# 4 *IMPACT ASSESSMENT APPROACH AND METHODOLOGY*

## 4.1 *INTRODUCTION*

An impact is essentially any change to a resource or receptor brought about by the presence of the project component or by the execution of a project related activity. The adequate assessment and evaluation of the impacts and benefits that will be associated with the project necessitates the development of a methodology that will reduce the subjectivity involved in making such evaluations. A clearly defined methodology is used in order to accurately determine the significance of the predicted impact on, or benefit to, the surrounding natural and/or socio-economic environment. For this reason, the project must be considered in the context of the area and the affected communities.

The purpose of impact assessment is to identify and evaluate the likely significance of the impacts on identified receptors and resources according to defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise, reduce or compensate for any potential adverse environmental effects, and to report the significance of the residual impacts that remain following mitigation. There are a number of ways that impacts may be described and quantified.

Nonetheless, an impact assessment will always contain a degree of subjectivity, as it is based on the value judgment of various specialists and EIA practitioners. The evaluation of significance is thus contingent upon values, professional judgment, and dependent upon the environmental and community context. Ultimately, impact significance involves a process of determining the acceptability of a predicted impact to society.

## 4.2 *ASSESSING IMPACTS*

Impacts are defined according to the impact characteristic which is described according to the type, extent, duration, scale and frequency of the impact, as summarised in *Table 4.1*.

*Table 4.1 Defining Impact Characteristics*

| Characteristic | Definition | Designation |
|---|---|---|
| Type | Indicates the relationship of the impact to the project (cause and effect). | Direct (Impacts that result from a direct interaction between the project and a resource/receptor (e.g., between occupation of a plot of land and the habitats which are affected).<br><br>Indirect (Impacts that follow on from the direct interactions between the project and its environment as a result of subsequent interactions within the environment (e.g., viability of a species population resulting from loss of part of a habitat as a result of the project occupying a plot of land)).<br><br>Induced (Impacts that result from other activities (which are not part of the project) that happen as a consequence of the project (e.g., influx of camp followers resulting from the importation of a large project workforce).) |
| Extent | The "reach" of the impact (e.g., confined to small area or projected for several kilometres, etc). | Local<br>Regional<br>International<br>(Defined on a resource/receptor-specific basis) |
| Duration | The time period over which a resource / receptor is affected. | Temporary<br>Short-term<br>Long-term<br>Permanent<br>(Defined on a resource/receptor-specific basis). |
| Scale | Size of the impact (e.g. size of damaged area or fraction of a resource lost or affected, etc.) | (No fixed designations; intended to be a numerical value). |
| Frequency | Measure of the constancy or periodicity of the impact. | (No fixed designations; intended to be a numerical value). |

The terminology and designations are provided to ensure consistency when these characteristics are described in an impact assessment deliverable.

An additional characteristic that pertains only to unplanned events (e.g., traffic accident, accidental release of fuel, community riot, etc.) is likelihood. The likelihood of an unplanned event occurring is designated using a qualitative (or semi-quantitative, where appropriate data are available) scale.

*Table 4.2 Definitions of Likelihood*

| Likelihood | Definition |
|---|---|
| Unlikely | The event is unlikely but may occur at some time during normal operating conditions. |
| Possible | The event is likely to occur at some time during normal operating conditions. |
| Likely | The event will occur during normal operating conditions (i.e. it is essentially inevitable). |

Likelihood is estimated on the basis of experience and/or evidence that such an outcome has previously occurred. It is important to note that likelihood is a measure of the degree to which the unplanned event is expected to occur, not the degree to which an impact or effect is expected to occur as a result of the unplanned event. The latter concept is referred to as uncertainty, and this is typically dealt with in a contextual discussion in the impact assessment deliverable, rather than in the impact significance assignment process.

### 4.2.1 *Assessing Significance*

Once the impact characteristics are understood, they are used to assign each impact a magnitude. Magnitude is a function of the following impact characteristics:

- Extent
- Duration
- Scale
- Frequency
- Likelihood (for unplanned events only)

Magnitude essentially describes the degree of change that the impact is likely to impart upon the resource/receptor. The magnitude designations are as follows:

- Positive
- Negligible
- Small
- Medium
- Large

The methodology incorporates likelihood into the magnitude designation (i.e. in parallel with consideration of the other impact characteristics), so that the "likelihood-factored" magnitude can then be considered with the resource/receptor sensitivity/vulnerability/importance in order to assign impact significance.

The magnitude of impacts takes into account all the various dimensions of a particular impact in order to make a determination as to where the impact falls on the spectrum from negligible to large. Some impacts will result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes can be regarded as essentially having no impact, and should be characterised as having a negligible magnitude.

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for a given impact is to define the sensitivity/vulnerability/importance of the impacted resource/receptor. There are a range of factors to be taken into account when defining the sensitivity/vulnerability/importance of the resource/receptor, which may be physical, biological, cultural or human. Where the resource is physical (for example, a water body) its quality, sensitivity to change and importance (on a local, national and international scale) are considered.

Where the resource/receptor is biological or cultural (for example, the marine environment or a coral reef), its importance (for example, its local, regional, national or international importance) and its sensitivity to the specific type of impact are considered. Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered. Other factors may also be considered when characterising sensitivity /vulnerability /importance, such as legal protection, government policy, stakeholder views and economic value.

As in the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations will vary on a resource/receptor basis. The universal sensitivity/vulnerability/importance designations are:

- Low
- Medium
- High

Once magnitude of impact and sensitivity/vulnerability/importance of resource/receptor have been characterised, the significance can be assigned for each impact. The following provides a context for defining significance.

*Table 4.3* *Context for Defining Significance*

| |
|---|
| • An impact of ***negligible*** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations. |
| • An impact of ***minor*** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards. |
| • An impact of ***moderate*** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently. |
| • An impact of ***major*** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts remaining even after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the project. |

Based on the context for defining significance, the impact significance rating will be determined, using the matrix below.

*Table 4.4* *Impact Significance Rating Matrix*

| | | **Sensitivity/Vulnerability/Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| **Magnitude of Impact** | Negligible | **Negligible** | **Negligible** | **Negligible** |
| | Small | **Negligible** | **Minor** | **Moderate** |
| | Medium | **Minor** | **Moderate** | **Major** |
| | Large | **Moderate** | **Major** | **Major** |

## 4.3 IDENTIFICATION OF MITIGATION MEASURES

Once the significance of a given impact has been characterised using the above matrix, the next step is to evaluate what mitigation measures are warranted. In keeping with the Mitigation Hierarchy, the priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e. to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

Once mitigation measures are declared, the next step in the EIA process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described below.

*Table 4.5 Mitigation Hierarchy*

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|---|
| **Avoid at Source; Reduce at Source:** avoiding or reducing at source through the design of the project (e.g., avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity). |
| **Abate on Site:** add something to the design to abate the impact (e.g., pollution control equipment, traffic controls, perimeter screening and landscaping). |
| **Abate at Receptor:** if an impact cannot be abated on-site then control measures can be implemented off-site (e.g., noise barriers to reduce noise impact at a nearby residence or fencing to prevent animals straying onto the site). |
| **Repair or Remedy:** some impacts involve unavoidable damage to a resource (e.g. agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures. |
| **Compensate in Kind; Compensate Through Other Means:** where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (e.g., planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries access, recreation and amenity space). |

## 4.4 SPECIALIST STUDY METHODOLOGY

A number of specialist studies were identified (predominantly during the scoping phase) as being necessary to effectively assess the potential impacts associated with the proposed development in the EIA phase. These include:

- Vegetation and terrestrial ecology;
- Socio-economic;
- Archaeological and cultural heritage;
- Palaeontology;
- Hydrology;

- Air quality; and
- Noise and vibration.

The following section provides a brief summary of the methodology used for each of these specialist studies. Please refer to Annex F for the full specialist reports and further details on the specific methodology.

### *4.4.1 Ecology and Biodiversity*

An ecology and biodiversity study was undertaken (report dated March 2013) to characterise the receiving biophysical environment and provide an assessment of the likely impact of the development on the fauna and flora of the proposed project site.

A literature review and data sourcing exercise was undertaken to identify relevant information on animal and plant species within the study area. This was followed by a site visit that was conducted on 4 October 2012. During the site visit the following activities where undertaken:

- The different biodiversity features, habitat, vegetation and landscape units present at the site were identified and mapped.
- Walk-through-surveys were conducted across the site. All plant and animal species that were observed were recorded.
- The entire development footprint was surveyed. All listed and protected plant species observed within the development area were recorded and located using a GPS.

A draft ecological sensitivity map of the site was produced by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various spatial databases that were reviewed. The ecological sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

- **Low** – Units with a low sensitivity where there is likely to be a negligible impact on ecological processes and terrestrial biodiversity (e.g. transformed habitats).
- **Medium**- Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact (such as erosion) low.
- **High** – Areas of natural or transformed land where a high impact is anticipated due to the high biodiversity value, sensitivity or important ecological role of the area.
- **Very High** – Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are essentially no-go areas from a developmental perspective and should be avoided at all costs.

Finally, a number of potential ecological impacts resulting from the proposed development were identified for the construction and operational phases of the project. In addition to this, specific mitigation measures were provided to minimise and/or avoid any adverse impacts identified. The specific sensitivity of the impacted area is discussed and assessed in *Chapter 7* below.

Please refer to Annex F for the specialist report.

### 4.4.2 *Archaeological and Cultural Heritage*

A Phase 1 Heritage Impact Assessment (HIA) was undertaken in October 2012 to determine whether or not any heritage resources of significance are positioned in close proximity to the project site. Through identifying such heritage resources, the study aimed to minimise and/or avoid any adverse impacts to such resources.

The study assessed the potential impacts on both tangible (e.g. monuments, stone artefacts, rock paintings) and intangible (e.g. the projects impact on the cultural characteristics of local traditional communities) heritage resources.

Data was collected through a desktop review of a previous archaeological study that was completed along the length of the railway line in 2008 (Archaic, 2008). The data was corroborated through a reconnaissance survey of the proposed site, undertaken on an intermittent basis from March 2012 to April 2012. In addition, the study was informed through consultation with local community members, authorities, museums, academic institutions and historical associations that was undertaken on a regular basis. Subsequent to a gap analysis additional information, in terms of the occurrence of significant heritage resources, was included and summarised.

The relevant tangible and intangible heritage resources identified during the initial phase of the study were classified in terms of their importance. Finally, a list of recommendations, alternatives and mitigation measures were provided in order to inform the sustainable management of such heritage resources and the final decision-making process on the feasibility of the proposed project.

Please refer to Annex F for the report.

### 4.4.3 *Palaeontology*

A desktop palaeontological specialist study was undertaken in September 2012 to provide an assessment of the observed or inferred palaeontological heritage resources within the proposed project site.

The study initially used geological maps and satellite images to identify fossil bearing rock units occurring within the broader study area. Known fossil heritage in each rock unit was inventoried using:

- A review of scientific literature (Almond 2010a, 2010b, 2011a, 2011b, 2012a, 2012b, among others);
- Previous assessments of the broader study region (Almond & Pether, 2008); and
- The author's field experience and palaeontological database.

Based on this data, as well as field examination of representative exposures of all major sedimentary rock units present, the impact significance of the proposed development was assessed with recommendations for any further studies or mitigation.

Please refer to Annex F for the report.

### *4.4.4 Noise and Vibration*

A noise and vibration specialist study was conducted to determine the baseline noise levels and to undertake the noise and vibration impact assessment of the proposed project. Noise measurements for the entire project, of which the Compilation Yard formed a part, were carried out over a 3 day period from 15 to 18 October 2012.

Ambient noise measurements were taken with a Type 1 Precision Impulse Integrating Sound Level Meter, in accordance with international standards for sound level meter specifications (IEC and ISO). Noise measurements were performed intermittently over a twenty-four hour period and were categorised in terms of daytime (07:00-22:00) and night-time (22:00-07:00). Abnormal disturbances, such as loud noise generation in close proximity, or sudden noise bursts that affect the measurement, were discarded.

Measurements were performed in compliance with the weather condition requirements specified by the SANS and ISO codes. As a result measurements were not performed when the steady wind speed exceeded $5ms^{-1}$ or wind gusts exceeded $10\ ms^{-1}$.

The code of practice for noise and vibration control on construction and open sites (BS 5228-1: 2009 standard, Part 1: Noise) was utilised for the calculation of noise levels during the construction phase and the determination of the sound level data from on-site equipment and site activities. Typical sound power levels utilised in the standard were taken from measurements at various sites, percentage on-times and power ratings for a wide range of construction activities. The expected worst-case mix of excavators, bulldozers, front-end loaders, graders, compressors and trucks utilised for the noise modelling was assumed by similar operations. It was also assumed, as a worst-case scenario, that all the equipment would be operated simultaneously at the construction site.

Noise modelling was performed using the Computer Aided Noise Abatement (CADNA) noise model. Sound propagation calculations were undertaken and

sound pressure levels around the proposed project site were predicted. A noise contour grid was determined. Noise levels were estimated at discrete receptors in the vicinity of the proposed project site.
Noise modelling and impact assessment was undertaken for two different scenarios relating to the proposed ramp-up in export capacity of the railway line:

- Scenario A - Based on transport of 12 Mtpa ore;
- Scenario B – Based on transport of 16 Mtpa ore.

Based on the noise modelling the resulting noise levels around proposed project site were estimated for both day- and night-time conditions. Finally, the impacts of construction and operation were assessed and mitigation measures and recommendation were provided, where necessary.

With respect to identifying vibration levels during the construction phase, there are no standards that provide a methodology to predict levels of vibration from construction activities, other than those contained within British Standard for noise and vibration control on construction sites and open sites (BS5228: Part 2).

Measurements for existing cargo trains were undertaken along the existing railway to determine the peak particle velocity (PPV). The PPV is used to measure vibration through a solid surface. A PPV value of 5.87 mm/s was used as a worst-case scenario. Vibration level calculations were undertaken according to the BS5228 standard at various distances from the railway. The results were used to estimate vibration levels at various distances from the track centreline.

Finally, the impacts of construction and operation were assessed and mitigation measures and recommendation were provided, where necessary.

Please refer to Annex F for the report.

#### *4.4.5 Air Quality*

An air quality specialist study was undertaken to assess the impact the proposed Compilation Yard may have on air quality.  The description of the climate in the study area is based on available meteorological information for the Northern Cape. The description of the state of air quality in the vicinity of the Compilation Yard and Common User Facility is based on an assessment of the sources of atmospheric emissions, the nature of the pollutants that are released and information in the Initial State of Air Report (DEA, 2005).

The assessment of impacts resulting from the emissions is done in three stages. The first is the development of a qualitative emission inventory for the main sources. Secondly to estimate ambient concentrations (PM10, PM2.5, SO2, NOx, benzene) and dust deposition using the US-EPA approved (US-

EPA, 2012) and DEA recommended (DEA, 2012) SCREEN 3 dispersion model, and lastly to assess the impacts by comparing the predicted concentrations with ambient air quality standards or guidelines.
The dust emissions methodology that has been used in this study is based on activity data, emission factors and control factors. Activity data in terms of estimated throughputs (tonnages) railed and design specifications for the proposed operations were obtained from the Final Scoping Report (ERM, 2013) and personal communication with the project team. The configuration of the operations in terms of the Compilation Yard and Common User Facility is based on the plant layout as provided in the Final Scoping Report (ERM, 2013).

The SCREEN3 model is designed to estimate the worst-case impact based on the meteorological matrix for use as a conservative screening technique. The SCREEN3 model does not use hourly meteorological data. Instead, the user can select one of the following options:

- Full Meteorology – model uses a predefined matrix of meteorological conditions that references all stability classes (A through F) and associated wind speeds, where the maximum wind speed is stability-dependent;
- Single Stability Class – user selects a single stability category, and the model automatically examines all wind speeds appropriate for that category; or
- Single Stability Class and Wind Speed – user selects a single stability category and wind speed combination.

The Full Meteorology option is used for routine application of the SCREEN3 model.

Recommendations on appropriate mitigation to reduce the impacts are based on best practice and the nature of the emitting activity. Input to the management of activities to ensure that impacts are minimised analyses the proposed activities to identify alternative approaches or methods to achieve the end result, but reducing the impact.

Please refer to Annex F for the report.

### 4.4.6 *Socio-economic Assessment*

The socio-economic baseline is compiled based on a combination of secondary and primary information. Publicly available secondary information used during the study included:

- StatsSA, Population Census 2011;
- District and Local Municipalities' Integrated Development Plan, 2011-2012;
- StatsSA, Quarterly Labour Force Survey, Quarterly 1, Jan- March 2012; StatsSA, Monthly earnings of South Africans, 2010; and
- Stats SA, Gross Domestic Product, Third Quarter, 2011.

The primary data used was derived from semi-structured, qualitative interviews with the project affected landowners and Community Development Workers' (CDW) as well as feedback received through the public participation process.

The potential impacts associated with establishment and operation of the Compilation Yard was assessed within the context of the baseline conditions. Finally, mitigation measures and recommendations for enhancement were provided.  As mentioned previously, the socio-economic specialist is part of the ERM EIA team and the assessment has been pulled directly into the report and is not included as a stand-alone report.