas project. Unless of course the change in property values does not include impacts due to air quality and noise pollution.

Furthermore, the change in property value should reflect the degree of visual impact, such that a larger change in property value occurs for a greater visual impact, such as for properties closer to the project site or those which a higher frequency and/or duration of impact.

This approach provides a lower bound estimate of the lost consumer surplus to nearby property owners resulting from the visual impact. The approach does not estimate the change in consumer surplus due to visual impacts to the local community and visitors to the area.\(^81\)

An alternative approach that may be considered is to estimate the change in the capital value of the property at the start of the period of visual dis-amenity. As this is a capital item, it should not be discounted or aggregated over time.

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\(^81\) See Bennett, J, 2011, *Maules Creek Coal Project Economic Impact Assessment: A review*. 

## Inputs and tasks for the Visual Amenity Valuation Workbook

**Task 1.** Estimate the change in property rental value due to the visual impact according to the degree of visual impact (low, central and high). The change in property rental value should be in line with the visual degree (low, medium and high).

**Task 2.** Calculate the annual undiscounted cost of visual dis-amenity. By multiplying the number of properties impacted (for a given average property rental value group and degree of visual impact) by the average property rental value and the decrease in property value (entered in the ‘Key Assumptions’ worksheet). The VAVW calculates the annual undiscounted cost of visual dis-amenity in the ‘NPV Calculation’ worksheet.

**Task 3.** Discount the annual cost of visual dis-amenity for each year of the appraisal period using a discount factor. A discount factor based on a 7 per cent discount rate has been applied to the unit damage costs in the VAVW in the NPV Calculation worksheet.

**Task 4.** Sensitivity Analysis of the duration of visual impact. Where there is uncertainty about the duration of visual impact, the economic cost for a low and high visual impact duration can be assessed. Enter into the ‘Key Assumptions’ worksheet a low and high duration of visual dis-amenity impact. Sensitivity analysis of the duration of impact is completed in the SA Duration of Impact worksheet of the VAVW.

**Task 5.** Sensitivity Analysis of the discount rate. Repeat Step 3 using a 4 per cent (low) and 10 per cent (high) discount rate (as per NSW Treasury’s guidelines for economic appraisal82). Sensitivity Analysis of the discount rate is completed in the SA Discount Rate worksheet.

The Summary worksheet of the VAVW summaries the present value of the dis-amenity cost for all scenarios assessed.

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Appendix A  Unit damage costs

PAEHolmes (2013) transferred damage cost values from the UK Department of Environment, Food and Rural Affairs (Defra).\(^83\) The UK damage costs have been estimated for areas with different population densities. PAEHolmes adjusted the UK damage cost values to account for differences between the Value of a Life Year (VOLY) in the UK and Australia, and differences in currency and inflation.\(^84\)

PAEHolmes (2013) estimated the linear relationship between adjusted damage cost and population density. This linear function was used with population density data to estimate unit damage costs weighted for population exposure for each SUA in Australia.

PAEHolmes (2013) recommend that these weighted unit damage costs be used for economic appraisals in NSW and Australia where there is no possibility of following the full impact pathway approach.\(^85\)

### A1  Unit damage costs by SUA (rounded to two significant figures) - NSW

<table>
<thead>
<tr>
<th>SUA code</th>
<th>SUA name</th>
<th>Area</th>
<th>Population</th>
<th>Population density</th>
<th>Damage cost/tonne of PM(_{2.5})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>km(^2)</td>
<td>people/km(^2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1030</td>
<td>Sydney</td>
<td>4.064</td>
<td>4,028,525</td>
<td>991</td>
<td>$280,000</td>
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<tr>
<td>1009</td>
<td>Central Coast</td>
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<td>304,755</td>
<td>538</td>
<td>$150,000</td>
</tr>
<tr>
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<td>Wollongong</td>
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<td>268,944</td>
<td>470</td>
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<td>1027</td>
<td>Port Macquarie</td>
<td>96</td>
<td>41,722</td>
<td>433</td>
<td>$120,000</td>
</tr>
<tr>
<td>1013</td>
<td>Forster - Tuncurry</td>
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<td>394</td>
<td>$110,000</td>
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<tr>
<td>1023</td>
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<td>398,770</td>
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<td>14,148</td>
<td>303</td>
<td>$85,000</td>
</tr>
</tbody>
</table>


\(^84\) PAEHolmes, 2013, Methodology for valuing the health impacts of changes in particle emissions - final report. Prepared for NSW Environment Protection Authority (EPA).

\(^85\) PAEHolmes, 2013, Methodology for valuing the health impacts of changes in particle emissions - final report. Prepared for NSW Environment Protection Authority (EPA).
<table>
<thead>
<tr>
<th>SUA code</th>
<th>SUA name</th>
<th>Area</th>
<th>Population</th>
<th>Population density</th>
<th>Damage cost/tonne of PM$_{2.5}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1010</td>
<td>Cessnock</td>
<td>69</td>
<td>20,262</td>
<td>294</td>
<td>$82,000</td>
</tr>
<tr>
<td>1034</td>
<td>Wagga Wagga</td>
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<td>52,043</td>
<td>272</td>
<td>$76,000</td>
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<tr>
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