1 Project Alternatives

Section 31 (3) of the EIA Regulations, 2010, requires that all S&EIR processes must identify and describe 'alternatives to the proposed activity that are feasible and reasonable'. Different types or categories of alternatives can be identified, e.g. location alternatives, type of activity, design or layout alternatives, technology alternatives and operational alternatives. The 'No Go' or 'No Project' alternative must also be considered.

Numerous alternatives were identified and considered during master planning for Cape Town International Airport, which informed the early feasibility and design phases of the project. These alternatives are described in more detail below, along with an indication of the stage at which and reasons why each of the alternatives was eliminated or selected for further assessment.

1.1 Location Alternatives

Airports Company South Africa's master planning did not consider other location alternatives (e.g. near Atlantis), for the following reasons:

- **The existing airport has not been developed to its projected ultimate capacity (i.e. optimised)**. The current airport location has the potential of facilitating upwards of 40 million passengers per year (based on the current Airport Master Plan – see Section 2 of Final EIA Report), with current passenger volumes at 8.5 million per year. The expansion of existing airports in preference to developing new airports is also recommended in the National Airport Development Plan;
- It is not considered **financially feasible** to develop a new airport on a greenfield (undeveloped) site when the current site has not yet been optimised, as a new airport would require major capital investment especially in the provision of transportation links to / from the new site, fuel supply pipelines and all associated bulk infrastructure. In the current economic climate, a new airport is not affordable. A further consideration was that the provision of services and access to the new site by the CoCT would place a huge burden on their financial position.

  It is a complex exercise to assess the absolute cost of a greenfield airport project. By way of comparison, King Shaka International Airport, the most recent greenfield airport development in South Africa, with a capacity of 7.5 million passengers per annum, was completed in 2010 at a cost of R7 billion *(R9 billion in 2014 Rands). This equates to a construction cost compared to airport size (passenger numbers) factor of 1.2 (R9b/7.5m). This factor (ratio) is at the low end of the spectrum: for example, the figure for Seoul Airport was 3.1, and Kuala Lumpur, 1.6 (NACO-RHDHV, 2014).*

  Passenger numbers at Cape Town International Airport are projected to reach 19 million by 2032, and the realigned runway will have the capacity to cater for this increase. Applying a (low) factor of 1.2 generates and indicative cost of R22.8 billion for a new airport servicing Cape Town.

  This cost excludes the following:

  - Land acquisition;
  - Reconstructing all associated bulk infrastructure leading to the new greenfield site, such as roads, water, sewerage and electrical infrastructure, public transport, fuel pipelines, etc.; and
  - Relocation of all secondary industries associated with and dependent on the airport and currently located around the perimeter of the airport, such as freight forwarders, distribution centres and associated warehouses.

Depending on the location of the alternative site, these costs can significantly increase the cost of relocating an existing airport to an alternative site. However, costs for just the first two exclusions, can easily double these factors (NACO-RHDHV, 2014), i.e. to an indicative R45.6 billion. Relocation of secondary industries would also add very significantly to this figure, though the costs would not be borne by ACSA;

- *Approximately 9 000 people working at the airport may or would need to* ***relocate*** *(or risk losing their jobs), very likely at considerable personal expense;*
- The **time** associated with the planning, approval and construction of a new airport would not allow for a new airport to be developed by the time additional capacity is required, thus limiting additional air access;
- The existing **economic benefits** of the airport in its current location are significant and optimising this would allow for these benefits to be maximised; and
- **Airports Company South Africa's mandate** from the DoT is to develop Cape Town International Airport to its optimal level in its current location and not to investigate an alternative location.

The EAPs are satisfied that an alternative location is not a reasonable and feasible alternative to assess at this time. Alternatives considered are thus limited to those associated with optimising utilisation of the existing airport in its current location.

Airports Company South Africa acknowledges that another airport may be necessary in the (distant) future and if Airports Company South Africa and the CoCT do not consider locations for a possible future site(s) at this stage, it may be difficult to secure a site in future. The identification of a second suitable site is not within Airports Company South Africa's mandate. The CoCT has considered alternative future airport sites for future planning purposes and has requested input from Airports Company South Africa in terms of technical feasibility only.

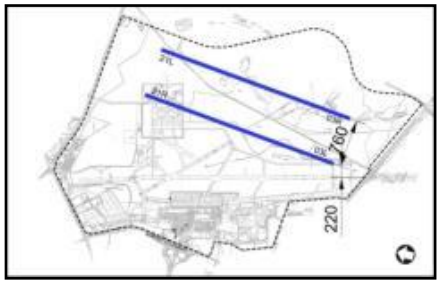
1.2 Master Plan Options

In 2006 Airports Company South Africa appointed NACO and Stewart Scott International (SSI) to review and update the Airport Mater Plan (see Section 2 of Final EIA Report). As part of the master planning process, six possible layout options were identified for the development of the airport in its current location (and property to the east of the existing airport, which Airports Company South Africa is in the process of acquiring). These included options in which the primary runway was rotated in a clockwise direction and in an anti-clockwise direction. Maintaining the primary runway in its current alignment was not considered a viable long term option due to safety reasons associated with the approach of aircraft over the Tygerberg Hills, and limitations placed on airport development, capacity and land use potential of the property, and was eliminated prior to the master planning process.

The six options identified were evaluated in a Feasibility Study and three were eliminated as they did not meet strategic and operational objectives for Cape Town International Airport. The eliminated options, illustrated and described in Table 1-1 below, were referred to as:

- **Maximum Spacing 1 505 m**;
- **Clockwise Rotation Parallel 760 m**; and
- **General Aviation Runway**.

Table 1-1: Layout Options Eliminated from Master Planning Exercise

Layout	Description	Reasons for Elimination
	**Maximum Spacing 1 505 m** • *Existing runway*: rotated anti-clockwise by 12.2 degrees. • *Second runway*: located as close as possible to the proposed airport boundary to maximize the space between the runways. • *Runway Capacity:* 80 hourly movements. • *Passengers per annum*: 40 million. • *Terminal expansion*: midfield only • *Runway operation*: independent	• Does not allow further development of existing terminal, but would allow for development of a midfield terminal (i.e. between the two runways). • Requires early and high initial investment for construction of midfield terminal. • Located too close to Symphony Way limiting possibilities for development in the east and resulting in unbalanced land use. • Would force airport into a multi-terminal configuration for the remainder of its life, with cost implications. • Operation of the existing runway would be disrupted during construction of the angled runway, as this is located at the same location as the northern end of the existing runway. • Limited possibilities for commercial development in the east as space between second runway and Symphony Way is limited. • Long taxiing times and higher associated fuel burn. ***This* option *was considered impractical and inefficient from a cost perspective and thus not evaluated further.***
	**Clockwise Rotation Parallel 760 m** • *Existing runway:* located 220 m to the north and rotated clockwise by 10 degrees • *Second runway:* located 760 m from first runway, allowing dependent approaches only. • *Runway capacity:* 72 hourly movements (approach capacity 36 movements) • *Passengers per annum:* 36 million • *Terminal expansion*: ample space for expansion of existing terminal • *Runway operation*: dependent	• High initial investment required due to the relocation of military area already required for first runway. • Reduction in ultimate airport capacity due to the limited runway movement capacity. • Long taxiing distances and longer taxiing times with higher associated fuel burn. • Limited space for commercial development to the east due to the closeness of the second runway to Symphony Way. ***This* option *was considered impractical from a technical perspective and thus not evaluated further.***

	**General Aviation Runway** A variation on the **Close parallel 760m** option (evaluated further as Alternative 3 below), but allowing a third runway for general aviation in the northern portion of the site.	• Large area required for construction of third runway, precluding commercial development in the east. • Third runway would not improve capacity of scheduled traffic. ***This* option *was considered a derivative of the Close Parallel 760m alternative, but with no benefits and was thus not evaluated further.***

The remaining three options further evaluated during the master planning review process and described and illustrated in Table 1-2 below were:

- **Option 1: Open V Concept**;
- **Option 2: Independent Use 1 035 m**; and
- **Option 3: Close Parallel 760 m**.

During the master planning review process, two sub-options were identified in terms of land use associated with Option 2:

- **Option 2A: Western Terminal**; and
- **Option 2B: Midfield Terminal** (i.e. a terminal building between runways with underground linkages).

1.2.1 Evaluation Criteria

Key criteria in the evaluation of the Airport Master Plan layout options (of which runway configuration was integral) are as follows.

Airside Area:

- *Capacity of runways and the ability of runways to operate independently for arrivals and departures.*
- *Operational flexibility with respect to runway usage, east-west cross taxiway circulation, number of taxiway crossing points, apron pushback constraints and taxiing distance.*

Land use:

- *Internal land use, including whether a single large terminal area could be accommodated, or whether two terminals would be required.*
- *Impact on land use outside the airport property boundaries, including the need for additional access roads.*
- *Availability of land for commercial development to subsidise aviation costs and create economic opportunities.*

Phasing and development flexibility:

- *The ability of a layout to accommodate future changes and phasing of development to allow this.*

Environmental aspects:

- *Noise: analysis using American Federal Aviation Authority's Integrated Noise Model, taking into account SABS noise standards.*
- *Stormwater, with the aim of providing sufficient space for stormwater retention.*

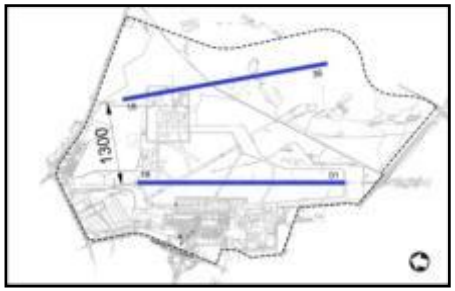
Terminal Area:

- *Efficiency with regard to development of the passenger terminal, with a single terminal considered favourable over a second mid-field terminal, which would also require major investment.*
- *The ability to consolidate cargo into a single area.*
- *Road access considering road capacity, simplicity of road network and connectivity to existing main road network.*
- *The possibility of a rail connection to Cape Town with a rail link and train station west of the existing passenger terminal.*

Cost:

- *Capital expenditures for development of new infrastructure.*
- *Operational expenditures associated with runway and taxiway maintenance and terminal operations.*
- *Net income from commercial real estate development and derived from air traffic volumes.*

Table 1-2: Layout Options Evaluated in Master Planning

Layout	Evaluation	
Option 1: Open V Concept  • *Existing runway*: upgraded. • *Second runway*: located at a distance of 1 300 m and rotated by 11.5 degrees. • *Runway capacity:* 72 hourly movements south and 60 movements north. • *Passengers per annum*: 30 million. • *Terminal expansion*: midfield only. • *Runway operation*: dependent.	*Airside:*	• Runways cannot operate independently. • Requires construction of only one runway. • Due to approach dependencies, runways have a lower capacity than other alternatives.
	Land use:	• Lack of space for expansion of western precinct (existing terminals and aprons). • Provides least space for commercial development. • Maximum capacity of airport premises not utilised. • Dual road access to existing terminal.
	Phasing and flexibility:	• Second runway to be constructed early to allow for upgrade of first runway. • Construction of midfield terminal required at an early stage.
	Environmental:	• Noise impact of existing runway same as current situation. • Largest physical area and number of erven affected by noise. • Most space available for stormwater attenuation after Option 2B.
	Terminal area:	• No expansion of existing terminal allowed, only midfield terminal.
	Cost:	• Incremental cash flow requirements least favourable.
	Reasons for Elimination • The runway configuration has the lowest capacity compared to Options 2 and 3. • Expansion of the existing terminal, which would be preferred over a midfield terminal, cannot be accommodated. • The early construction of a midfield terminal would be required, with high capital investment. • This alternative is least favourable in terms of cash flow.	
Option 2: Independent Use 1 035 m  • *Existing runway*: relocated 220 m and rotated	*Airside:*	• Runway capacity can be maximised. • Spacing between runways is sufficient for independent approaches (i.e. runways can operate independently).
	Land use:	• Dual road access to existing terminal and midfield terminal. (The runways are located just far enough apart to allow for construction of a midfield terminal. This maintains strategic flexibility).
	Phasing and flexibility:	• Better development flexibility with respect terminal development. • Phasing to ultimate development is most efficient (for Option 2B) due to single terminal which can be developed incrementally based on demand.
	Environmental:	• Noise impact of both new runways will affect areas not currently affected. • Size of the area and number of erven affected by noise smaller than Alternative 1 but larger than Option 3.

Layout	Evaluation	
anti-clockwise by 11.5 degrees. • *Second runway*: located at a distance of 1035 m from and parallel to the first runway. • *Runway capacity:* 72 - 80 hourly movements depending on use of midfield and number of runway crossings. • *Passengers per annum*: 40 million. • *Terminal expansion*: **Two Options:** ○ **2A**: midfield terminal or ○ **2B**: expansion of existing terminal possible. • *Runway operation*: independent**.**		• Option 2B has most space available for stormwater attenuation, Option 2A has the least.
	Terminal area:	• Preferred crown shape (western) terminal layout can be accommodated. • Existing terminal can be expanded to match maximum runway capacity.
	Cost:	• Incremental cash flow requirements most favourable (most cost efficient).
	Reasons for Selection • The runway configuration allows for maximum runway capacity. • The existing terminal can be expanded to match maximum runway capacity. • Runway configuration allows for better development flexibility – either Option 2A or 2B can be developed in future depending on circumstances and requirements. • Phasing to ultimate development most efficient due to a single terminal which can be developed incrementally based on demand.	
Option 3: Close Parallel 760 m  • *Existing runway*: relocated 220 m and rotated anti-clockwise by 10 degrees. • *Second runway*: located at a distance of 760 m from and parallel to the first runway. • *Runway capacity:* 72 hourly movements (approach capacity 36 movements) • *Passengers per annum*: 36 million. • *Terminal expansion*: existing terminal. • *Runway operation*: dependent.	*Airside:*	• Parallel runways do not allow independent approaches. • Better runway capacity than Alternative 1 but not as good as Option 2.
	Land use:	• Largest contiguous area available for commercial development. • Space for commercial development in the eastern precinct is maximised. • Single road access to existing terminal.
	Phasing and flexibility:	• Phasing to ultimate development most efficient (along with Option 2A) due to a single terminal which can be developed incrementally based on demand. • Limited flexibility as a midfield terminal cannot be accommodated.
	Environmental:	• Noise impact of both new runways will affect areas not currently affected. • Size of area and number of erven affected by noise is smaller than for other alternatives. • Limited area available for stormwater attenuation.
	Terminal area:	• Preferred crown shape (western) terminal layout can be accommodated. • Existing terminal can be expanded to match maximum runway capacity. • Midfield terminal is not possible.
	Cost:	• More cost efficient than Alternative 1 but less efficient than Alternative 2.
	Reasons for Elimination • Runway configuration allows lower runway capacity than Option 2. • No development flexibility is allowed in terms of the terminal location, as the closeness of the runways does not allow for a midfield terminal in future • Less cost efficient compared to Option 2.	

The Master Plan review process included consultation with key airport stakeholders, representatives of the City of Cape Town and the Western Cape Government. The purpose of this consultation was to foster a collaborative and integrated approach to planning, and included a number of meetings held between December 2006 and September 2007. Consultation also facilitated the incorporation and/or consideration of future airport configurations into planning documents, e.g. the Tygerberg District Plan: SDP and EMF (see Section 2 of Final EIA Report).

In 2008, Airports Company South Africa appointed NACO and SSI to initiate the Preliminary Design of the Re-aligned Runway 18-36 which was concluded in 2010. During this time comprehensive consultation took place with key stakeholders such as Air Traffic & Navigational Services (ATNS), the South African Civil Aviation Authority (SACAA) and the Airline Pilots Association of South Africa (ALPA) to address and discuss major conceptual matters.

1.2.1.1 Single Runway EIA Alternatives

While the Master Plan considered various layout options for two runways, the current project proposes the re-alignment of the primary runway, and required the consideration of runway alignment alternatives for a single runway.

Potential runway alignments (and airport configurations) at Cape Town International Airport are constrained by:

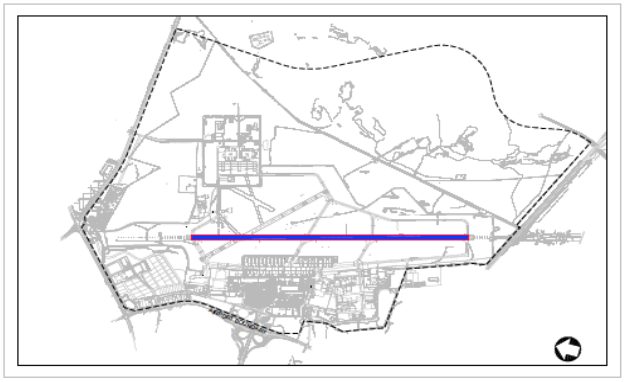
- The elliptical shape of the property which limits re-alignment options to ~20^0 – clockwise or anticlockwise – of the current runway alignment. Rotating alignments through, e.g. 40-90^0 is not possible;
- Prevailing winds; which are generally from the south-east (in summer) and which in winter rotate through 180^0 as prevailing north-westerlies. Runway alignments roughly aligned with prevailing winds are required to meet safety and usability requirements; and
- Surrounding terrain to the north (notably the Tygerberg Hills) which constrains flight paths/approaches.

As such, in concept there are only four potentially plausible categories of alignment for an initial single runway (see Figure 1-1):

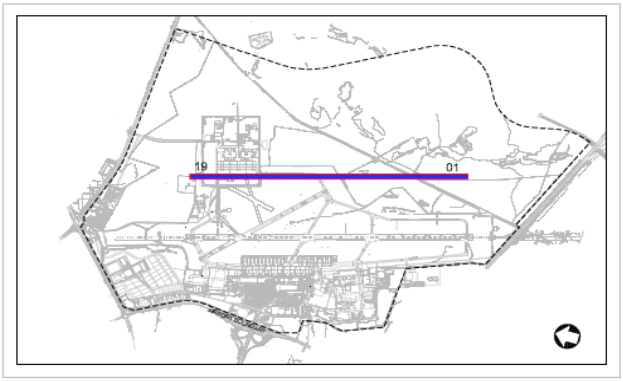
1. Existing alignment (runway as is);
2. Existing alignment with a **parallel shift** to the North East;
3. Counter clockwise rotation of runway; and
4. **Clockwise** rotation of runway

Shifting the runway to the south east would have a significant impact on the existing airport infrastructure and associated developments south of the airport and is thus considered practically impossible. This alignment was thus eliminated from further consideration.

Although all four categories of single runway alignment identified above were considered **technically feasible** (i.e. could be constructed without any technical constraints), only two alignment were considered operationally feasible (i.e. aircraft would not experience any significant operational constraints which would impact on runway capacity and safe runway operations).

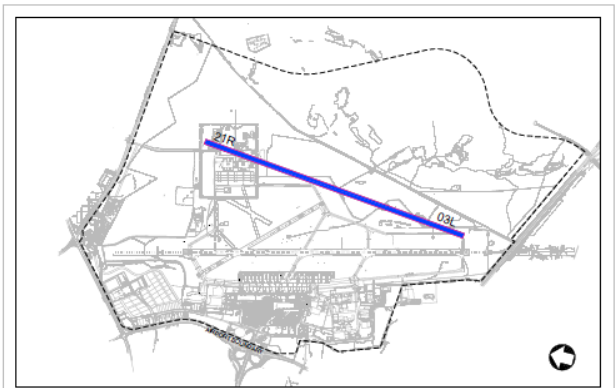


Existing alignment



Parallel shift North east

Counter clockwise rotation



Clockwise rotation

srk consulting	**Figure 1-1: Single Runway Alignment Alternatives**	Project No. 445354

Source: Naco-RHDHV, 2014

The **parallel** shift alternative is not feasible due to safety concerns posed to approach paths over the Tygerberg Hills. In particular, the approach surface of such an alignment (and even the existing alignment) is below the elevation of the Tygerberg Hills and is non-compliant with the International Civil Aviation Organisation (ICAO) Annex 14, making this runway option unsuitable for landing in a southerly direction, reducing capacity of the runway by 60%. This is considered unacceptable and eliminates this alternative.

The **clockwise** rotation alternative is not feasible due to capacity and safety concerns. In particular, crosswinds are a major concern and will reduce runway usability to 92% at a 15 knot crosswind limit (applicable to B737-800 and B747-400 aircraft). A 92% usability is non-compliant with the ICAO minimum recommendation of 95**%** usability. Usability for smaller aircraft will be even lower, while larger aircraft can land but with increased safety risks. Another concern is security risks (perimeter breaches and potential stowaways). These elements are considered unacceptable and eliminate this alternative.

When evaluating the remaining two categories of alignment for a single runway, implications of a second runway must also be considered. The existing runway would be supplemented by a second runway rotated anticlockwise (the **Open V** concept) while the re-aligned runway

would supplemented by a parallel runway (either the **Independent Use 1 035 m** or **Close Parallel 760 m** concepts**).**

The parallel configuration is considerably better across a wide range of criteria, (see Section 1.2.1). Technically this is a much better alternative while the **Open V** is sub-optimal and severely limits land use and provides no flexibility for a second runway. Crucially, in the long term it is expected that parallel runways will have fewer noise impacts in terms of geographic spread than the **Open V** concept which will have two diverging noise cones with a more extensive footprint. As such only the parallel configuration is feasible and reasonable in the long term, and consequently only a re-aligned single runway is comparatively assessed in the EIA.

Based on the Master Plan evaluation, the **counter clockwise rotation** would allow for the long term development of the **Independent Use 1 035 m** parallel runway configuration. This would allow the Airports Company South Africa to optimise utilisation of the airport in its current location.

1.2.1.2 EAP Comment on Alternative Evaluation Process

The EAPs have comprehensively reviewed the process which culminated in the selection of the **counter clockwise rotation** runway configuration and has independently reached the conclusion that other configurations are not reasonable or feasible alternatives, and therefore do not qualify for further comparative assessment in the EIA process. Many of the reasons are presented in preceding sections of this report.

In summary, the EAPs recognise the following:

ACSA owns and operates Cape Town International Airport on an existing property in Cape Town. At this juncture it is not reasonable or feasible to assess an alternative location, primarily, though not exclusively because of the prohibitive costs associated with a new, greenfields airport.

Potential runway alignments (and airport configurations) at Cape Town International Airport are constrained by the shape of the property, prevailing wind conditions and surrounding terrain, allowing only four plausible categories for alignment, of which only the existing alignment and counter clockwise rotation are operationally feasible. However the counter clockwise rotation offers significant operational benefits and is anticipated to have fewer environmental (noise) impacts in the long term and, consequently, is the only alternative comparatively assessed in the EIA.

The EIA will also assess the potential impacts of the existing alignment in its capacity as the No Go alternative (see Section 1.3).

1.3 The No Go Alternative

The No Go alternative will be considered in the EIA in accordance with the requirements of the EIA Regulations, 2010. The No Go alternative entails no change to the existing runway, which will remain in its current position. However, the No Go alternative is not synonymous with the baseline or *status quo,* since a number of developments are permitted and/or may occur whether the runway is re-aligned or not.

The No Go alternative includes any further development at the airport which could be undertaken with the existing runway without requiring separate environmental authorisation (or assessment).

The existing runway (Runway 01-19) has a declared maximum capacity of 30 ATM per hour. The No Go alternative assumes that the current demand profile remains the same (i.e. growth in air traffic movements will follow similar trends to the existing demand profile, however this could change considering Cape Town International Airport is a 24 hour airport operation.) The No Go alternative thus assumes operation of the existing Runway 01-19 at its maximum capacity, since Airports Company South Africa requires no further environmental (NEMA) authorisations to accommodate the projected growth in ATMs. The No Go alternative also includes increased road traffic associated with the operation of the existing runway at maximum capacity.

The noise contours associated with the current operations at the airport are likely to expand (incorporate a larger area) with the increase in use of the existing runway and associated increase in the frequency of flights during certain hours. This expansion, which is not expected to be significant, is nevertheless also incorporated in the No Go alternative.

The No Go alternative does mean that associated infrastructure (additional taxiways and aprons as described in this report - see Section 3 of the Final EIA Report), as well as earthworks to the east of the current airport property, would not be constructed or occur.

In most respects the No Go alternative is one and the same as Scenario 2 presented in Section 6 of the Final EIA Report.