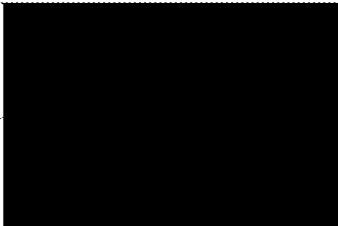
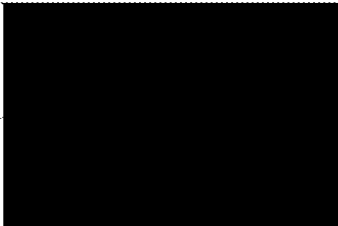


ARUNDEL ROAD, ANGMERING – BOUNDARY RISK ASSESSMENT

CLIENT	Gladman Developments
SITE ADDRESS	Arundel Road Angmering BN16 4LA
CLIENT CONTACT	Steve Barker

REPORT NUMBER	LSUK.18-0500	
REVISION NUMBER & DATE	1.0	13/06/2018
REPORTED BY		Louis Keeley Consultant
APPROVED BY		Kathryn Severn Operations Manager

SUMMARY	To assess the potential risk of cricket balls being hit into a proposed new development adjacent to the cricket field at a recreation ground on Arundel Road, Angmering, Labosport Ltd has reviewed the site including distances to ascertain the risk of balls landing beyond the site boundaries; and advise on the type and level of mitigation recommended to provide a suitable level of protection. This report forms the bases of a risk assessment and if required a recommended mitigation strategy to minimise potential risks.
---------	---

INTRODUCTION

To assess the potential risk of cricket balls being hit into a proposed new development adjacent to the cricket field at Arundel Road, Angmering, Labosport Ltd has reviewed the site plan including distances to ascertain the risk of balls landing in the adjacent areas and advise on the type and level of mitigation recommended to provide a suitable level of protection. Mitigation options taken into consideration where applicable include; fencing, location and orientation of the cricket square and wickets, player ability, location of junior and senior wickets, development type.

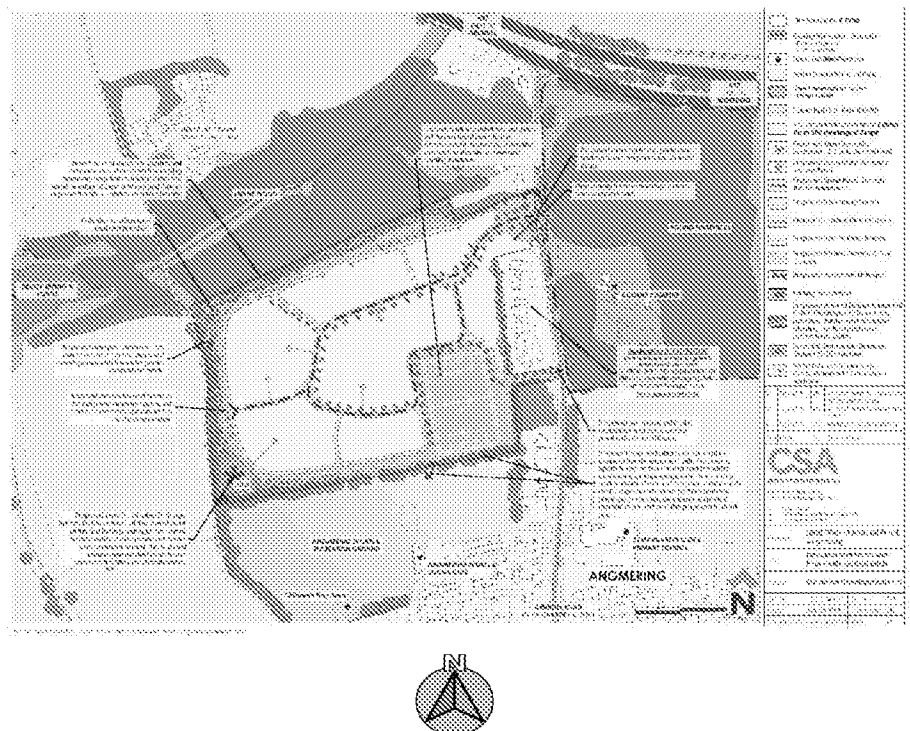
Using a ball projectile model and supporting data from research undertaken, based on professional level cricket, by Labosport for the England and Wales Cricket Board (ECB) the following risk assessment has been produced. As with any model and sensible risk assessment the proportionality linked to risk (comprising likelihood and severity) are included in this report.

Note: A set of measurements were taken by Labosport in situ based on information provided by the client. The site visit took place on the 06th June 2018. Locations of the proposed development have been provided by the client and any errors in location are not the responsibility of Labosport and this assessment is undertaken on the basis of accurate data.

SITE SPECIFICS

The below diagrams illustrate the layout of the cricket field (1 artificial wicket) in relation to the site boundaries and proposed development. The proposed development consists of a new full-size football pitch, vehicular access / path ways, and a housing development to the North of the recreation ground. There is an existing 2 m height fence separating the recreation ground and the proposed build areas, with a hedgerow / treeline along the same boundary. The cricket wicket runs in a North-South orientation.

Site Proposal



Site Measurements



Please note, site measurements sketch has been included to show the directions and measurements that have been used for the report. All measurements have been taken on the date of the site visit, and using the image of the proposals provided.

Orientation of Risk

The focus on the boundary assessment is based on the shortest distances from the edge of the cricket square to the proposed boundary of the development and hence worst-case scenario. This can be identified in the above site plan as the North and North-East orientations.

SITE MEASUREMENTS

The above diagram illustrates the minimum measured distances from the cricket square to the proposed development boundary. Note as this is a risk assessment the worst case scenarios are considered; consequently the shortest measured (and calculated) distance is used for the study.

Measured Distance	Shortest Boundary (m)
North – Edge of the artificial cricket wicket to the site boundary.	Circa 56.0 m
**North – Opposing edge of the artificial cricket wicket to the site boundary.	Circa 76.12 m
North-East – Edge of the artificial cricket wicket to the proposed football pitch.	Circa 108.0 m

******The likely direction of travel from a ball is not the same for all directions from the cricket wicket (i.e. balls hit directly behind a player are not going to occur with the same velocity and angle of impact as a forward or sideways shot from a player) and it is unlikely

to be of the same magnitude/distance. The distance from the furthest stump has therefore also been considered as the type of shot required to hit the ball directly behind a player is uncommon and the occasional "top edge" shot resulting in this trajectory will be most likely not to travel the full distance.

Previous work undertaken for the England and Wales Cricket Board (ECB) led to the development of a model used to estimate the distance a ball would travel and its trajectory given a specific velocity and angle.

Model limitations:

The size of a cricket ball and its estimated drag coefficient has been added to the model, this in combination with classical Newtonian Physics for the influence of air resistance and gravity have been used to predict the projectile path. However, for simplicity, there are some limitations to the model including but not limited to bat/ball restitution, atmospheric conditions, wind (speed and direction) and spin of the ball. Due to these limitations the model is regarded as an indicative prediction tool.

The below table highlights the total estimated distance a ball will travel for typical shots (angles and velocities) taken from assessment of in-game action ranging from 20 degrees to 50 degrees and 20 m/s (45 mph) to 50 m/s (112 mph).

Total Estimated Distance (m)		Angle (degrees)						
		20	25	30	35	40	45	50
Velocity (m/s)	20	20.70	23.24	25.82	27.22	28.04	27.84	27.10
	25	28.82	32.8	35.29	37.01	37.95	37.66	36.25
	30	37.32	41.99	44.91	46.31	47.34	46.51	45.27
	35	45.95	50.48	53.80	55.40	55.96	55.04	53.15
	40	53.71	58.79	61.82	63.62	63.73	62.73	60.24
	45	60.50	66.15	69.52	70.93	70.62	69.17	66.53
	50	67.88	73.23	76.29	77.88	77.15	75.62	72.09

Note: the trajectory for the above distances will be very different depending on the angle and velocity of shot as can be seen in the assessment below.

The hit angles and velocities are estimated from in-game action to cover a range of 'typical' shots ranging from 20 degrees to 50 degrees and 20 m/s (45 mph) to 50 m/s (112 mph).

The following distances have been used to calculate the height of the ball for different shot conditions as specified below:

Measured Distance	Shortest Boundary (m)
North – Edge of the artificial cricket wicket to the site boundary.	Circa 56.0 m
**North – Opposing edge of the artificial cricket wicket to the site boundary.	Circa 76.12 m
North-East – Edge of the artificial cricket wicket to the proposed football pitch.	Circa 108.0 m

ESTIMATED BALL HEIGHT (USING THE PROJECTION MODELLING TOOL)

North Orientation

Estimated Ball Height @ 56.0 m		Angle (degrees)						
		20	25	30	35	40	45	50
Velocity (m/s)	20	0	0	0	0	0	0	0
	25	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0
	40	0	2.3	5.7	8.5	10.7	11.4	9.3
	45	3.3	7.4	11.2	14.6	18.0	20.0	20.1
	50	6.4	10.7	15.1	19.1	23.1	26.3	28.3
Estimated Ball Height @ 76.1 m		Angle (degrees)						
		20	25	30	35	40	45	50
Velocity (m/s)	20	0	0	0	0	0	0	0
	25	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0
	40	0	0	0	0	0	0	0
	45	0	0	0	0	0	0	0
	50	0	0	1.1	3.2	3.4	0	0

North-East Orientation

Estimated Ball Height @ 108.0 m		Angle (degrees)						
		20	25	30	35	40	45	50
Velocity (m/s)	20	0	0	0	0	0	0	0
	25	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0
	40	0	0	0	0	0	0	0
	45	0	0	0	0	0	0	0
	50	0	0	0	0	0	0	0

See Appendix A for example trajectories.

RISK ASSESSMENT DISCUSSION

This report has been prepared to assess the potential risk of cricket balls being hit into a proposed new development adjacent to the recreational cricket wicket at Arundel Road, Angmering, and advise on the type and level of mitigation recommended to provide a suitable level of protection. Mitigation options taken into consideration where applicable include; fencing, location and orientation of the cricket square and wickets, player ability, location of junior and senior wickets, development type.

The exact frequency of shots resulting in a cricket ball being hit into the adjacent area is unknown and impossible to predict with certainty (player skills, type of game and many other factors can influence this) hence a proportionate approach needs to be taken to provide safety to these users. In reality there will always be a "freak" shot that will result in a further than expected trajectory, however, the implications of planning for this type of worst case approach would result in the closure of hundreds of cricket ground across the country hence a balanced risk mitigation strategy needs to be implemented that is proportionate. Indeed there are risks associated with many everyday activities, but plans need to be developed to reduce risk following good practical health and safety principles including a combination of likelihood and severity.

Report Number LSUK.18-0500

Date 13/06/2018

Page 5 of 8

This report contains 8 pages, it may not be used for commercial purposes unless it is reproduced in its entirety

LABOSPORT LTD, Unit 3 Aerial Way, Hucknall, Nottinghamshire, NG15 6DW, England (5185905)

Labosport Ltd have undertaken this type of assessment for other cricket grounds over the past 3 years when there have been perceived problems with cricket balls exceeding the boundary or the influence a new development may have on an existing club.

The basis of the shot velocity (50 m/s) is calculated on professional (1st class and international) players. Typically for community cricket clubs we undertake the assumption that 40 m/s is a suitable speed given the speed of bowling and batsman's skill when contrasted with elite players. It is on this basis that the below recommendations have been made.

Risks Overview/Mitigation Approach

The shortest distance from the edge of the cricket square to the site boundary in the North orientation is 56.0 m. At 56.0 m all but the fastest shots for community/amateur level cricket will be stopped by a 10 m high mitigation system. A 10 m high system will not stop all shots from landing beyond the boundary but it is believed from the assessment of ball trajectory it will significantly reduce their frequency. In order to almost completely remove the risk of cricket balls landing in the area beyond this boundary a mitigation system 11.5 m high would be required.

The distance from furthest stump has also been considered as the type of shot required to hit the ball directly behind a player is uncommon and the occasional "top edge" shot resulting in this trajectory will most likely not travel the full distance. The distance from the furthest stump is circa 76.12 m. The height calculations of the ball trajectory suggest that at this distance a good level of protection for community/amateur cricket will be provided. Only those shots calculated on professional 1st class international players may be capable of surpassing these distances, which is considered unlikely or very rare at community/amateur level.

Based on the height calculations of the ball trajectory combined with the experiential information regarding shot scenario, direction of play and site specifics it is recommended that a 3 m high mitigation system would be a sensible and suitable solution. A 3 m high mitigation system will protect pedestrians and users within the proposed development from horizontal trajectories and low level balls surpassing the boundary. This may not stop all shots from landing beyond this boundary but it is believed from the assessment of ball trajectory it will significantly reduce their frequency.

This report does not recommend the specific design of a mitigation system, however options could include;

- Ball stop netting
- Rigid panel fencing
- Closed board fencing
- Permanent or temporary fencing structures

It is recommended the client discuss design options with the relevant stakeholders including the LPA, Sport England, the ECB and the cricket club.

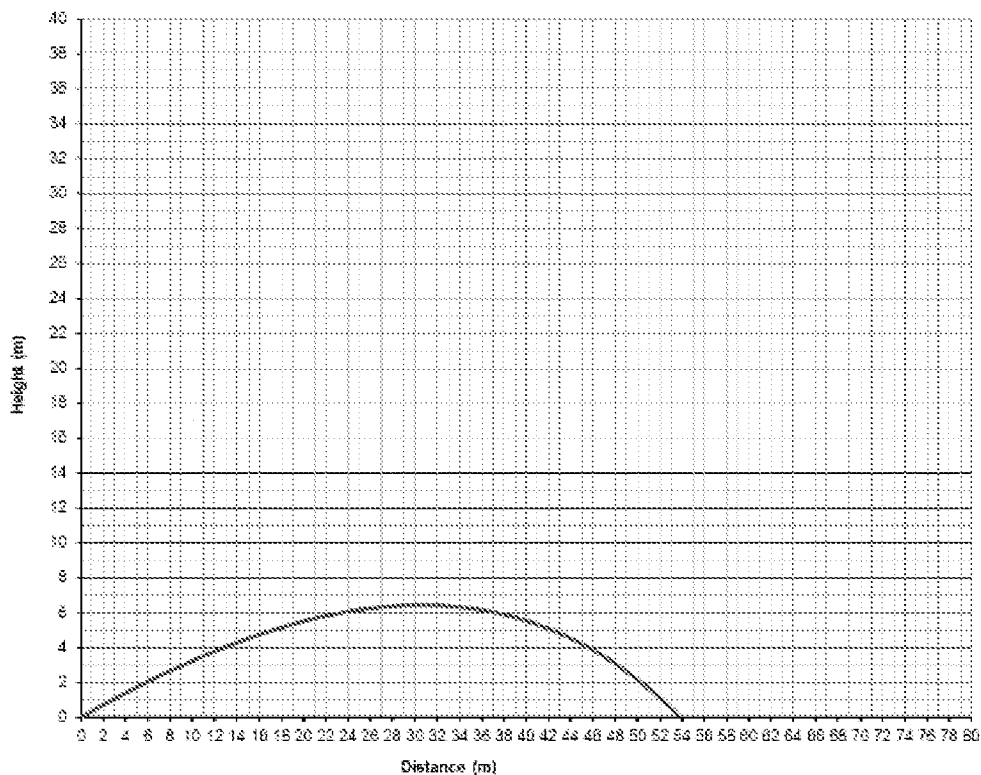
As the distance from the edge of the artificial cricket wicket increases towards the North-East and North-West orientations the risk of cricket balls surpassing the site boundary will reduce. At and beyond a distance of 65 m a good level of protection for community level cricket should be provided. The shortest distance from the edge of the cricket square to the proposed football pitch area in the North-East orientation is 108.0 m. At 108 m the height calculations of the ball trajectory suggest that at this distance a good level of protection for community/amateur and professional cricket will be provided.

Further notes:

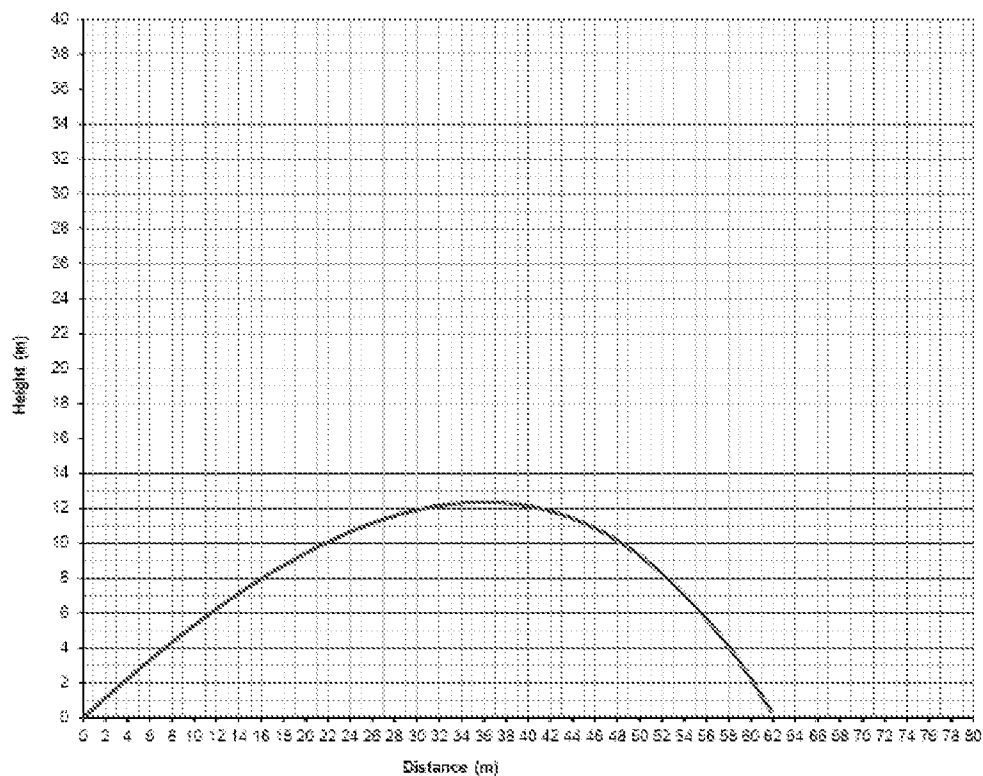
It is recommended the client discuss the plan with the England and Wales Cricket Board (ECB) or other relevant organisations such as Sport England along with the club to ensure whatever system if proposed is both suitable in mitigating the risk but also practicable for the cricket club's day to day use.

APPENDIX A – TYPICAL EXAMPLE TRAJECTORIES

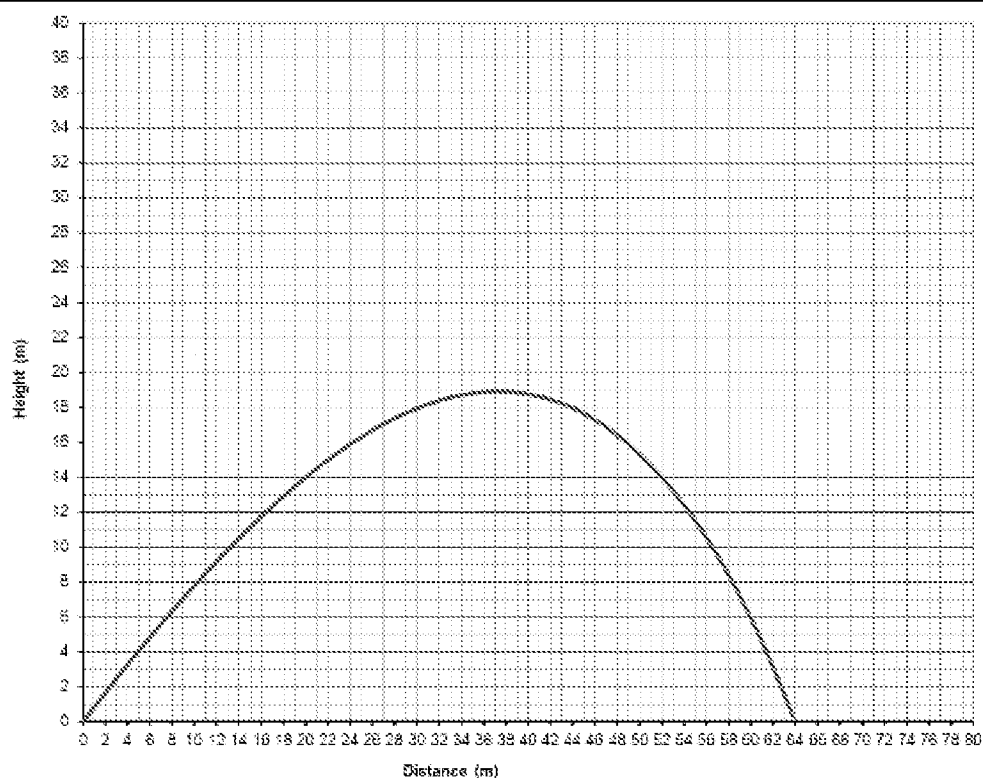
20 ° @ 40 m/s



30 ° @ 40 m/s



40 ° @ 40 m/s



Report Number LSUK.18-0500

Date 13/06/2018

Page 8 of 8

This report contains 8 pages, it may not be used for commercial purposes unless it is reproduced in its entirety

LABOSPORT LTD, Unit 3 Aerial Way, Hucknall, Nottinghamshire, NG15 6DW, England (5185905)