Technical Note

Project:	**14C00570-01-10-210-R2**	Job No:14C00570
Subject:	**Preliminary design Report**	
Prepared by:	**David Lee**	Date: 09 April 2014
Reviewed by:	**Christian Di Dio**	Date: 14 April 2014
Approved by:	**Ulrich Huber**	Date: 19 May 2014

Rev No	Comments	Prepared by	Approved by	Date
00	Issued to the client 23/04/2014	DL	CDD	17/04/2014
01	Revised Watercrossings	EF	UH	08/05/2014
02	Revised Watercrossings	EF	UH	13/05/2014
03	Revised Watercrossings	EF	UH	15/05/2014
04	Revised Watercrossings	EF	UH	16/05/2014
05	Editorial Revisions	EF	UH	19/05/2014

Introduction

Following the completion of an initial track layout and after the topographical data has been provided a design review was undertaken which including horizontal track realignment, vertical track review, cut and fill volume assessment, watercourse crossing identification, crane pad alignment and consideration of construction risks.

The following report summarises the findings of this review.

Track Alignment

The initial track layout produced for Longyuan Mulilo De Aar 2 North Wind Energy Facility (hereafter referred to as De Aar 2) consisted of the following:

- Approximately 111.2km of new tracks,
- 14 new watercourse crossing locations,
- 3 potential watercourse crossing upgrades, and;
- Multiple locations where the track traversed unnecessarily over steep gradients.

A horizontal review of the proposed track was undertaken which resulted in a realigned route resulting in the following:

- Approximately 101.2 km of new tracks,
- 14 new watercourse crossing locations,
- 3 potential watercourse crossing upgrades, and;
- Better aligned route to the topography of the site.

The realigned route therefore reduces the track length and avoids areas of steep gradient thereby reducing engineering works on site. Consequently, the realigned route reduces the significance of the following negative impacts associated with the construction of the wind farm:

- Area disturbed by construction activities: By reducing the track length and avoiding areas of steep gradient, the volume of cut and fill is reduced. This will reduce the overall development footprint and reduce construction time allowing for rehabilitation to commence at an earlier date.

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- Freshwater impacts: By reducing track length, freshwater impacts, such as erosion, sedimentation and disturbance of freshwater related habitats, triggered by engineering works at water crossings are reduced.

The reduction in track length equates to approximately 16,000m² of stone (assumed depth of 0.4m and width of 4m) which would have to be either won on site or imported to site. The track length reduction will also result in less engineering works associated with cut and fill.

A vertical alignment review was also undertaken in order to review the buildability of the tracks and to produce initial cut and fill volumes, as detailed below.

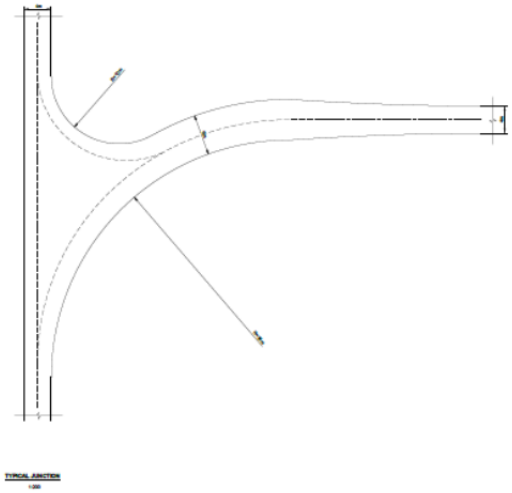
- Volume of cut = 99,740.48m³
- Volume of fill = 120,216.19m³
- **Net = 20,475.71m³ (Fill)**

Track Design Specification

The horizontal and vertical alignment review and resulting track route where undertaken against the follow criteria:

- Track width;
  - Straight track (0 – 20°) – 4m
  - Bend (20 – 60°) – 5m
  - Bend (60 – 90°) – 6m
- Min horizontal curve – 35m (inside radius)
- Min vertical curve – 400m
- Longitudinal Gradient;
  - Preferred gradient – 10% (where possible)
  - Max gradient – 14%
- Track cross fall – 5% (max)
- Spacing between bends (>60°) – 40m

Typical junction is shown below

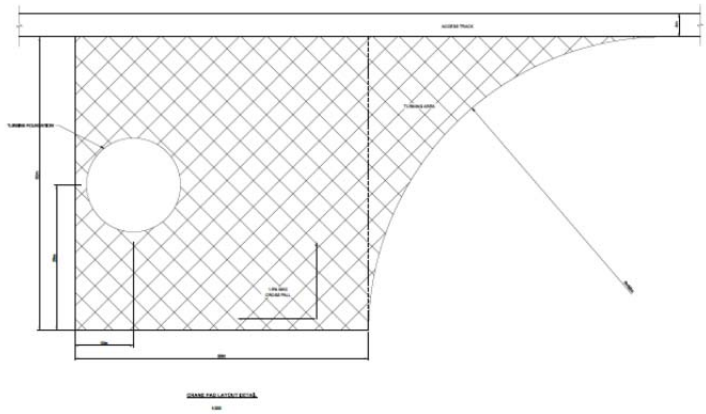


Crane Pad Alignment

The maximum cross fall for the crane pads is 1.5%, given the proposed crane pad dimensions are 50m x 50m the maximum height difference across the width / length of the crane pad is 0.75m.

The orientation of crane pads have been aligned to minimise the height difference across them and hence minimise the amount of cut and fill required. On average the height difference across the crane pads ranges from 2 – 4m however there are locations where this is greater than 6m.

Typical Crane Pad is shown below



Construction Yards
The initial layout proposed the following construction yards:

- CY1 – 400m x 200m = 80,000m²
- CY2 – 400m x 200m = 80,000m²
- CY3 – 400m x 200m = 80,000m²

It is anticipated that the construction yard will consist of the following:

- Welfare facilities including;
    - Canteen
    - Toilette
    - Offices
    - Changing Rooms
    - Meeting Rooms
    - Parking
- Storage including;
    - Bunded fuel areas
    - Oil storage areas
- General stores (containers)
- Skips

It is believed the initial proposed size of the construction yards can be reduced to the following:

- CY1 – 350m x 200m = 70,000m²
- CY2 – 200m x 100m = 20,000m²
- CY3 – 200m x 100m = 20,000m²

The reduced construction yard footprints will result in a total area cleared of 110,000m^2. This is 130,000m^2 less than initially planned.

Watercourse Crossings

Fourteen new watercourse crossings are required, with 3 existing watercourse crossings, WC2, WC4 and WC5, potentially needing upgrades; the coordinates (X, Y - Cape LO25 and UTM WGS84/34) of each are listed below:

Existing water-crossings that may potentially require upgrades:

WC2 X=-57746.766 Y=-3382201.011
WC4 X=-53533.756 Y=-3381895.261
WC5 X=-52419.224 Y=-3381527.102

New watercourse crossings:

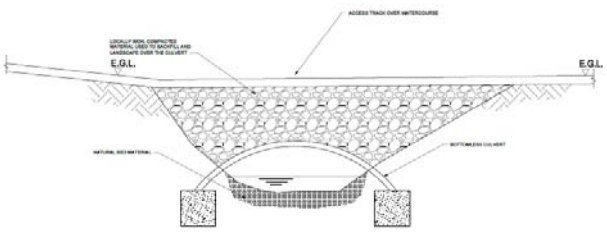
WC1 X=-72528.481 Y=-3378818.677
WC3 X=-57175.620 Y=-3381805.252
WC6 X=-70667.072 Y=-3378404.462
WC7 X=-73724.079 Y=-3378581.169
WC8 X=-73369.926 Y=-3378929.074
WC9 X=-70177.064 Y=-3381562.674
WC10 X=-70035.486 Y=-3381718.488
WC11 X=-72634.623 Y=-3379404.598
WC12 X=-64495.528 Y=-3381314.869
WC13 X=-56945.203 Y=-3380554.936
WC14 X=-56933.001 Y=-3380293.952
WC15 X=-56527.893 Y=-3379898.818
WC16 X=-57480.635 Y=-3378160.716
WC17 X=-72829.983 Y=-3379293.902

All watercourse crossings will be installed in accordance with DWA guidelines and will be based on the following principles:

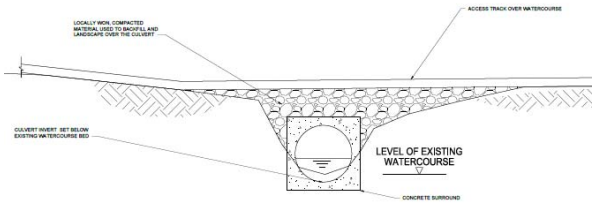
- The alignment of the culvert will be parallel to the existing channel;
- The gradient of the culvert will be similar to the existing channel;
- The width of the culvert will be greater than the active width of the channel;
- The height of the culvert will be greater than the active height of the channel;
- There will be no hydraulic drops at the inlet or outlet of the culvert; and
- The culverts will be partially buried and natural bed material reinstated within the culvert.

The type and size of crossing will be determined at the detailed design stage; however, it is likely they will either a bottomless arch culvert or a closed pipe culvert depending on the watercourse size.

Typical watercourse crossings are shown below:



Bottomless Arch Culvert



Closed Pipe Culvert

Following construction, the watercourse crossings will remain in place for the lifetime of the wind farm and will then be removed and the natural bed reinstated.

Constraints and Restrictions
The main constraints and resections that present at De Aar 2 are detailed below:

- High sensitivity botanical areas
  - Cliff Area with 100m buffer
- Heritage areas:
  - All rock kraals designated as no go areas.
  - Buffer zones must be implemented around farm buildings which are older than 60 years, according to heritage specialist recommendations
- Aquatic features with a minimum 32 m buffer
- Vendussiekuil Dam with 500 m buffer
- Verreaux's Eagle nests with 800 m buffer:
  - Nest 1 : 30º32 47.39"S 24º14'12.09"E
  - Nest 2: 30º32'47.30"S 24º14'11.00"E
  - Nest 3: 30º32'59.91"S 24º14'17.99"E
- Archaeological no go areas with buffer

Several watercourses are also present across the site, a 35m buffer has been applied to minimise any potential impact on the watercourse.

In order to ensure the protection of ecological areas, storage of the main construction material on site (crushed rock and concrete), will adhere to the following mitigation measures:

- All site works to be undertaken shall be contained within the boundary of the site;
- A "no-go" area will be determined prior to construction work commencing on site which will cover the land outside of the working area;
- No equipment associated with earthworks will be allowed within the "no-go" areas, unless expressly agreed in advance by the Environmental Control Officer / Engineer.

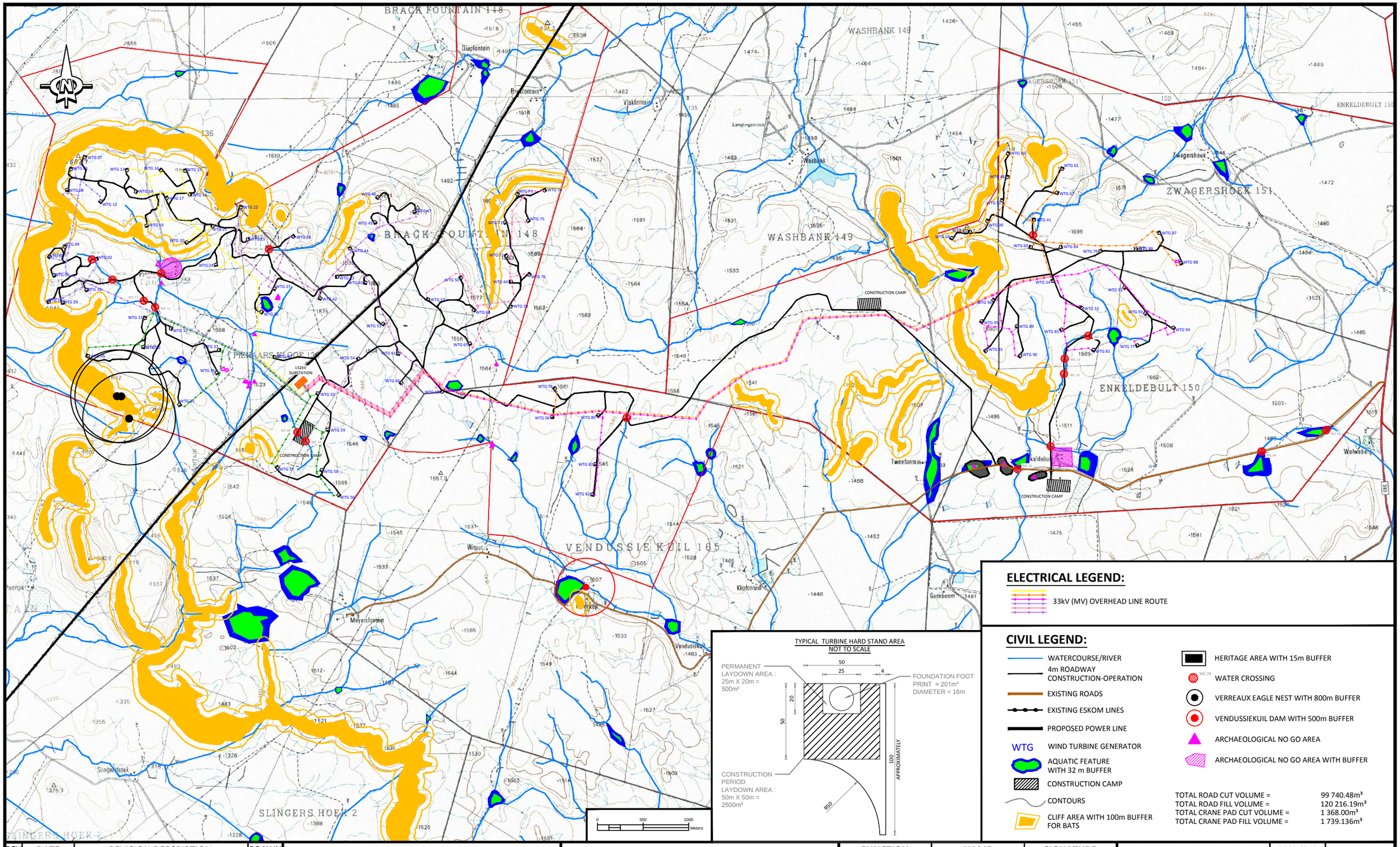
Construction Issues
The main construction issues on site are a result of topography and the proposed wind turbine locations and are summarised below:

- Crane pad construction – due to the proposed location of several wind turbines and the proposed crane pad layout significant engineering works will be required to achieve the desired cross fall of 1.5%.
- Wind turbine erection – steep slopes are adjacent to many of the wind turbines which may make the erection of the turbine difficult. It may not be possible to assemble the blades to the rotor on the ground.
- Roads Width – due to the topography of the site the proposed specific width (straight track 4m) might create complication for transport.

Conclusions and Recommendations
The realigned track presents a more buildable route in terms of reducing the amount of engineering works required in comparison to the initial layout as well as having the potential to reduce construction costs and potential environmental impacts.

The main construction risks are a result of the steep gradient present in some locations across the site, to reduce the impact from the steep gradients it the following is recommended:

- Reduce the size of the crane pad layout – The current crane pads are propped to be 50m x 50m and include the turbine foundation within them. It is believed that these are oversized and a reduction in size will reduce the amount of cut and fill required.
- Micro-siting of wind turbines – Many of the wind turbines have been located on peaks across the site which will increase the amount of cut and fill associated with the crane pads as well making the wind turbine erection difficult. Micro-siting turbine to flatter areas would reduce the amount of cut and fill required as well as simplifying the erection process.
- Internal road should have straight value of approximately 4m.



TYPICAL TURBINE HARD STAND AREA
NOT TO SCALE

ELECTRICAL LEGEND:

- 33kV (MV) OVERHEAD LINE ROUTE

CIVIL LEGEND:

- WATERCOURSE/RIVER
- 4m ROADWAY CONSTRUCTION-OPERATION
- EXISTING ROADS
- EXISTING ESKOM LINES
- PROPOSED POWER LINE
- WTG — WIND TURBINE GENERATOR
- AQUATIC FEATURE WITH 32 m BUFFER
- CONSTRUCTION CAMP
- CONTOURS
- CLIFF AREA WITH 100m BUFFER FOR BATS
- HERITAGE AREA WITH 15m BUFFER
- WC01 — WATER CROSSING
- VERREAUX EAGLE NEST WITH 800m BUFFER
- VENDUSSIEKUIL DAM WITH 500m BUFFER
- ARCHAEOLOGICAL NO GO AREA
- ARCHAEOLOGICAL NO GO AREA WITH BUFFER

TOTAL ROAD CUT VOLUME =	99 740.48m³
TOTAL ROAD FILL VOLUME =	120 216.19m³
TOTAL CRANE PAD CUT VOLUME =	1 368.00m³
TOTAL CRANE PAD FILL VOLUME =	1 739.136m³

REV	DATE	REVISION DESCRIPTION	DRAWN

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DISCIPLINE: **ENERGY**

THE MASTER HELD AT THE AECOM OFFICE BEARS THE ORIGINAL SIGNATURE OF APPROVAL.

CLIENT: MULILO

PROJECT DESCRIPTION: **DE AAR 2 NORTH WIND FARM**

DRAWING TITLE: **ENVIRONMENTAL SENSITIVITY LAYOUT**

FUNCTION	NAME	SIGNATURE
DESIGNED BY		N/A
DRAWN BY	R DE SWARDT	N/A
DESIGN CHECKED BY		N/A
DRAWING CHECKED BY	C DI DIO	N/A

APPROVAL - CONSULTANT

NAME		SIGNATURE	
DATE		PROF. REG No.	

DRAWING STATUS CODES:
D=DRAFT F=FINAL R=REPORT
P=PRELIMINARY C=CONSTRUCTION
T=TENDER A=AS-BUILT/RECORD

FIRST ISSUE DATE	SCALE	SHEET	SHEET SIZE
2014-04-17	1 : 60000	1 OF 1	A3

AECOM DRAWING NUMBER

AECOM PROJ. No.	SUB-No.	DISCIPLINE	NUMBER	STATUS	REVISION
14C00570	34	09	**EL02**	**P**	**04**