3 Alternatives

3.1 Introduction

This chapter provides a description of route alternatives considered for the Rio Tinto Simandou Railway. It outlines how potential social and environment impacts were considered in the route selection process and provides justification for the route selected. Therefore this chapter focuses on the assessment of alternatives that include social and environmental outcomes.

The remainder of this chapter is structured as follows:

- Section 3.2: Project Development Phases;
- Section 3.3: Analysis of Alternatives; and
- Section 3.4: Alternatives Considered.

3.2 Project Development Phases

Rio Tinto’s project development processes follow a similar pathway for all Projects, beginning with a concept and ending with a robustly demonstrated business case after working its way through a number of discrete phases. This logical sequence of project phases ensures a sound investment strategy for shareholders and provides a business case to be made between projects and between options within a project. Each phase of the project varies in complexity, duration, effort and cost, and is also dependent on the nature of the project. The key project phases for the Simandou Project are illustrated in Figure 3.1 below.

Figure 3.1 Key Project Phases
The duration of each stage varies according to the work required, but typically study duration and detail increases with progression of the project. The dominant theme throughout these development phases is reducing uncertainty and risk. At all phases social and environment considerations form an integral part of the study. Surveys are initiated, preliminary impact and risk assessments conducted, and the overall knowledge base becomes increasingly detailed and used to inform analysis of alternatives.

3.3 Analysis of Alternatives

The analysis of alternatives takes into account a range of factors with varying criteria depending on the option being assessed. Examples include health, safety, social, and environment; technical risk; capital and operating costs; operability; construction schedule; and geo-political risk. Typically, the selected alternative represents a compromise or balanced outcome as it is unlikely that all criteria for all factors can be simultaneously maximised and in fact maximising one factor may come at the expense of another. However, it is important to note that for the factors identified as determinants in the selection of an option, minimum criteria is understood and still achieved for each of those factors. The analysis of alternatives is therefore iterative and represents an interplay of potentially competing demands.

3.4 Alternatives Considered During Development of the Railway

The alternatives discussed in this chapter include:

- selection of the initial rail study corridor;
- reduction of study corridor width (Screening Study);
- route alternatives through the mountainous Mamou region;
- traversing protected areas;
- application of avoidance criteria to refine the rail alignment; and
- rail sections associated with the assessment of Port locations north and south of Conakry.

The final locations for the rail loops at the mine and port were considered in a larger context setting that includes the infrastructure associated with the mine and port areas. Any discussion on alternative rail loop locations is therefore included in Volumes I and III, Chapter 3: Alternatives.

3.4.1 Selection of Initial Rail Study Corridor

Heavy haulage rail systems have strict operating criteria for factors like gradient, curvature and vertical alignment. As outlined in Chapter 2: Project Description, the iron ore locomotives and wagons have a combined length of approximately 2.8 km and a payload in excess of 33 000 tonnes. There are tremendous energies and forces that require detailed consideration and operating the railway within narrow tolerances is necessary to ensure safe and reliable delivery of material, minimising maintenance demands and maximising capacity of the rail system. Train speed is also a key criterion with minimum and maximum speeds required to prevent engine stalling, breaking of train components, excessive wear and in order to meet production schedules.

It follows therefore that topography plays a crucial role in the selection of a suitable rail route and mountainous areas in particular are avoided wherever possible as the cost of construction escalates rapidly due to the extensive earthworks required to achieve acceptable gradients and curves. As a result of these constraints it became apparent in the early phase of the Project that there is literally no choice other than the study corridor shown in Figure 3.3 (green outline). This corridor is approximately 20 km in width except at in the Mamou region where the mountainous terrain clearly required further investigation and the Forécariah region where the final location was not yet decided. There was however one alternative that was considered early in the project but subsequently rejected and this was the full or partial use of the existing freight / passenger rail corridor that stretches from Kankan in the east through to Conakry in the west.

The Kankan route, shown in Figure 3.2, is largely in a state of disrepair but was designed for mixed freight and passenger use in colonial times. Such rail systems are not faced with the same engineering constraints as heavy haulage. Currently there is approximately 40 km of narrow gauge in use in the Conakry area and approximately 580 km of abandoned track from the Kindia area to Kankan. The Kankan line when compared
to the selected corridor in Figure 3.3 traverses less protected and sensitive environmental areas, although it does pass through the northern edge of the Ramsar site of Niger-Mafou. Many more communities would also be encountered as this railway is close to the major population centres of Kankan, Kouroussa, Dabola, Mamou and Kindia. Any refurbishment of the railway formation to upgrade to heavy haul would require significant physical resettlement.

If this Kankan line were rehabilitated it would remain severely restricted by gradient and curvature through approximately 340 km of mountainous terrain. This affects train speed, train length, low axle loads and capacity. A complete rebuild would require massive and costly earthworks, new bridges, take longer to construct and would still have lower capacity than the selected corridor. The rehabilitation and rebuild scenarios also require approximately 140 km of new track to connect the mine to the Kankan line. The Kankan alternative, whilst initially appearing an attractive and obvious option is not a viable project alternative. It is cost prohibitive (requiring approximately an extra US$2 billion), results in a minimum 12 month production delay, is capacity limited and hence a detailed comparative social and environmental analysis is not required.

Shorter trains were also considered as part of a study which could mean a slight relaxing of gradient, curvature and vertical profiles however this alternative also proved unfeasible as substantial earthworks are still required, track maintenance was expected to be excessive, fuel consumption would increase and the technology required to manage increased train movements posed significant safety concerns.

**Figure 3.2 Existing Kankan Railway**

![Existing Kankan Railway Map]

3.4.2 Reduction of Study Corridor Width

Once the identification of an initial rail study corridor was complete, two further studies were conducted with the aim of reducing the width of the corridor whilst balancing any social and environmental constraints, engineering requirements and capital cost.
A Screening Study collated all available data and information of a social and environmental nature including sensitive and protected areas, land use, community data, production systems etc. The biophysical and social elements of the receiving environment were classified by the degree of social, environmental, and techno-economic constraints they present to construction of the railway. The degree of social and environmental constraint was defined by integrating potential impact and value of the element under consideration.

In parallel, a second study using a computer software package Quantm was used to generate a set of alignments that take into account terrain, geometry, cost structures, and geographic constraints. The social and environmental information gathered as part of the Screening Study was also used to help determine an optimal alignment corridor using Quantm.

The Quantm software enables hydrology, geotechnical, and land use factors to be integrated into the alignment selection process, while the socio-political issues and environmental constraints can be protected (defined as no-go), costed (by running optimisation with and without constraints to determine the alignment and cost implications), or modelled (by adding an extra-land-cost to reflect higher purchase or mitigation costs). As such, the Quantm system is a comparative tool that proposes different alternatives based on the available GIS data and help to select a corridor and an alignment among different options.

Numerous scenarios were run with different inputs and Quantm mapped the ‘best’ 5 options for each scenario. The best options were the ones that avoided the highest priority constraints and which presented the best financial value. They were also often the shortest one because the cost generally increases in proportion with the length of the alignment. The GIS data that fed into the Quantm scenarios included data on social, infrastructure, land use, biological and physical parameters.

The results of the Quantm study confirmed that the majority of the alignments proposed by the software were located inside the proposed 20 km study corridor, Quantm generated long tunnels and bridges (for example 20 km through the Mamou hills) that were not considered appropriate at this stage. The study recommended that more precise topographical data should be used once available to help improve results in the Mamou area.

As a result of the Screening Study and the Quantm study, the corridor was reduced from 20-50 km wide to 5-20 km wide (widening in the Mamou region where the mountains pose significant constraints). The optimised corridor covered an area of about 5 700 km² which is roughly three times less than that originally proposed.

The study highlighted that the vast majority of the corridor included ‘medium’ level constraints. The territory with ‘very strong’ constraints identified was primarily concentrated in the solid masses of Fouta Djalon as the escarpments and steep slopes represent important techno-economic constraints for engineering design. The areas with ‘strong’ constraints were more dispersed, and comprised floodplains, mangroves and mangrove rice crops, the Ramsar site of Niger-Mafou, and the National Park of Haut-Niger.

Figure 3.3 shows the progression of the rail corridor from the 20-50 km wide corridor originally identified (in green), to the 5-20 km corridor identified during the Screening Study (in blue). It also shows the best case corridor identified as part of the Quantm analysis (in orange).
3.4.3 Route Alternatives through the Mountainous Mamou Region

3.4.3.1 Overview of Options

The rail design team developed conceptual alignments, profiles, and cross sections to explore alternative routes through the Mamou mountains. Each alternative identified needed to balance a range of requirements including meeting the technical challenges of building a railway through mountainous terrain (ie a technically feasible solution), avoiding or minimising resettlement of local communities, avoiding or minimising impacts on areas of high biodiversity value, meeting construction schedules agreed with Government of Guinea, minimising capital costs and maintaining an acceptable distance from the Sierra Leonean border.

All the options traversed the central mountain range south of the town of Mamou. The alignment options departed from a common point approximately 150 km east of the Port area and converged to a common point 95 km further east, near the village of Ouré Kaba.

Many alternatives were considered however most were discounted early mainly due to excessive grades and / or excessive additional capital cost resulting from extra tunnel length, massive earthworks and in one case a large bridge span. A more detailed analysis was conducted on the final three alternatives presented in Figure 3.4 and a description of these is provided below.
Figure 3.4 Alignment Options for Mamou
3.4.3.2 VES Base Case

As detailed on Figure 3.4, this option starts from the 250 km point (ie 250 east of the port) near to the village of Ouré Kaba and to the east of the Mamou mountain range. The route corridor for this option then heads west, following an alignment south of the Mamou mountain range for approximately 100 km to the 150 km point from the port.

This option includes two tunnels of 11 and 10 km, to the east and west of the section respectively. This option minimises the length of the rail alignment in comparison with the Northern Bypass route option. The railway would need to cross one major road and five large rivers.

An optimised VES alignment (Optimised VES 1) was also considered with a slight deviation from the VES Base Case. This deviation included a northern diversion to take the railway further away from the border with Sierra Leone as well as to shorten tunnel distances. As shown on Figure 3.4 this optimised option consists of a deviation in the alignment west of the village of Ouré Kaba with a slight arch to the north before returning onto a south westerly direction back towards the Sierra Leone border. It would mean two tunnels of shorter length, 8.5 and 3 km respectively. However this alternative was also discounted primarily because it contained a number of excessive grades (eg -2.4% grade for 9km) that could not be safely negotiated.

3.4.3.3 Northern Bypass 1

As detailed on Figure 3.4, this option starts from the 250 km point east of the port near to the village of Ouré Kaba and to the east of the Mamou mountain range. The route corridor for this option then heads west from Ouré Kaba, following an alignment north of the Mamou mountain range for approximately 100 km to the point 150 km east of the port. This Northern Bypass 1 option is 130 km long, with three tunnels of 2 km, 1 km and 2 km. Significant sections of the alignment have steep grades and significant curves. It includes three major road crossings and six large river crossings.

A comparison of the VES Base Case and the Northern Bypass options is set out in Table 3.1 below. The Optimised VES 1 option is discussed below.

Table 3.1 Social and Environmental Analysis of Options

<table>
<thead>
<tr>
<th></th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| VES Base Case        | • Impacts on settlements and agriculture will be reduced as the land take requirements will be less. This option would require in the region of 300 people to be re-settled living in approximately 40 dwellings (based on a 100 m buffer from the railway).  
• Significantly shorter length of track than Northern Bypass 1 that will lead to shorter running time, reduced fuel usage and greenhouse gas emissions.  
• Significantly lower earthwork volumes compared to Northern Bypass 1.  
• Tunnels minimise surface habitat degradation, and act as land bridges across the railway maintaining habitat connectivity. | • The southern Mamou VES Base Case option would require compensation for around 850 ha of agricultural land based on a 100 m buffer of the rail alignment.  
• Intersects the Pinselli Classified Forest - an area known to contain populations of chimpanzee.  
• This route passes through the proposed trans-boundary park, an area known for its high biodiversity value. Constructing a railway through this area will create induced access issues, cause habitat fragmentation may create a serious (impermeable to semi-permeable) barrier for wildlife.  
• This route option is located close to the border with Sierra Leone and as such poses potential social and political transboundary issues.  
• One major road and five large water way crossings. |
### Advantages

- **Northern Bypass 1**
  - This option avoids significantly more areas of forest and high biodiversity potential, including the trans-boundary park area. It also avoids most known chimpanzee locations.
  - Located a significant distance from the Sierra Leone border (at least 50 km) and as such does not pose any potential social and political transboundary issues.

### Disadvantages

- The Northern Bypass 1 option is more densely populated than the Southern VES Base Case Option. Within a 100 m buffer there was estimated to be around 1 000 people living in around 160 dwellings requiring re-settlement (based on a 100 m buffer from the railway).
- The Northern Bypass 1 option would also require compensation for around 350 ha of agricultural land, based on a 100 m buffer of the rail alignment.
- Three major road crossings and six large river crossings.

As outlined in Table 3.1 the Northern Bypass 1 alternative contains steep grades, multiple tight curves as well as longer track length and longer running times. The route has poor horizontal and vertical alignment, low operational efficiency and maintainability, higher earthworks requirements and higher constructability risk. The gradient criteria needed (varying track length can tolerate different grades) to ensure safe speeds could not be achieved. To overcome the engineering challenges would result in excessively long tunnels (in the order of 40 km) and an additional direct capital cost in the order of US$1 billion. The route would also result in approximately 60% more re-settlement and create additional community severance and safety issues.

The Northern Bypass 1 alternative clearly offers the best environmental outcome however the alignment is not a viable project alternative and consequently the VES Base Case represents the only feasible alignment through the Mamou region. The means the proposed alignment will pass through areas of high biodiversity value (described in detail in Chapter 11: Biodiversity).

### 3.4.4 Traversing Protected Areas

#### 3.4.4.1 Overview

Four legally protected biodiversity areas have been identified as being impacted by the construction of the proposed railway alignment corridor: the Niger-Mafou Ramsar site, National Park of Upper Niger (Haut Niger) and the Pic de Fon and Pinselli Classified Forests. The Ramsar site (see Chapter 11: Biodiversity) was unable to be avoided based on the selected rail study corridor discussed above, and avoidance of the Pic de Fon Classified Forest is discussed in Volume I Chapter 3: Alternatives.

Haut Niger covers approximately 12 500 km² in the north-eastern portion of Guinea. The core protected zones of the park (Kouya and Mafou) are also designated as Key Biodiversity Areas; in addition, the Mafou core zone is also an International Bird Area and a Classified Forest. The railway intersects the park’s southern buffer zone, outside of these core areas. The park was established in 1997 to protect one of the few remaining relatively intact areas of dry woodland in the region. It also plays an important role in protecting the Niger River watershed.

The Classified Forest of Pinselli was a wildlife reserve used for big game hunting in the 1930s and during this period much of the wildlife was hunted to near extinction. However it is still an important biodiversity area that supports over 120 local species, including some endangered species. These forests are protected to support growth of native plants and trees, protect watersheds and control soil erosion. Further detail on these protected biodiversity areas can be found in Chapter 11: Biodiversity.

The remainder of this section discusses the outcome of the option assessment that was undertaken to ensure the impacts on these protected areas were minimised as far as reasonably practicable, balancing environmental impacts with engineering constraints.
3.4.4.2 Haut (Upper) Niger National Park

Three options were considered for the alignment that passes through the southern boundary buffer zone of the Haut Niger National Park located in Section 7 of the railway (refer to Figure 3.5 and Chapter 2: Project Description). Outside of the core area of the Park, in the buffer zones local people are permitted to use natural resources sustainably. Farming and the collection of non-timber forest products are allowed, and government forestry administrations co-manage fishing, hunting and timber harvesting in cooperation with local communities (refer to Section 11.3.3.4 in Chapter 11: Biodiversity).

All three rail alignments considered were required to pass through the Haut Niger National Park buffer zone firstly to avoid nine villages, one which is a very significant settlement at approximately 479 km from the port. Secondly, there is a large change in elevation at approximately 478 km from the port; the gradient in the vicinity of the elevation change would result in large cut and fill volumes, potentially large borrow pit and spoil amounts and would have operation impacts such as design criteria (train speeds and operator safety). Therefore, it was not feasible to evaluate an alignment that did not pass through this area of the National Park. Table 3.2 illustrates the comparison data for the options including the length of the railway within the National Park, cut and fill volumes and village impacts for the three options that were considered.
Figure 3.5 Haut Niger National Park Alignment Options
Table 3.2  Comparison Data

<table>
<thead>
<tr>
<th></th>
<th>VES Base Case</th>
<th>Option 1 (preferred option)</th>
<th>Option 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length within National Parks (m)</td>
<td>35 054</td>
<td>20 271</td>
<td>5 068</td>
</tr>
<tr>
<td>No of Villages Impacted</td>
<td>30</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total Cut Volume (m³)</td>
<td>3 608 572</td>
<td>4 358 997</td>
<td>4 761 902</td>
</tr>
<tr>
<td>Total Fill Volume (m³)</td>
<td>3 336 213</td>
<td>4 348 750</td>
<td>4 720 714</td>
</tr>
<tr>
<td>Cut to Fill Balance (m³)</td>
<td>272 359</td>
<td>10 247</td>
<td>41 188</td>
</tr>
</tbody>
</table>

The VES Base Case option (pink on Figure 3.5) required the greatest length through the National Park (35 054 m). It required that over half of the total distance of Section 7 of the railway (refer to Chapter 2: Project Description) would be within the National Park. This option would have also resulted in significant fill material being required (272 359 m³).

Option 1 (yellow on Figure 3.5), the preferred option, required less length through the National Park (20 271 m), resulted in 28 less villages being affected, 3 fewer curves, 12 fewer road crossings and also lowered the overall cut to spoil balance to 10 247 m³.

Option 2 (orange on Figure 3.5) was also evaluated with a view to further reducing the length of alignment through the National Park. Option 2 would have would have resulted in 28 less villages being affected than for the VES Base Case and so would have resulted in the same magnitude of impact on settlements as Option 1. However, in comparison to Option 1 it would have required greater volumes of fill at 41 188 m³ and a greater volume of spoil to dispose of. It also required 3 additional curves, with significant resultant cost and schedule impacts. As a result, Option 2 was eliminated in favour of Option 1.

3.4.4.3  Pinselli Classified Forest

Four options were considered through the Pinselli Classified Forest located in section 4. All four options considered were required to pass through the forest due to engineering constraints, and in particular to avoid significant curves which have significant impacts on cost and risks to operability. Figure 3.6 shows the options under consideration and Table 3.3 below illustrates the comparison data for the options.

Between the points 230 km and 240 km from the port, the approximate area in which the optimised alignment passes through Pinselli there are significant gradients adjacent to the forest boundary and all alignments were required to be engineered through a valley. These steep gradients would have made rail construction and operation through the area adjacent to the Forest boundary infeasible. To avoid large cut and fill volumes and curves, large volumes of borrow materials or earthworks spoils, all alignment options were required to pass through Pinselli. Additionally, alignment gradients in this area would have serious impacts on train speed, operational performance and costs, and safety for train operations. The alignment option that was chosen through this area reduced the total number of kilometres through the Pinselli Forest thereby minimising the impact as much as possible.

Table 3.3  Pinselli Classified Forest Comparison Data

<table>
<thead>
<tr>
<th></th>
<th>VES Base Case</th>
<th>Option 1 (Preferred Option)</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length (m)</td>
<td>50 000</td>
<td>49 338</td>
<td>50 497</td>
<td>50 427</td>
</tr>
<tr>
<td>No. of villages Impacted</td>
<td>245</td>
<td>227</td>
<td>252</td>
<td>243</td>
</tr>
<tr>
<td>Total Cut Volume (m³)</td>
<td>3 324 630</td>
<td>3 326 552</td>
<td>4 603 105</td>
<td>3 544 057</td>
</tr>
<tr>
<td>Total Fill Volume (m³)</td>
<td>2 601 656</td>
<td>3 280 174</td>
<td>4 745 413</td>
<td>3 749 303</td>
</tr>
<tr>
<td>Cut to Fill Balance (m³)</td>
<td>722 974</td>
<td>46 378</td>
<td>-142 308</td>
<td>-205 246</td>
</tr>
</tbody>
</table>
Option 1 (shown as yellow on Figure 3.6) was the recommended option. This option impacts the least number of villages and reduces the number of village impacts over the VES Base Case (black line on Figure 3.6) by 18. This option also had the best earthworks balance with only 46,378 m$^3$ of fill required compared to the VES Base Case route having a significant excess of spoil (722,974 m$^3$), and Options 2 and 3 needing significant fill material. This was a large determining factor in choosing this option.

### 3.4.5 Application of Avoidance Criteria to Refine the Rail Alignment

Having established a preferred route alignment corridor for the railway, as set out in the previous sections, the Project design investigated continuing refinement of the proposals. This involved a process of optimising or 'fine-tuning' the route alignment factoring environmental and social sensitivities into the detailed alignment along with financial and engineering considerations.

This process is based upon a set of avoidance criteria used to guide the detailed alignment and design of the railway. Essentially, the avoidance criteria consist of minimum distances by which areas of social and environmental sensitivity should be avoided described as 'buffers'. These are presented in Table 3.4 below.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Minimum Offset (Buffer) in metres</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Community</td>
</tr>
<tr>
<td>Mainline Track &amp; Passing Sidings Equipment</td>
<td>1,000</td>
</tr>
<tr>
<td>Maintenance Facility, Material Storage Depot, Freight Load / Unload, and Train Stabling</td>
<td>1,000</td>
</tr>
</tbody>
</table>

These criteria were applied using the most recently available information on locations and areas of environmental and social sensitivity, which were evaluated alongside engineering considerations. The criteria were applied in an initial pass for the entire rail corridor and high-level environmental and social conflicts identified and reported and fed to the engineering design team for closer examination. Examples include locations where the corridor crossed a major part of an identified biodiversity hotspot, or passed very close to a village. As the detailed design of the alignment progressed, further lower-level conflicts were identified and also avoided, where possible, by the engineering design team.

Optimisation has taken place for the entire route alignment corridor and has resulted in an overall reduction in the number of settlements which the railway would pass at a distance of less than 1,000 m. A 1,000 m buffer was drawn around all settlements and the route alignment was optimised to avoid these buffers wherever practical. The optimisation process also assessed the number of settlements impacted within a 200 m buffer and 500 m buffer where the 1,000 m buffer could not be completely avoided. A summary of the results is outlined in Table 3.5.
Figure 3.6  Pinselli Classified Forest Alignment Options
Table 3.5  Summary of Impacts on Property

<table>
<thead>
<tr>
<th>Section</th>
<th>Villages within 200m</th>
<th>Villages within 200–500m</th>
<th>Villages within 500m–1 000m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Southern VES (Base Case)</td>
<td>Optimised</td>
<td>Southern VES (Base Case)</td>
</tr>
<tr>
<td>1A</td>
<td>13</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>1B</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>29</td>
<td>0</td>
<td>73</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>33</td>
<td>26</td>
<td>75</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
<td>11</td>
<td>38</td>
</tr>
<tr>
<td>6</td>
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<td>0</td>
<td>Data not available</td>
</tr>
<tr>
<td>7</td>
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<td>0</td>
<td>Data not available</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>102</td>
<td>58</td>
<td>221</td>
</tr>
</tbody>
</table>

Note: the numbers of settlements identified in this table are those where 1 000 m buffer fall within the specified distance of the centreline. This is not the same as the numbers of settlements within 500 m and 1 000 m reported in Chapter 2: Project Description. Those Data are based on the settlement centrepoints.

The optimisation process also resulted in a reduction in the length of alignment passing through or close to biodiversity areas:

- a reduction of 9 km in the length of alignment passing through designated and proposed designated areas, from 315 km to 306 km;
- where engineering or social constraints prevent the alignment from completely avoiding designated areas, the alignment is now generally in buffer or mixed-use zones or in parts which, being near the edge of the designated area, tend to be more disturbed and degraded and thus likely to be of lower biodiversity value;
- a reduction of one bridge crossing a river; and
- a significant improvement in the balance of cut and fill material which will reduce the total disturbance of habitats by negating the need for spoil disposal and reducing the requirement for material to be sourced from borrow pits and quarries.

3.4.6 Rail Sections Associated with the Assessment of Port Locations North and South of Conakry

A review of the social and environmental issues posed by the railway corridor for potential port sites north and south of Conakry was undertaken. The port sites under consideration and the associated rail alignment corridors considered are shown in Figure 3.7. It should be noted that the options analysis was primarily driven by the location of the preferred port option (see Volume III, Chapter 3: Alternatives, for additional information), however social and environmental constraints were analysed in a comparative analysis, with a summary of the results present below in Table 3.6.
Table 3.6 Social and Environmental Comparative Analysis of Options

<table>
<thead>
<tr>
<th>Comparison criterion</th>
<th>Mine - Ile Kabak Port Option (Ile Matakong)</th>
<th>Mine - Ile Kabak Port Option (Modified VES Base Case)</th>
<th>Mine - Cap Verga (Northern Mamou)</th>
<th>Mine - Cap Verga (Southern Mamou)</th>
<th>Mine - Ile Binari (Northern Mamou)</th>
<th>Mine - Ile Binari (Southern Mamou)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total surface of the footprint (ha)</td>
<td>7 252</td>
<td>7 011</td>
<td>8 832</td>
<td>8 790</td>
<td>9 091</td>
<td>9 049</td>
</tr>
<tr>
<td>Potential physical resettlement within the footprint</td>
<td>2 050</td>
<td>1 715</td>
<td>2 657</td>
<td>2 002</td>
<td>2 675</td>
<td>2 020</td>
</tr>
<tr>
<td>potential compensation within the footprint (estimated number of people)</td>
<td>15 255</td>
<td>15 414</td>
<td>24 638</td>
<td>26 216</td>
<td>25 732</td>
<td>27 310</td>
</tr>
<tr>
<td>Mangrove forest (soil of low bearing capacity) (ha)</td>
<td>1 544</td>
<td>1 547</td>
<td>0</td>
<td>0</td>
<td>2 080</td>
<td>2 080</td>
</tr>
<tr>
<td>Dense forest including gallery forest (ha)</td>
<td>4 136</td>
<td>3 213</td>
<td>9 507</td>
<td>7 870</td>
<td>8 256</td>
<td>6 619</td>
</tr>
<tr>
<td>Clear forest including wooded grassland and grassland savanna (ha)</td>
<td>46 743</td>
<td>46 737</td>
<td>49 451</td>
<td>49 183</td>
<td>50 112</td>
<td>49 844</td>
</tr>
</tbody>
</table>
The above comparative analysis concluded that the most southern rail option to a port location south of Conakry to be the most favourable primarily because the total length of this option was 200 km shorter than the next shortest option. The shorter rail length would minimise the total development footprint as well as the potential displacement of communities leading to physical resettlement and the potential loss of agricultural land.
Figure 3.7 Rail Alignment Options to Service the Northern and Southern Port Options