



CAR PARK SURFACING & DRAINAGE OPTIONS REPORT

East Heath Car Park, Hampstead Heath

for

City of London

May 2017

Car Park Surfacing and Drainage Options Report

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1.0 Introduction

- 1.1 The Stilwell Partnership has been instructed by the City of London to investigate suitable drainage solutions and three options for a new surface at East Heath Car Park, Hampstead Heath.
- 1.2 As part of this study, we have been asked to set out the advantages and disadvantages of each option, determine maintenance requirements, costs and approximate lifespan. This report first of all sets out the current issues and constraints associated with the car park, and those set out by the Client, and then goes on to outline each surfacing option in more detail and the most suitable drainage solution, before making a recommendation as to which option should be taken forward.
- 1.3 The general limitations of this assessment are that:
- A number of data sources have been used in compiling this report. Whilst The Stilwell Partnership (TSP) believe them to be trustworthy; it is unable to guarantee the accuracy of the information that has been provided by others.
 - This report is based on information available at the time of preparation. There is potential for further information to become available, which may create a need to modify conclusions drawn in this report.

2.0 Current Issues and Constraints

- 2.1 The existing car park is the busiest car park serving Hampstead Heath and as such, a suitable surface is required in order to withstand frequent turning movements. The current surface is a self-binding Coxwell Gravel, which was laid a few years ago see the site layout in **Appendix A**. This surface has not held up well to the daily operations of the car park see photo in **Appendix B**. The surface has been dug up in places, leaving numerous potholes and resulting in some of the material being washed away to the south-eastern corner of the car park when it rains, and further onto East Heath Road during heavy periods of rain.
- 2.2 The City of London has tried to fill the potholes, but this is soon washed away again when heavy rain returns. As a result, the Client requires a new surface to be installed which will deliver suitable natural drainage and provide a surface which will be able to withstand the daily rigours of the car park operations. In addition, the Client would like to keep the colour and texture of the existing car park surface, in order for it to remain in keeping with the surrounding conservation area.
- 2.3 There are sections of tarmac surfacing within the car park; from the entrance heading north to the grassed area to the north of the car park (which provides access for Fairground vehicles) and at the south-eastern corner of the car park for the disabled spaces. Both of these tarmac areas are to be reinstated.
- 2.4 The Client has also specified that the new surface adopted must be able to have the individual bays discreetly marked out.

3.0 Description of the Surfacing Options

- 3.1 Within the brief the Client set out two options which should be given consideration and stated that one other should be considered. The two which were set out within the brief were 'Groundtrax Cellpav' or similar, with gravel in fill and Asphalt and chip finish. The third option we have considered is a resin bound finish on a macadam surface. A description of each surface, the advantages and disadvantages, maintenance issues and approximate cost of installation is outlined below for each option.

Option 1 – Groundtrax CellPave 40

- 3.2 Groundtrax CellPave is an interlocking cellular paving grid system, which can be used for car parks, but is also safe for pedestrians to go over. The CellPave tiles would be laid down onto geotextile fabric, above a prepared sub-base (usually 250mm, but soil investigations would need to be undertaken to determine exact thickness) and a gravel in-fill used between the grid system. A typical cross section from an extract from Groundtrax CellPave 40 installation guide can be seen in **Figure 1 and Appendix C** below. This system would cost in the region of £200,000 to install.
- 3.3 In terms of maintenance, the main issue would be the dislodging and required topping up of the gravel infill. The anticipated lifespan of this system would be in the region of 10 years, according to the supplier. At which point, some, if not all, of the CellPave tiles would need to be replaced. If vehicles larger than cars or small vans entering the car park then damage may occur. If vehicles larger than cars or small vans entering the car park then damage may occur.

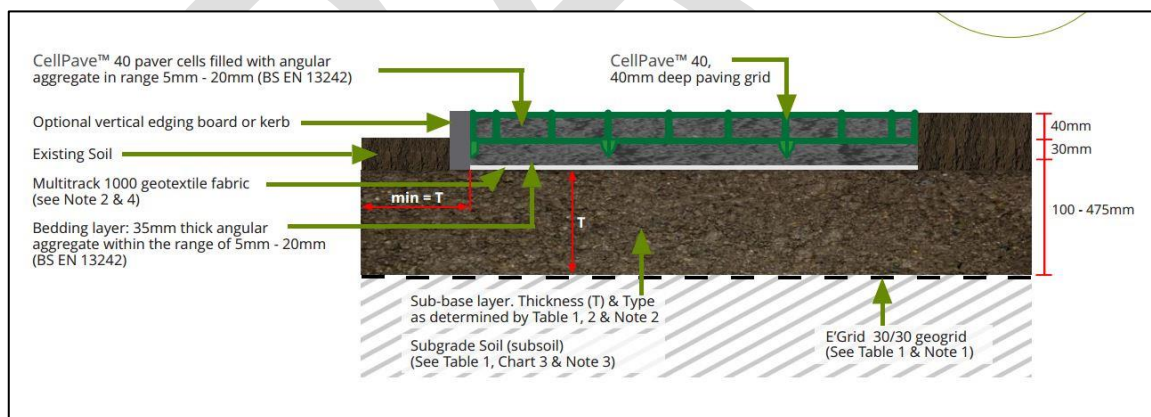


Figure 1: CellPave 40 Cross Section (Source: Groundtrax)

- 3.4 The advantages and disadvantages of this system are as follows:

Advantages:

- Tiles allow water to pass through, therefore maintaining natural drainage;
- Durable construction;
- Good running surface for vehicles;
- Low cost compared to other options;
- Green - made from recycled PE/PP;
- Would prevent material being washed away into the carriageway, like the current scenario with Coxwell gravel.

Disadvantages:

- Not compatible with all bases;
- Gravel could be displaced by the movement of vehicles;
- The finished surface is not aesthetically pleasing as the cells can be seen at the surface;
- Difficult to mark-up car parking bays and road markings;
- Tends to be used as a temporary car park solution rather than a permanent car park solution.
- Not suitable for heavy vehicles

Option 2 – Asphalt and Chip finish



Figure 2: Surface Dressing - (Source: Foster Contracting)

- 3.5 This method essentially consists of a macadam construction and surface course, with a layer of bitumen laid down before stone chippings are scattered onto the surface. The coloured stone chipping used would match the existing car park surface colour and provide a rustic texture however the blade bitumen will. The cost of this method would be in the region of £210,000. The car park construction would include the following layers:
- 250mm type 1 sub base (subject to on site CBR tests);
 - 60mm dense bitumen macadam binder course;
 - 30mm dense bitumen macadam surface course;
 - A spray and chip surface dressing is applied to the surface course.
- 3.6 In terms of maintenance, the main issue would be the clearance of loose stones. Brushing with a soft brush or removal by a leaf blower should be undertaken regularly. If they are not cleared regularly, there is a danger that they could get thrown up into the air and washed away into the south-eastern corner of the car park, potentially blocking up the drainage system. This method tends to have a 5 to 10 year lifespan, subject to regular maintenance.

3.7 The advantages and disadvantages of this method are as follows:

Advantages

- Good running surface for vehicles;
- Good surface for pedestrians;
- Easy to apply clear road markings afterwards;
- The chipping surface gives a more pleasing look to the overall car park.
- The subgrade can act as an attenuation for surface water run off.

Disadvantages

- Possible Maintenance and schedule to re-spray and chip surface could be required after 3 to 3 years; and every planed off every 5 years.
- In areas of tight manoeuvres there is a tendency for the chippings to be removed which can leave bare patches within the car park;
- The cost of the car park is increased as the spray and chip surface is a straight addition to the basic construction of the car park.
- A full positive drainage system is required with full height kerbs on the low side of the site.

Option 3 – Resin Bound finish

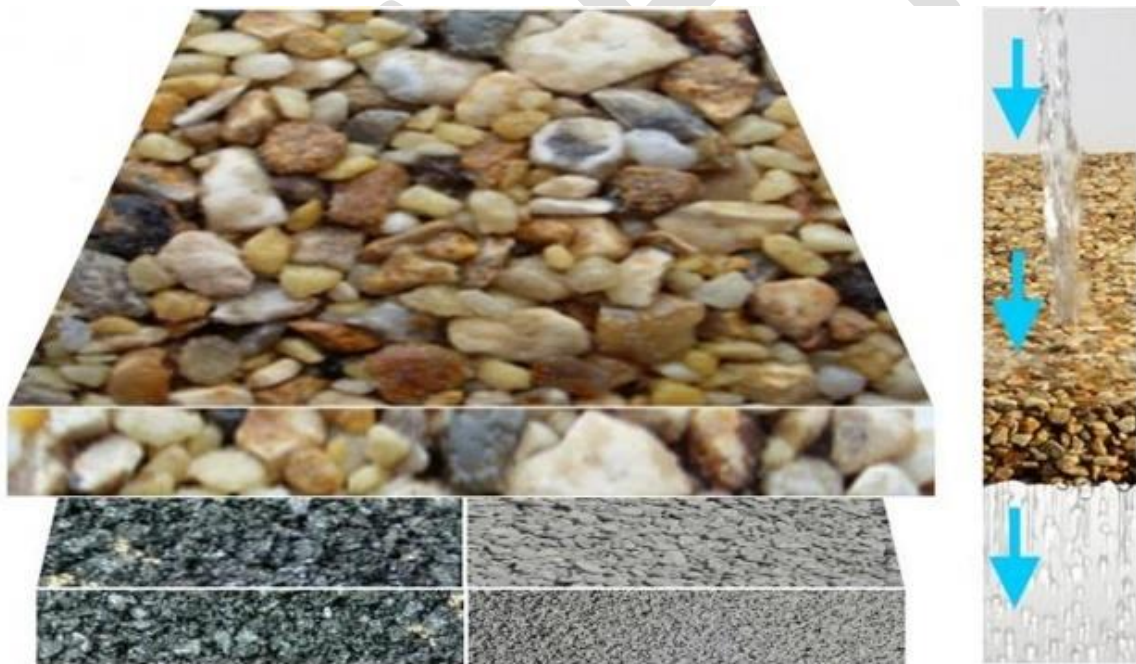


Figure 3: Resin Bound Aggregate (Source: Sureset)

3.8 With this system, a resin bound aggregate is mixed with a clear resin on site so that each particle is completely coated with the resin see **Figure 3** above and **Appendix D**. Once the resin and aggregates are fully mixed they are applied to the base and laid to give a permeable, smooth and durable finish. The finished depth of the bound system usually varies between 12mm and 24mm. The aggregate used would be of a similar colour to the existing car park surface. The resin bound layer would be laid on top of a new porous tarmacadam surface, which may include; 250mm clean stone, 60mm bitumen macadam binder course and 30mm bitumen macadam surface course. This option could cost in the region of £290,000.

- 3.9 It should be noted that the resin bound layer could take around 15 to 18 days to lay and it can only be applied during summer months. This may, of course, affect the programme of works.
- 3.10 In terms of maintenance, the main issues are going to be keeping the permeable pores free of debris and clearing any loose aggregate. Regular brushing with a soft brush, or removal by a leaf blower should be undertaken regularly and the surface should be inspected for damage, moss and weeds. Moss or weed killer can be applied to affected areas, if required, ensuring that no solvent or petrochemical products are used at a time. A pressure wash every 6 months will ensure that the pores are kept clear and permeability is maintained in the resin.
- 3.11 In adverse weather conditions the surface may be prone to frost and/or ice. The surface will not be affected by the application of granular sodium chloride or grit, but it is recommended that the surface is brushed to eliminate any spoil, grime or build. The lifespan of the resin bound layer is over 10 years, with one of the bigger manufacturers, SureSet, guaranteeing their product for 18 years.

Advantages:

- Comes in wide range of colours so can be coloured to suit existing surface;
- Fast setting, allowing car park to be reopened within hours;
- Versatile – The resin can be applied to awkward areas such as steps and in corners;
- Lightweight – The finished surface can be as little as 12mm thick;
- Is porous, so contributes towards a Sustainable Urban Drainage system;
- UV stable, slip resistant, easy to maintain;
- Good surface for pedestrians;
- Easy to apply clear road markings afterwards;
- Does not loose stones, which end up on the adjacent carriageway;
- The chipping surface would give a more pleasing look to the overall car park.

Disadvantages:

- This surface is fairly new to the market and, therefore, long term durability is not proven;
- More expensive than the other options;
- Bitumous blacktop/tarmac surfaces are prone to movement with changes in temperature. This may result in cracking of the bound screed;
- Possible maintenance to resin bound surface required after 5 to 8 years
- More expensive than other options.

4.0 Compatible Drainage Options

4.1 It should be noted that the underlying strata is likely to be clay. Therefore, a positive connection to the existing surface water sewer is required. As the car park is more than 20 spaces, there is a requirement for oil interception and treatment in accordance with the Pollution Prevention Guidelines (PPG). A positive connection to the existing inspection chamber (IC @73.720m AOD) will be utilized. All surface water drainage options will ultimately discharge into Hampstead No. 1 pond, east of the car park. There should be no interaction with the groundwater table in any drainage solution.

4.2 Considering the above constraints and the proposed surfacing options outlined in the previous section, we have considered the most suitable drainage solutions for each surfacing option and these are set out below, along with their advantages and disadvantages.

Groundtrax CellPave

4.3 This surface system is permeable and so a drainage system would be utilised to collect surface water from underneath the surface. The drainage system would consist of a geotextile layer below the CellPave grid and gravel in-fill material. 250mm of clean open-graded stone would be laid below a permeable geotextile. A partial infiltration pipe wrapped in a geotextile would be laid across the site, to convey the surface water to the outfall. The pipe would be 150mm diameter and set in a 450mm wide trench of clean open graded stone, wrapped in geomembrane. Treatment to PPG will be provided in the clean stone layer and textiles, which will be infused with bio-treatment systems.

4.4 The advantages and disadvantages of this system related to drainage are as follows:

Advantages

- Low cost;
- Good treatment train – i.e. there will naturally be at least two stages of treatment of surface water before it meets the outfall.

Disadvantages

- Poor durability;
- Maintenance of the gravel in-fill.

Asphalt and chip finish

4.5 This surface system is impermeable and so surface water will need to be collected by gullies at the surface level and directed to the gullies by kerbs along the edges. Trapped gullies will be placed to accommodate a maximum of 150 square metres of car park area each (suited falls). 150mm diameter plastic standard piped drainage system would be used to convey surface water to the outfall. Treatment would be via the trapped gullies. Due to the size of the car park and the lack of filtration material, a bypass petrol interceptor may be required at the outfall.

4.6 The advantages and disadvantages of this system related to drainage are as follows:

Advantages

- Good durability;
- Low cost.

Disadvantages

- Poor treatment train – i.e. the system may struggle to provide sufficient treatment without the inclusion of an oil interceptor. This would have cost implications and may introduce level constraints and complexities during installation.

Resin Bound finish above porous asphalt surfacing

4.7 This surface system is permeable and so a drainage system would be utilised to collect surface water from underneath the surface. The drainage system would consist of a geotextile layer below the Resin topping and gravel in-fill material. 250mm of clean open-graded stone would be laid below a permeable geotextile. A partial infiltration pipe wrapped in a geotextile would be laid across the site, to convey the surface water to the outfall. The pipe would be 150mm diameter and set in a 450mm wide trench of clean open graded stone, wrapped in geomembrane. Treatment to PPG will be provided in the clean stone layer and textiles, which will be infused with bio-treatment systems.

4.8 The advantages and disadvantages of this system related to drainage are as follows:

Advantages

- Good treatment train – i.e. there will naturally be at least two stages of treatment of surface water before it meets the outfall.
- Aesthetics.

Disadvantages

- Poor durability
- High cost.

5.0 Recommendations and Conclusions

- 5.1 In considering which of the surfacing options and their associated drainage solutions outlined in **Sections 3.0** and **4.0**, there are a number of factors which need to be considered. With all of the options we have considered the following factors:
- Aesthetics;
 - Usability;
 - Potential maintenance issues;
 - Lifespan; and
 - Cost.
- 5.2 In terms of aesthetics, the resin bound finish would look more in keep with the location, although the asphalt and chip finish surface could also match the existing surface colour and texture just as well. The CellPave option, however, is unlikely to be in keep and is likely to result in the build-up of gravel at the edges of the car park. This is also a potential issue with the asphalt and chip finish, if not sufficiently maintained.
- 5.3 Manufacturers of all options state that they are safe for pedestrians to walk across. However, with the CellPave and, to a lesser extent, the asphalt and chip finish, there is a potential for loose stone and gravel to build up in channels and areas where frequent turning occurs. This could be an issue for drainage maintenance, as well as a safety issue for pedestrians.
- 5.4 Maintenance has been touched on already and it is clear that the loose aggregate is the main issue from the surfacing perspective. From a drainage perspective, any porous surfacing option would need to be regularly cleaned of grit, moss, or any other detritus which may find its way into the pores.
- 5.5 In terms of the lifespan, the resin bound surface finish would appear to be the best option. However, it is a relatively new type of surface and it is not fully clear if the surface would be able to last for the full period claimed by the manufactures. Clearly it would come down to the level of use of the car park and clearly the site in question is extremely well used. Therefore, a thick surface and sufficiently strong resin would have to be used. Although further discussions with the manufacturer would have to be had in order to ensure that the correct specification is applied.
- 5.6 In terms of cost, the asphalt and chip finish is the cheapest. However, when the factor in potential maintenance issues and the relatively poor lifespan, it is not as clear cut. Whilst the resin bound surface finish is the most expensive, the maintenance issues would be relatively minimal. In addition, the permeability of the surface would allow a more natural (sustainable) drainage option to be installed, which would provide a good treatment train, when compared to the traditional drainage system required for the asphalt and chip finish surface.

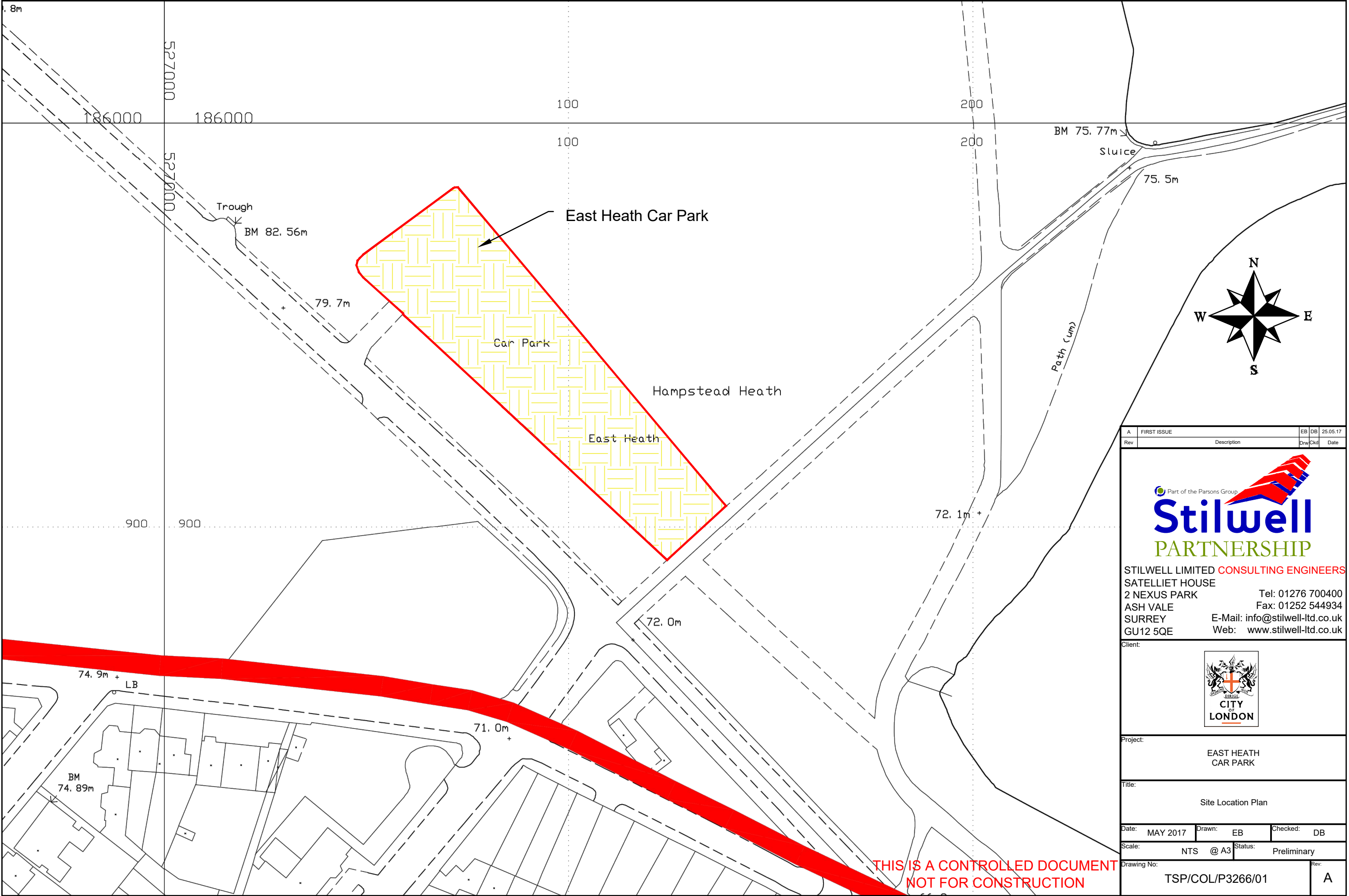
- 5.7 In summary, I would suggest that the resin bound surface finish on a permeable construction would be the preferred option and our recommendation. This would allow for a more sustainable drainage solution and would, in our view, work out to be the more cost effective option in the long run.

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Appendix A

Site Location Plan

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A	FIRST ISSUE	EB	DB	25.05.17
Rev	Description	Drw	Ckd	Date



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Project:	
EAST HEATH CAR PARK	
Title:	
Site Location Plan	
Date: MAY 2017	Drawn: EB
Checked: DB	
Scale: NTS @ A3	Status: Preliminary
Drawing No: TSP/COL/P3266/01	Rev: A

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Appendix B

Pothole Photograph

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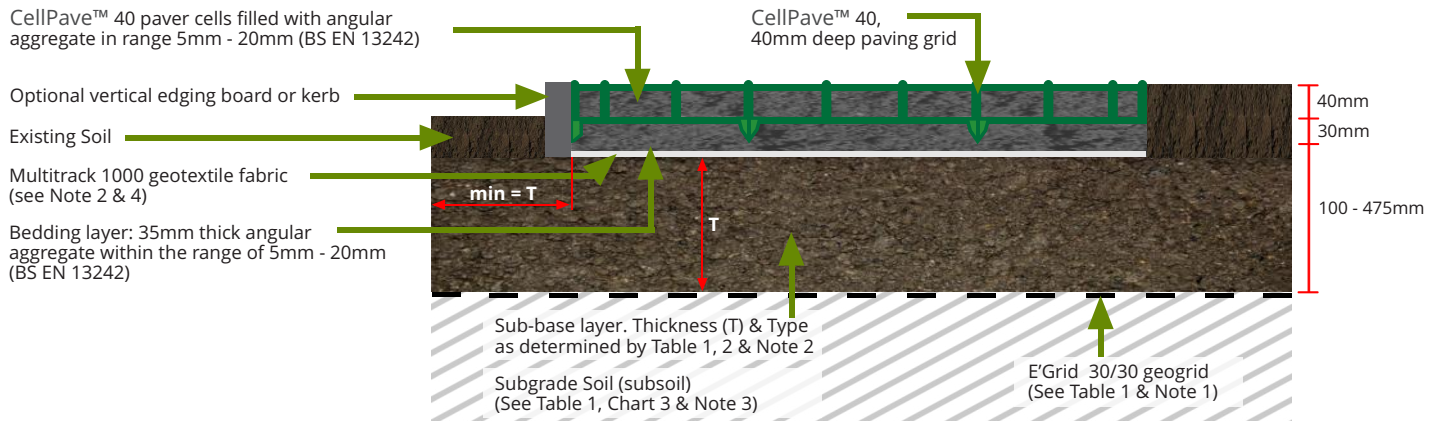
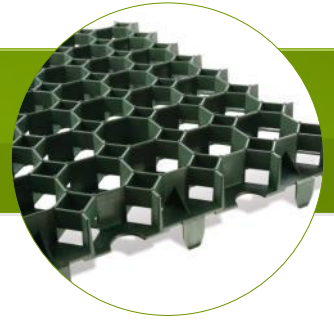
Appendix C

Ground Trax CellPave 40

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CELLPAVE™ 40

CELLPAVE™ 40 - Interlocking Cellular Paving Grid System INSTALLATION GUIDE - GRAVEL SURFACES



Installation Method

1. Place paver units with spikes downward onto the prepared well consolidated bedding layer. Edging boards or kerbs can be used where required, according to existing soil conditions.
2. Connect the pavers using the ground spikes and loops, progressing over the area in rows. Use protective gloves to avoid abrasions.
3. Pavers can be cut using a hand or power saw to fit around obstructions and curves. Cut pieces which are less than half the original size should be avoided where possible.
4. Fill the pavers to the top of the cells with the specified angular decorative aggregate. If required, use a light vibrating plate to consolidate the aggregate into the cells. Top up cells with aggregate as necessary. Fully rounded 'pea gravel' is not recommended.
5. If the area is to be used as horse paddock, it is preferable to cover the area with a 50-100mm thick layer of fine sand/mulch.
6. The surface may be trafficked immediately.

Note 1: If the geogrid layer is omitted, then the total sub-base layer thickness (T) must be increased by 50%.

Note 2: A 'DoT Type 1' sub-base may be used, provided that an adequate drainage system is installed (refer to note 4). Alternatively a porous/open-graded (reduced fines) sub-base layer may be specified, e.g as part of a Sustainable Urban Drainage System (SUDS) application. If a 'reduced fines' sub-base layer is specified, this must be covered with either a geotextile filter membrane and/or a suitable clean gravel blinding layer, to avoid fine particles entering the sub-base layer. Do not use sand for the paver bedding layer.

Note 3: Specific advice on ground conditions, CBR% and construction over ground with a CBR less than 1% is available from Groundtrax Systems Ltd. CBR% = California Bearing Ratio, a measurement of subgrade soil strength.

Note 4: Typical drainage details; 100mm diameter perforated pipe drain laid at minimum gradient 1:100, bedded on gravel in trench backfilled with 'DoT Type A' drainage aggregate, covered or wrapped with Multitrack 1000 geotextile fabric and leading to a suitable outfall or soakaway. Drains placed down centre or one edge of access routes up to 5m wide. Wider areas may require additional drains at 5m - 10m centres. Drainage design to be determined by the specifier based on specific conditions on site. Specific advice on Drainage and Sustainable Urban Drainage Systems (SUDS) is available from Groundtrax Systems Ltd.

Note 5: Maximum advised gradient for traffic applications is 12% (1:8) 7°. Pegging may be required. Specific advice for the use of CellPave™ 40 on slopes can be obtained from Groundtrax Systems Ltd.

Note 7: CellPave™ 40 complies with BS8300:2001 - "Design of buildings and their approaches to meet the needs of disabled people" - Code of Practice. (ISBN 0580384381)

CELLPAVE™ 40 - Interlocking Cellular Paving Grid System

INSTALLATION GUIDE - GRAVEL SURFACES

Table 1: Typical Sub-base Thickness (T) Requirements - refer to construction profile

Application / Load	CBR (%) strength of subgrade soil (see Chart 1)	(T) DoT sub-base thickness (mm) (see Note 2)	Geogrid (see Note 1)
Fire engine and occasional HGV access	≥ 6	100	E'Grid 30/30
	= 4 < 6	120	E'Grid 30/30
	= 2 < 4	190	E'Grid 30/30
	= 1 < 2	380	E'Grid 30/30
Light vehicle access and overflow car parking	≥ 6	100	E'Grid 30/30
	= 4 < 6	100	E'Grid 30/30
	= 2 < 4	135	E'Grid 30/30
	= 1 < 2	260	E'Grid 30/30

Table 2: Paving Grid Specification

Product	CellPave™ 40
Material	Rigid 100% recycled polyethylene
Colour	Black
Paver Dimensions	500mm x 500mm x 40mm
Paver Size	500mm x 500mm (4 grids per m2)
Nominal Cell Size	60mm Octagonal
Cell Wall Thickness	2.7mm - 3.2mm
Weight	1.2kg/paver - (4.80kg/m2)
Load Bearing Capacity	150 tonnes/m2 (Crush resistance)
Central Base Support	25mm long pegs on underside (4 per paver)
Open Cell %	Top 95% / Base 75%
Connection Type	Spike and loop edge connection
Chemical Resistance	Excellent
UV Resistance	High
Toxicity	Non Toxic
Bedding Layer	30mm thick of 5-20mm angular aggregate (BS EN 13242)
Paver fill	To top of pavers using 5-20mm crushed aggregate (BS EN 13242)
Sub-Base Type	DoT Type 3 or a modified porous sub-base (Table 1 & Note 2). DoT Type 1 with drains
Base Reinforcement	E'Grid 30/30 geogrid (Table 1 & Note 1) - Specifications available on request.

NOTE:

This field guide is provided as an aid to assessing the mechanical stabilisation requirements in commonly encountered site conditions. Groundtrax Systems Ltd accepts no responsibility for any loss or damage resulting from the use of this guide.

Chart 1: Field guidance for estimating sub-grade strengths

Consistency	Indicator			Strength	
	Tactile (feel)	Visual (observation)	Mechanical (test) SPT	CBR %	CU kN/m ²
Very Soft	Hand sample squeezes through fingers	Man standing will sink >75mm	<2	<1	<25
Soft	Easily moulded by finger pressure	Man walking sinks 50-70mm	2-4	Around 1	Around 25
Medium	Moulded by moderate finger pressure	Man walking sinks 25mm	4-8	1-2	25-40
Firm	Moulded by strong finger pressure	Unloaded construction vehicle ruts 10-25mm	8-15	2-4	40-75
Stiff	Cannot be moulded but can be indented with thumb	Loaded construction vehicle ruts by 25mm	15-30	4-6	75-150



For more information, contact us today or visit our website:
www.cellpave.com

GROUNDTRAX
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Appendix D

Sureset – Resin Bound

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PERFECT PAVING

We take pride in the fact we offer great customer service along with great products.

From start to finish we can offer technical advice, full supply and installation and a 18 year guarantee to complete the service.

Our resin bound paving solutions offer natural and recycled materials, unlimited colours, and a design flexibility no other type of paving can match.

Unlike many traditional paving systems SureSet is permeable; this means that any proposal including SureSet demonstrates a sustainable approach to water management.

As a market leader in permeable resin bound paving, we have the reputation, experience and innovative approach to make any design outstanding throughout the world.

- Durable
- Permeable
- Quick and easy to install
- Unlimited colours
- Flexible design capability
- Low maintenance
- Smooth, hardwearing finish
- Colour stable
- 18 year guarantee

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