BROMYARD DEPOT – BOUNDARY RISK ASSESSMENT

CLIENT	Keepmoat Homes
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SUMMARY	To assess the potential risk of cricket balls being hit into a proposed residential development adjacent to the cricket field at Hereford Road, Bromyard, Labosport Ltd has reviewed the site 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. This report forms the basis 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 residential development adjacent to the cricket field at Hereford Road, Bromyard, Labosport Ltd has reviewed the provided 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:** This is a desk study, Labosport have not visited the site, taken measurements or carried out a visual inspection. All measurement information has been provided by the client and any errors in measurements 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 existing cricket square in relation to the proposed residential development. Note the proposed layouts are illustrative only. The client has informed that the wickets are orientated in a North-West to South-East direction. The proposed development is located to the South-East of the cricket ground. **Site Overview** 

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Development Site Plan

Site Measurements

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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 South-East orientation.

Cricket Nets:
Cricket nets are located directly adjacent the development boundary. If used and maintained correctly, it is expected that the system will be fully caged and therefore prevent many ball strikes from being hit outside the area. Batting nets / cages do not result in aerial shots (the nets prevent this) and therefore the risk of crossing the boundary is low. No further assessment is deemed necessary at this stage.

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)
South-East – Edge of the cricket square to the boundary.	Circa 44 m
****South-East** –Distance from the furthest stump to the boundary.	Circa 64 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 sideway 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.

ESTIMATED BALL HEIGHT (USING THE PROJECTION MODELLING TOOL)

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).

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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)
South-East – Edge of the cricket square to the boundary.	Circa 44 m
****South-East** –Distance from the furthest stump to the boundary.	Circa 64 m

Estimated Ball Height @ 44 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	1.3	3.5	4.6	4.8	3.1
	35	1.3	4.4	7.5	10.3	12.8	14.7	14.9
	40	4.8	8.1	11.5	14.8	18.1	21.0	22.9
	45	6.9	10.6	14.3	18.0	21.7	25.4	28.7
	50	8.6	12.4	16.3	20.3	24.4	28.6	32.7

Estimated Ball Height @ 64 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	2.7	6.0	9.3	10.6	10.7	6.7
	50	2.8	7.5	11.8	15.6	18.4	19.8	18.9

See Appendix A for example trajectories.

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RISK ASSESSMENT DISCUSSION	This report has been prepared to assess the potential risk of cricket balls being hit into a proposed residential development adjacent to the cricket field at Hereford Road, Bromyard, 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 grounds 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. 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** **South-East Orientation** The shortest distance from the edge of the cricket square to the boundary in the South-East orientation is 44 m. At 44 m all but the fastest shots for community/amateur level cricket will be stopped by a 15 m high mitigation system. A 15 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 the boundary a mitigation system 23 m high would be required which is unlikely to be practical or proportionate. 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 shortest distance from the furthest stump is circa 64 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 along this orientation is a sensible and suitable solution. This will protect the public/owners of the dwellings from horizontal trajectories and low-level balls surpassing the boundary. This may 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.

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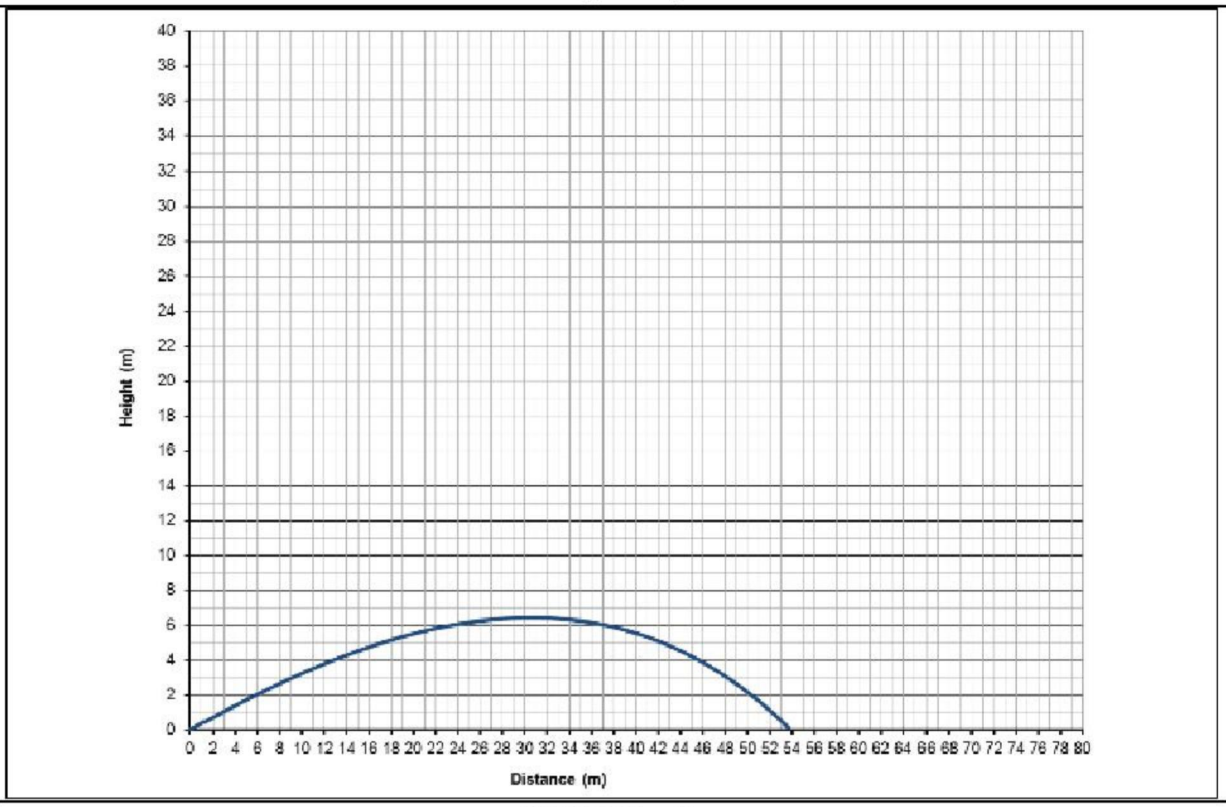
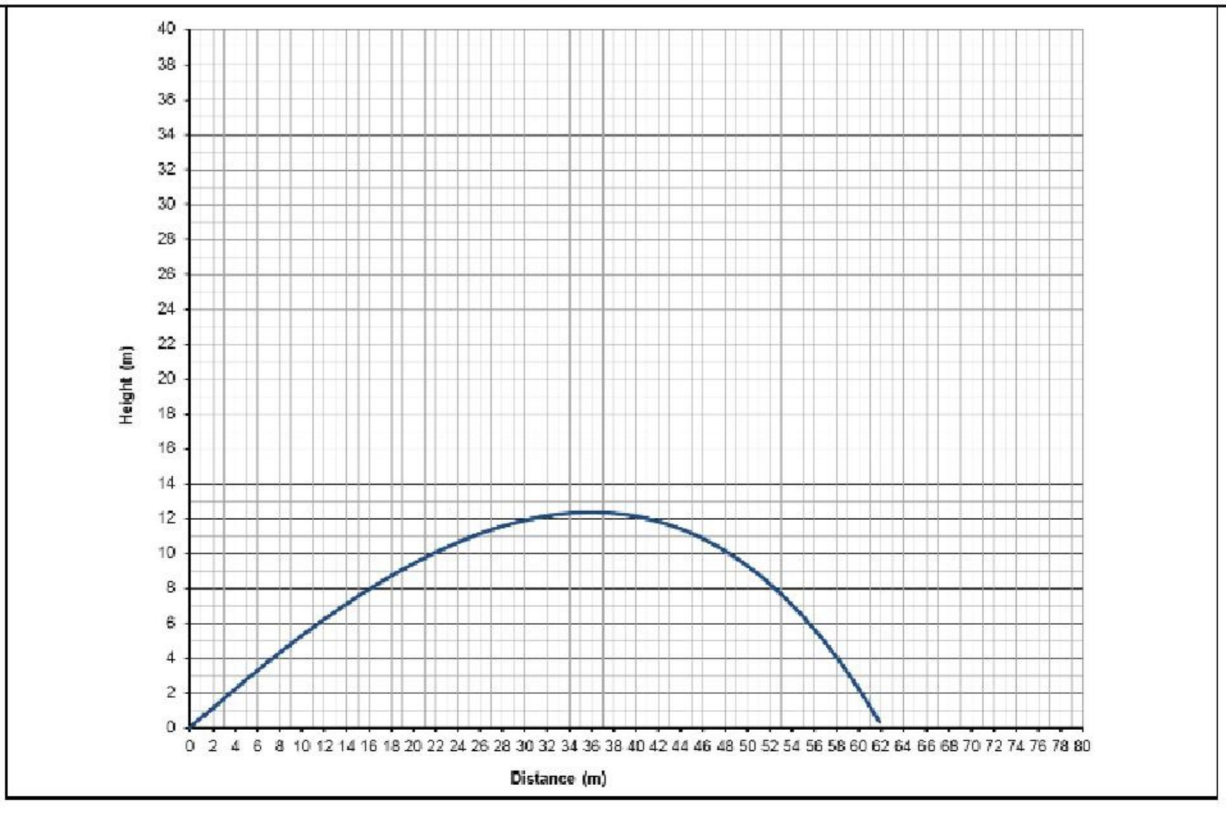
	Further notes: This report does not recommend the specific design of a mitigation system, however options could include; • Ball stop netting • Rigid panel fencing • Closed board fencing • Permanent or temporary fencing structures It is recommended the client discuss design options with the relevant stakeholders including the LPA, Sport England, the ECB and the cricket club. 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

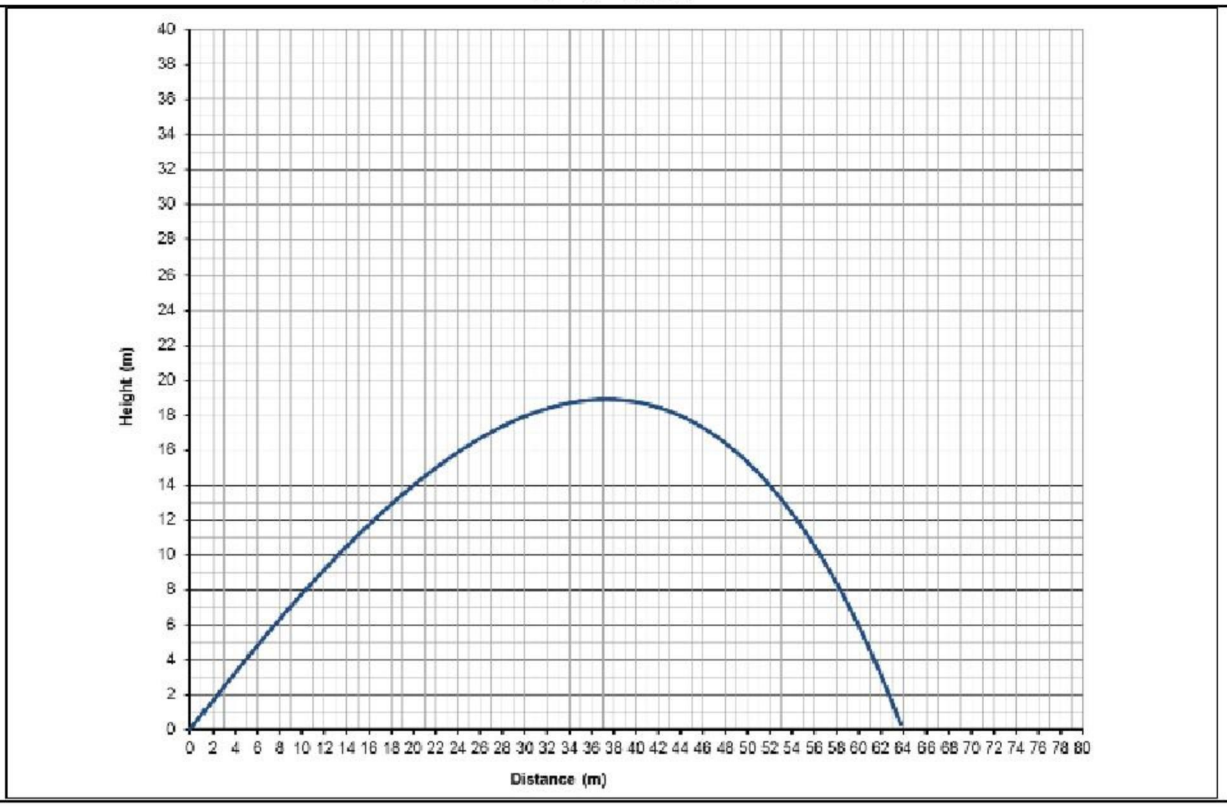
20 ° @ 40 m/s



30 ° @ 40 m/s



40 ° @ 40 m/s



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