TETE IRON ORE PROJECT

VISUAL IMPACT ASSESSMENT

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<td>September 2014</td>
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<tr>
<td>Michael Bailey</td>
<td>Reviewer</td>
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(Report writing)

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(Report review)

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EXECUTIVE SUMMARY

The landscape of the project area is mildly transformed by subsistence agriculture, but there are no features of natural beauty that attract visitors to the area. The functionality of the landscape will be changed within the project area, where non-mine employees will be excluded from the area. They will no longer be able to farm or hunt in the mine area. From a land use perspective, the mine will have a large impact on current land use but the extent of the impact will be limited to the mine area. The vegetation of the area is dense and lush in the wet season, with grass easily reaching above two metres. In the winter though, vegetation cover is significantly less. Infrastructure will be more visible during the dry (winter) season.

The project area is not a tourist destination and the development of the mine will not have any negative effects in that regard. It is likely that the entire area will experience a rather large change in character in the next decade or so, as various other mining companies establish themselves in the area to exploit the large coal resources.

The topography of the area consists of low lying hills, which are interspersed in an otherwise generally flat terrain. A number of tributary rivers and streams flow through the area, and drain into the Zambezi river. Within the project area, the largest of these tributaries of the Zambezi are the Revuboe and Ncondezi Rivers. The project area varies in height between 270 to 390 masl, and the prominent hill that will be mined, Tenge Hill, stands out from the surrounding topography with a height of 390 masl. Its loss from the landscape will be quite obvious at first to locals, until they become accustomed to the change. Tall and obvious mine infrastructure such as the waste rock dumps and the Tailings Storage Facility (TSF) are likely to contribute most to the visibility of the mine.

The following heights were used in the calculation of viewsheds, based on currently available knowledge:

- The Tailings Storage Facility (TSF) – 45 metres
- Waste rock dump – 45 metres;
- A beneficiation plant, which will include: crusher and screening units, dry magnetic cobber, hydrocyclone, process water dam – 20 metres;
- A production plant, which will include: a multi-hearth furnace, rotary kiln, transfer flask, waste heat boiler, melting furnace – 20 metres;
- Storage sheds – 15 metres;
- The haul road – not a feature of height but nevertheless a feature whose visibility needs to be considered;
- The rail siding – 15 metres;
- Ancillary offices and infrastructure, including: staff accommodation, workshops, kitchens, recreation areas, laundry rooms, fuel storage depots, concrete mixing area, water treatment facility and a sewage treatment plant – all single story structures not exceeding 6 metres in height.
- The mine pit – not widely visible on a level plain, but highly visible from the air. Not a feature of height, but nevertheless it will contribute to the visual impact of the development.

Only a small number of landscape character types may potentially be affected by the proposed mine. These are the surrounding villages. The following villages are located within 12 kilometres of the mine:

- Nhambia
- Nhamidima
- Matacale
- Muchena
- Nkakame
- Tchissi
- Massamba
- Caundo
- Kapenda

<table>
<thead>
<tr>
<th>Village</th>
<th>Proportion of mine visible</th>
<th>ZTV Category</th>
<th>Visual exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nhambia</td>
<td>60-80%</td>
<td>Visually intrusive</td>
<td>High - Very high</td>
</tr>
<tr>
<td>Nhamidima</td>
<td>60-80%</td>
<td>Visually dominant</td>
<td>Very high</td>
</tr>
<tr>
<td>Matacale</td>
<td>0-20%</td>
<td>Noticeable</td>
<td>Low - Moderate</td>
</tr>
<tr>
<td>Muchena*</td>
<td>0-80%</td>
<td>Noticeable</td>
<td>Moderate - High</td>
</tr>
<tr>
<td>Nkakame</td>
<td>20-40%</td>
<td>Element of landscape</td>
<td>Low</td>
</tr>
<tr>
<td>Tchissi</td>
<td>0%</td>
<td>Element of landscape</td>
<td>Negligible</td>
</tr>
<tr>
<td>Massamba</td>
<td>0%</td>
<td>Element of landscape</td>
<td>Negligible</td>
</tr>
<tr>
<td>Caundo</td>
<td>0%</td>
<td>Element of landscape</td>
<td>Negligible</td>
</tr>
<tr>
<td>Kapenda</td>
<td>0%</td>
<td>Element of landscape</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

*This village is elongated on the north-south axis, meaning that certain sections of the village will have views of up to 70% of infrastructure, while others will see zero.

There are more villages within 12 kilometres of the mine, that have been identified using aerial imagery, but their names are unknown. They may be outlying sections of these known villages.

Of the other features that are typically considered in visual impact assessments such as tourist areas and accommodation, national parks, and scenic routes, there are none. There will be a 50 metre wide corridor connecting the mine site to the rail siding at Moatize. The corridor will contain a haul road, a 220 kV electrical line, and possibly a railway line. The power line is likely to be cable strung on tall pylons (approximately 20 metres high and 300 meters apart) of a steel lattice structure, which will be highly visible to viewers within 2 kilometres of it. Dust from the road is likely to be a problem, unless it is correctly managed.
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1 INTRODUCTION

EOH Coastal and Environmental Services (CES) has been appointed by Capitol Resources Lda., as independent environmental assessment practitioners to undertake an Environmental Impact Assessment (EIA) of a proposed iron ore mine in Tete Province of Mozambique. One of the required specialist studies as identified in the Final Scoping Report is that of a Visual Impact Assessment (VIA) of the proposed development.

As Mozambique does not have a set of guidelines for VIAs, this report is based on guidelines for visual assessment specialist studies as defined by Oberholzer (2005). Other guidelines have also been used, namely, those presented by the Landscape Institute of the UK (2002).

1.1 Objective

The Department of Environmental Affairs and Development Planning (DEA&DP) is a South African government department responsible for development planning in the Western Cape. They have issued South Africa’s only guidelines for visual impact assessments, which are used for this Mozambican development in the absence of local guidelines. According to the DEA&DP guidelines (Oberholzer 2005), the following specific concepts should be considered during visual input into the EIA process:

- An awareness that 'visual' implies the full range of visual, aesthetic, cultural and spiritual aspects of the environment that contribute to the area's sense of place.
- The consideration of both the natural and the cultural landscape, and their inter-relatedness.
- The identification of all scenic resources, protected areas and sites of special interest, together with their relative importance in the region.
- An understanding of the landscape processes, including geological, vegetation and settlement patterns, which give the landscape its particular character or scenic attributes.
- The need to include both quantitative criteria, such as 'visibility', and qualitative criteria, such as aesthetic value or sense of place.
- The need to include visual input as an integral part of the project planning and design process, so that the findings and recommended mitigation measures can inform the final design, and hopefully the quality of the project.
- The need to determine the value of visual/aesthetic resources through public involvement.

1.2 Terms of Reference

The overall aim of a Visual Impact Assessment (VIA) is to determine the current landscape quality (scenic views, visual sensitivity) and the visual impact of the proposed development. The terms of reference of the VIA include the following tasks:

- Undertake a desktop survey using 1:50 000 survey maps, 1:10 000 orthophotos, any digital colour aerial photography and any other high resolution images.
- Conduct a site reconnaissance visit and photographic survey of the proposed project site. The focus of this survey should be on natural and cultural features, protected areas, coastal views and landscape, view sites, and scenic routes.
- Conduct a desktop mapping exercise and develop a Digital Elevation Model to establish visual sensitivity:
  - Describe and rate the scenic character and sense of place of the area and site.
  - Establish extent of visibility by mapping the view-sheds and zones of visual influence.
  - Establish visual exposure to viewpoints.
  - Establish the inherent visual sensitivity and visual absorption capacity of the site by mapping slope grades, landforms, vegetation, special features and land use and overlaying all relevant map layers to assimilate a visual sensitivity map.
• Review relevant legislation, policies, guidelines and standards.
• Preparation of a Visual Baseline/Sensitivity report which shall include, inter alia:
  o Assessing visual sensitivity criteria such as extent of visibility, the sites inherent sensitivity, visual sensitivity of the receptors, visual absorption capacity of the area and visual intrusion on the character of the area.
  o Prepare photomontages of the proposed development.
  o Assess the proposed project against the visual impact criteria (visibility, visual exposure, sensitivity of site and receptor, visual absorption capacity and visual intrusion) for the site.
  o Assess impacts based on a synthesis of criteria for each site (criteria = nature of impact, extent, duration, intensity, probability and significance).
  o Establish mitigation measures/recommendations with regards to minimizing visual impacts.

1.3 Assumptions and Limitations

1.3.1 Spatial data accuracy

Spatial data used in this study has been acquired from various sources, or been created based on information provided by the client. The output of calculations based on this data has been critically reviewed for accuracy.

1.3.2 Viewshed calculations

Calculation of the viewsheds does not take into account the potential screening effect of vegetation and buildings. The following heights were used in the calculation of viewsheds, based on currently available knowledge:

• The Tailings Storage Facility (TSF) – 45 metres
• Waste rock dump – 45 metres;
• A beneficiation plant, which will include: crusher and screening units, dry magnetic cobber, hydrocyclone, process water dam – 20 metres;
• A production plant, which will include: a multi-hearth furnace, rotary kiln, transfer flask, waste heat boiler, melting furnace – 20 metres;
• Storage sheds – 15 metres;
• The haul road – not a feature of height but nevertheless a feature whose visibility needs to be considered;
• The rail siding – 15 metres;
• Ancillary offices and infrastructure, including: staff accommodation, workshops, kitchens, recreation areas, laundry rooms, fuel storage depots, concrete mixing area, water treatment facility and a sewage treatment plant – all single story structures not exceeding 6 metres in height.
• The mine pit – not widely visible on a level plain, but highly visible from the air. Not a feature of height, but nevertheless it will contribute to the visual impact of the development.

The mine is likely to require a maximum of 100 MW of electricity, broken down as follows: Mine - 3 MW, Beneficiation Plant - 17 MW; and Smelter Complex - 80 MW (SNC Lavalin, 2012). It is not known at this stage where electricity will be sourced from, but the following options are being considered:

The national grid

In this scenario, power will be routed to site from one of two potential substations: the Matambo substation on the southern side of the Zambezi river (will require a 103 km long, 220 kV line to site), or from the new Vale Moatize substation (will require a 86 km long line to site). These power
lines will use a 100 metre wide corridor, connecting the site and a point along the Moatize-Sena Railway line. Also in this corridor will be the haul road, and potentially in the future, a railway line.

**Self-generation: HFO / Diesel**

This option involves the use of an on-site generator to produce power, using fuel delivered to site. This will be a costly option (SNC Lavalin, 2012).

**Self-generation: Coal**

This option involves the use of a coal-fired generation plant. It is unknown where it will be located.
2 METHOD

2.1 The Assessment

A Geographic Information System (GIS) using a Digital Elevation Model (DEM) was used to calculate viewsheds for mine infrastructure. The viewsheds and information gathered during the field survey are used to define criteria such as visibility, viewer sensitivity, visual exposure and visual intrusion for the proposed development. These criteria are, in turn, used to determine the intensity of potential visual impacts on sensitive viewers. All information and knowledge acquired as part of the assessment process are then used to determine the potential significance of the impacts according to the standardised rating methodology as described in the Final Scoping Report (CES 2013).

2.2 Site visit and photographic survey

The field survey (conducted from the 10th to the 15th of April 2014) provided an opportunity to:

- Determine the actual or practical extent of potential visibility of the proposed development, by assessing the screening effect of landscape features;
- Conduct a photographic survey of the landscape surrounding the development;
- Take photographs for use in landscape character images and panoramic views;
- Identify sensitive landscape and visual receptors, such as surrounding villages, tourism areas, national parks and other protected areas.

Viewpoints were chosen using the following criteria:

- High visibility – sites from where most of the mine development will be visible.
- High visual exposure – sites at various distances from the proposed site.
- Sensitive areas and viewpoints from which mine infrastructure will potentially be seen.

2.3 Description of receiving environment

A desktop and field study was conducted to establish and describe the landscape character of the receiving environment. A combination of GIS, literature review and photographic surveys was used to analyse land cover, landforms and land use in order to gain an understanding of the current landscape within which the development will take place. Landscape features of special interest were identified and mapped, as were landscape elements that may potentially be affected by the development.

2.4 Visual Impact Assessment criteria

2.4.1 Visual assessment criteria used in assessing magnitude and significance

The potential visual impact of the proposed mine is assessed using several criteria which assist in postulating the magnitude and determining the significance of the potential impact (Oberholzer 2005).

The visibility of the project is an indication of where in the region the development will potentially be visible from. The rating is based on viewshed size only and is an indication of how much of the region will potentially be affected visually by the development. A high visibility rating does not necessarily equate to a high visual impact, although it can if the region is densely populated with sensitive visual receptors.

Viewer (or visual receptor) sensitivity is a measure of how sensitive potential viewers of the development are to variations in their views. Visual receptors are identified by looking at the development viewshed, and include scenic viewpoints, residents, motorists and recreational users of facilities within the viewshed. A large number of highly sensitive visual receptors can be a predictor of a high magnitude visual impact although their distance from the development...
(measured as visual exposure) and the current composition of their views (measured as visual intrusion) will have an influence on the significance of the impact.

2.4.2 Visibility

Visibility of Project refers to the geographic area from which the project will be visible, or view catchment area. The actual zone of visual influence of the project will be smaller due to screening by existing vegetation (trees) and buildings. This also relates to the number of receptors affected (Oberholzer 2005). Visibility can be split into the following categories:

- High visibility - visible from a large area (e.g. several square kilometres).
- Moderate visibility – visible from an intermediate area (e.g. several hectares).
- Low visibility – visible from a small area around the project site.

Over and above the geographic area from which the project will be visible, this assessment also takes into account what proportion of the mine infrastructure will be visible. This is referred to as a cumulative viewshed, which indicates not only where a feature is visible from (the meaning of visibility as used in the definition above), but also how much of the feature will be visible from that point or area.

In this case the assessment has split the view catchment area into eleven categories, namely, areas from where you will see none of the mine infrastructure, see 10% of the development, with increasing increments of 10% until the entire development can be seen.

2.4.3 Sensitive viewers and viewpoints

Viewer sensitivity refers to the assessment of the receptivity of viewer groups to the visible landscape elements and visual character and their perception of visual quality and value. The sensitivity of viewer groups depends on their activity and awareness within the affected landscape, their preferences, preconceptions and their opinions.

A rating system provided by the Landscape Institute of the United Kingdom was used to determine viewer sensitivity:

- **Exceptional**
  - Views from major tourist or recreational attractions or viewpoints promoted for or related to appreciation of the landscape, or from important landscape features.
- **High**
  - Users of all outdoor recreational facilities including public and local roads or tourist routes whose attention may be focussed on the landscape;
  - Communities where the development results in changes in the landscape setting or valued views enjoyed by the community;
  - Residents with views affected by the development.
- **Moderate**
  - People engaged in outdoor sport or recreation (other than appreciation of the landscape).
- **Low**
  - People at their place of work or focussed on other work or activity;
  - Views from urbanised areas, commercial buildings or industrial zones;
  - People travelling through or passing the affected landscape on transport routes.
- **Negligible**
  - Views from heavily industrialised or blighted areas.
2.4.4 Visual exposure

For the purposes of this assessment, the maps in this report divide the Zones of Theoretical Visibility (ZTV) into the following:
1. Visually dominant zone (within 2km);
2. Visually intrusive zone (between 2km and 4.5km);
3. Noticeable zone (between 4.5 and 8km);
4. “Element of landscape” zone (between 8km and 12km) and the;
5. Negligible Zone (beyond 12km).

Visual exposure was determined using a matrix which compares the ZTV zone against the proportion of mine infrastructure visible (Table 2.1).

Table 2.1: Visual Exposure Matrix derived from pairing the ZTV category and the proportion of mine infrastructure visible.

<table>
<thead>
<tr>
<th>Proportion of mine visible</th>
<th>Visually dominant (&lt;2km)</th>
<th>Visually intrusive (2 - 4.5km)</th>
<th>Noticeable (4.5 – 8 km)</th>
<th>Element of Landscape (8 – 12 km)</th>
<th>Negligible (&gt;12km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>20%</td>
<td>High</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>30%</td>
<td>High</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
<td>Negligible</td>
</tr>
<tr>
<td>40%</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Negligible</td>
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<tr>
<td>50%</td>
<td>Very high</td>
<td>High</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>60%</td>
<td>Very high</td>
<td>Very high</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>70%</td>
<td>Very high</td>
<td>Very high</td>
<td>Very high</td>
<td>Moderate</td>
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<tr>
<td>80%</td>
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<td>Very high</td>
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<tr>
<td>90%</td>
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<td>100%</td>
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<td>0%</td>
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<td>Low</td>
<td>Negligible</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

It is important to note that the visual exposure rating takes the entire mine into account, and not individual infrastructure components. For example, a viewer may feel that they have a very high exposure to the mine if they can see 10% of the infrastructure less than 3km’s away. However, according to the above matrix they will be moderately exposed to the entire mine infrastructure. In a second example, a viewer who is also 3km’s away but can see 80% will have a very high exposure to the mine infrastructure, as they are the same distance but can see a larger proportion of the mine. Similarly, a viewer 7 km from the mine and who can see 100% of the mine will have a very high exposure. While they are further away than the viewer in the first example, they are still relatively near and can see a larger proportion of the whole project, and are thus more exposed to the project.

2.4.5 Visual intrusion

Visual intrusion indicates the level of compatibility or congruence of the project with the particular qualities of the area – its sense of place. This is related to the idea of context and maintaining the integrity of the landscape (Oberholzer 2005). It can be ranked as follows:
- High – results in a noticeable change or conflicts with the surroundings;
- Moderate – partially fits into the surroundings, but is clearly noticeable;
- Low – minimal change or blends in well with the surroundings.

Sense of place is defined by (Oberholzer 2005) as: ‘The unique quality or character of a place. [It] relates to uniqueness, distinctiveness or strong identity.’ It describes the distinct quality of an area that makes it memorable to the observer.
2.5 Visual Impact Assessment

2.5.1 Methodology for assessing the significance of impacts

Four factors need to be considered when assessing the significance of impacts, namely:

1. Relationship of the impact to temporal scales - the temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.

2. Relationship of the impact to spatial scales - the spatial scale defines the physical extent of the impact.

3. The severity of the impact - the severity/beneficial scale is used in order to scientifically evaluate how severe negative impacts would be, or how beneficial positive impacts would be on a particular affected system (for ecological impacts) or a particular affected party.

4. The likelihood of the impact occurring - the likelihood of impacts taking place as a result of project actions differs between potential impacts. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident), and may or may not result from the proposed development. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.

Each criterion is ranked according to Table 2.2 to determine the overall significance of an activity. The criterion is then considered in two categories, viz. effect of the activity and the likelihood of the impact. The overall significance of the impact is determined using Table 2.3. The overall significance is either negative or positive.

The severity of impacts can be evaluated with and without mitigation in order to demonstrate how serious the impact is when nothing is done about it. The word ‘mitigation’ means not just ‘compensation’, but includes concepts of containment and remedy. For beneficial impacts, optimization means anything that can enhance the benefits. However, mitigation or optimization must be practical, technically feasible and economically viable.

The environmental significance scale is an attempt to evaluate the importance of a particular impact. This evaluation needs to be undertaken in the relevant context, as an impact can either be ecological or social, or both. The evaluation of the significance of an impact relies heavily on the values of the person making the judgment. For this reason, impacts of especially a social nature need to reflect the values of the affected society.

Prioritising

The evaluation of the impacts, as described above is used to prioritise which impacts require mitigation measures.

Negative impacts that are ranked as being of “VERY HIGH” and “HIGH” significance will be investigated further to determine how the impact can be minimised or what alternative activities or mitigation measures can be implemented. These impacts may also assist decision makers i.e. numerous HIGH negative impacts may bring about a negative decision.

For impacts identified as having a negative impact of “MODERATE” significance, it is standard practice to investigate alternate activities and/or mitigation measures. The most effective and practical mitigations measures will then be proposed.

For impacts ranked as “LOW” significance, no investigations or alternatives will be considered. Possible management measures will be investigated to ensure that the impacts remain of low significance.
**Table 2.2: Ranking of evaluation criteria**

<table>
<thead>
<tr>
<th>Temporal Scale</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short term</td>
<td>Less than 5 years</td>
</tr>
<tr>
<td>Medium term</td>
<td>Between 5-20 years</td>
</tr>
<tr>
<td>Long term</td>
<td>Between 20 and 40 years (a generation) and from a human perspective also permanent</td>
</tr>
<tr>
<td>Permanent</td>
<td>Over 40 years and resulting in a permanent and lasting change that will always be there</td>
</tr>
</tbody>
</table>

**Spatial Scale**

| Localised       | At localised scale and a few hectares in extent |
| Study Area      | The proposed site and its immediate environs |
| Regional        | District and Provincial level |
| National        | Country |
| International   | Internationally |

**EFFECT**

<table>
<thead>
<tr>
<th>Severity</th>
<th>Severity</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slight</td>
<td>Slight impacts on the affected system(s) or party(ies)</td>
<td>Slightly beneficial to the affected system(s) and party(ies)</td>
</tr>
<tr>
<td>Moderate</td>
<td>Moderate impacts on the affected system(s) or party(ies)</td>
<td>Moderately beneficial to the affected system(s) and party(ies)</td>
</tr>
<tr>
<td>Severe/Beneficial</td>
<td>Severe impacts on the affected system(s) or party(ies)</td>
<td>A substantial benefit to the affected system(s) and party(ies)</td>
</tr>
<tr>
<td>Very Severe/Beneficial</td>
<td>Very severe change to the affected system(s) or party(ies)</td>
<td>A very substantial benefit to the affected system(s) and party(ies)</td>
</tr>
</tbody>
</table>

**LIKELIHOOD**

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unlikely</td>
<td>The likelihood of these impacts occurring is slight</td>
</tr>
<tr>
<td>May Occur</td>
<td>The likelihood of these impacts occurring is possible</td>
</tr>
<tr>
<td>Probable</td>
<td>The likelihood of these impacts occurring is probable</td>
</tr>
<tr>
<td>Definite</td>
<td>The likelihood is that this impact will definitely occur</td>
</tr>
</tbody>
</table>

*In certain cases it may not be possible to determine the severity of an impact thus it may be determined: Don't know/Can’t know*

**Table 2.3: Impact severity**

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unlikely</td>
<td>Slight</td>
</tr>
<tr>
<td>May Occur</td>
<td></td>
</tr>
<tr>
<td>Probable</td>
<td></td>
</tr>
<tr>
<td>Definite</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2.4: Description of environmental significance ratings**

<table>
<thead>
<tr>
<th>Significance Rate</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>An acceptable impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in either positive or negative medium to short term effects.</td>
</tr>
<tr>
<td>Level</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Moderate</td>
<td>An important impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in either a positive or negative medium to long-term effect on the social and/or natural environment.</td>
</tr>
<tr>
<td>High</td>
<td>A serious impact, if not mitigated, may prevent the implementation of the project (if it is a negative impact). These impacts would be considered by society as constituting a major and usually a long-term change to the (natural &amp;/or social) environment and result in severe effects or beneficial effects.</td>
</tr>
<tr>
<td>Very High</td>
<td>A very serious impact which, if negative, may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts cannot be mitigated and usually result in very severe effects, or very beneficial effects.</td>
</tr>
</tbody>
</table>
3 PROJECT DESCRIPTION

3.1 Overview of project

Capitol Resources plans to develop the Tete Iron Project, in Tete Province, Mozambique. The project seeks to mine the Tenge Prospect, an area of mineralisation containing magnetite, titanium and vanadium, for the production of pig iron. The mineral resource at Tenge is expected to be 159 million tons (Mt). The mining process will involve conventional open pit mining, with ore extracted by drilling and blasting. Additional infrastructure will include: a waste rock dump, a tailings storage facility, a beneficiation plant, a production plant (to process pig iron), and associated infrastructure such as offices, an accommodation area, a workshop, storage sheds, and a haul road to Moatize where a rail siding will be constructed for storage prior to transport by rail.

3.2 Project components and activities related to visual impacts

3.2.1 Construction

The following main components related to construction activity will potentially cause visual impacts. Some of these will be temporary and will be removed or rehabilitated after the construction phase:

- Clearing of land for construction compounds and laydown areas;
- Site compounds for contractors;
- Borrow pits;
- Tall cranes required to lift building parts into position;
- Large trucks will be required to haul construction material to site;
- Heavy equipment such as bulldozers, graders, trenching machines and concrete trucks will be required;
- Construction of the haul road which will be a gravel surface in the construction phase, and an asphalt surface in the operations phase;
- Internal access roads will need to be established.

3.2.2 Operation

An open pit mine will be established, with benches ranging from 10 to 15 meters in height. Ore will be extracted by drilling and blasting. Ore will be loaded onto haul trucks, and transported to the beneficiation plant, where it will be crushed, milled and separated through magnetic separation circuits. Three production scenarios are currently under consideration (Table 3.1).

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Throughput (Mtpa*)</th>
<th>Total Material Mined (Mt)</th>
<th>Crusher Feed (Mt)</th>
<th>Waste Rock (Mt)</th>
<th>Mine Life (Years)</th>
<th>Pig Iron Produced (Mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>285</td>
<td>110</td>
<td>175</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>390</td>
<td>130</td>
<td>260</td>
<td>21</td>
<td>42</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>820</td>
<td>315</td>
<td>500</td>
<td>25</td>
<td>100</td>
</tr>
</tbody>
</table>

* Million tonnes per annum

The iron-ore product produced after the crushing and screening stages will be classified and undergo a reduction reaction in a furnace, to produce pig iron and by-products (including titanium and vanadium slag). Pig iron ingots will be the final product.

Infrastructure besides the open cast pit and processing plant will include the following:
- Tailings storage facility
- Waste rock dump – likely to be split into true waste and low grade ore
- Topsoil stockpiles
- Workshop and office buildings
- Workforce accommodation
- A servitude corridor, which will definitely contain a road and in addition could contain a powerline and railway line.
- Access roads within the mine

The pig iron ingots will be transported via the haul road to a siding on the Sena railway line. The exact location of the siding is unknown at this stage.

The potential negative impacts associated with lighting of the mine site at night cannot be quantified but need to be considered. It is possible that the mine will operate 24 hours a day. A large and well-lit mine site will contrast with present conditions on site. It will be necessary to consider the mitigation measures suggested in Chapter 5 of this report, to minimise light straying into the surrounding environment.
Figure 3.1: Conceptual layout of the proposed mine and associated infrastructure
4 DESCRIPTION OF THE RECEIVING ENVIRONMENT

This VIA follows best practise principles in that it takes into account the specific nature of the environment within which the project is proposed. Therefore, this chapter describes the project and all of its proposed components, as well as the surrounding biophysical, social and economic environment within which the development layout will be located.

4.1 Environmental context of the project site

Tete is renowned for its hot weather. The warmest month of the year is November (mean minimum = 24°C; mean maximum 36°C). June and July are the coldest months of the year (mean minimum = 16°C; mean maximum = 28°C). The predominant wind direction is from the south east. There is no weather station on site, so rainfall data used is from the Revuboe catchment area. The area has a mean annual rainfall of 1,000 mm. The majority of rainfall falls from November to March (averaging 178.2 mm per month) with highest rainfall in January (average = 229 mm). The driest months are August and September, with rainfall of 6 mm and 5 mm respectively (CES, 2013).

There are several villages within 12 km of the project area. Villagers utilise the surrounding bush for various livelihood strategies including hunting, fishing and the collection of medicinal plants. For a complete assessment of villagers’ use of their natural environment, see the Natural Resource Use study compiled as part of this EIA (CES 2013). There are also a small number of agricultural fields, where predominantly maize is grown.

The Revuboe river transects the project area, is joined by the Ncondezi river about 12 kilometres south of the project area, and eventually drains into the Zambezi at Tete in the south. Within and nearby to the project area, the Revuboe river is fed by the Ncacame, Tshissi and Nhambia rivers.

4.2 Landscape Baseline

This section describes the existing elements, features, characteristics, character, quality and extent of the landscape.

4.2.1 Topography

The topography of the area is undulating with occasional tall hills. The Tenge mountain, which is to be mined, is one of these hills. The surrounding landscape is drained by shallow drainage lines, with rivers which tend to only flow during the rainy season. These smaller rivers with sporadic flow all eventually flow into the larger rivers such as the Revuboe and the Ncondezi (see Figure 4.1).
Figure 4.1: Elevation of the mine area in relation to surrounding settlements
Zones of Theoretical Visibility (ZTV) are included: 2km, 4.5km, 8km & 12km from project infrastructure.
4.2.2 Geology

Please see section 4.4.2 of the Final Environmental Pre-feasibility Scoping Study and Terms of Reference (CES 2013) for a detailed description of the site and surrounding area geology. For the sake of brevity, it will not be repeated here.

4.2.3 Land use and access

The project is located in a rural area. There are small isolated villages dispersed throughout this district, most with no vehicular access during the rainy season. Villages utilise the surrounding bush to sustain themselves, and procure products some of which they sell in order to generate a small income. Natural resources are relied on for construction, medicinal consumption and to supplement their food. Agriculture is mainly subsistence, with villagers rearing livestock (mostly goats) and some crops, mainly maize. The rivers are fished. There is evidence of commercial logging being undertaken south of the Ncondezi river, although this is outside the project area. Charcoal was observed being sold on the side of the road.

The exploration camp is accessed using National Road N221, a two lane surfaced road approximately 6.5 metres wide, with a shoulder of compacted gravel. The road is in very bad condition with numerous potholes for about 15 kilometres after leaving Tete, after which it improves. After approximately 35 km, there is a Y-Junction, at which point a traveller to the mine site will branch off right onto the N222, a gravel road. This road runs for approximately 36 kilometres to the village of Machenga, where a vehicle track splits off and leads to the exploration camp and various surrounding villages. This road is often only passable using 4x4 vehicles, especially during the wet season. This road also leads to the Revuboe river, where a pontoon is available to cross the river. This pontoon is not capable of transporting a vehicle larger than a standard sized 4x4. See Plate 4.1 below. After the pontoon, it is approximately 1 km to the Tenge Camp.

Plate 4.1: The Pontoon, approximately 1 kilometre before the exploration camp. (In the background can be seen Tenge hill, which will be mined).
4.2.4 *Built Environment*

The towns of Tete and Moatize are located about 70 km by road, to the south of the project area. Villages in the project area do not have electricity or a landline, and cell phone reception can only be obtained in the higher lying areas. Villages are accessed by poor roads, many of which started as footpaths and have developed slightly to be accessible to vehicles. The drilling and exploration activities in the area have made these villages more accessible to vehicles. The less frequently used roads are often impassable during the wet season. There is no other infrastructure.

4.3 *Landscape Character*

Landscape character refers to the distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement. It creates the particular sense of place of different areas of the landscape (Landscape Institute, 2002).

Taking the elements considered in Section 4.2 into account, it is obvious that only a small number of landscape character types may potentially be affected by the proposed mine. These are the surrounding villages. The following villages are located within 12 kilometres of the mine:

- Nhambia
- Nhamidima
- Matacale
- Muchena
- Nkakame
- Tchissi
- Massamba
- Caundo
- Kapenda

There are more villages within 12 kilometres of the mine, that have been identified using aerial imagery, but their names are unknown. They may be outlying sections of these known villages.

Of the other features that are typically considered in visual impact assessments such as tourist areas and accommodation, national parks, and scenic routes, there are none.

4.4 *Landscape Character Sensitivity*

Landscape character sensitivity provides an indication of the ability of a landscape to absorb change from the proposed development without changing character. A pristine landscape prized for its natural beauty, or a landscape of high cultural value will have high sensitivity to changes brought about by new developments.

The landscape of the project area is mildly transformed by subsistence agriculture, but there are no features of natural beauty that attract visitors to the area. The functionality of the landscape will be changed within the project area, where non-mine employees will be excluded from the area. They will no longer be able to farm or hunt in the mine area. From a land use perspective, the mine will have a large impact on current land use but the extent of the impact will be limited to the mine area.

The project area is not a tourist destination and the development of the mine will not have any negative effects in that regard. It is likely that the entire area will experience a rather large change in character in the next decade or so, as various other mining companies establish themselves in the area to exploit the large coal resources.
4.5 Visual Absorption Capacity (VAC)

Visual absorption capacity (VAC) is the capacity for the landscape to conceal the proposed development. The VAC of a landscape depends on its topography and on the type of vegetation that naturally occurs in the landscape. The size and type of the development also plays a role.

The topography of the area consists of low lying hills, which are interspersed in an otherwise generally flat terrain. A number of tributary rivers and streams flow through the area, and drain into the Zambezi river. Within the project area, the largest of these tributaries of the Zambezi are the Revuboe and Ncondezi Rivers. The project area varies in height between 270 to 390 masl, and the prominent hill that will be mined, Tenge Hill, stands out from the surrounding topography with a height of 390 masl.

The vegetation of the area is dense and lush in the wet season, with grass easily reaching above two metres. In the winter though, vegetation cover is significantly less. Infrastructure will be more visible during the dry (winter) season.

Plate 4.2: Vegetation of the project area (wet season)
Figure 4.2: Surrounding potentially sensitive viewpoints.
5 ASSESSMENT AND MITIGATION OF IMPACTS

The assessment and mitigation of impacts is conducted in the following steps:

- Identification of visual impact criteria (key theoretical concepts).
- Conducting a visibility analysis.
- Assessment of impacts of the project on the landscape and on receptors (viewers) taking into consideration factors such as sensitive viewers and viewpoints, visual exposure and visual intrusion.

5.1 Visual Impact Concepts and Assessment Criteria

5.1.1 Visibility

The topography of the area is undulating with occasional tall interspersed hills. The vegetation is lush and thick in summer, but quite bare in winter. The Tenge hill is a prominent feature in the project area. This hill will be mined. Its loss from the landscape will be quite obvious at first to locals, until they become accustomed to the change. Tall and obvious mine infrastructure such as the waste rock dumps and the Tailings Storage Facility (TSF) are likely to contribute most to the visibility of the mine.

There will be a 50 metre wide corridor connecting the mine site to the rail siding at Moatize. The corridor will contain a haul road, a 220 kV electrical line, and possibly a railway line. The power line is likely to be cable strung on tall pylons (approximately 20 metres high and 300 meters apart) of a steel lattice structure, which will be highly visible to viewers within 2 kilometres of it. Dust from the road is likely to be a problem, unless it is correctly managed.

5.1.2 Sensitive Viewers and Viewpoints

A Visual Impact Assessment normally considers the following important and sensitive viewpoints:

- Areas with protection status, such as national parks or nature reserves;
- Proclaimed heritage sites or scenic routes;
- Areas with intact wilderness qualities, or pristine ecosystems;
- Areas with intact or outstanding rural or townscape qualities;
- Areas lying outside a defined urban edge line;
- Areas of important tourism or recreational value;
- Areas with important vistas or scenic corridors;
- Areas with visually prominent ridgelines or skylines.

In this rural landscape, the only sensitive viewpoints identified are the villages within 12 kilometres of the mining area boundary. The viewshed analysis undertaken will reveal each of these villages’ exposure to the mine infrastructure. In summer time (the wet season), the screening effect of vegetation will play a large role in blocking views of the mine.
Figure 5.1: Map showing the cumulative viewshed calculated for the project infrastructure.
Different areas will be able to view different amounts of the project infrastructure, as indicated in the map legend. Zones of Theoretical Visibility (ZTV) are used here to incorporate distance from the nearest project infrastructure.
Figure 5.2: Viewshed analysis of the haul route.
5.1.3 Visual Exposure

The following can be deduced from the Figure 5.1: the area to the north-east of the mine site will see less of the mine than areas in other directions. However, views to the north-east are currently blocked by Tenge hill, which will be mined, meaning that in future these areas will have views of the mine as well.

Residents of surrounding villages

Table 5.1 lists surrounding villages which will be affected by the mine, and calculates their visual exposure based on the methodology discussed in section 2.4.4. These exposure ratings do not take into consideration the screening effect of vegetation and adjacent buildings. These visual exposure ratings are therefore worst case scenario ratings.

Table 5.1: Visual exposure of surrounding villages

<table>
<thead>
<tr>
<th>Village</th>
<th>Proportion of mine visible</th>
<th>ZTV Category</th>
<th>Visual exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nhambia</td>
<td>60-80%</td>
<td>Visually intrusive</td>
<td>High - Very high</td>
</tr>
<tr>
<td>Nhamidima</td>
<td>60-80%</td>
<td>Visually dominant</td>
<td>Very high</td>
</tr>
<tr>
<td>Matacale</td>
<td>0-20%</td>
<td>Noticeable</td>
<td>Low - Moderate</td>
</tr>
<tr>
<td>Muchena*</td>
<td>0-80%</td>
<td>Noticeable</td>
<td>Moderate - High</td>
</tr>
<tr>
<td>Nkakame</td>
<td>20-40%</td>
<td>Element of landscape</td>
<td>Low</td>
</tr>
<tr>
<td>Tchissi</td>
<td>0%</td>
<td>Element of landscape</td>
<td>Negligible</td>
</tr>
<tr>
<td>Massamba</td>
<td>0%</td>
<td>Element of landscape</td>
<td>Negligible</td>
</tr>
<tr>
<td>Caundo</td>
<td>0%</td>
<td>Element of landscape</td>
<td>Negligible</td>
</tr>
<tr>
<td>Kapenda</td>
<td>0%</td>
<td>Element of landscape</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

*This village is elongated on the north-south axis, meaning that certain sections of the village will have views of up to 70% of infrastructure, while others will see zero.

There are numerous settled areas within the mine’s viewshed that were identified using aerial imagery of the site. It has not been possible to determine the names of these villages. On the viewshed map these areas appear as UN 1 – 20 (UN stands for Unnamed). These may be outlying sections of the known villages. Some of these have high exposure, especially UN14, which occurs in the project area.

5.1.4 Visual Intrusion

Plates 5.1 - 5.3 and the corresponding Figures 5.3 – 5.5 show the various viewpoints and their corresponding 3D simulation produced in ArcScene of the mine from the same points.
Plate 5.1: View 1

Figure 5.3: ArcScene view from the same point from which the photos in Plate 5.1 were taken.

In the foreground the reader can see the plant area (red)
Plate 5.2: View 2

Figure 5.4: ArcScene view from the same point from which the photos in Plate 5.2 were taken.

Dark red to the right = TSF; light red in centre = plant area; grey on left = waste rock dump
Plate 5.3: View 3

Figure 5.5: ArcScene view from the same point from which the photos in Plate 5.3 were taken.

Dark red on left = TSF; light red in centre = plant area; grey area on right = waste rock dump
**Table 5.2: Summary of visual impact criteria**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viewer Sensitivity</td>
<td>Sensitive viewpoints identified are the villages within 12 kilometres of the mine border. The sensitivity of the inhabitants to the changes that the mine will bring will be gauged during the public participation undertaken as part of the EIA process. The viewshed analysis conducted has allowed inhabitants to determine how much of the mine will be visible from their particular village.</td>
</tr>
<tr>
<td>Visibility of Development</td>
<td>The project is likely to be fairly highly visible to areas that the topography allows. The infrastructure will be tall and the screening effect of vegetation minimal during winter. However during summer, the screening effect of vegetation will be far more significant, it many cases obscuring views of the mine completely.</td>
</tr>
<tr>
<td>Visual Exposure</td>
<td>Visual exposure for each village has been quantified in Table 5.1.</td>
</tr>
<tr>
<td>Visual Intrusion</td>
<td>The study area is quite remote. There is minimal infrastructure, and the area is host to a number of villages which sustain themselves with subsistence agriculture. There are no protected or tourist areas in the vicinity. In the coming years, the character of the area is likely to change quite significantly as mines become established to exploit the significant coal resources in the area.</td>
</tr>
</tbody>
</table>

### 5.2 Significance of visual impacts on viewers and the landscape

Landscape impacts refer to the change in the elements, characteristics, character and qualities of the landscape as a result of development (Landscape Institute, 2002). These effects can be positive or negative, and result from removal of existing landscape elements, addition of new elements, or the alteration of existing elements.

Visual impacts refer to the changes to the visual character of available views resulting from the development that include: obstruction of existing views; removal of screening elements thereby exposing viewers to unsightly views; the introduction of new elements into the viewshed experienced by visual receptors and intrusion of foreign elements into the viewshed of landscape features thereby detracting from the visual amenity of the area.

**5.2.1 Impact 1: Impact of introducing highly visible mine infrastructure into a rural, undeveloped landscape.**

**Cause and Comment**

The relatively large buildings with straight edges and smooth surfaces are likely to stand out in contrast to the surrounding, undeveloped nature of the area. The passage of large vehicles and the influx of people associated with the mine will have an impact on the sense of remoteness of the region. Dust from mining activity is likely to increase the severity of the visual impact.

The viewshed analysis has shown that the villages of Nhambia, Nhamidima and Muchena will have moderate to very high visual exposure to the mine.

**Mitigation Measures**

The following mitigation measures are proposed:

- Maintain as much natural vegetation as possible between the mine buildings and the edge of the mine area.
- Non-reflective paint should be used on all buildings and roofs of buildings. Galvanised steel structures should be darkened to prevent glare.
- Rehabilitate areas that have been cleared of vegetation during the construction phase.
- Treat roads to reduce dust emissions.
- Light fixtures installed should not spill light beyond the mine area, where they are needed for 24 hour mine operation. Direct the light beams downwards, and use blinds as
necessary.

- Use timer switches or motion detectors to provide light in areas where light is not needed continuously.

**Significance Statement**

The duration of the impact will be “Permanent”. The extent is “Study Area” due to the visibility and size of the project. The severity of the impact is expected to be “Low” since the landscape has a low sensitivity to the development type. The likelihood of surrounding villagers being negatively impacted is “Probable” if mitigation measures are not employed. If mitigation measures are employed, the effect of these impacts will be reduced to “May occur”.

<table>
<thead>
<tr>
<th>Operation Phase</th>
<th>Impact</th>
<th>Effect</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Mitigation</td>
<td>Permanent</td>
<td>Study Area</td>
<td>Low</td>
<td>Probable</td>
</tr>
<tr>
<td>With Mitigation</td>
<td>Permanent</td>
<td>Study Area</td>
<td>Low</td>
<td>May occur</td>
</tr>
</tbody>
</table>

5.2.2 **Impact 2: Visual intrusion on views of sensitive visual receptors due to mine construction**

**Cause and Comment**

There are various activities which will take place during construction which will have impacts on sensitive visual receptors:

- Large areas of vegetation will need to be cleared to make way for construction of the processing plant, accommodation, site offices, etc.
- There will be a large increase in the movement of vehicles in the area: large trucks delivering supplies and construction material; graders, excavators and bulldozers; light vehicle movement around site; large trucks hauling rubble and construction waste, etc.
- Soil stockpiles and heaps of vegetation debris.
- Dust emissions from construction activity.

**Mitigation Measures**

The following mitigation measures are proposed:

- The construction contractor should clearly demarcate areas for roads, clearing and stockpiling so as to minimise site disturbance.
- To make space for stockpiles necessary during the construction phase, consider clearing areas for this purpose that will need to be cleared for mining activities during the operation phase.
- Treat roads to reduce dust emissions.

**Significance Statement**

The duration of the construction phase impacts will be “Short Term”. The extent is “Study Area” as people beyond the immediate environs will not be impacted by construction activity. The severity of the impact is expected to be “Moderate” should mitigation measures not be employed. If they are, the impact is expected to be “Slight”. The likelihood of surrounding villagers having their views impacted by surrounding construction activity is “Definite”, there are no feasible mitigation measures to reduce this this. Since a person's perception of the impacts from the construction activities relies on their own judgement. The true impact in this regard is best assessed through public consultation. The public participation process of the EIA will reveal the public's perception of
the mine.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Temporal Scale</th>
<th>Spatial Scale</th>
<th>Severity of Impact</th>
<th>Risk or Likelihood</th>
<th>Overall Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Mitigation</td>
<td>Short term</td>
<td>Study area</td>
<td>Moderate</td>
<td>Definite</td>
<td>Moderate</td>
</tr>
<tr>
<td>With Mitigation</td>
<td>Short term</td>
<td>Study area</td>
<td>Slight</td>
<td>Definite</td>
<td>Low</td>
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</tbody>
</table>
6 CONCLUSIONS

The project area topography is characterised by isolated hills (of which Tenge is one) surrounded by generally flat topography. The area is not densely populated, with villagers mainly engaged in subsistence agriculture. Infrastructure in the area is virtually non-existent and vehicle access to the area is difficult. In the wet season, many roads are un-passable without a 4x4 vehicle, and some roads are un-passable even with a 4x4 vehicle. The activities associated with the exploration drilling programme have improved access slightly in the area.

The VIA has identified no visually sensitive areas, besides the surrounding villages. There are no protected areas, tourism or recreation areas, scenic routes, or heritage sites within 12 km of the mine area. A viewshed analysis has calculated the villages’ visual exposure to the mine, with Nhambia, Nhamidima and Muchena having been found to be most exposed. The public’s feeling toward to visual impact of the mine will need to be gauged as part of the public participation process.

Impacts associated with the construction and operation phases of the mine have been identified. All impacts have been determined to be of low significance post-mitigation. The construction phase visual impact has been determined to be of moderate significance however, mitigation measures suggested will assist in reducing this to low.
REFERENCES

Coastal and Environmental Services, 2013. Final Environmental Pre-feasibility Scoping Study and Terms of Reference: Capitol Resources Mozambique: Tete Iron Project. CES, Grahamstown.

