REPORT

West End MSCP Life Care Plan

Prepared for

Bristol City Council

May 2018

Burderop Park
Swindon, SN4 0QD
GB
+44 1793 812 479
+44 1793 812 089

Contents

Section Page

SECTION 1

Acronyms and Abbreviations

AAR	Alkali Aggregate Reaction
ACM	Asbestos Containing Materials
ASR	Alkali Silica Reaction
ASTM	American Society for Testing and Materials
BCC	Bristol City Council
BRE	Building Research Establishment
ICE	The Institution of Civil Engineers
LCP	Life Care Plan
MSCP	Multi-Storey Car Park
RC	Reinforced Concrete
UKAS	United Kingdom Accreditation Service

SECTION 1

Executive Summary

1.1 Scope

This report details the inspection and assessment of the structure and fabric of West End MSCP in Bristol, in accordance with the Institution of Civil Engineers report 'Recommendations for the inspection, maintenance and management of car park structures, 2002'. The elements of this work included the following:

- An Initial Appraisal involving a review of archive material to assess in-situ construction details and previous inspection reports;
- Condition Survey and Structural Investigation which included site and laboratory testing of the concrete elements characterise properties and condition;
- Structural Appraisal - an evaluation of the structure via desk study and calculations;
- Recommendations for prioritised remedial actions and maintenance works; and
- Recommended inspections, assessments and maintenance regimes.

This report provides recommendations for the immediate actions (Table 1.1), and sets out further analysis that is required to optimise the future management of, and expenditure on this structure.

The regimes for daily surveillance, routine inspections, special inspections and appraisals, including maintenance and repair guidelines, are set out in Table 8.1 of this report.

1.2 Condition Survey and Structural Investigation

The main high and medium priority defects and actions noted were:

- Extensive spalling to the concrete deck (especially on lower level) and soffit, resulting primarily from chloride-induced reinforcement corrosion, and requiring repair and future enhanced protection.
- Stair tower glazing systems extensively deteriorated and in need of substantial refurbishment and repair.

1.3 Structural Appraisal

There is no evidence of any structural distress that could be caused by inadequate capacity of the members.

The deck members are broadly adequate given the uncertainties that arise in the method of construction (propped or unpropped), and rigidity of connections to the columns.

Despite absence of any structural distress, we are unable to prove conclusively that any of the columns are adequate and would suggest invasive investigations be carried out to establish concrete and steel strength.

Three historical drawings referred to in the Blue Sky report are to be found and others searched for, This will be immensely beneficial in reducing the cost and potentially harmful effect of invasive investigations.

1.4 List of Actions

The recommended maintenance works are given in Table 1.1 for Option C:

TABLE 1.1
Summary of Maintenance Actions for Option C

Item	Priority	Maintenance action	Cost (£)
1	High	Investigations to determine the condition of the spalling concrete framework to the staircase. Access cost included.	£5,500
2	High	Replacement of roof-level expansion joints	£32,000
3	High	Install additional handrailing to stairwells	£5,000
4	High	Thorough refurbishment of the Staircase patent glazing	£18,000
5	High	Thorough repair of the Staircase concrete element defects as seen	£9,500
6	High	Thorough refurbishment of the Staircase brickwork	£6,500
7	High	Application of anti-carbonation coating to the external concrete	£6,000
8	High	Cost of scaffolding access to Staircase externally (for above items)	£7,500
9	High	Replacement of below roof-level movement joints	£9,000
10	High	Replacement of roofing material to staircases and lift core roofs	£5,000
11	High	Concrete deck replacement Levels 1A, 2B and 2A, plus line marking	£600,000
12	High	Deck concrete repairs	£33,932
13	High	Soffit & upstand concrete repairs	£32,993
14	High	Lining	£14,746
15	High	Install new perimeter vehicle barriers (long elevations)	£179,511
16	High	Install new internal vehicle barriers	£112,199
17	High	Application of high quality deck coatings	£498,078
		Total	**£1,575,459**

SECTION 2
Introduction

2.1 Background

CH2M HILL/Jacobs was appointed by Bristol City Council (BCC) to undertake a study to provide the necessary baseline information and determine the maintenance and inspection requirements of the structure and fabric for the West End MSCP, to allow the development of a Life Care Plan (LCP).

A survey of the current condition of the infrastructure was required to help preserve and enhance safety, functionality and future revenue, and identify and address any related health and safety concerns. Of particular concern to BCC is identification of failures of the structure, including spalling, pot holes and any other risks to customers / the general public, and managing the risk of closure due to structural defects.

BCC also wishes to introduce additional CCTV, paint the stairwells and have proprietary coatings for the decks, lift lobbies and stairs. The overall purpose of this commission is to assess current condition and identify, specify, and supervise works to be undertaken by others in order to meet BCC's aspirations.

2.2 Scope

The scope of the study was in accordance with the guidance detailed in the Institution of Civil Engineers (ICE) publication titled "*Recommendations for the inspection, maintenance and management of car park structures*", first published in 2002. This is summarised in Section 2.3.

Based on the Initial Appraisal, Condition Survey, Structural Investigation and Structural Appraisal, recommended actions in terms of remedial works, further inspection and assessment have been set out to enable the management of the structure in accordance within the ICE Guidelines.

These works were initiated with on-site visual inspection for the Condition Survey and intrusive sampling for the Structural Investigation.

This document presents the necessary information to form a LCP for West End MSCP.

The scope includes the inspection and proposals for the following items:

- Concrete Condition (Ceilings, ramps, decks, pillars, stairwells, walls, fascia panels to decks)
- Drainage
- Curtain wall glazing (Southern stairwell)
- Crash Barriers
- Entry / Exit layout from Jacobs Wells Rd
- Level 2 Entry / Exit bridge (provided in a separate Principle Inspection report)
- Deck Surfaces
- Hand rails within stairwells
- Lift motor room structure
- Aesthetic upgrade of external elevations

Excluded are:

- Electrics
- Toilets

- Topographic, surface & soffit levels survey
- Ground floor areas occupied / operated by BCC
- Creation of AutoCAD drawings

2.3 Requirements of the ICE Guidelines

The requirements detailed in the ICE Guidelines clearly sets out the responsibilities of the asset owner/operator in terms of maintaining their structure in a safe and serviceable condition.

The Guidelines set out how this can be achieved in a process called Life-care planning. One of the key aspects of this process is ensuring that the safety and serviceability of the structure is verifiable and that evidence of this action is contained in a specific file relating to that facility.

The Guidelines state that the development of a Life-care Plan is based upon a review of the existing records of previous maintenance and repair works, inspection reports and structural appraisals. It is stated that the plan should identify the need for immediate actions and plan for scheduled actions such as further surveillance, inspection or repair, as necessary to implement the overall plan. In this manner, the risks posed by aging structures can be properly managed and major disruption through un-planned emergency repair works is avoided.

The document also recommends that the Owner/Operator of the asset should appoint an experienced Chartered Engineer to advise on structural safety, inspection and maintenance of each existing structure.

The ICE Guidelines introduces specific terms and actions which are used in this report. These are as follows:

Initial Appraisal

The Initial Appraisal is centred upon checking existing records for completeness and detailing specific needs in terms of further inspection and maintenance by a desk study of records prior to the Condition Survey.

Condition Survey

The Condition Survey is a detailed visual examination of the structure to identify structural form, general material condition and to identify areas worthy of further examination.

Structural Investigation

The findings of the Condition Survey are used to plan the Structural Investigation, which is aimed at deriving the material condition at specific structurally vulnerable positions and/or to record parameters such as cover, carbonation depth, chloride contamination, material strength and reinforcement corrosion activity.

Structural Appraisal

A Structural Appraisal considers the integrity of the asset in terms of its residual load capacity, particularly at vulnerable positions which may exist as a result of inadequate design, inappropriate repair or material deterioration. This appraisal should address the main structure as well as the adequacy of edge barriers.

Maintenance and Repair

The need for Maintenance and Repair will stem from the previous surveys, inspections and appraisals and should be planned and executed in a timely manner, ensuring a solution that is both affordable to the client and correct for the extent of deterioration encountered.

Typical recommendations for the content of the LCP is detailed below although this may need amendment depending on the individual circumstances, and upon the recommendations of the Engineer,

- Daily Surveillance, usually by operations staff
- Routine Inspections, typically every 6 months
- Periodic Initial Appraisal and Condition Survey of key components, including cladding and edge protection, prompting Special Inspections as required at intervals of less than 8 years
- Structural Appraisal at intervals of not more than 16 years[1]

Maintenance and repair works are carried out as circumstances dictate as and when instructed by the Owner/Operator, including routine and protective/preventive works and the recording thereof.

[1] IICE, 2002 footnote 'd' given below Table 5.1 on Page 14 states that 'Shorter intervals than the maximum values given are likely to be appropriate. The Engineer should advise the Owner/Operator taking into account the condition of the car park structure and the defects known to be present'. Given the age and current condition of West End MSCP 5 years and 10 years are deemed appropriate for the condition surveys and structural appraisals respectively.

SECTION 3

Description of the Structure

3.1 Orientation

West End MSCP lies with its long axis running in a Northeast to Southwest orientation. For the purposes of this report, and consistency with previous reports, the elevations are distinguished as follows:

- North East elevation (approximately 35m length)– facing the bridge access from Upper Berkeley Place, and the Triangle beyond.
- South East elevation (approximately 80m length)– facing the B4466 Berkeley Place and QEH.
- South West elevation – above the car rental facility and facing Burton Court.
- North West elevation – facing the Liberty Park residence (converted historic cathedral).

Plans and elevations are provided in Appendix A.

3.2 Components and arrangement

West End Multi Storey Car Park dates from approximately 1966 and has approximately 525 spaces. It is a split-level structure with 14 different levels above Ground level, as follows: 0 (the lowest level, with 2-way access via Berkeley Place at ground level, and rising as a ramp at the rear north west elevation upwards), 1B (with a horizontal deck extending along the whole front, south east elevation), 1A (with a ramped deck extending along the northwest elevation), 2B (with a horizontal deck and two-way access to the bridge off Upper Berkeley Place), 2A (ramped deck), 3B (horizontal deck), 3A (ramped deck), 4B (horizontal deck), 4A (ramped deck), 5B (horizontal deck), 5A (ramped deck), 6B (horizontal deck), 6A (ramped deck at roof level), 7B (highest level, roof-level horizontal deck). Ground level sits below level 1B, and is occupied by Europcar (southern end), the Bath Store (northern end) and a number of plant rooms, attendant's office and toilets (central section).

The car park is composed of steel columns and beams encased in concrete. The decks are of reinforced concrete. Vehicle and pedestrian restraint to the exterior elevations is provided by pre-cast concrete parapets that were stitched to the insitu-concrete deck. The interior restraint is provided by steel barriers. There is a transverse movement joint across the middle of the car park, separating each ramp and horizontal deck level into 2 sections.

There is a central stair and lift tower, and a stair tower at the southeast corner. Both towers serve all levels. Vehicle circulation is via two-way aisles with an aisle width of 6m.

The columns, soffits and interior walls are painted. There is a mastic asphalt coating to Level 1B. The remaining decks are bare concrete with the exception of the roof level decks (6A and 7B).

The south west end has been enclosed from Ground level to Level 6B by cavity walls. The south east, north west and north east elevations remain open to the elements between the top of the parapets and the soffit. There is a galvanised steel security mesh along the west elevation at Level 0.

SECTION 4

Initial Appraisal

The Initial Appraisal comprises a desk study of the existing available records. The available documents relating to West End were collated by BCC and provided to CH2M HILL/Jacobs. A summary of the review is presented in the following sections. The information is dominated by the most recent Structural Appraisal Report by Blue Sky Consultants, February 2012.

4.1 Drawings

Blue Sky prepared basic floor layouts in CAD, but these drawings were '*not based on a dimensional survey and should not be relied upon for accuracy*.'

Blue sky consultants Drawings:

11019/20 West End Car Park Bristol: Defect Location drawing level 0-1B, November 11

11019/21 West End Car Park Bristol: Defect Location drawing level 1A-2B, November 11

11019/22 West End Car Park Bristol: Defect Location drawing level 2A-3B, November 11

11019/23 West End Car Park Bristol: Defect Location drawing level 3A-4B, November 11

11019/24 West End Car Park Bristol: Defect Location drawing level 4A-5B, November 11

11019/25 West End Car Park Bristol: Defect Location drawing level 5A-6B, November 11

11019/26 West End Car Park Bristol: Defect Location drawing level 6A-7B, November 11

11019/DR01 West End Car Park Bristol: Drainage Survey Undertaken by PlumDrain

11019/EA1 West End Car Park Bristol: Existing Arrangement 1 (deck and parapet cross section)

11019/EA2 West End Car Park Bristol: Existing Arrangement 2 (deck and wall cross section)

11019/EA3 West End Car Park Bristol: Existing Arrangement 3 (vehicle restraint and handrail, elevation)

11019/EA4 West End Car Park Bristol: Existing Arrangement 4 (bridge deck, section)

11019/EA5 West End Car Park Bristol: Existing Arrangement 5 (railings, elevation))

11019/T01 West End Car Park Bristol: Testing Locations Level 0-1B

11019/T02 West End Car Park Bristol: Testing Locations Level 1A-2B

11019/T03 West End Car Park Bristol: Testing Locations Level 2A-3B

11019/T04 West End Car Park Bristol: Testing Locations Level 3A-4B

11019/T05 West End Car Park Bristol: Testing Locations Level 4A-5B

11019/T06 West End Car Park Bristol: Testing Locations Level 5A-6B

11019/T07 West End Car Park Bristol: Testing Locations Level 6A-7B

Blue Sky consultants also reported '*Some existing drawings are known to be held by Bristol City Council*', listing the following (which have not been made available in 2017/8):

- City and County of Bristol City Engineers Office – Sheet No 2 "Ground Floor Plan" dated June 1966 (A3 paper copy).

- City and County of Bristol City Engineers Office – Sheet No 7B "1/16th Scale Elevations and Sections" dated February 1967 (A3 paper copy).
- City and County of Bristol City Engineers Office – not numbered "Typical Floor Plan" dated 12 December 1968 (A3 paper copy).
- Hydrock Consultants – C/232/002 "Bridge Elevations" dated 14 November 1997.

4.2 Structural and Testing Reports

Blue Sky reported they received paper copies of the following previous reports:

- Mouchel Parkman report "West End Multi-Storey Car Park Structural Survey Report 2004" dated February 2005.
- Mouchel Parkman report "West End Access Bridge Structural Survey Report 2004" dated February 2005.
- Martech Technical Services Limited report "Concrete Condition Testing on West End MSCP, Bristol" undated but referring to testing in March 2007 (part copy of report only).

The above documents were not provided to CH2M. We have reviewed the Structural Appraisal Report by Blue Sky Consultants, February 2012 (ref 11019/JC/LH/20.2.12 20). The relevant information in these reports is summarised below as *italicised* extracts:

4.2.1 Mouchel Parkman West End Car Park Structural Survey Report 2004/2005

'The report identifies itself to be the latest in a series of annual reports undertaken between 1998 and 2004 and, consequently, is able to identify any changes and deterioration in the various defects noted.

The report identifies several areas of hairline cracking, spalling concrete and occasional exposed reinforcement and recommends repairs to the latter. We would expect much of the cracking to be due to early age shrinkage of the concrete or long-term settlement/deflection of the concrete elements. This appears to be in agreement with the reports findings in 2005. Of greatest significance is that none of the defects is reported to show significant deterioration over the years inspected.

The report refers to concrete testing carried out in 1995 but the results are not included.'

4.2.2 Part copy of Martech Concrete Testing on West End MSCP, Bristol – March 2007

'Parts of the report provided to us indicate concrete testing results for carbonation, chloride ion content and half-cell results carried out in 2007. These are discussed below:

Carbonation

Carbonation results in the multi storey car park appear to have generally increased compared against test results under this Appraisal (reference 9.2.3). Mean carbonation in the decks has increased from 12mm to 36mm, in parapets from 7mm to 45mm and in the soffits from 12mm to 25mm. If these results are correct this represents a significant increase in carbonation over a four year period.

Chloride ion content

Chloride ion results are stated as being based on an assumed 14% cement content.

The results indicate high chloride percentage in the decks, with the highest readings being found at 25mm to 50mm depth. This broadly matches our testing undertaken as part of this Appraisal (reference 9.2.4). It is not possible to make a direct comparison between the 2007 results and our own recent testing as the chloride ion content fluctuates greatly with location. We note, however,

that the maximum recorded value in the deck has increased from 1.15 to 1.21, in the soffit increased from 0.24 to 0.49, and in the parapet decreased from 0.24 to 0.17. These results must also be considered in conjunction with the change in cement content.

Half-cell potential

The 2007 report includes the half-cell potential test results for 20 locations in the decks. Of these, 20 results showed voltages to be sufficiently negative to indicate a greater than 90% chance of active reinforcement corrosion. These results do not compare to our own tests undertaken as part of this Appraisal, all of which show less than 10% of active reinforcement corrosion (reference 9.2.6).'

4.2.3 Mouchel Parkman report "West End Access Bridge Structural Survey Report 2004" dated February 2005

This relates to the access bridge and is reported on separately in the CH2M/Jacobs Principal Inspection Report (2018).

4.2.4 Blue Sky Consultants, February 2012

In 2012, the condition was reported as follows:

'*Frame: Concrete encased steel beams on concrete encased steel columns. Clear span frames at 4.8m centres. Condition generally good.*

Columns: Concrete encased steel columns. Condition generally good although regular tension cracking in external face.

Beams: Concrete encased steel downstand beams cast with deck. Condition generally good.

Floors: Generally adequate. Insitu concrete decks 175mm thick. Many patch repairs and areas of spalling on lower decks. Spalling at edge of movement joint throughout. No significant delamination, other than those areas of spalling, etc, recorded on the Defects Drawings.

Soffits: Generally good with few areas of spalling requiring repair.

Cladding: Partial brickwork cladding in acceptable condition but requires improved restraint.

Expansion Joints: Failed through all decks except Level 1B (over occupied area).

Pedestrian restraint: Perimeter rails have no mesh infill. Split level barriers have no infill and are climbable.

Roof: Waterproofing nearing end of life. Movement joint leaking.

Brickwork: Generally acceptable. Unprotected masonry around both stair enclosures. Internal masonry adequate but unprotected. External masonry (south gable) generally acceptable but requires improved restraint and barrier protection

Barriers: Car Park – Precast concrete upstand parapets inadequate for vehicle impact at end of aisles. Access Bridge – Steel railings inadequate for vehicle impact. Access Bridge – Barrier fixing bolts corroded. Car Park – Precast parapet upstands generally adequate except at ends of aisles. Access Bridge – Edge barrier inadequate.

Medium level of spalling in decks. Low level of spalling concrete at height. Low risk of spalling/falling concrete.'

Defect schedules were also prepared, showing defects by level, as follows:

<u>Deck Defect Schedule</u>

- Level 6B: 12no. defects (one 1300mm x 250mm)
- Level 5A: 10no. defects (all <150mm x 400mm)

- Level 5B: 12no. defects (one 3000mm x 1200mm)
- Level 4A: 22no. defects (one 2500mm x 1300mm
- Level 4B: 8no. defects (one 1200mm x 7500mm)
- Level 3A: 13no. defects (three with dimensions >1000mm)
- Level 3B: 19no. defects (one 4300mm x 600mm)
- Level 2A: 30no. defects (five with dimensions ≥1000mm)
- Level 2B: 40no. defects (eight with dimensions ≥1000mm)
- Level 1A: 52no. defects (seventeen with dimensions ≥1000mm)
- Level 0 (access/egress ramp) 6no. defects

Soffit and Column Defect Schedule

- Level 6b/5a Soffit and Column Defect Schedule: 23no. defects
- Level 5b/4a Soffit, Beam and Column Defect Schedule: 22 no. defects
- Level 4b/3a Soffit and Column Defect Schedule: 16 no. defects
- Level 3b/2a Soffit, Column and Wall Defect Schedule: 34 no. defects
- Level 2b/1a Soffit and Column Defect Schedule: 20 no. defects
- Level 1b/0 Soffit Defect Schedule: 34 no. defects

Sketches of the breakouts were included, as follows:

- 11019/B01 - Parapet Upstand Breakout, showing 10mm rebar, twisted, with 58mm cover
- 11019/B02 - Deck Over Primary Beam (Parking Bay) Breakout, showing 12mm ribbed bar with 45mm cover, and 10mm ribbed bar behind
- 11019/B03 - Perimeter Column Breakout, showing 90mm cover to the approximately 200x200 steel column
- 11019/B04 - Beam Breakout on Primary Beam, showing 22mm bottom flange with 45mm cover
- 11019/B05 - Cantilever Deck Breakout, showing 12mm ribbed rebar at 45mm cover
- 11019/B06 - Deck Soffit at Mid Span Breakout, showing 12mm ribbed bar at 22mm cover and 10mm ribbed bar behind
- 11019/B07 - South Elevation Upstand Wall Breakout, showing 12mm ribbed bars with cover 62mm
- 11019/B08 - North Elevation Upstand Parapet Breakout, showing 10mm twisted bars with 65mm cover
- 11019/B09 - Access Bridge Soffit, showing 38mm plain bar at 42mm depth

The report also refers to the results of testing, '*Ian Farmer Associates dated January 2012 (report reference 19650) which includes all relevant test certificates. This report is held by Blue Sky Consultants and is available for inspection on request';* a H&H (Heath and Hardie Geosciences Ltd) Petrographic Examination of Concrete, which shows concrete taken from Level 5B was in a generally sound condition but carbonation to a depth of 30mm; and a Plum Drain Drainage Survey Report.

The report also included Appendix J - '*Life Cycle Costs*', which recognises that some maintenance items and costs could be periodic and repeated.

We note from the image in this report that at September 2011 the columns within the car park were painted, but we are unable to confirm whether the beams and slab soffits were painted at that time (they were painted when observed by CH2M in 2017).

4.3 Asbestos Survey Report (October 2011)

A single asbestos survey was provided: '*Refurbishment survey report, assessment and register of asbestos containing materials at the lift shaft, West End car park, Jacob's Wells Road, Bristol, for BCC: 1473.213 October 2011*', by Enquin Environmental Ltd

This report states that '*All reasonably accessible areas of the lift shaft were surveyed*' and identified string as an asbestos containing material (ACM). The string was tied to cables within a conduit in Lift Shaft 1, and assumed to be present within conduits in the other lift shafts (2 and 3).

4.4 Gaps in the information

The original (1966) as-built drawings and structural design calculations were not available for review, nor were reports from between 1995 and 2008. No asbestos survey information has been provided other than that for the lift shaft. Known reports may have gone missing. Blue Sky consultants may still have access to some originals. Of particular significance is the absence of any Blue Sky structural appraisal calculations; whilst the 2012 report text is available, detailed appended information is missing.

4.5 Information generated in this commission

4.5.1 Drawings

Plans and elevations of the car park have been developed by CH2M based on the 2012 Blue Sky drawings (which were in turn based on earlier drawings). Locations of defects in the reinforced concrete components have been marked on these, and are provided in Appendix A, and include the following:

TABLE 4.1
Drawing Register

Drawing Number	Drawing Description
673846-WE- 000	West End - Location Plan
673846-WE- 001	West End - Location Plan - Site Plan
673846-WE- 101	West End - Level 0, Staircase Defects Location
673846-WE- 102	West End - Level 0 - Entrance/Exit, Defects Location
673846-WE- 103	West End - Level 0 - 1B, Staircase Defects Location
673846-WE- 104	West End - Level 0 - 1B, Defects Location
673846-WE- 105	West End - Level 1A - 2B, Staircase Defects Location
673846-WE- 106	West End - Level 1A - 2B, Deck Defects Location
673846-WE- 107	West End - Level 1A - 2B, Soffit and Upstand Defects Location

TABLE 4.1
Drawing Register

Drawing Number	Drawing Description
673846-WE-108	West End - Level 2A - 3B, Staircase Defects Location
673846-WE- 109	West End - Level 2A - 3B, Deck Defects Location
673846-WE- 110	West End - Level 2A - 3B, Soffit and Upstand Defects Location
673846-WE- 111	West End - Level 3A - 4B, Staircase Defects Location
673846-WE- 112	West End - Level 3A - 4B, Deck Defects Location
673846-WE- 113	West End - Level 3A - 4B, Soffit and Upstand Defects Location
673846-WE- 114	West End - Level 4A - 5B, Staircase Defects Location
673846-WE- 115	West End - Level 4A - 5B, Deck Defects Location
673846-WE- 116	West End - Level 4A - 5B, Soffit and Upstand Defects Location
673846-WE- 117	West End - Level 5A - 6B, Staircase Defects Location
673846-WE- 118	West End - Level 5A - 6B, Deck Defects Location
673846-WE- 119	West End - Level 5A - 6B, Soffit and Upstand Defects Location
673846-WE- 120	West End - Level 6A - 7B, Staircase and Lift Room Defects Location
673846-WE- 121	West End - Level 6A - 7B, Defects Location
673846-WE- 122	West End - North West Elevation, Defects Location
673846-WE-123	West End - South West and North East Elevation, Defects Location
673846-WE-124	West End - South East Elevation, Defects Location
673846-WE- 125	West End - Drainage Inspection
673846-WE- 125	West End - Drainage Inspection
673846-WE-XX1-Rev A	Entrance re-design preferred option for re-modelling access and egress

4.5.2 Test data

The chloride test data are included in Appendix B.

4.5.3 Digital images

There are a series of digital images and digital video files which illustrate condition resulting from the inspections undertaken by CH2M. These are not included but are available to BCC on request.

SECTION 5
Condition Survey

5.1 Approach

The condition survey involved a visual inspection using the plans and elevations of the car park to assist in recording defects. All works were undertaken by a team of at least two inspectors. The following sections provide a summary of the features and conditions found in 2017/8, and are presented by structural component or part or by the functional activity required.

5.2 Structural frame

5.2.1 Columns and beams

The car park is composed of steel columns and beams encased in concrete. Columns are located every two parking bays (approximately 4.8m centres) and support downstand beams clear spanning each split level. Columns are typically 375mm by 375mm section size and the downstand beams 670mm deep by 375mm wide.

There are four lines of columns in the northwest/southeast orientation, spaced at approximately 4.85m centres. These support a total of 12no. beams (spanning transversely, northeast/ southwest) at each level. The beam/column connection at the turning areas at the far ends of each level are slightly more complex due to the off-set levels and arrangement of the longitudinal and transverse beams.

The columns and beams are painted white (see Figure 5-1). The coating is typically in good condition. There are a small number of defect in the beams and columns that relate to, or appear to relate to corrosion of embedded reinforcement. However, there is no evidence of distortion or significant structural damage, with the exception of one location affected by spalling at the southern stairwell (Figure 5-2). The damage here is historic and has been treated by installation of a square section steel prop. In 2017/18 the exposed reinforcement was covered over by a repair mortar.

Figure 5-1. Structural arrangement
Typical slab, column, beam, and soffit arrangement (at northeast end of car park)

Figure 5-2. Column at south corner of car park, Level 6B
Open spalling to the column with reinforcement corrosion and existing steel prop in place.

5.2.2 Walls

Most elevations of the car park are bounded by pre-cast concrete units joined to the deck slabs. There are infill cavity walls to the southwest elevation. The walls are full height (floor to ceiling), and span between the columns and the car park slabs. They are of cavity construction, with blockwork inner leaf and brickwork outer facing.

There are also concrete block walls at the stairwells and lift core.

The arrangement means that there is no formal longitudinal or transverse bracing or shear panels and, as reported by Blue Sky, "*stability appears to be provided by a combination of the central stair core and the beam to column connections and the insitu deck slab to beam connections*".

The southwest elevation can be inspected from the car parking areas to the residential properties behind Burton Court (see Figure 5-3). The brickwork was placed directly on top of the perimeter of the reinforced concrete deck slabs and the external face is nominally flush with the deck. There is minor irregularity to some courses, apparently most commonly at the bottom and top of the lifts. For the main part, the external brickwork appears in acceptable condition. There is some vegetation (ivy) growth at the west corner of the face, which may in the long term contribute to deterioration.

Figure 5-3. Southwest elevation
External brickwork off reinforced concrete decks in acceptable condition

Figure 5-4. South corner elevation
Note repairs to brickwork close to the glazed stair tower

There are some defects visible in the external brickwork at the south corner by the south stair tower (see Figure 5-4). These appear to have been repaired by re-pointing, or re-building sections of the wall. The defects appear to have been related to movement of the structural frame at the stairwell, and may relate to thermal movement at the south corner of the building. The condition of the wall should be monitored and inspected at touching distance when the glazing and stairwell structural frame are next inspected using external access.

5.2.3 Ground bearing slabs

Part of the ground floor concrete slab is visible at the southwest end of the car park in the area occupied by Europcar. No defects were recorded in this area. The ground level slabs to the northeast area occupied by the Bath Store are not visible; these are tiled over.

5.2.4 Suspended slabs

The beams support an insitu concrete deck of 175mm depth.

The appearance of the top surfaces at each floor are as-expected for a multi-storey car park of this age, with a significant amount of texture remaining from the original concrete construction, plus abundant evidence of road grime, oil and tyre markings. The white lining (delineating turning circles and parking bays) are typically worn.

The condition of the concrete is generally poor particularly on the lower levels. There is extensive spalling in the top surface, resulting in open spalls, unravelling of the surface, and some 'hollow' sounding incipient spalls, with the worst areas being on 1A, 2B and 2A. Some areas of deck contain multiple defects in the same vicinity and it is anticipated that it would be difficult to repair each in isolation (see Figure 5-5). The defects appear to relate to corrosion of embedded reinforcement; this is supported by the high chloride levels found in the decks.

Figure 5-5. Spalling to lower level deck
Multiple phases of repair to the deck in the turning area over an extensive area

There are also cracks prevalent in the deck slab. These tend to radiate from columns, and are noted in the soffits as well as the top surfaces of the slabs. Commonly there are continuous cracks between columns along the sides of the car park decks, at the outermost (cantilevered) section (see Figure 5-6).

Figure 5-6. Southeast side of the car park looking toward the east corner of the car park
Note continuous crack in deck spanning between columns, sealed with bituminous material

5.2.5 Waterproofing

The roof decks (Levels 6A and 7B) are coated with a bituminous material which appears worn but remains largely intact. This was previously reported by Blue Sky (2012) to appear generally water-resistant with only a few locations of water ingress, but approaching the end of its life. The roof-level waterproofing appears little different some five years on, and is apparently largely still functional (see Figure 5.7).

Figure 5-7. Northeast corner of the car park, Level 7B
Worn area of bituminous surfacing material

The deck of Level 1B is situated above the occupied or utilised areas of the ground floor. The deck is coated with mastic asphalt. Whilst the mastic asphalt layer is generally intact there are some locations where it is blistered or worn to the point where bare concrete is visible. Some localised

patching of the mastic asphalt may be required in the coming years to maintain a high degree of water resistance.

The disabled parking bays on Level 1A have a deck coating in blue/white which is delaminating from the concrete substrate in places. We estimate that around 5% of the coating has failed.

5.2.6 Movement Joints

The car park contains a single transverse expansion joint located to the south of the main stair and lift core. This divides the structure in two, comprising 7-spans to the south of the joint and 9-spans to the north.

At roof level the joint has a raised profile and is covered with the bituminous surfacing (see Figure 5-8). However, there are crack-like partings parallel to the joint through which rainwater can penetrate, and the joint is not fully water-resistant.

Figure 5-8. Roof-level (7B) expansion joint
Note raised profile to the joint and multiple transverse cracks in the bituminous surfacing material

At the intermediate deck levels the joints are approximately 20mm wide and mastic-filled. There is clear evidence of water ingress through the joints, and it is suspected that the sealant has failed in numerous locations. Figure 5-9a shows evidence of seepage at the soffit, and Figure 5-9b shows that there is a rope-like material sagging from the joint. This is likely to have been part of the original joint filling media, and it is recommended this is inspected by a specialist company to assess its composition.

Figure 5-9a (left) and 9b (right). Expansion joint at columns and soffit, intermediate level
Note mastic-like sealant between the columns and rope-like infill to the soffit joint.

5.3 Lift and stair enclosures

5.3.1 Arrangement of enclosures

The main stairs and the lifts are located in an enclosure in the centre of the car park. The enclosure serves each split level (secondary stairs provide access to the rear 'A' decks). The main stair tower is constructed of brickwork and 9" blockwork panels built within the steel and concrete frame.

A second stair-only enclosure is located at the southeast corner. The enclosure is formed with brickwork walls separating it from the parking decks and single glazing to the two external elevations.

Figure 5-10. Main stairs at Level 6A
Note painted floor, anti-slip nosings to the treads and stalagmites forming below leaking concrete roof.

The stair flights and landings for both stairwells are of precast concrete (see Figure 5-10) with painted steel handrails. The walls, ceilings and landings are painted. The stair treads have high friction edgings /nosings.

5.3.2 Lift motor room and roof

The lift motor room is accessible via a locked door from the top deck of the car park, accessed from the painted metal stairs on Level 6A. The room is constructed from a reinforced concrete frame (beams, columns and roof slab) with walls of blockwork and brickwork. The room showed no evidence of water ingress although there is incipient and open spalling to the soffit slab that appears to relate to low cover reinforcement corrosion.

Externally the roof comprises a covered concrete flat roof with perimeter upstands in concrete, with an attached lightning strip (see Figure 5-11). The roof appears to be covered with overlapping rolls of a sheet membrane, with additional lapping at the upstands, with a partly degraded white or silver painted coating.

Figure 5-11 Lift motor room roof
Roofing material in good condition and standing water from file GOPR0424

5.3.3 Main stair roof

The main stairwell roof consists of is at a lower level to the lift motor room roof. It is a horizontal flat roof bounded at the perimeter by a low upstand, as shown in Figure 5-12. The roof and low upstands are covered with what appears to be sheets of a dark grey roofing product, which may have been finished or coated in the past with a silver or white layer (presumably a solar reflective treatment).

The roof covering appears to be generally in good condition, with a few circular and linear blister-like features. However, leaks from the soffit were found inside the stairwell (above the main landing and above the secondary stairs) indicating that there are defect in the roof waterproofing which were not apparent from the outside.

There is an outlet at the southeast corner of the lower flat roof section, providing drainage to a hopper and downpipe.

Figure 5-12 Main stairwell roof
Roofing material in good condition and standing water from file GOPR0423

5.4 Stairs at south corner

5.4.1 Concrete stair units

The full-height staircase, to the southeast corner of the car park (Figure 5-13), comprises of pre-cast concrete stairs and integral landings (215mm thick), resting on the car park framework at each floor level. They incorporate yellow paint applied non-slip nosings.

Figure 5-13 Location of south stairwell (ringed)
Stairwell at southeast corner of West End MSCP

Where the landings abut the staircase walls, they are sealed and the landings generally painted. Along the stringers (sides) of the staircases, they do not abut the perimeter walls to all sides, allowing cleaning surface water and the like to cascade over and onto the staircase glazing and walls,

causing staining and premature deterioration of the brickwork and concrete elements enclosing the staircase. It would be prudent to review this design and perhaps allow for edge protection to the exposed stringers to limit future soiling and corrosion.

In addition to the above, it would be beneficial, from a cosmetic point of view, to paint all the stairs, if only to allow deeper cleaning when soiled. In addition to the above, it would be beneficial, from a cosmetic point of view, to paint the stairwells (walls and soffits).

Painted steel balustrades are bolted to the staircases. These appear to be in average condition and would benefit from cleaning as a minimum and re-coating in some locations.

The handrailing is discontinuous on the 'outer' perimeter of the stairwell at the internal brickwork wall. Absent sections could to be readily added.

Figure 5-14 Internal views of stairwell
Views toward the southwest, illustrating façade glazing, handrails, stair units, structural frame and brickwork

5.4.2 Facades

The south staircase to this car park is mostly clad with aluminium patent glazing, fixed to a reinforced concrete supporting framework. There are brick apron panels to the landings and to the entire ground floor.

The patent glazing system is considered to be original and comprises of:

- Aluminium transoms and mullions
- Single glazing with rubber gaskets to the framework
- Reinforced concrete supporting framework

Overall, the glazing system is tired and damaged in part, with local areas of water ingress evident. One panel is missing and replaced with plywood. We noted that the glazing and bead sealing compound is generally beginning to extrude and crack and in time further water ingress will occur. The surface coating of the exterior is generally heavily soiled and faded. The expected serviceable life therefore, before major refurbishment is required, is less than five years.

Figure 5-15 External views of stairwell
Views illustrating façade glazing, stair units, structural frame and brickwork

In light of the above, the glazing system is in need of substantial refurbishment and repair within the next 12 – 24 months we suggest. Given the extent of the work required in terms of labour and storage, plus the general poor cosmetic appearance of the system installed, consideration should be given to replacing all of the façade glazing systems. New systems are likely to have a payback period of five to 10 years, given the life of the existing system and the need to continually maintain.

Figure 5-16 Internal views of façade
Views illustrating deterioration of glazing beads and seals and an example of spalling to concrete framework

The concrete supporting framework appears to be in fair to poor condition. Local cracking, expected to be the result of reinforcement corrosion, is evident in areas and repairs are now required. It may be that carbonation is occurring and the corrosion exacerbated by the use of cleaning agents to the staircase - further investigations are recommended for this year and consideration given to the use of anti-carbonation coatings applied as part of any remedial works, to reduce the deterioration of the reinforcement further.

Heavy efflorescence (salt staining) is evident at ground floor level and we suspect that cleaning agents may be the cause of this problem. Local cleaning of brickwork and repairs and repointing will be required.

5.4.3 Stair tower roof

At roof level (Level 7B) the stair tower is enclosed to the northeast and northwest by brick walls. There is a concrete beam atop the wall, which extends above roof level as an upstand. There is a lightning tape attached to the perimeter upstand. The tape is detached in the south corner.

The roof is a simple flat roof of concrete coated with what appears to be a multiple strips of a thin (<5mm thick), dark grey, bituminous system, possibly some form of bituminous felt. Only 20% to 30% of the surface is visible as the remainder is covered with moss-like vegetation and small stones (presumably loose felt-chippings). Where visible, the surfacing appears to be in reasonable condition, but there appear to be tears in at the perimeter where the flat section is lapped up the internal face of the upstand.

Drainage from the flat roof is provided via a lead-lined penetration through the upstand southwest corner, draining into a hopper then downpipe. Despite the vegetation apparently impeding the drainage, at the time of the survey drainage appeared to be effective, and there was no water leakage through the roof into the stairwell.

Figure 5-16 South corner stairwell roof
Vegetated roof in degraded condition, and loose lightning strip from file GOPR0426

5.5 Foundations

The foundations are not visible without excavation, which is outside of the remit of the survey completed to date, and therefore have not been inspected. However, there is no evidence of settlement, movement or tilting of the structure.

5.6 Edge protection

5.6.1 External perimeter

The exterior of the car park is enclosed with blockwork on the southwest side, with the remaining 3 sides part open to the elements. The perimeter to these three sides is formed from L-section precast concrete panels integral with the insitu concrete deck (see Figures 5-6 and 5-17). Despite being continuously attached to the deck, the panels are separated vertically by keyed joints. The panels provide a continuous vertical parapet of 835mm above kerb level with an additional height (to 1080mm) provided by a metal hand rail.

There are numerous cracks and spalls in the outer and soffit faces of the pre-cast panels, as illustrated in Figure 5-17. These may relate to reinforcement corrosion and/or restrained thermal movement. It is our professional opinion that the parapets will deteriorate over time, as both reinforcement corrosion continues to occur in the deck and in the external faces of the parapet

units. These processes might reduce the capacity of the parapet over time. As such it may not be prudent to rely on the parapet to provide vehicle restraint function in the long term.

Figure 5-17 Southest (front) elevation from pavement level
Note junction between deck soffits and pre-cast panels, with spalling of concrete at some vertical joints

The northeast and southwest ends of the car park have new rigid post and rail barrier type which was installed after the Blue Sky report in 2012. The details of this should be checked to determine if the barrier installed was designed to resist the twice force loads required for ramp end barriers.

5.6.2 Internal perimeter

The internal barriers between the split levels are formed from steel C-section posts supporting Armco-type steel barrier rails at low level and a mid and top-level steel hand rail. The posts are bolted to the deck. The condition of the edge protection is generally good. There is localised corrosion of the posts, baseplates and holding-down bolts. Neither the length of the bolts nor the engagement depth is known, nor the condition of the bolts below the baseplate.

The existing edge protection does not meet current standards for the following reasons:

- the rigid post supports (steel C-sections) are incapable of accommodating the current vehicle impact loadings,
- the barriers are easily climbable, and of insufficient height, and
- the spacing between the elements permit the passing of a 100mm diameter ball, and as such the barrier fails to prevent children from accidently endangering themselves.

5.7 Drainage

The surface water drainage from the decks relies on cross-falls (and the gradient of the ramped section) to the internal edges (i.e. those between the split levels), to grates which feed down pipes. The cross-falls are not entirely continuous, and water ponds extensively during periods of rainfall, at various locations and levels, including at the internal perimeter of the B decks. There are a total of 6no. down pipes which each connect to grates at each half-deck. There are no downpipes located at the external perimeter.

The down-pipes are metallic and are coated with a black paint system in reasonable condition. At ground level they continue to a sub-surface drainage system. This was surveyed in 2011 and is shown in Blue Sky consultants drawing 11019/DR01, which shows all downpipes connected to either

a surface water or combined (foul and surface water) pipe , all eventually leading to manhole chamber close to the un-used exit ramp on Berkeley Place, and then discharging to the east. At the time of the 2011 survey, some of the manhole covers could not be lifted. In 2018, most of the visible covers could not be lifted, and one in the Bath Store appeared to have been covered by new flooring. The covers have corroded to the frames, and would need to be freed up using a combination of angle grinder, hand-tools and lifting gear.

5.8 Entry / Exit layout

The ground-level access from Jacob's Wells Road is constrained by the layout of the superstructure (i.e. the columns and beams supporting the decks above) and walls (see Figure 5-18).

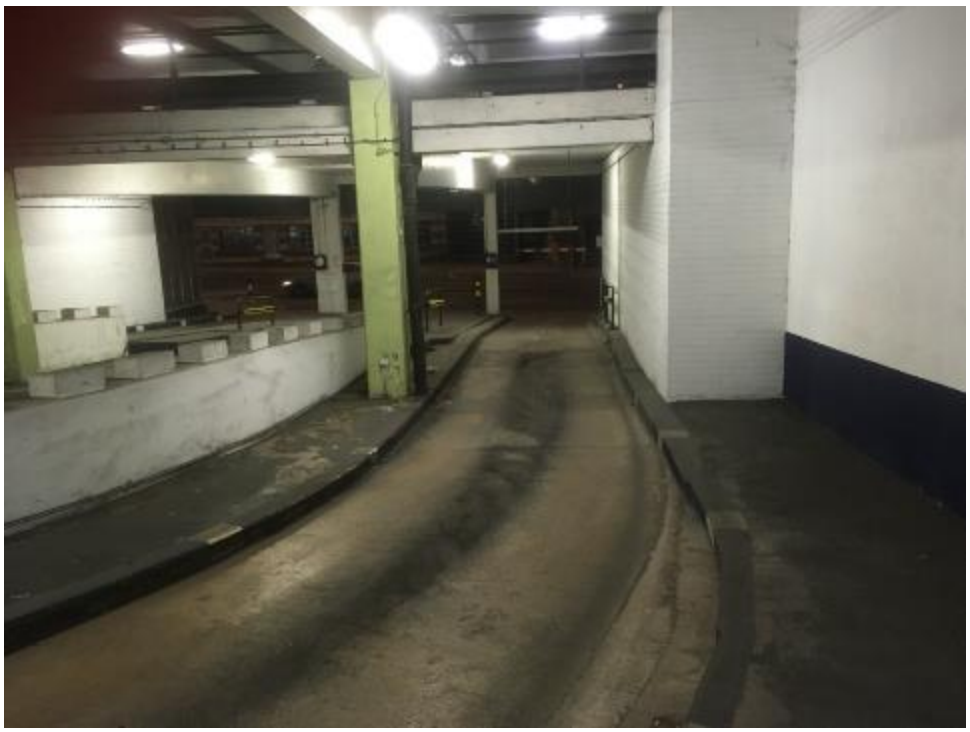


Figure 5-18 Entrance ramp
Illustrating the bottleneck formed by the retaining wall, column, down pipe, kerbs and masonry wall

CH2M have reviewed the ground floor entry/exit layout and determined that the only viable option is to move the existing kerb back. BCC have moved the kerb before and the benefits gained would be limited as the width of only one lane can be improved. The proposed arrangement is shown in CH2M Drawing 673846-WE-XX1-Rev A, an extract of which is included in Figure 5-19.

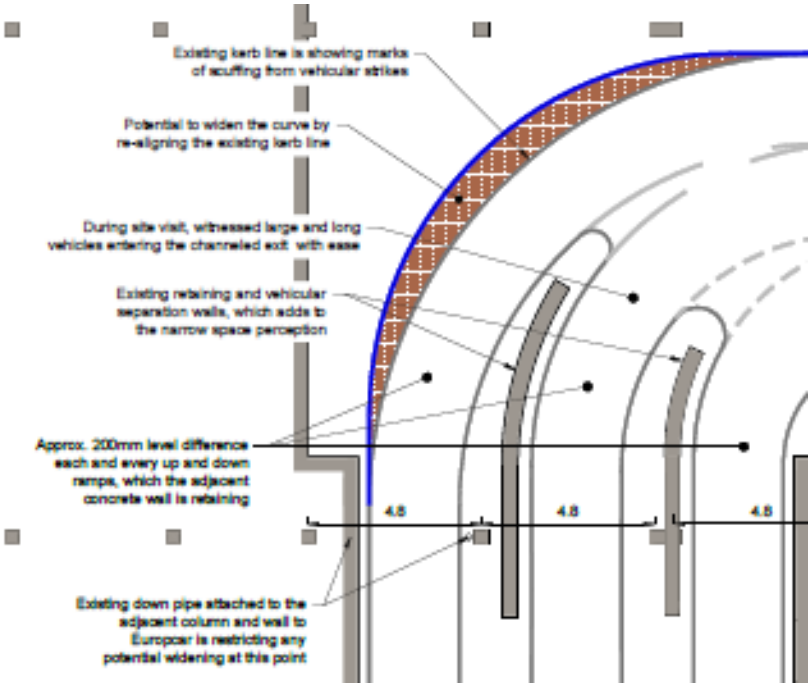


Figure 5-13 Entrance re-design

Preferred option for re-modelling access and egress

5.9 Aesthetic upgrade of external elevations

Any upgrade to the elevations should be considered in conjunction with the agreed actions for other parts of the car park, particular those exposed to Jacob's Wells Road (notably the south stairwell glazing, its concrete support structure, the brickwork to the southwest elevation, and critically the perimeter pre-cast parapet units). Any external upgrade theme is likely to involve cleaning and potentially coating.

SECTION 6

Structural Investigation

6.1 Approach

We understand that there are no contemporary construction drawings, structural drawings, previous records of structural appraisal, or records of maintenance and repair activity for this structure. On this basis, a structural investigation was designed and undertaken, recording parameters such as chloride ion content, cover depth, carbonation depth and compressive strength.

The structural investigation was aimed at deriving the material condition and properties so that load assessments could be undertaken, at specific structurally vulnerable positions. It was also aimed at assessing the overall condition, type and extent of deterioration, and risk of future deterioration, which are important factors in assessing the potential demand for repair and maintenance.

Is was not possible to undertaken a full assessment of all elements of the car park at all levels; columns, beams and slabs have been sampled and tested at specific locations only.

This section of the report documents the findings of the site investigation and associated laboratory testing.

CH2M HILL/Jacobs appointed a specialist contractor, EDS to undertake the sampling and testing work. Intrusive sampling was carried out at 24 locations and included:

- measurement of minimum cover depth to reinforcement;
- carbonation depth,
- incremental dust drilling for laboratory testing for chloride content, and
- 'break outs' to locally remove concrete cover to expose a reinforcing bar for calibration of instruments and visual confirmation of corrosion condition.

In addition, three, 50mm diameter core samples were also cut and removed from beam soffit, column and deck positions. These samples were conveyed to a specialist laboratory to determine compressive strength and density.

These sample and test locations are shown in Table 6.1 below:

TABLE 6.1
Chloride sample locations and results

Location reference	Level	Element	Chloride content %by weight of cement at 35-50mm depth	BRE Corrosion risk assessment
WE1	4B	Deck, bay	0.63	Moderate
WE2	4B	Deck, bay	0.87	High
WE3	4B	Deck, aisle	0.34	Low
WE4	3B	Deck, bay	0.78	High
WE5	3B	Deck, bay	1.12	Very high
WE6	3B	Deck, aisle	0.53	Moderate
WE7	2B	Deck, bay	1.80	Extremely high
WE8	2B	Deck, bay	1.65	Extremely high
WE9	2B	Deck, aisle	3.11	Extremely high
WE10	0	Entrance aisle	0.29	Low

All drilled sample holes, core holes and break-out areas were reinstated using a BS EN 1504-3 Class R4 repair material.

6.2 Record of defects

6.2.1 Visual and Hammer Tap Survey

All visible areas were checked for defects and accessible areas where defects were found were checked for debonding of the cover concrete from the reinforcing bars using a light chipping hammer and noting the audible response. A 'drummy' note indicated hollowness whilst a 'ringing' signified a sound bond to the bars.

A summary of concrete defects identified is presented in the Charts 6-1 and 6-2. Of note is the general pattern of reduction of the number of deck defects with increasing level in the car park, the large number of decst at Levels 1A, 2A and 2B, and the absence of these defects at Level 1B (coated with mastic asphalt).

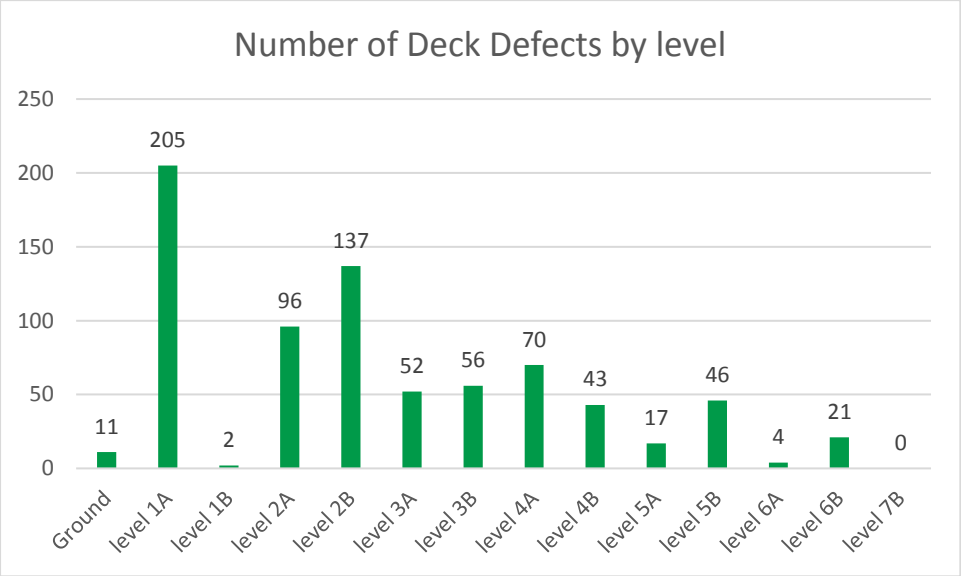


Chart 6-1 Number of defects on each deck

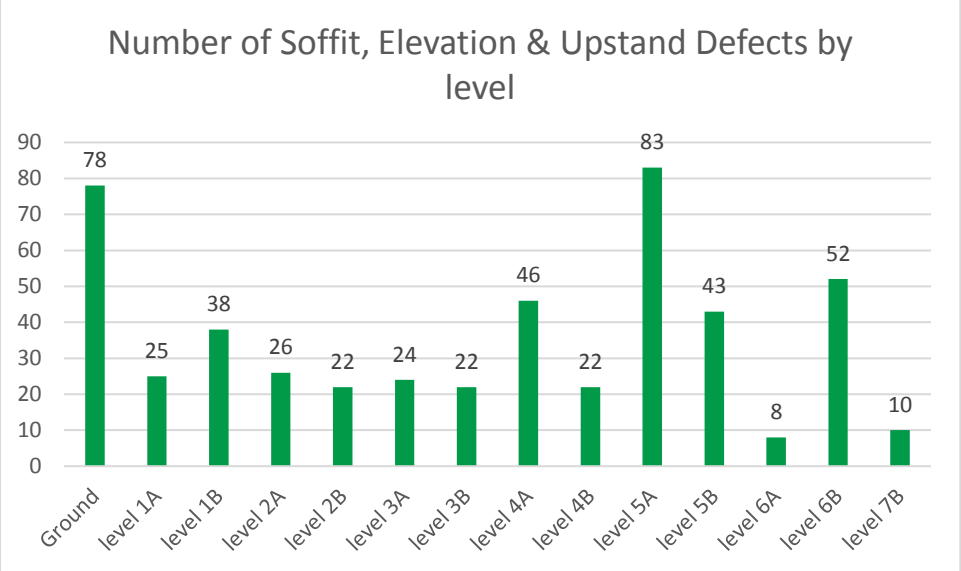


Chart 6-2 Number of soffit, elevation and upstand defects by level

6.2.2 Chloride Ion content of the decks

At deck locations (the parking bays and aisles of Levels 0, 2b, 3b, and 4b), drilled dust samples were collected using a rotary-percussive drill and large diameter masonry bit in accordance with recommendations detailed within BRE-IP 21/86.

The concrete dust was collected in approximate depth increments as follows: 5-20mm, 20-35mm and 35-50mm. The outermost 5mm was assumed to be weathered and therefore non-representative and discarded.

The dust samples were then submitted to a UKAS accredited laboratory, Quartz Scientific Ltd, for chemical analysis for determination of chloride ion content in accordance with the procedures detailed within BS 1881: Part 124. The laboratory test certificates are presented in Appendix B. The cement content is shown as 14% by weight of concrete but we have re-analysed using 20.6% as previously determined by Blue Sky (2012).

The data was assessed using the criteria given in BRE Digest 444: Part 2 for a 40 year old structure (assumed damp with pH>10), and against the threshold value above which the levels of chloride ion are considered to induce corrosion (i.e. 0.4% by weight of cement for chloride). Given its age it is feasible that cast-in chlorides are present, however, this not believed to be the case.

The data is summarised in Table 6.1 and shows significant elevations over the expected chloride content in the outer 50mm of the deck slabs. Chlorides could have originated from the use of de-icing salts spread across the car park or tracked in by vehicles during winter periods.

We have also reviewed previous results for sampling and testing for chloride content. Measurements in 2012 in the deck were mostly lower that would be expected to initiate reinforcement corrosion in the 5-25mm and 25-50mm depth increments in the decks, soffits, parapets, beams and columns. Isolated high chloride values were reported in 2 deck locations on Level 2 A.

6.2.3 Compressive strength testing

No core sampling was undertaken in 2017/8. Blue Sky took samples of concrete in 2012. The data is summarised in Table 6.2.

TABLE 6.2
Compressive strength results, 2012

Location reference	Element	Density	Estimated insitu cube strength
Core – Level 2A	Deck	2410 kg/m^3	26.6N/mm^2
Core – Level 5B	Deck	2600 kg /m	27.6N/mm^2
Core – Access Bridge	Column	2415 kg/m^3	66.7N/mm^2

6.2.4 Cover depth

No cover work was undertaken in 2017/8. The Blue Sky data from 2012 is summarised in Table 6.3. There were 9 (out of 20) cover measurements reported at between 20mm and 30mm depth. The mean depth is therefore skewed by the deeper covers, and it is significant that many deck locations have limited (and what might be considered low) protection afforded by cover concrete.

TABLE 6.3
Cover results, 2012

Element	Range, mm	Mean, mm	Number of readings
Suspended Deck	20-69	36	20
Column	31-48	40	4
Parapet/Wall	16-65	45	20
Soffit	19-61	25	12

6.2.5 Carbonation depth

No carbonation depth assessment was undertaken in 2017/8. The Blue Sky data from 2012 The data is summarised in Table 6.4. There is clearly some risk of carbonation-induced reinforcement corrosion for the deck slabs.

TABLE 6.4
Carbonation depth results, 2012

Element	Range, mm	Mean, mm	Number of readings
Suspended Deck	8-43	31	20
Column	5-31	52	4
Parapet/Wall	5-21	10	19
Soffit	8-41	23	12

Blue Sky reported that '*The individual test results …. show that the recorded carbonation depth exceeds the cover in some of the test locations…… The results indicate a Medium risk of reinforcement corrosion due to carbonation in the decks and soffits*.'

Carbonation can be expected to have progressed in the deck since 2012, although not in the painted columns and soffits (assuming the coating is an anti-carbonation coating).

6.3 Discussion of main findings

6.3.1 Chlorides and deck reinforcement

In assessing likely future behaviour and maintenance demand it is important to consider the evidence of deterioration as well as the test results from past and current investigations. There is abundant evidence of low cover in the deck slabs and soffits in both. The current extent of deterioration in the decks, and apparent multiple phases of repair is concerning and indicative of historic and ongoing reinforcement corrosion. Whether this was originally carbonation-induced or chloride-induced corrosion is largely irrelevant as there are now sufficient failures in the lower deck

levels to permit ready ingress of de-icing salts and generate aggressive chloride-induced corrosion cells. As such, the decks of Level 1A, 2B and Level 2A are expected to be actively corroding, difficult to treat in isolation, and result in a greater number of spalls and potentially larger spalling areas. Corrosion may also become increasingly associated with weak points in the concrete, including the cracks visible radiating from columns or spanning between columns at the cantilever sections.

There is abundant evidence of cracking and spalling associated with the the pre-cast deck units. This may be in part related thermal movement. However, we cannot rule out the possibility of reinforcement corrosion caused by the drainage of chloride-contaminated run-off at each deck level. The abundance of cracking and spalling in these pre-cast units could increase and needs to be managed by regular inspection and removal of spalling material.

It is likely that the deck spalling seen at higher levels is also related to chloride-induced reinforcement corrosion. Isolated areas are easier to treat and maintain.

SECTION 7
Structural Appraisal

7.1 Car Park Regular Grid Area

The car park has a predominantly regular grid pattern of columns and drop beams spanning transversely at a 15' 11" pitch (16' may have been intended). The car park was analysed as a plane frame with each member representing 15' 11" (4.851m) width of floor. The spans between the centres of the columns are 2 x 50' (2 x 15.24m). The weight of the cantilevers and edge walls that extend 1.8m beyond the perimeter columns are also taken into account.

7.2 Assessment criteria

The concrete cube strength is assessed as 24.8N/mm^2. This is based on two cores taken by Blue Sky (report para. 9.2.1) which yielded results of 26.6N/mm^2 and 27.6N/mm^2, reduced to the 95% confidence level by the method given in BS 6089. Note that in the assessment of composite construction, the minimum permitted concrete strength considered to be effective is 25N/mm^2 (BD 61/10 clause 8.1). However as the core value is close to the minimum, the concrete contribution will be allowed.

Structural steel yield strength 247N/mm^2, based on BS 15:1948 amended 1959 (BD 21/01 Table C2).

Concrete density 25kN/m^3 and steel density 77kN/m^3.

Car park loading 2.5kN/m^2 assumed (BS EN 1991-1-1:2002 Table NA.6).

Floor members are modelled as T beams: breadth 120.62" depth 33" flange 7" web 15". The actual breadth of 191" is reduced by shear lag using the method in BS 5400 part 3 Table 4 with ψ = 0.6318.

Floor members contain a steel beam section 610 x 229 x 140 (Blue Sky 11.3).

Perimeter columns are 15" x 15" (381mm sq.) containing UC 203 x 203 x 86 (Blue Sky 11.8).

Internal columns are 18" x 18" (457mm sq.) but there is no mention of what size steel column is enclosed.

At the car park turning ends, the two semi decks are aligned vertically (Figure 7-1, left) while at mid length the decks are out of phase by up to half a storey height (Figure 7-1, right). The vertical storey height is 3.048m throughout above the first floor.

Permanent loads and live loads are applied to every part of structure, using two computer models in Leap5 classic. The individual member loads are obtained and factored by spreadsheet for ULS. The factor γf3 = 1.1 is not added to the loads, but allowed for in the assessment of material strength.

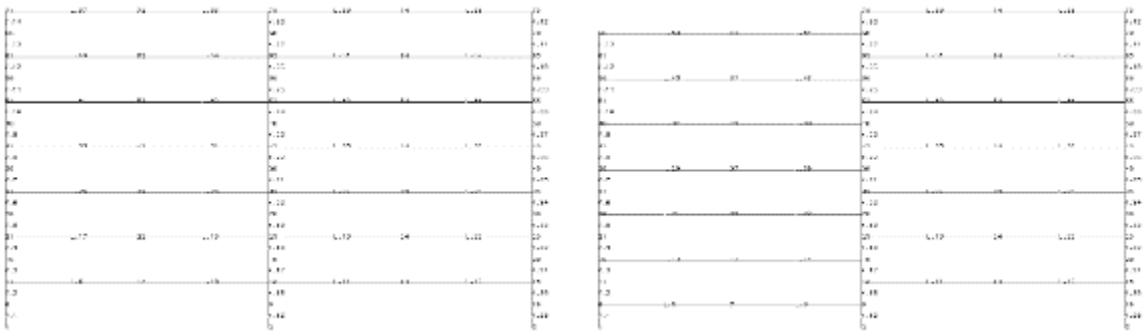


Figure 7-1. Structural arrangement
Typical arrangement by floors, section at turning ends (left) and mid length (right()

TABLE 7.1
Summary of loads

	Adverse load factor	Relieving load factor
Permanent loads	1.15	1.0
Live loads	1.50	0.0

7.3 Assessment results

7.3.1 Load cases

The following worst case scenarios are obtained that apply anywhere: Deck slab transverse results are obtained by using formulae in Steel Designers' Manual

TABLE 7.2
Worst case loads for deck and columns

ULS excluding γf3	Total	Permanent	Live
Deck member sagging	1404.8kNm	634.9kNm	769.9kNm
Deck member hogging	-1274.6kNm	-779.4kNm	-495.2kNm
Deck end shear force	548.6kN	265.9kN	282.7kN
Perimeter column axial load	3563.9kN	2421.7kN	1142.1kN
Interior column axial load	6216.7kN	4038.8kN	2177.9kN
Perimeter column coexisting moment	86.6kNm		
Interior column coexisting moment	30.1kNm		

Deck slab transverse results are obtained by using formulae in the Steel Designers' Manual.

TABLE 7.3
Deck slab loads

ULS excluding γf3	Total	Permanent	Live
Deck slab sagging	15.3kNm/m	5.5kNm/m	9.8kNm/m
Deck slab hogging	-22.8kNm/m	-11.0kNm/m	-11.75kNm/m
Deck slab shear force	29.0kN/m	16.6kN/m	12.4kN/m

7.3.2 Capacity of longitudinal deck beams

The longitudinal beams are analysed using the staged construction approach. Initially it is assumed that the beams were not propped during construction, since to do so would greatly increase the temporary works input and time duration. The car park comprises a steel frame clad in concrete which provides fire protection and composite action. The presumption that composite action must exist is based on the realisation that beams in isolation fall far short of the required bending capacity. However the presence and adequacy of shear studs required for transmission of longitudinal shear at the material interface is unknown. Steel reinforcement provided in the

direction aligned with the steel beams comprises 6mm bars at 100mm centres (wrapping) and 10mm bars at 300mm centres in the slab. Both are ignored.

Stage 1: For un-propped construction, the steel beams alone would be required to carry self weight, formwork, weight of wet concrete and construction live loads. The maximum bending moment from the table above is 779.4kNm (hogging). The elastic section modulus for UB 610x229x140 is 3622cm^3, resulting in an extreme fibre stress of 215.2N/mm^2. This stress would be increased further by the weight of formwork and construction live load.

It is implausible that stage 1 loads would induce stresses so close to 247N/mm^2 yield, which suggests that either a higher grade of steel was used or the formwork was propped. The above calculation does not take into account any reduction that might be needed to prevent lateral torsional buckling.

Stage 2: The composite section carries live load in addition to the locked in stage 1 steel stresses. The section capacity is derived using the plastic modulus of the steel with concrete in tension ignored.

The comparison of capacities and applied loads are tabulated below:

TABLE 7.4
Slab capacity vs applied loads

Deck	Capacity	Applied load	Utilisation factor
Sagging	1620.1kNm	1404.8kNm	0.87
Hogging (as per Figure 7-1 left)	-1026.7kNm	-1274.6kNm	1.24
Hogging (as per Figure 7-2, right)	-1026.7kNm	-816.5kNm	0.80

Maximum hogging moment occurs where the deck beam ends are connected to the internal columns in the same plane as indicated in Figure 7-1. This assumes a fully rigid connection as opposed to being simply supported. The articulation cannot be fully evaluated without knowing the connection details. As a minimum, partial rigidity would be expected for stage 1 loads and full rigidity would be expected for stage 2 live loads. In the latter case the steel beam encapsulation contributes to capacity where it is in compression below the neutral axis.

The end bays that accommodate the turning areas have a different column arrangement such that the span dimensions are 35’ + 30’ + 35’ instead of the 50’ + 50’ as represented by Figure 7-1. This reduces the hogging moment to 40%. However this is offset by greater spacing in the orthogonal direction which potentially doubles the moment.

7.3.3 Capacity of deck transversely

The shorter spanning direction comprises the 7” thick deck slab only spanning 16’ nominal distance between longitudinal members. The investigations conducted by Blue Sky show that the tension reinforcement in both hogging and sagging zones comprises 12mm ribbed bars at 300mm and 150mm centres respectively. Assuming use of imperial units, it is more probable that the spacing of bars would be 12” (304.8mm) and 6” (152.4mm) so on that basis the area of steel is 371mm^2/m and 742mm^2/m. The latter figures have been used.

The comparison of capacities and applied loads as tabulated below show adequacy:

TABLE 7.5
Slab capacity vs applied loads

Deck transverse to main beams	Capacity	Applied load	Utilisation factor
Sagging bending moment	18.8kNm/m	15.3kNm/m	0.81
Hogging bending moment	-30.1kNm/m	-22.8kNm/m	0.76
End shear force	94.1kN/m	29.0kN/m	0.31

7.3.4 Capacity of columns

Blue Sky did not take any core samples from the columns, therefore by default the same strength concrete is assumed as for the deck. Likewise steel strength is taken as 247N/mm2. On this basis the utilisation factor for the perimeter columns is 1.41.

To test sensitivity to changes in the material properties, it is found that by increasing steel and concrete strength to 355N/mm2 and 30N/mm2 respectively, a near satisfactory utilisation factor of 1.04 can be obtained.

The internal columns measure 18” sq. (457mm), so are able to accommodate larger steel column sections of either the UC 254x254 or UC 305x305 series while still retaining sufficient cover for fire resistance. Different sizes that have been tested are shown in *italics* below. The use of UC 254x254 is most probable.

TABLE 7.6
Column capacity and applied loads

Column	Capacity	Applied load	Utilisation factor
Perimeter column	2533.3kN	3563.9kN	1.41
Perimeter column (fs=355, fcu= 30)	*3430.3kN*	*3563.9kN*	*1.04*
Internal column (UC 203x203x86)	*3789.1kN*	*6216.7kN*	*1.64*
Internal column (UC 254x254x167)	*5658.6kN*	*6216.7kN*	*1.10*
Internal column (UC 305x305x283)	*8321.5kN*	*6216.7kN*	*0.75*

It should be noted that the applied load figures occur at ground level only. The column weights would be expected to reduce with vertical height upwards. At the uppermost floor, axial loads reduce to 479.6kN and 925.7kN for the perimeter and internal columns respectively i.e. about 15% of what they are at ground level. Any reduction in the steel column section size or weight must in any case remain commensurate with the requirement to make a satisfactory bolted connection to the deck beams, which are all uniformly the same size.

7.3.5 Implications of the effect of deck repairs upon column strength

In the assessment of column buckling strength, an effective height of 3.048m has been used, which is the vertical distance between the centres of the floor slabs. In the event of floor slabs being

removed for the replacement of chloride afflicted concrete, there is a risk that the lateral restraint to columns will be reduced resulting in an increase in effective height and reduction of buckling capacity.

Weakness in the columns may be further exacerbated since removal of deck panels one at a time will inevitably create out of balance moments due to differences in deck weights either side of a column.

The deck demolition operation will need to be managed to ensure that:

(a) Loading imposed by construction plant does not exceed 2.5kN/m2 generally, with a limitation on magnitude of individual wheel loads

(b) Arisings from deck demolition shall not be allowed to accumulate on the decks below, and dynamic affects shall be kept to a minimum

(c) Construction sequence shall be limited to single bays or parts of bays to minimise any out of balance moments and torsions propagating through the car park frame that may have a harmful effect

(d) Propping of adjoining bays or parts of bays be needed

(e) Locked in stresses must be predicted and designed for.

7.4 Progressive Collapse

Current design standards and the Building Regulations require consideration of progressive collapse in the design of key elements. It is possible given the age of the structure that progressive collapse was not considered in detail (or at least not to a recognised standard) in the design.

We have identified that under current loading and material assumptions, the columns have high utilisation factors and could be susceptible to vehicle impact on a column. If a column or columns were to buckle, progressive collapse (laterally and vertically) would be a possible outcome. Collapse could occur as a result of a sustained fire beneath the slab or beams exceeding the fire resistance of these elements. Given the uncertainty as to the resistance of the structure to progressive collapse, consideration should be given to undertaking further structural analysis and if necessary increasing protection to these columns.

7.5 Conclusion and Recommendations

This structural study is based on the outcome of invasive investigations undertaken by Blue Sky in 2012, supplemented by our own site inspections. The assessment results that we have obtained are necessarily limited in their scope by the availability of that information and assumptions made. There is no evidence of any structural distress that could be caused by inadequate capacity of the members.

The deck members are broadly adequate given the uncertainties that arise in the method of construction (propped or unpropped), and rigidity of connections to the columns.

Despite absence of any structural distress, we are unable to prove conclusively that any of the columns are adequate and would suggest invasive investigations be carried out to establish concrete and steel strength. Furthermore, the steel section size for the central columns needs to be known.

Before any deck demolition (other than minor deck repairs) can take place, it is necessary to accumulate further information to enable 3-d modelling of the sequence of deck removable and replacement.

Three historical drawings referred to in the Blue Sky report are to be found and others searched for. This will be immensely beneficial in reducing the cost and potentially harmful effects of invasive investigations.

SECTION 8

Life-care Recommendations

8.1 The Plan –

The Initial Appraisal, Condition Survey, Structural Investigation and Structural Appraisal have been used as the baseline for the development of a LCP. In developing recommendations it has been assumed that the requirement is to upgrade the structure to near modern standards as far as is reasonably practicable and then maintain it in its current condition for 20 years. The main elements of the recommendations for the content of the LCP, including the inspection and recommendations, are identified in Table 8.1.

8.2 Routine Inspections

Routine inspections should be undertaken on 6-monthly cycles and should include the following aspects: visual inspection of key elements (structural frame, masonry, drainage etc). These inspections should be based on a checklist including but not limited to the items given in Table 8.1.

8.3 Condition Surveys

Following the condition survey report herein, condition surveys should be carried out at a maximum interval of 5 years. The proposed dates for these are given in Table 8.1. Items to be considered in future condition surveys should be based on the findings of the intervening inspections and the survey works undertaken and described in this report. The results of each future condition survey should be used to re-calibrate the LCP.

8.4 Structural Appraisals

Based upon the findings of the limited structural appraisal herein, future structural appraisals should be undertaken at 10-year intervals. The proposed date for this activity is given in Table 8.1. Items to be considered at that time shall rely upon contemporary condition and special inspection information.

8.5 Record Keeping

All existing documents, such as those listed in Section 5 and all other relevant documents created in the future, should be recorded. These will form the basis of the historical records that need to be kept as part of the Life-care Plan. All other existing information, such as test reports, calculations, drawings and photographs, should also be added to this record.

To assist in the keeping and updating of the records, the following main categories should be listed:

1. Document title;
2. Document type;
3. Reference number;
4. Date produced;
5. Storage location;
6. Life care Plan action;
7. Other comments.

The record should be updated whenever work is carried on the car park. It is recommended that this responsibility for updating and keeping the records is given to a designated person.

Table 8.1

Inspection and Investigations of Elements for West End MSCP (based on Table 5.1 of ICE 2002 Recommendations)

Action	Work by	Report to	Required	Scope
Daily surveillance	On-site staff	Property manager	Daily	Record and report any incidents, signs of damage/collisions or failures/breakdown of equipment. To include lighting, signage, security, drainage, columns, decks, walls, soffits, beam, etc.
Routine inspection	Inspector and/or Engineer	Property manager	Every 6 months with an Engineer conducting at least one inspection per annum	**Deck, soffits, Structural Elements:** Check beams, columns and deck soffits for new calcite, rust staining, damage, cracking or spalling. Check and report any movement, damage or deterioration and loose material. Check for new sites of leakage to the soffit. **Drainage** Check for signs of damage or new seepage from connections, rodding eyes, etc. **Handrails** Check holding down bolts and report any missing and or any signs of deterioration. Check for evidence of impact.
Condition Survey	Engineer	BCC	2023, 2028	Carry out future condition surveys based on findings from this report, plus any subsequent inspections.
Structural Appraisal	Engineer	BCC	2028	Items to be considered in further Structural Appraisal should be based on the findings of the previous Structural Appraisal plus also all subsequent inspection and survey works.
Special Inspection	Engineer	BCC	As required	As advised by Engineer e.g. safety inspections.
Maintenance & Repair	On-site Staff	Property Managers	Monthly	Keep drains unblocked and clear of debris likely to restrict flow. Remove any loose concrete in and over public areas. Monitor or repair trip hazards. Make good any minor damage and repair leaks to the drainage system.

8.6 Maintenance Requirements

The maintenance works recommended to be carried out over the next 5 year period (until the next condition survey), along with their priority and estimated cost, are summarised in Table 8.2. It should also be noted that additional maintenance actions may be required after this time, in particular additional concrete repairs. The high value repair and maintenance items are discussed in more detail below.

8.6.1 Reinforcement Corrosion

Chloride induced corrosion is the main mechanism behind the corrosion and spalling noted on the deck tops and is consistent with de-icing salts being brought into the car park by vehicles, as well as possible historic operational use of de-icing salts in the winter. Damage is extensive, and has been visible for many years, necessitating various rounds of reactive repair. It is clear that corrosion of reinforcement is ongoing and new locations of concrete spalling/ delaminations will continue to occur and this will need to be addressed to maintain the structural integrity. In the higher levels, this could be achieved by a rolling programme of concrete repairs, carried out every 5-10 years depending on the severity/extent and location of damage. A coating system to the deck would also give some benefit in preventing further chloride ingress and reducing the rate of ongoing corrosion.

We are of the opinion that the existing deck surface damage and chloride contamination in Levels 1A, 2B and 2A is so extensive that some degree of propping will be required during any surface patch repairs. Furthermore, during those repairs, the lateral extent of deteriorated concrete and reinforcement is likely to require even larger and potentially full depth repairs. Such repairs are unlikely to be durable for 10-years unless significant additional corrosion protection is applied in the form of either embedded galvanic anodes or an impressed current cathodic protection system, in combination with a high quality surface wearing course. The complexity and cost of such repairs (and their interfaces) are such that full depth reconstruction of the slabs has been considered to provide a more reliable long-term durability solution (i.e. durable for 50-years). The cost is significant, but better value in the medium and long term.

Replacement of those levels, in part or in full, will also necessitate removal of the existing pedestrian and vehicle restraint systems, with largely new systems being installed to the new decks (i.e. the existing parapets would be removed and replaced with new, requiring some architectural input).

It is important to maintain the waterproofing above the retail/commercial units below Level 1B, where the existing mastic asphalt or bituminous layer needs repair. It is not clear how much deterioration may be found in the underlying concrete if this material is taken up; we have costed for full replacement of the coating only.

Further up the car park, the decks should respond satisfactorily to patch repairs with galvanic anodes; we have allowed for a high quality surface coating over decks up to Level 4A to provide reasonable confidence in long-term durability.

8.6.2 Edge protection

The vehicle safety barriers do not comply with current regulations and standards and do not provide adequate protection from a vehicle impact. It is recommended that these barriers are replaced with a suitable system that meets current standards and regulation; this represents a significant cost.

8.6.3 South stairwell

We have allowed for thorough overhaul of the existing glazing cladding system and concrete and brickwork repairs, but BCC may consider, in terms of forward maintenance and longevity, full replacement of the patent glazing system as an alternative to overhaul.

We would expect the cost of replacement to the patent glazing to be approximately £80,000.

8.6.4 Options for short medium and long term

We have prepared a spreadsheet West End Cost Optioneering.xls which identifies the costs associated with maintenance and repair actions. The possible actions are considered in three different scenarios, based on the potential longevity and performance of West End, as follows:

Option A – undertaking works to address existing health and safety risks (e.g. barriers), durability risks (e.g. glazing, deck expansion joints) and executing a comprehensive insitu repair strategy for deteriorating reinforced concrete decks. The concrete repair strategy is likely to be the minimum required to extend functionality for 10-years. It does not fundamentally prevent further deterioration of the deck and future cyclic concrete repairs (at 3 to 6 year intervals, for example) could be reasonably expected. It should be noted that the extent of defects on Levels 1A, 2B and 2A will require an assessment to be undertaken to determine the method and size of repairs and it is anticipated that staged or staggered repairs and some temporary propping of badly affected decks could be necessary.

Option B – as for option A but with an enhanced repair strategy including a high performance deck coating to help minimise future deck deterioration, and alleviate the need for widespread concrete repairs in the next 5-10 years. Some localised concrete repairs (with reinstatement of coating) would still be anticipated. This option has the potential to extend the functionality of the decks beyond the 10-year horizon, but due to wear and tear on the new coating and it's underlying repairs, and the known issues relating to high chloride contamination of the existing decks, it should be anticipated that a further cycle of repair and coating could be required after 10-15 years.

Option C - as for Option B but for Levels 1A, 2B and 2A extensive replacement of the existing deck is carried out, rather than repairs and coatings. This is because these decks are the most highly contaminated with chlorides and have an extensive number and extent of defects, resulting in a future life well beyond 20-years and with no or very low maintenance demand in the next 20-years for those replaced deck areas. Deck replacement (or sections thereof) represents major works which would require further detailed assessment and design. This might be difficult to achieve given the absence of as-built drawings for the structure.

The costs associated with Option C (£1,575,000) are presented in Table 8.2. Option A is £592,000 and Option B is £1,062,000.

8.6.5 Summary of Actions

The following actions for Option C are compiled below in Table 8.2:

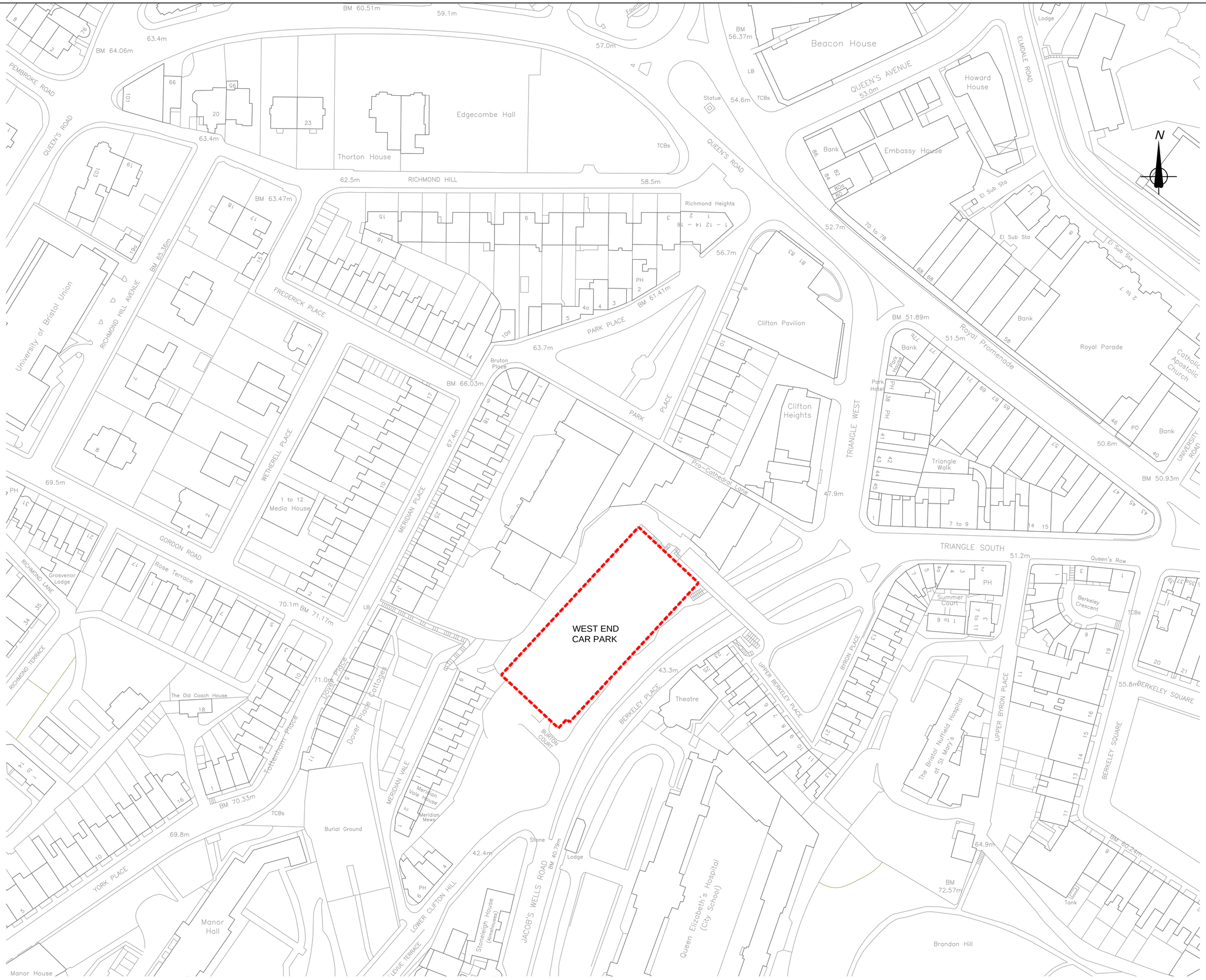
TABLE 8.2
Summary of Maintenance Actions

Item	Priority	Maintenance action	Cost (£)
Item	**Priority**	**Maintenance action**	**Cost (£)**
1	High	Investigations to determine the condition of the spalling concrete framework to the staircase. Access cost included.	£5,500
2	High	Replacement of roof-level expansion joints	£32,000
3	High	Install additional handrailing to stairwells	£5,000
4	High	Thorough refurbishment of the Staircase patent glazing	£18,000
5	High	Thorough repair of the Staircase concrete element defects as seen	£9,500
6	High	Thorough refurbishment of the Staircase brickwork	£6,500
7	High	Application of anti-carbonation coating to the external concrete	£6,000
8	High	Cost of scaffolding access to Staircase externally (for above items)	£7,500

TABLE 8.2
Summary of Maintenance Actions

Item	Priority	Maintenance action	Cost (£)
Item	**Priority**	**Maintenance action**	**Cost (£)**
9	High	Replacement of below roof-level movement joints	£9,000
10	High	Replacement of roofing material to staircases and lift core roofs	£5,000
11	High	Concrete deck replacement Levels 1A, 2B and 2A, plus line marking	£600,000
12	High	Deck concrete repairs	£33,932
13	High	Soffit & upstand concrete repairs	£32,993
14	High	Lining	£14,746
15	High	Install new perimeter vehicle barriers (long elevations)	£179,511
16	High	Install new internal vehicle barriers	£112,199
17	High	Application of high quality deck coatings	£498,078
		Total	**£1,575,459**

Appendix A - Drawings



LOCATION PLAN
NOT TO SCALE

KEY

CAR PARK EXTENTS

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK
CONDITION SURVEY

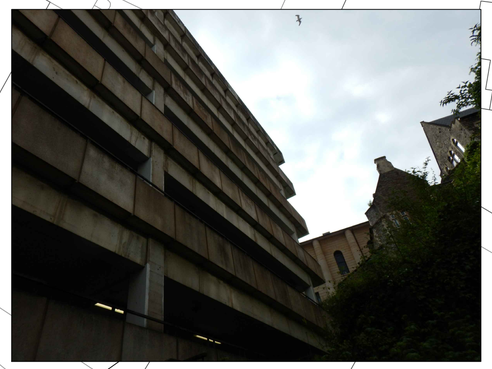
Drawing

WEST END CAR PARK
LOCATION PLAN

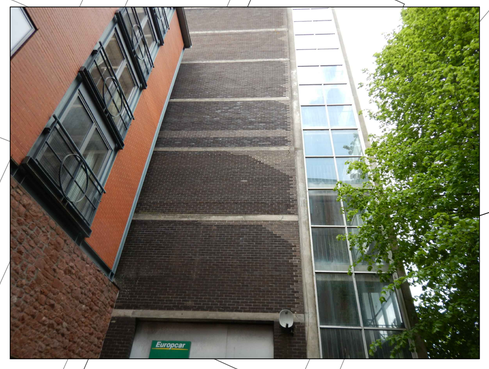
Drawn by: FG	Date: 17/10/17	
Checked by:	Date:	
Approved by:	Date:	
Drawing No. 673846-WE- 000	Status	Revision
Drawing Scale: NOT TO SCALE		

Drawing file path & name \\Swin-fs-061\transportation1\TQMATERIALS\PROJ\AM&EB\CC-MSC\PD\drawings\West End - Location Plan\673846-WE- 000 West End - Location Plan.dwg
Xreference file path \\Swin-fs-061\transportation1\TQMATERIALS\PROJ\AM&EB\CC-MSC\PD\drawings\West End - Location Plan\
User and Plot Date POLAKS - 13.3.2018 - 2:3 pm

NORTH WEST ELEVATION



NORTH EAST ELEVATION



SOUTH WEST ELEVATION

SOUTH EAST ELEVATION

WEST END
CAR PARK

LOCATION PLAN
NOT TO SCALE

KEY

CAR PARK EXTENTS

Rev	By	Chkd	App	Date	Description

Client

Bristol City Council

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK
CONDITION SURVEY

Drawing

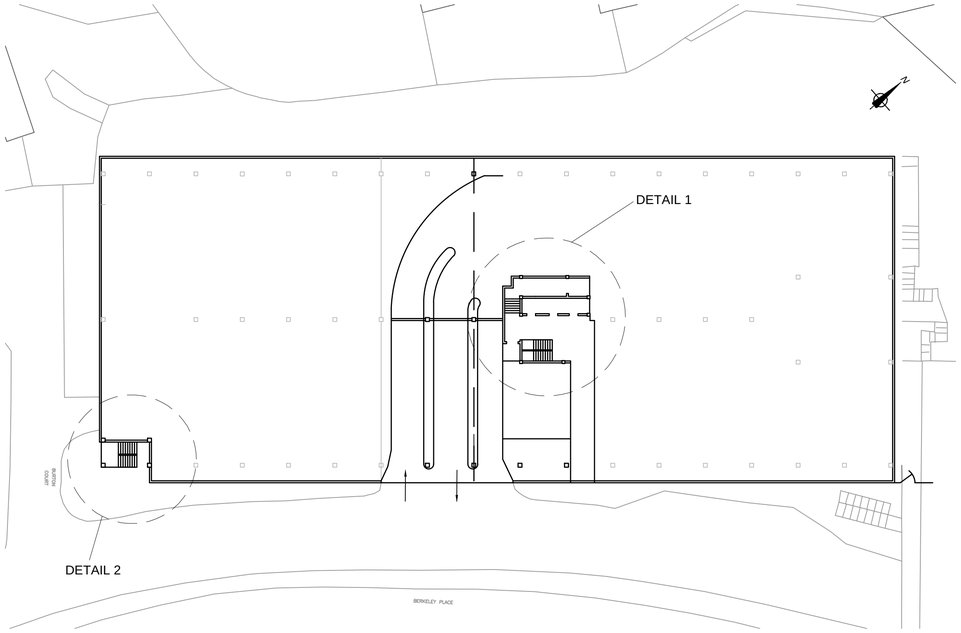
WEST END CAR PARK
SITE PLAN

Drawn by:	FG	Date:	17/11/17
Checked by:		Date:	
Approved by:		Date:	

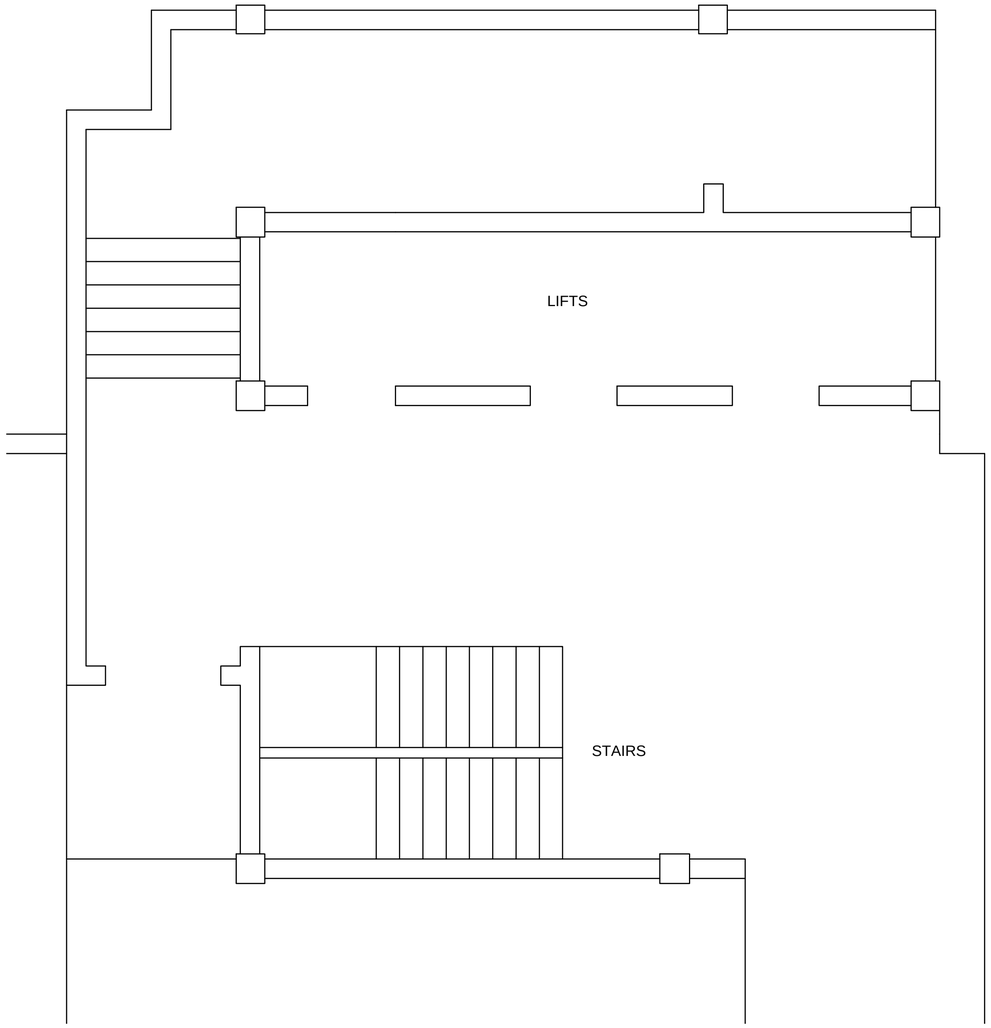
Drawing No.	Status	Revision
673846-WE- 001		

Drawing Scale: NOT TO SCALE

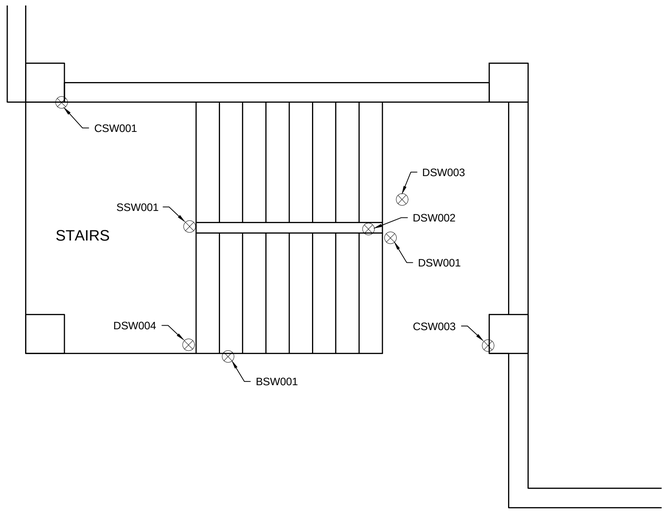
Drawing file path & name: \\Swin-fs-06\Transportation\TQ\MATERIALS\PROJ\AMEB\CC-MSCP\Drawings\West End - Location Plan\673846-WE - 001 West End - Location Plan - Site Plan.dwg
Xreference file path: \\Swin-fs-06\Transportation\TQ\MATERIALS\PROJ\AMEB\CC-MSCP\Drawings\West End - Location Plan
User and Plot Date: POLAKS - 13.3.2018 - 2:3 pm



LEVEL 0 FLOOR PLAN
NOT TO SCALE



DETAIL 1
NOT TO SCALE



DETAIL 2
NOT TO SCALE

CONCRETE REPAIR SCHEDULE - BEAM- STAIR WELLS		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
BSW001	200	100

CONCRETE REPAIR SCHEDULE - COLUMN- STAIR WELLS		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
CSW001	300	200
CSW002	200	100
CSW003	600	100

CONCRETE REPAIR SCHEDULE - SOFIT- STAIR WELLS		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
SSW001	200	100

CONCRETE REPAIR SCHEDULE - DECK- STAIR WELLS		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
DSW001	250	250
DSW002	300	100
DSW003	200	200
DSW004	300	200

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK CONDITION SURVEY

Drawing

WEST END CAR PARK LEVEL 0 STAIRCASE DEFECTS LOCATION

Drawn by: SP Date: 13/03/18
Checked by: Date:
Approved by: Date:

Drawing No. 673846-WE- 101
Status
Revision

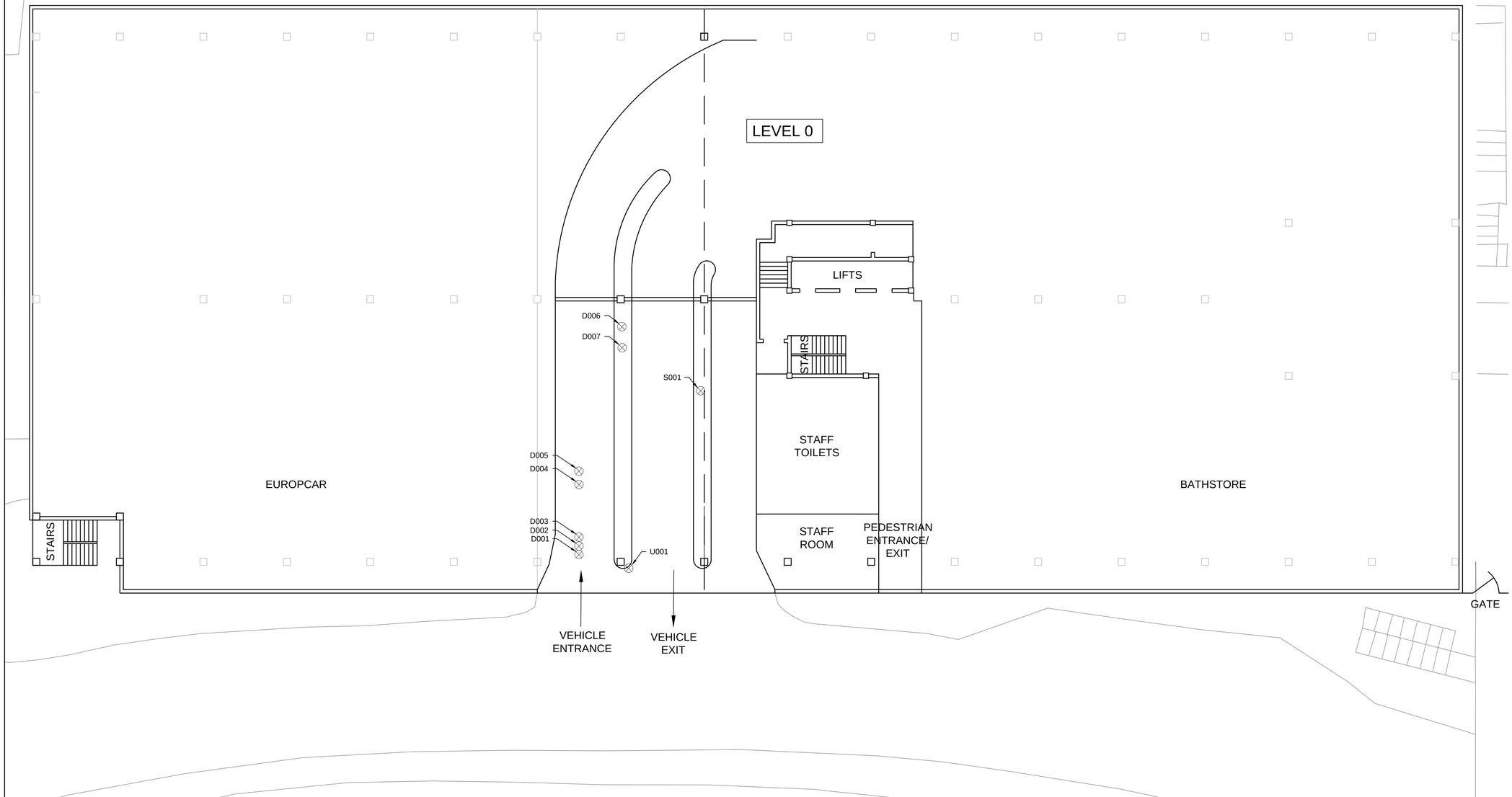
Drawing Scale: NOT TO SCALE

Drawing file path & name: \\Sws-fs-06\Transportation\TQM\TERRALS\PROJ\AM&E\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 101 West End Level 0 Staircase Defects.dwg
Xreference file path: \\Sws-fs-06\Transportation\TQM\TERRALS\PROJ\AM&E\BCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date: POLAKS - 13.3.2018 - 2:3 pm

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 0		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D001	500	200
D002	400	300
D003	200	200
D004	200	200
D005	250	150
D006	400	500
D007	500	200

CONCRETE REPAIR SCHEDULE - UPSTAND- LEVEL 0			
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)
U001	450	500	200

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 0		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S001	400	300



LEVEL 0 ENTRANCE/ EXIT FLOOR PLAN

NOT TO SCALE

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK CONDITION SURVEY

Drawing

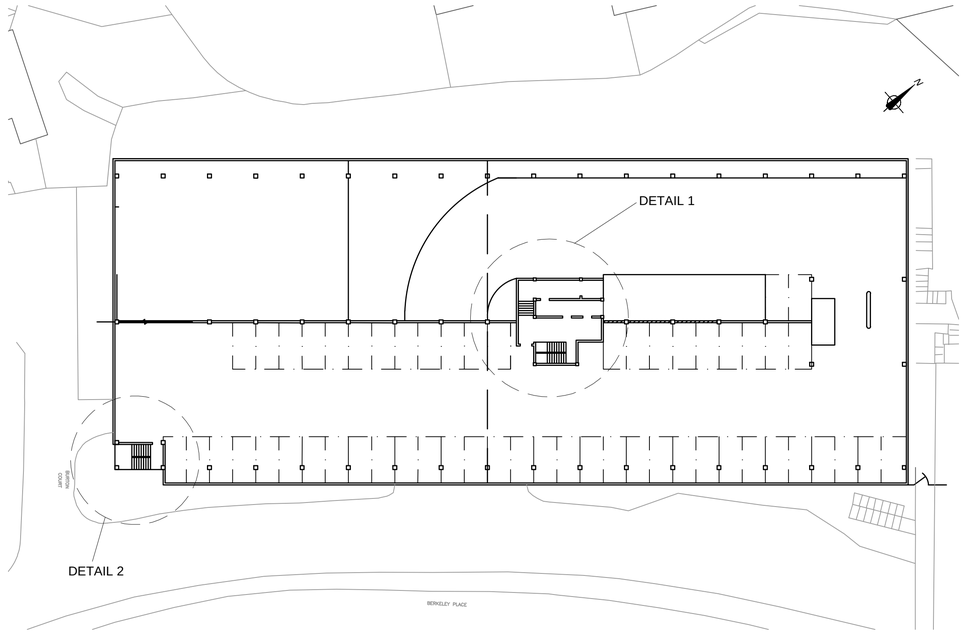
WEST END CAR PARK LEVEL 0 - ENTRANCE / EXIT DEFECTS LOCATION

Drawn by:	FG	Date:	16/10/17
Checked by:		Date:	
Approved by:		Date:	

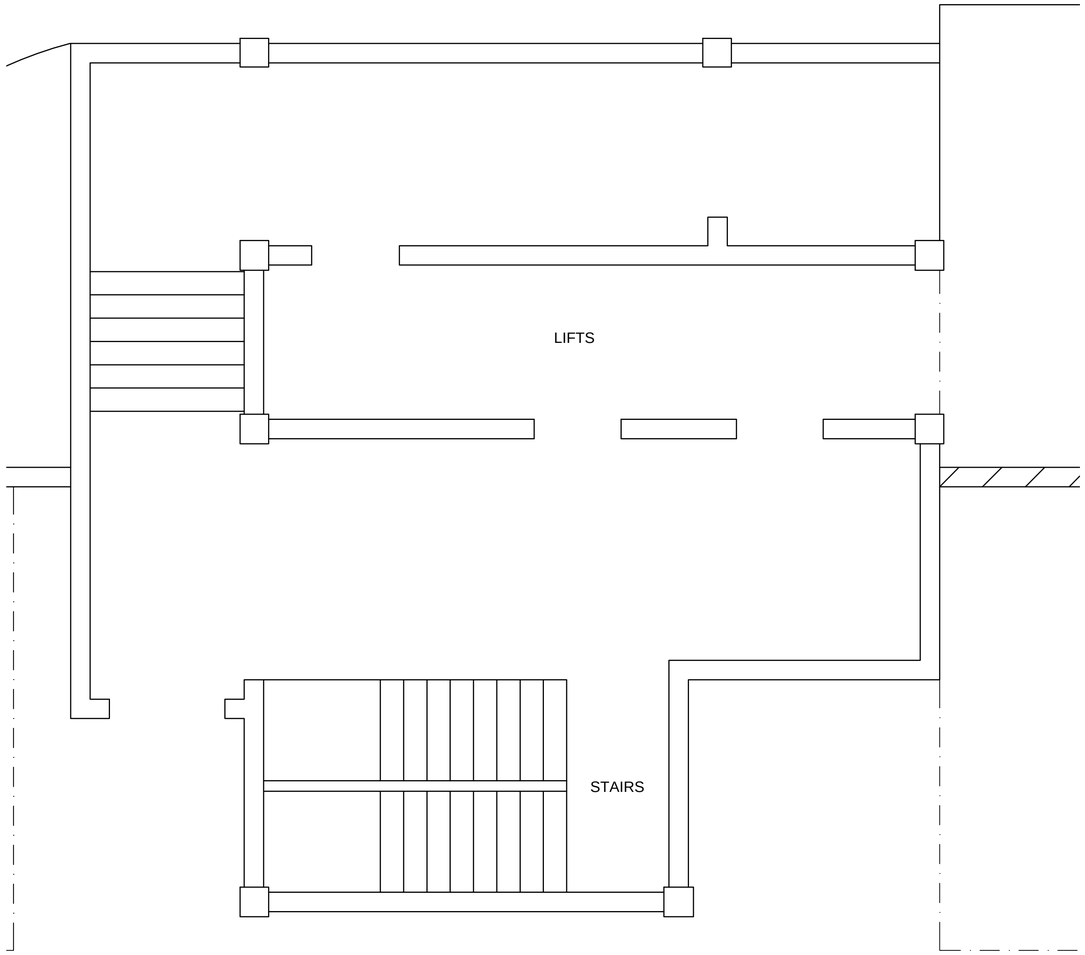
Drawing No.	Status	Revision
673846-WE- 102		

Drawing Scale: NOT TO SCALE

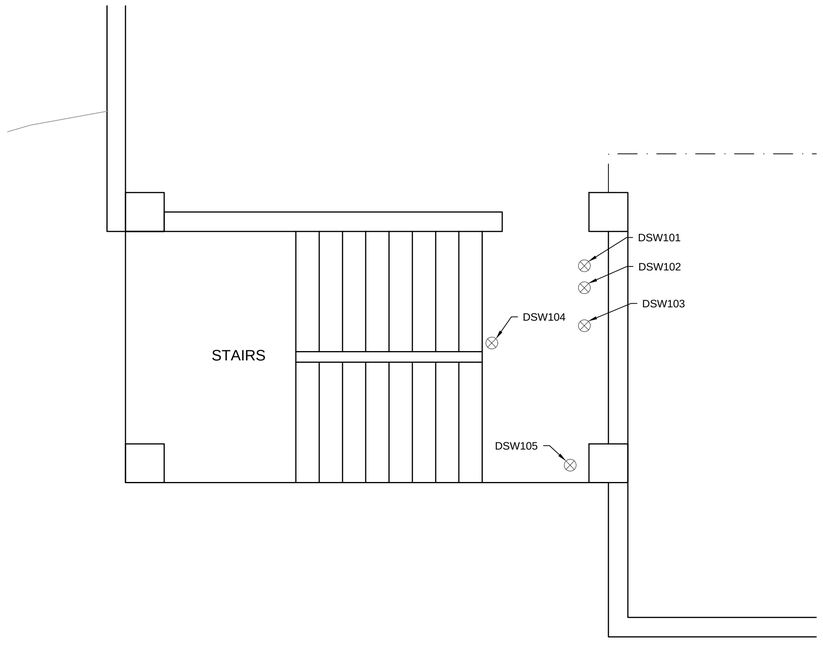
Drawing file path & name: \\Swin-fs-06\Transportation\TQM\TERIALS\PROJ\AMEE\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 102 West End Level 0 Entrance Exit Defects.dwg
Xreference file path: \\Swin-fs-06\Transportation\TQM\TERIALS\PROJ\AMEE\BCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date: POLAKS - 13.3.2018 - 2:3 pm



LEVEL 0-1B FLOOR PLAN
NOT TO SCALE



DETAIL 1
NOT TO SCALE



DETAIL 2
NOT TO SCALE

CONCRETE REPAIR SCHEDULE - DECK- STAIR WELLS		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
DSW101	300	200
DSW102	400	200
DSW103	250	250
DSW104	150	150
DSW105	100	50

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK
CONDITION SURVEY

Drawing

WEST END CAR PARK
LEVEL 0 - 1B
STAIRCASE
DEFECTS LOCATION

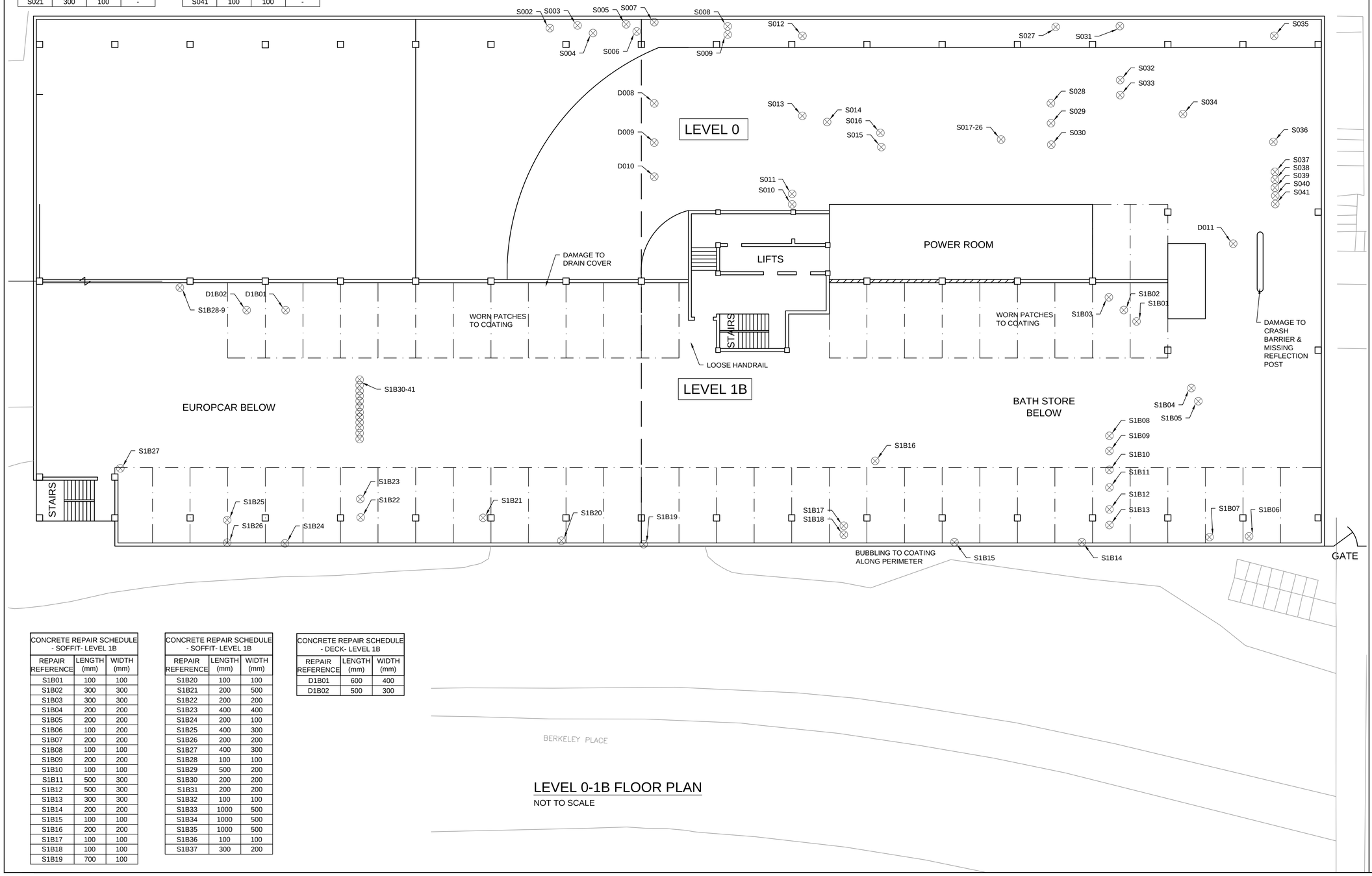
Drawn by: FG	Date: 16/10/17	
Checked by:	Date:	
Approved by:	Date:	
Drawing No. 673846-WE- 103	Status	Revision
Drawing Scale: NOT TO SCALE		

Drawing file path & name \\Swin-fs-06\Transportation\TQMATERIALS\PROJ\AM&E\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 103 West End Level 0-1B Staircase Defects.dwg
Xreference file path \\Swin-fs-06\Transportation\TQMATERIALS\PROJ\AM&E\BCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date POLAKS - 13.3.2018 - 2:3 pm

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 0			
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)
S002	400	300	-
S003	500	200	-
S004	600	500	-
S005	500	200	-
S006	100	100	-
S007	300	200	-
S008	100	100	-
S009	100	100	-
S010	800	200	-
S011	300	200	-
S012	800	500	-
S013	800	500	-
S014	400	300	-
S015	100	100	100
S016	100	100	-
S017	300	100	100
S018	200	200	-
S019	300	100	-
S020	300	100	-
S021	300	100	-

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 0			
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)
S022	300	100	-
S023	300	100	-
S024	100	100	-
S025	100	100	-
S026	100	100	-
S027	700	100	-
S028	700	200	-
S029	200	200	-
S030	100	100	-
S031	100	200	-
S032	200	200	-
S033	100	100	-
S034	200	100	-
S035	100	100	-
S036	300	200	-
S037	200	200	-
S038	100	100	-
S039	100	100	-
S040	100	100	-
S041	100	100	-

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 0		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D008	200	250
D009	200	200
D010	200	150
D011	500	250



LEVEL 0-1B FLOOR PLAN

NOT TO SCALE

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 1B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S1B01	100	100
S1B02	300	300
S1B03	300	300
S1B04	200	200
S1B05	200	200
S1B06	100	200
S1B07	200	200
S1B08	100	100
S1B09	200	200
S1B10	100	100
S1B11	500	300
S1B12	500	300
S1B13	300	300
S1B14	200	200
S1B15	100	100
S1B16	200	200
S1B17	100	100
S1B18	100	100
S1B19	700	100

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 1B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S1B20	100	100
S1B21	200	500
S1B22	200	200
S1B23	400	400
S1B24	200	100
S1B25	400	300
S1B26	200	200
S1B27	400	300
S1B28	100	100
S1B29	500	200
S1B30	200	200
S1B31	200	200
S1B32	100	100
S1B33	1000	500
S1B34	1000	500
S1B35	1000	500
S1B36	100	100
S1B37	300	200

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 1B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D1B01	600	400
D1B02	500	300

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK CONDITION SURVEY

Drawing

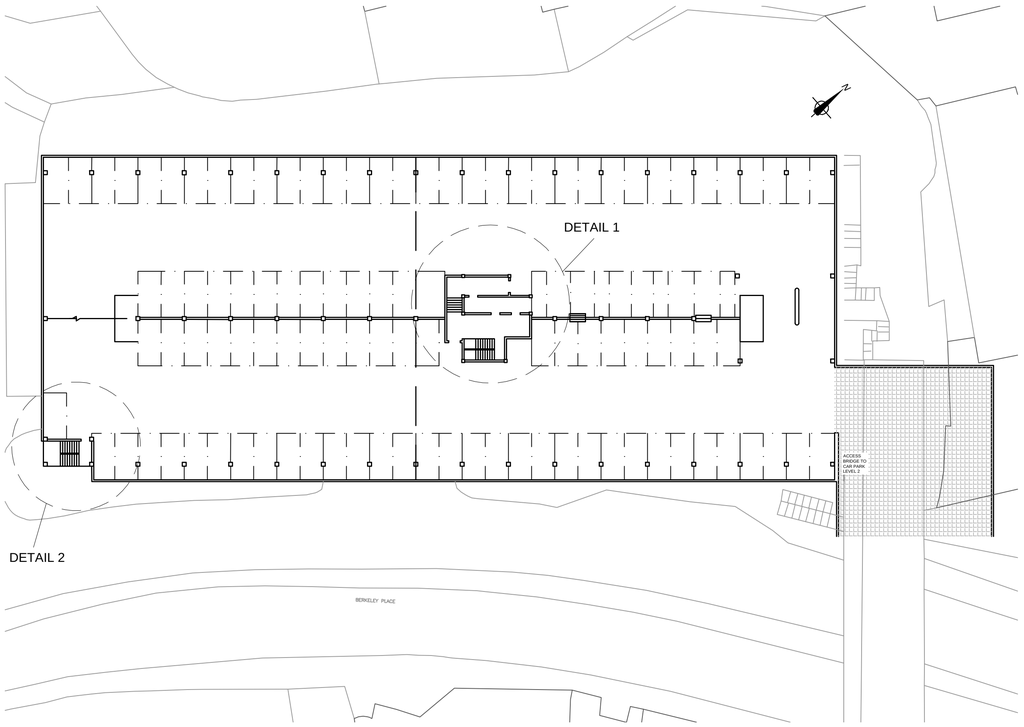
WEST END CAR PARK LEVEL 0 - 1B DEFECTS LOCATION

Drawn by:	FG	Date:	16/10/17
Checked by:		Date:	
Approved by:		Date:	

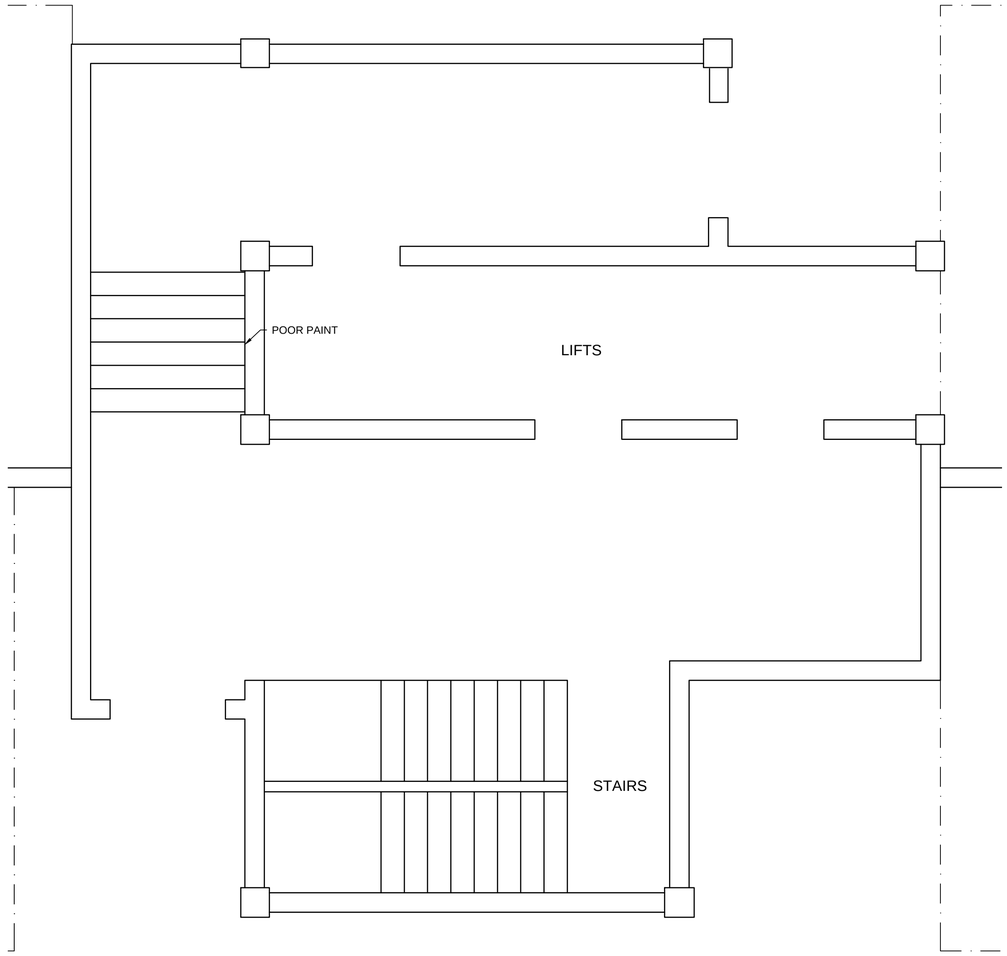
Drawing No.	Status	Revision
673846-WE- 104		

Drawing Scale: NOT TO SCALE

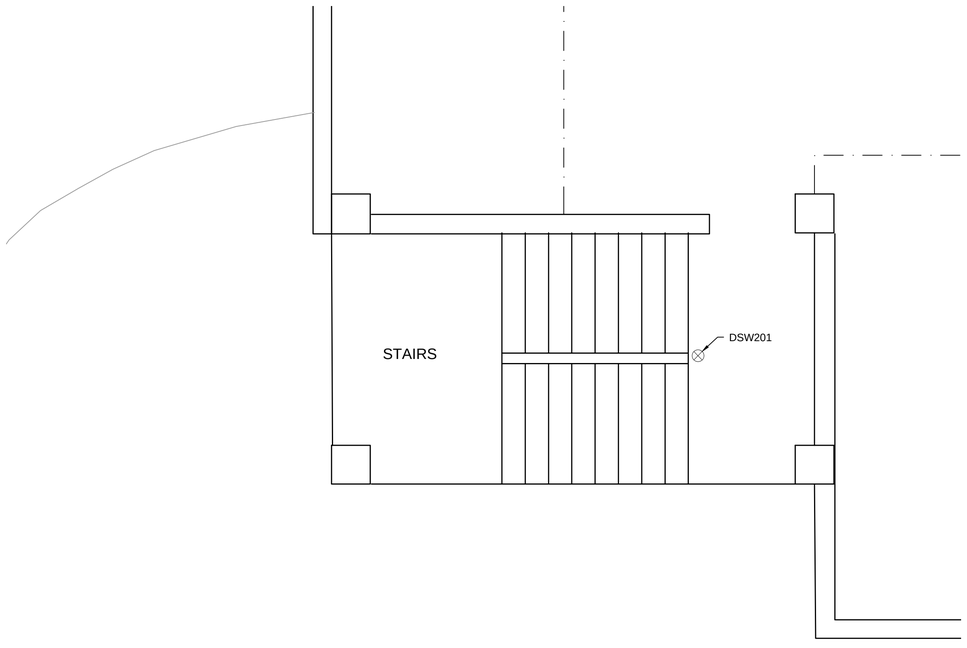
Drawing file path & name: \\Svsh-fs-06\Transportation\TQM\TERALS\PROJ\AMEB\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 104 West End Level 0-1B Defects.dwg
Xreference file path: \\Svsh-fs-06\Transportation\TQM\TERALS\PROJ\AMEB\BCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date: POLAKS - 13.3.2018 - 2:3 pm



LEVEL 1A-2B FLOOR PLAN
NOT TO SCALE



DETAIL 1
NOT TO SCALE



DETAIL 2
NOT TO SCALE

CONCRETE REPAIR SCHEDULE - DECK- STAIR WELLS		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
DSW201	200	100

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK
CONDITION SURVEY

Drawing

WEST END CAR PARK
LEVEL 1A - 2B
STAIRCASE
DEFECTS LOCATION

Drawn by: FG	Date: 16/10/17
Checked by:	Date:
Approved by:	Date:

Drawing No.	Status	Revision
673846-WE- 105		

Drawing Scale: NOT TO SCALE

Drawing file path & name: \\Swin-fs-06\Transportation\TQMATERIALSPROJ\AM&EBCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 105 West End Level 1A-2B Staircase Defects.dwg
Xreference file path: \\Swin-fs-06\Transportation\TQMATERIALSPROJ\AM&EBCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date: POLAKS , 13.3.2018 - 2:3 pm

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 1A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D1A01	500	1200
D1A02	650	650
D1A03	500	400
D1A04	300	250
D1A05	400	300
D1A06	1000	500
D1A07	400	300
D1A08	300	200
D1A09	600	900
D1A10	250	200
D1A11	200	200
D1A12	350	300
D1A13	200	150
D1A14	250	400
D1A15	200	150
D1A16	1200	500
D1A17	900	700

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 1A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D1A18	750	1150
D1A19	200	250
D1A20	900	350
D1A21	400	500
D1A22	600	1000
D1A23	100	100
D1A24	500	400
D1A25	2500	150
D1A26	650	250
D1A27	900	300
D1A28	500	500
D1A29	650	200
D1A30	500	200
D1A31	500	300
D1A32	400	200
D1A33	500	250
D1A34	500	300

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 1A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D1A35	750	600
D1A36	1000	650
D1A37	1000	800
D1A38	300	200
D1A39	500	200
D1A40	300	150
D1A41	450	400
D1A42	500	350
D1A43	700	150
D1A44	200	300
D1A45	900	600
D1A46	150	200
D1A47	250	200
D1A48	700	350
D1A49	500	400
D1A50	400	500
D1A51	1200	1300

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 1A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D1A52	1600	500
D1A53	800	500
D1A54-A	1800	600
D1A154-B	1600	900
D1A154-C	1400	200
D1A55	400	200
D1A56	100	100
D1A57	800	800
D1A58	600	200
D1A59	400	350
D1A60	350	300
D1A61	400	300
D1A62	500	400
D1A63	600	200
D1A64	350	500
D1A65	500	450
D1A66	250	200
D1A67	450	400

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 1A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D1A68	900	400
D1A69	1000	500
D1A70	1700	600
D1A71	700	600
D1A72	700	500
D1A73	900	700
D1A74	1000	800
D1A75	2600	600
D1A76	1100	650
D1A77	900	500
D1A78	300	400
D1A79	1400	700
D1A80	2400	1700
D1A81	250	200
D1A82	600	200
D1A83	500	200

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 1A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D1A84	600	400
D1A85	300	200
D1A86	700	800
D1A87	2000	1200
D1A88	800	900
D1A89	600	250
D1A90	600	200
D1A91	500	200
D1A92	500	200
D1A93	550	300
D1A94	350	500
D1A95	500	450
D1A96	250	200
D1A97	1100	450
D1A98	800	300
D1A99	1000	650
D1A100	1000	450

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 1A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D1A101	1600	400
D1A102	1300	900
D1A103	800	600
D1A104	700	200
D1A105	150	100
D1A106	600	350
D1A107	800	350
D1A108	500	600
D1A109	700	100
D1A110	300	200
D1A111	600	500
D1A112	700	500
D1A113	800	300
D1A114	900	600
D1A115	200	200
D1A116	300	200
D1A117	800	200

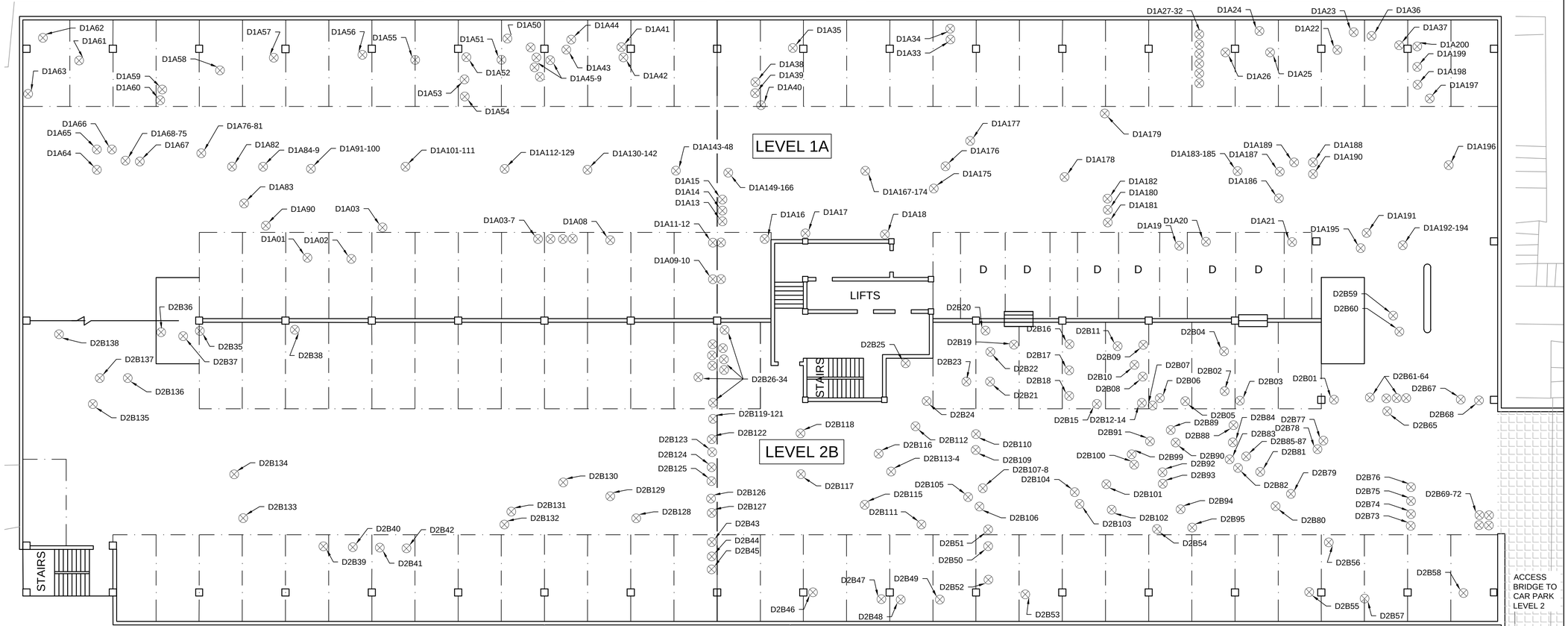
CONCRETE REPAIR SCHEDULE - DECK- LEVEL 1A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D1A118	300	200
D1A119	800	300
D1A120	300	200
D1A121	400	300
D1A124	500	100
D1A125	200	300
D1A126	400	300
D1A127	800	1000
D1A128	300	300
D1A129	200	200
D1A130	200	200
D1A131	300	200
D1A132	400	500
D1A133	400	200
D1A134	300	200
D1A135	400	200
D1A136	200	200

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 1A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D1A137	100	200
D1A138	900	300
D1A139	700	700
D1A140	900	400
D1A141	900	500
D1A142	400	150
D1A143	900	300
D1A144	600	300
D1A145	200	400
D1A146	400	400
D1A147	400	400
D1A148	600	300
D1A149	300	200
D1A150	200	100
D1A151	500	500
D1A152	300	200
D1A153	400	300

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 1A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D1A154	100	100
D1A155	100	100
D1A156	500	300
D1A157	500	300
D1A158	700	300
D1A159	400	200
D1A160	700	300
D1A161	300	300
D1A162	1300	1600
D1A163	200	200
D1A164	500	300
D1A165	600	400
D1A166	900	400
D1A167	500	1500
D1A168	400	600
D1A169	300	200
D1A170	100	100

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 1A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D1A171	1000	400
D1A172	600	900
D1A173	700	300
D1A174	600	300
D1A175	500	200
D1A176	600	200
D1A177	400	300
D1A178	600	900
D1A179	200	200
D1A180	700	200
D1A181	600	200
D1A182	400	200
D1A183	400	600
D1A184	2500	900
D1A185	800	900
D1A186	500	300
D1A187	300	200

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 1A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D1A188	1100	800
D1A189	1200	300
D1A190	600	700
D1A191	600	300
D1A192	1700	700
D1A193	2200	1600
D1A194	900	500
D1A195	500	500
D1A196	600	900
D1A197	400	200
D1A198	200	300
D1A199	400	300
D1A200	200	200



LEVEL 1A-2B FLOOR PLAN

NOT TO SCALE

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 2B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D2B01	600	700
D2B02	2100	800
D2B03	700	600
D2B04	900	700
D2B05	300	1300
D2B06	600	300
D2B07	500	300
D2B08	800	200
D2B09	800	500
D2B10	1200	900
D2B11	800	600
D2B12	1200	300
D2B13	500	300
D2B14	300	200
D2B15	600	500
D2B16	600	600
D2B17	400	300
D2B18	400	300
D2B19	400	400
D2B20	1000	900
D2B21	700	500
D2B22	1100	1700
D2B23	1900	1200
D2B24	300	400
D2B25	900	150
D2B26	400	500
D2B27	100	200
D2B28	300	200
D2B29	800	400
D2B30	200	300

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 2B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D2B31	800	600
D2B32	700	400
D2B33	300	100
D2B34	1000	300
D2B35	300	400
D2B36	500	600
D2B37	500	100
D2B38	700	700
D2B39	600	400
D2B40	500	400
D2B41	400	500
D2B42	400	500
D2B43	300	200
D2B44	200	100
D2B45	800	300
D2B46	900	1000
D2B47	1100	900
D2B48	1600	400
D2B49	600	400
D2B50	500	800
D2B51	1100	400
D2B52	600	400
D2B53	700	200
D2B54	600	300
D2B55	700	300
D2B56	400	400
D2B57	300	300
D2B58	300	300
D2B59	2900	1000

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 2B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D2B61	800	800
D2B62	600	600
D2B63	700	500
D2B64	1500	1000
D2B65	600	500
D2B66	200	100
D2B67	2500	800
D2B68	500	600
D2B69	200	100
D2B70	200	100
D2B71	300	200
D2B72	300	200
D2B73	700	700
D2B74	300	200
D2B75	300	200
D2B76	300	300
D2B77	1100	400
D2B78	300	200
D2B79	800	300
D2B80	800	300
D2B81	800	400
D2B82	600	300
D2B83	700	200
D2B84	200	100
D2B85	1100	600
D2B86	600	500
D2B87	300	400
D2B88	1300	1200
D2B89	100	400
D2B90	300	300

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 2B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D2B91	600	200
D2B92	900	900
D2B93	200	200
D2B94	400	500
D2B95	600	200
D2B96	400	800
D2B97	600	300
D2B98	2600	300
D2B99	900	500
D2B100	300	400
D2B101	400	400
D2B102	200	200
D2B103	500	400
D2B104	300	400
D2B105	2600	500
D2B106	700	500
D2B107	700	200
D2B108	800	400
D2B109	900	900
D2B110	2400	1000
D2B111	200	200
D2B112	500	300
D2B113	2200	1800
D2B114	400	500
D2B115	900	1000
D2B116	900	800
D2B117	1400	500
D2B118	1000	500
D2B119	200	200
D2B120	300	300

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 2B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D2B121	200	400
D2B122	900	200
D2B123	1200	500
D2B124	200	300
D2B125	1300	600
D2B126	300	300
D2B127	300	400
D2B128	4500	1200
D2B129	300	300
D2B130	500	400
D2B131	1000	800
D2B132	100	100
D2B133	200	100
D2B134	800	500
D2B135	1400	400
D2B136	1100	800
D2B137	300	600
D2B138	3300	400

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK
CONDITION SURVEY

Drawing

WEST END CAR PARK
LEVEL 1A - 2B
DECK DEFECTS LOCATION

Drawn by:	FG	Date:	16/10/17
Checked by:		Date:	
Approved by:		Date:	

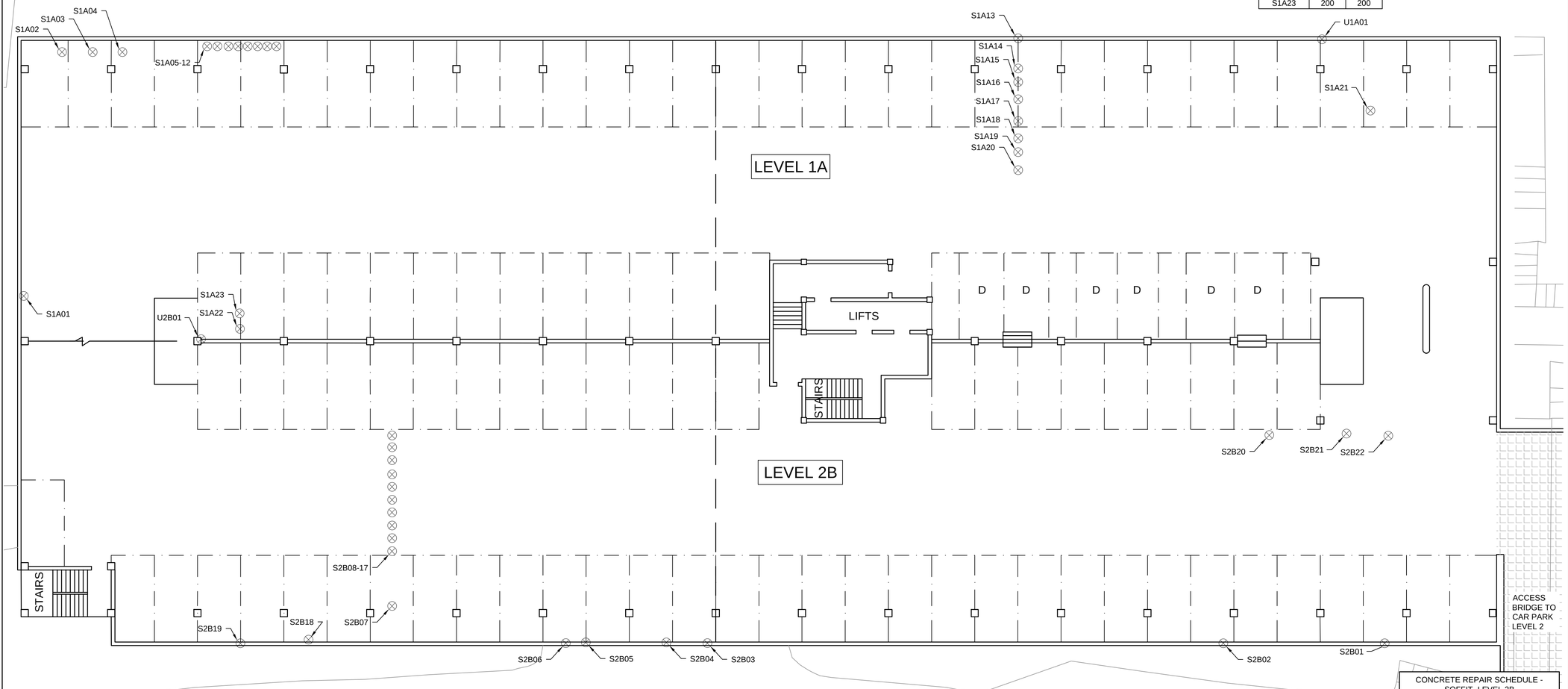
Drawing No.	Status	Revision
673846-WE- 106		

Drawing Scale: NOT TO SCALE

Drawing file path & name: \\Swin-fs-001\Transportation\TO\MATERIALS\PROJ\AMEB\CC-MSCP\Drawings\West End - Floor Plans\ 673846-WE - 106 and 673846-WE - 107 West End Level 1A-2B Defects.dwg
Xreference file path: \\Swin-fs-001\Transportation\TO\MATERIALS\PROJ\AMEB\CC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date: POLAKS - 13.3.2018 - 2:3 pm

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 1A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S1A01	400	200
S1A02	600	300
S1A03	500	200
S1A04	500	200
S1A05	100	200
S1A06	100	200
S1A07	100	300
S1A08	200	100
S1A09	100	100
S1A10	200	200
S1A11	200	400
S1A12	700	200
S1A13	1200	200
S1A14	200	200
S1A15	300	300
S1A16	500	300
S1A17	200	200
S1A18	300	200
S1A19	200	100
S1A20	300	200
S1A21	100	100
S1A22	200	200
S1A23	200	200

CONCRETE REPAIR SCHEDULE - UPSTAND- LEVEL 1A			
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)
U1A01	100	100	100



LEVEL 1A-2B FLOOR PLAN

NOT TO SCALE

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 2B			
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)
S2B01	100	200	100
S2B02	300	200	-
S2B03	300	200	-
S2B04	300	300	-
S2B05	300	400	-
S2B06	200	200	-
S2B07	200	200	-
S2B08	200	200	-
S2B09	300	200	-
S2B10	200	200	-
S2B11	300	200	-
S2B12	200	200	-
S2B13	200	200	-
S2B14	300	300	-
S2B15	100	100	-
S2B16	100	100	-
S2B17	100	100	-
S2B18	200	200	-
S2B19	300	200	-
S2B20	1500	300	-
S2B21	800	400	-
S2B22	2000	300	-

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK CONDITION SURVEY

Drawing

WEST END CAR PARK LEVEL 1A - 2B SOFIT AND UPSTAND DEFECTS LOCATION

Drawn by: FG Date: 16/10/17

Checked by: Date:

Approved by: Date:

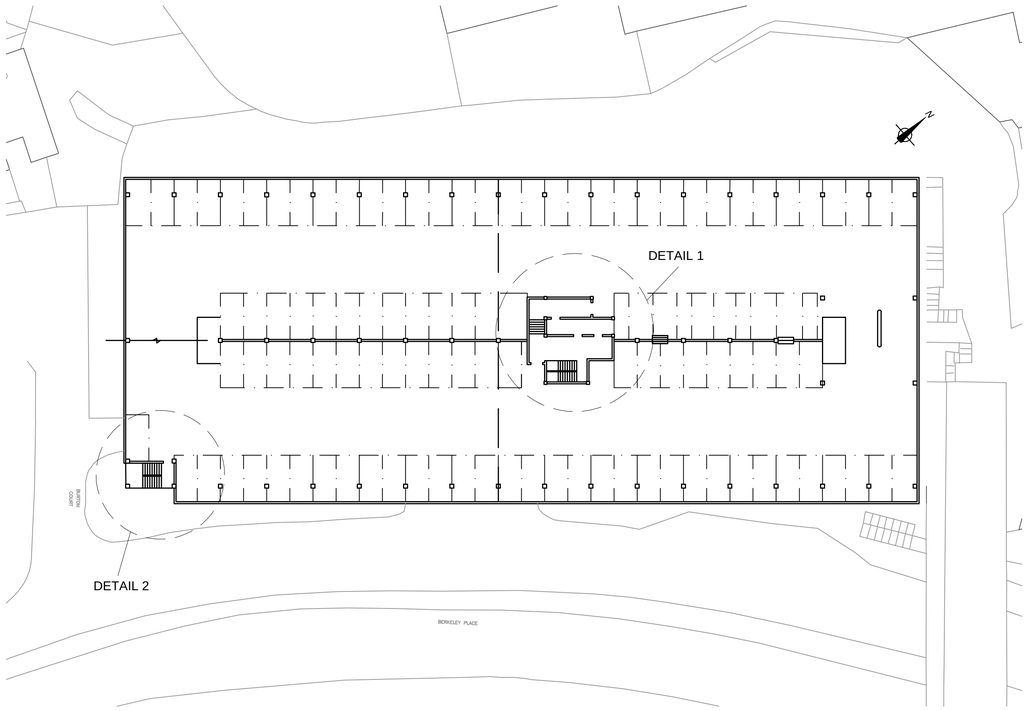
Drawing No. 673846-WE- 107

Status

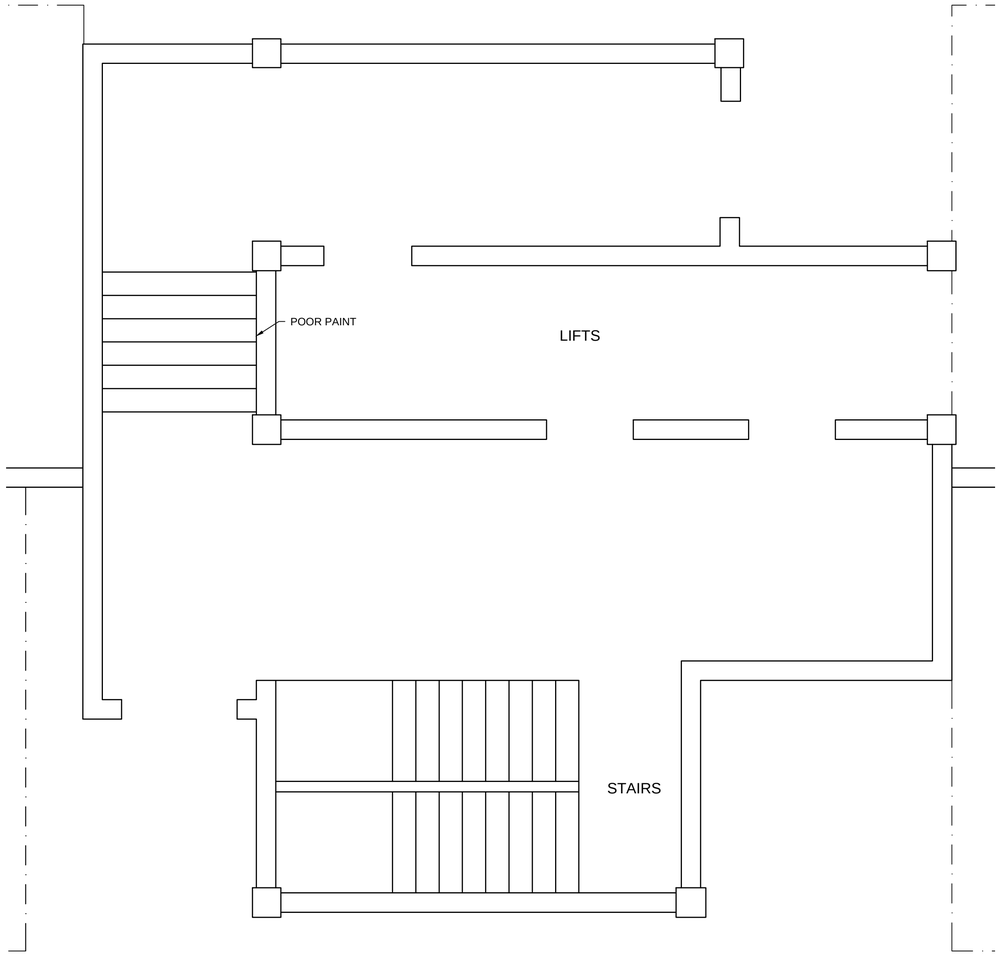
Revision

Drawing Scale: NOT TO SCALE

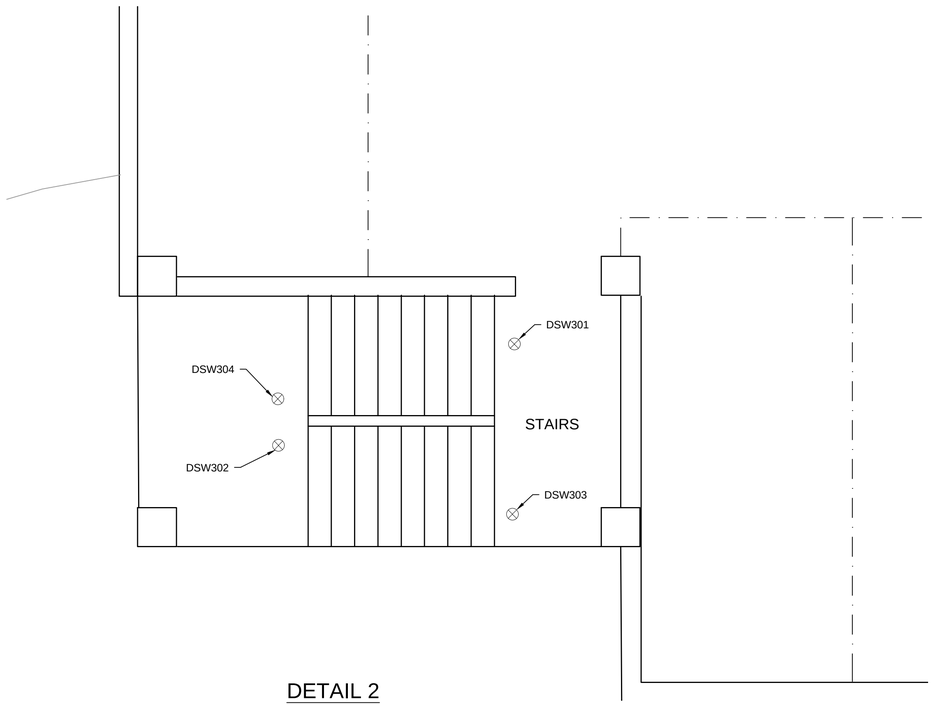
Drawing file path & name: \\Swin-fs-06\Transportation\TQ\MATERIALS\PROJ\AM&E\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 106 and 673846-WE- 107 West End Level 1A-2B Defects.dwg
Xreference file path: \\Swin-fs-06\Transportation\TQ\MATERIALS\PROJ\AM&E\BCC-MSCP\Drawings\West End - Floor Plans\
Date and Plot date: 13/12/2017 2:47 pm



LEVEL 2A-3B FLOOR PLAN
NOT TO SCALE



DETAIL 1
NOT TO SCALE



DETAIL 2
NOT TO SCALE

CONCRETE REPAIR SCHEDULE - DECK- STAIR WELLS		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
DSW301	200	200
DSW302	200	200
DSW303	200	200
DSW304	200	200

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK
CONDITION SURVEY

Drawing

WEST END CAR PARK
LEVEL 2A - 3B
STAIRCASE
DEFECTS LOCATION

Drawn by:	FG	Date:	16/10/17
Checked by:		Date:	
Approved by:		Date:	

Drawing No.	Status	Revision
673846-WE- 108		

Drawing Scale: NOT TO SCALE

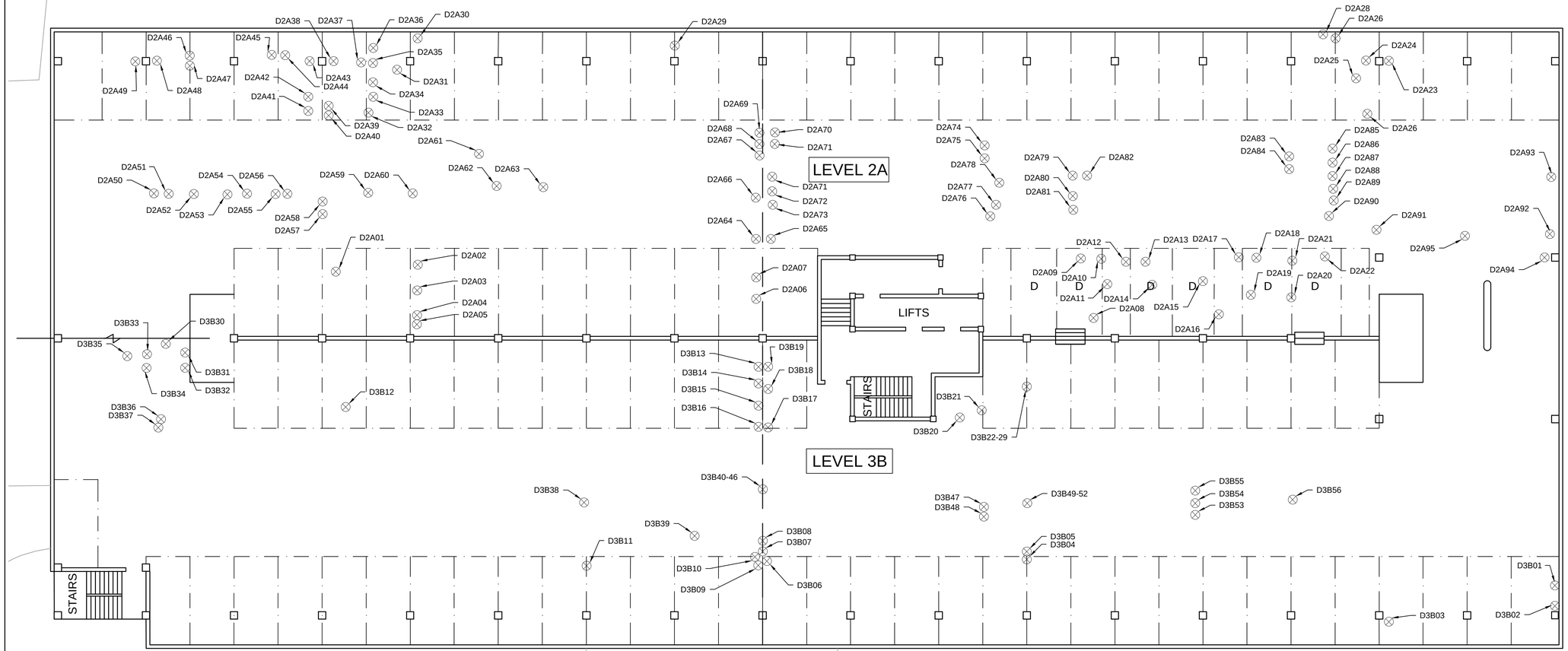
Drawing file path & name: \\Svwn-fs-06\Transportation\TQMATERIALS\PROJ\AMEB\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 108 West End Level 2A-3B Staircase Defects.dwg
Xreference file path: \\Svwn-fs-06\Transportation\TQMATERIALS\PROJ\AMEB\BCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date: POLAK'S - 13.3.2018 - 2:3 pm

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 2A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D2A01	1200	500
D2A02	200	300
D2A03	500	400
D2A04	600	300
D2A05	300	300
D2A06	400	300
D2A07	100	100
D2A08	700	400
D2A09	600	500
D2A10	900	900
D2A11	600	500
D2A12	500	500
D2A13	700	400
D2A14	900	500
D2A15	900	700
D2A16	500	500
D2A17	500	400
D2A18	500	600
D2A19	300	400
D2A20	800	600
D2A21	400	400
D2A22	300	300
D2A23	900	600
D2A24	900	600
D2A25	300	300

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 2A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D2A26	500	500
D2A27	1400	300
D2A28	400	400
D2A29	100	200
D2A30	400	300
D2A31	400	400
D2A32	300	300
D2A33	800	500
D2A34	600	600
D2A35	2900	1000
D2A36	700	900
D2A37	1000	900
D2A38	300	200
D2A39	700	700
D2A40	400	400
D2A41	900	800
D2A42	900	500
D2A43	1200	900
D2A44	1200	800
D2A45	1300	1000
D2A46	600	400
D2A47	600	200
D2A48	1500	900
D2A49	600	400
D2A50	900	400

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 2A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D2A51	500	400
D2A52	500	500
D2A53	400	400
D2A54	300	300
D2A55	900	300
D2A56	400	800
D2A57	900	500
D2A58	1200	900
D2A59	1000	400
D2A60	1000	1000
D2A61	400	400
D2A62	800	700
D2A63	100	200
D2A64	300	200
D2A65	200	200
D2A66	300	100
D2A67	300	200
D2A68	300	200
D2A69	100	100
D2A70	300	300
D2A71	700	500
D2A72	500	100
D2A73	700	600
D2A74	200	200
D2A75	1200	600

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 2A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D2A76	250	250
D2A77	1500	800
D2A78	200	200
D2A79	900	700
D2A80	500	300
D2A81	400	200
D2A82	1000	900
D2A83	300	300
D2A84	200	200
D2A85	500	300
D2A86	400	400
D2A87	200	200
D2A88	400	300
D2A89	400	300
D2A90	500	600
D2A91	700	500
D2A92	1300	300
D2A93	800	400
D2A94	800	600
D2A95	500	400



CONCRETE REPAIR SCHEDULE - DECK- LEVEL 3B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D3B01	100	200
D3B02	900	500
D3B03	800	300
D3B04	1200	600
D3B05	700	300
D3B06	150	1200
D3B07	200	400
D3B08	400	300
D3B09	200	300
D3B10	300	200
D3B11	600	500
D3B12	600	400
D3B13	300	500
D3B14	200	200
D3B15	400	250
D3B16	200	200
D3B17	500	600
D3B18	600	600
D3B19	900	500
D3B20	300	200
D3B21	200	200

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 3B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D3B22	700	600
D3B23	1200	600
D3B24	400	300
D3B25	1000	200
D3B26	1200	300
D3B27	900	300
D3B28	400	800
D3B29	500	300
D3B30	400	500
D3B31	900	200
D3B32	200	200
D3B33	200	100
D3B34	400	200
D3B35	100	100
D3B36	500	300
D3B37	200	200
D3B38	700	500
D3B39	300	200
D3B40	500	300
D3B41	3500	600
D3B42	3000	300

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 3B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D3B43	400	300
D3B44	200	200
D3B45	300	200
D3B46	400	200
D3B47	200	200
D3B48	100	200
D3B49	400	400
D3B50	200	300
D3B51	300	300
D3B52	200	100
D3B53	200	300
D3B54	200	300
D3B55	200	200
D3B56	300	200

LEVEL 2A-3B FLOOR PLAN

NOT TO SCALE

BERKELEY PLACE

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK CONDITION SURVEY

Drawing

WEST END CAR PARK LEVEL 2A - 3B DECK DEFECTS LOCATION

Drawn by:	FG	Date: 16/10/17
Checked by:		Date:
Approved by:		Date:

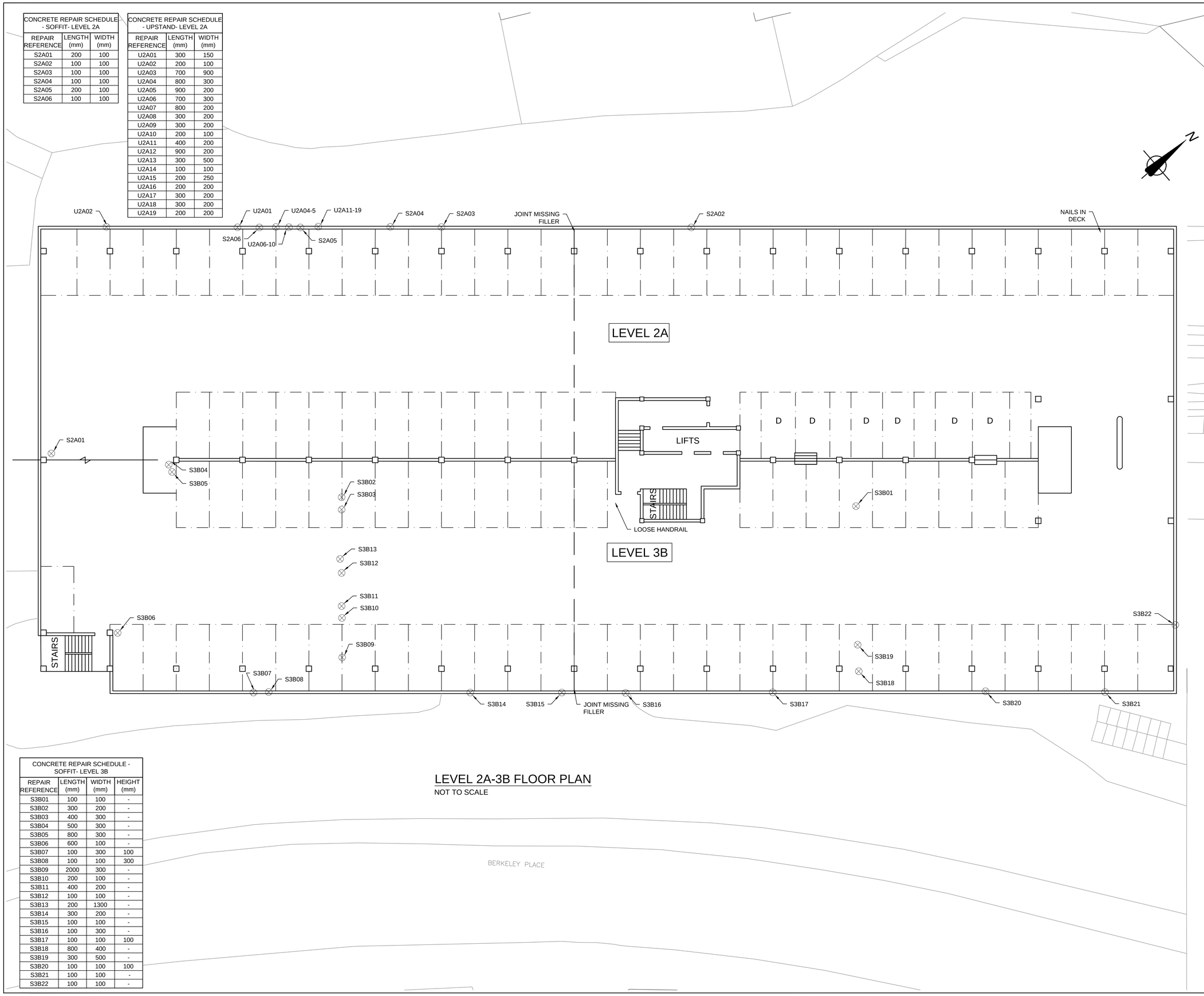
Drawing No.	Status	Revision
673846-WE- 109		

Drawing Scale: NOT TO SCALE

Drawing file path & name: \\Swin-fs-06\Transportation\TQMATERIALS\PROJ\AM&E\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 109 and 673846-WE- 110 West End Level 2A-3B Defects.dwg
Xreference file path: \\Swin-fs-06\Transportation\TQMATERIALS\PROJ\AM&E\BCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date: POLAKS - 13.3.2018 - 2:3 pm

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 2A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S2A01	200	100
S2A02	100	100
S2A03	100	100
S2A04	100	100
S2A05	200	100
S2A06	100	100

CONCRETE REPAIR SCHEDULE - UPSTAND- LEVEL 2A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
U2A01	300	150
U2A02	200	100
U2A03	700	900
U2A04	800	300
U2A05	900	200
U2A06	700	300
U2A07	800	200
U2A08	300	200
U2A09	300	200
U2A10	200	100
U2A11	400	200
U2A12	900	200
U2A13	300	500
U2A14	100	100
U2A15	200	250
U2A16	200	200
U2A17	300	200
U2A18	300	200
U2A19	200	200



CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 3B			
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)
S3B01	100	100	-
S3B02	300	200	-
S3B03	400	300	-
S3B04	500	300	-
S3B05	800	300	-
S3B06	600	100	-
S3B07	100	300	100
S3B08	100	100	300
S3B09	2000	300	-
S3B10	200	100	-
S3B11	400	200	-
S3B12	100	100	-
S3B13	200	1300	-
S3B14	300	200	-
S3B15	100	100	-
S3B16	100	300	-
S3B17	100	100	100
S3B18	800	400	-
S3B19	300	500	-
S3B20	100	100	100
S3B21	100	100	-
S3B22	100	100	-

LEVEL 2A-3B FLOOR PLAN

NOT TO SCALE

BERKELEY PLACE

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK CONDITION SURVEY

Drawing

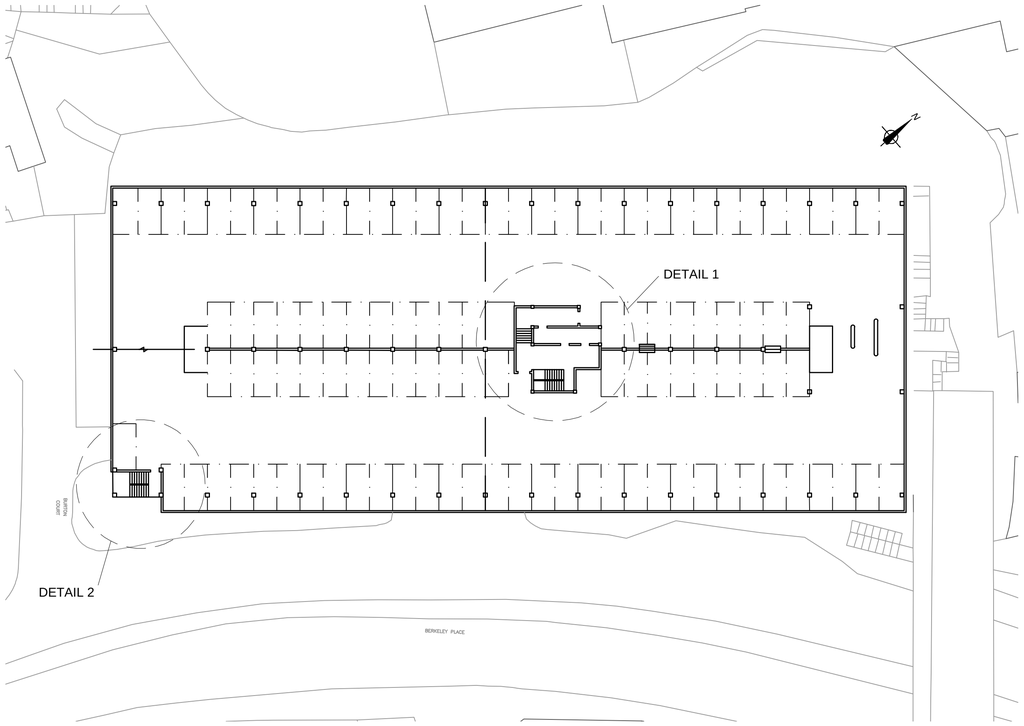
WEST END CAR PARK
LEVEL 2A - 3B
SOFIT AND UPSTAND
DEFECTS LOCATION

Drawn by:	FG	Date: 16/10/17
Checked by:		Date:
Approved by:		Date:

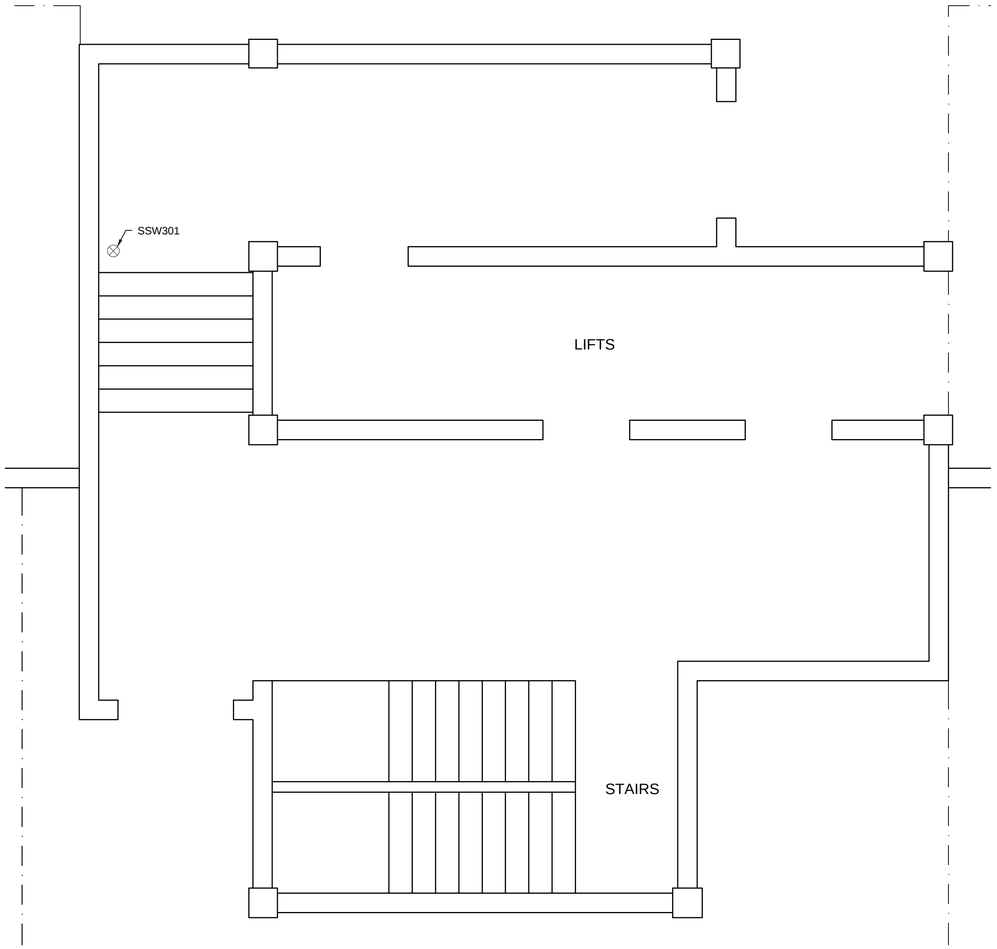
Drawing No.	Status	Revision
673846-WE- 110		

Drawing Scale: NOT TO SCALE

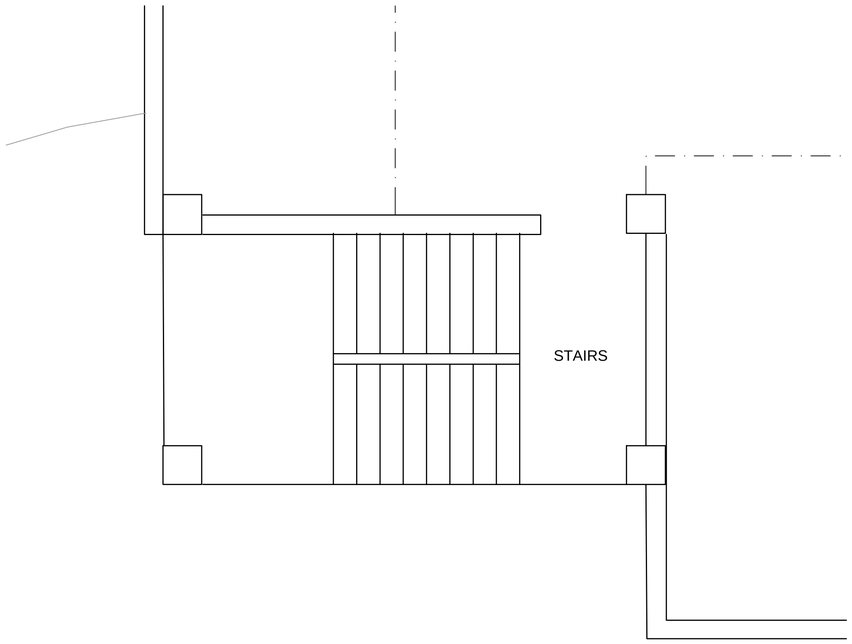
Drawing file path & name: \\Swin-fs-06\Transportation\TQM\TERIALS\PROJ\AMEB\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 109 and 673846-WE- 110 West End Level 2A-3B Defects.dwg
Xreference file path: \\Swin-fs-06\Transportation\TQM\TERIALS\PROJ\AMEB\BCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date: POLAKS - 13.3.2018 - 2:3 pm



LEVEL 3A-4B FLOOR PLAN
NOT TO SCALE



DETAIL 1
NOT TO SCALE



DETAIL 2
NOT TO SCALE

CONCRETE REPAIR SCHEDULE - SOFFIT- STAIR WELLS		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
SSW301	500	200

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK CONDITION SURVEY

Drawing

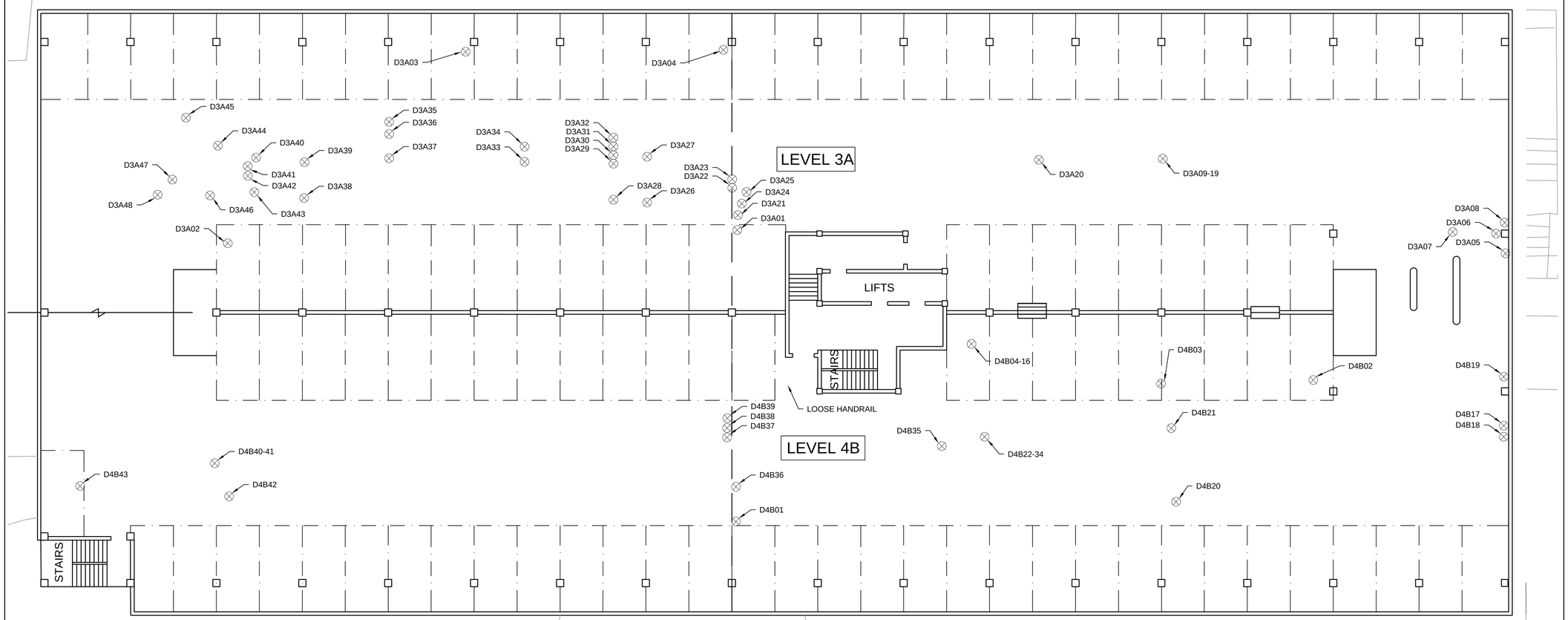
WEST END CAR PARK LEVEL 3A - 4B STAIRCASE DEFECTS LOCATION

Drawn by: FG	Date: 16/10/17	
Checked by:	Date:	
Approved by:	Date:	
Drawing No. 673846-WE- 111	Status	Revision
Drawing Scale: NOT TO SCALE		

Drawing file path & name \\Swin-fs-06\Transportation\TQMATERIALSPROJAM&E\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 111 West End Level 3A-4B Staircase Defects.dwg
Xreference file path \\Swin-fs-06\Transportation\TQMATERIALSPROJAM&E\BCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date POLAKS : 13.3.2018 - 2:3 pm

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 3A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D3A01	200	100
D3A02	200	200
D3A03	700	200
D3A04	500	400
D3A05	400	400
D3A06	300	300
D3A07	200	300
D3A08	300	200
D3A09	200	200
D3A10	800	300
D3A11	800	600
D3A12	300	300
D3A13	400	600
D3A14	400	400
D3A15	300	400
D3A16	200	500
D3A17	400	400
D3A18	1000	300
D3A19	200	200
D3A20	400	400
D3A21	300	200
D3A22	400	200
D3A23	400	1600
D3A24	100	200

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 3A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D3A25	300	200
D3A26	2100	800
D3A27	500	600
D3A28	500	200
D3A29	200	500
D3A30	200	200
D3A31	200	200
D3A32	300	300
D3A33	350	150
D3A34	300	200
D3A35	900	300
D3A36	300	500
D3A37	600	500
D3A38	800	200
D3A39	500	800
D3A40	500	400
D3A41	500	300
D3A42	300	200
D3A43	500	500
D3A44	1100	900
D3A45	1100	400
D3A46	500	500
D3A47	700	400
D3A48	500	600



CONCRETE REPAIR SCHEDULE - DECK- LEVEL 4B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D4B01	700	500
D4B02	300	200
D4B03	600	500
D4B04	1200	200
D4B05	400	200
D4B06	200	300
D4B07	150	200
D4B08	400	300
D4B09	500	700
D4B10	500	600
D4B11	900	400
D4B12	500	400
D4B13	300	200
D4B14	200	100
D4B15	300	200
D4B16	500	200
D4B17	300	300
D4B18	200	300
D4B19	200	300
D4B20	800	450
D4B21	1000	800
D4B22	300	900

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 4B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D4B23	1000	800
D4B24	300	400
D4B25	500	400
D4B26	300	400
D4B27	200	100
D4B28	400	300
D4B29	200	100
D4B30	900	400
D4B31	500	600
D4B32	1300	1000
D4B33	800	500
D4B34	800	300
D4B35	200	300
D4B36	400	300
D4B37	300	200
D4B38	300	300
D4B39	100	200
D4B40	700	800
D4B41	400	300
D4B42	200	500
D4B43	200	300

LEVEL 3A-4B FLOOR PLAN

NOT TO SCALE

BERKELEY PLACE

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK
CONDITION SURVEY

Drawing

WEST END CAR PARK
LEVEL 3A - 4B
DECK DEFECTS LOCATION

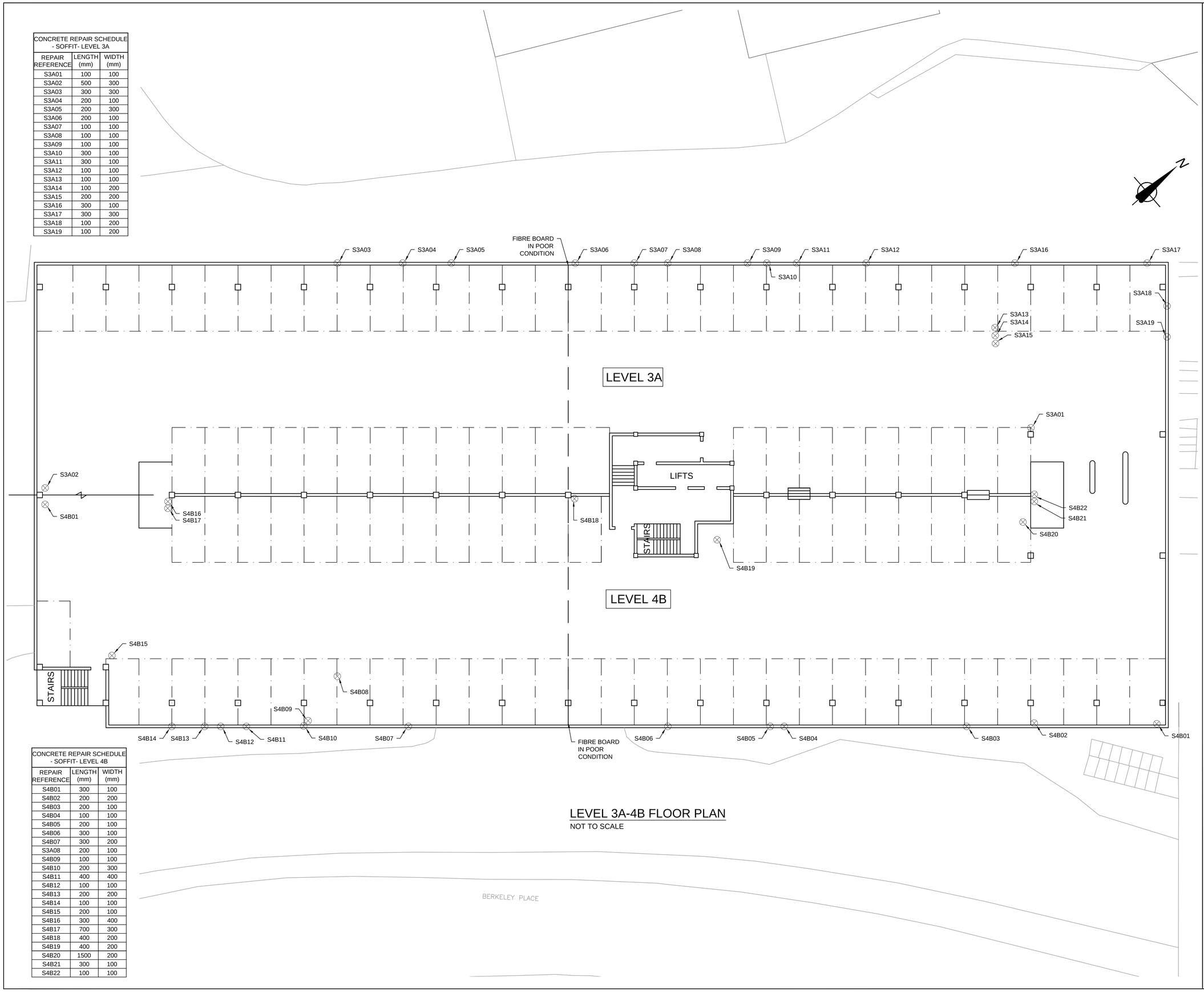
Drawn by:	FG	Date:	16/10/17
Checked by:		Date:	
Approved by:		Date:	

Drawing No.	Status	Revision
673846-WE- 112		

Drawing Scale: NOT TO SCALE

Drawing file path & name: \\Swin-fs-06\Transportation\TQ\MATERIALS\PROJ\AMEB\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 112 and 673846-WE- 113 West End Level 3A-4B Defects.dwg
Xreference file path: \\Swin-fs-06\Transportation\TQ\MATERIALS\PROJ\AMEB\BCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date: POLAKS - 13.3.2018 - 2:3 pm

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 3A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S3A01	100	100
S3A02	500	300
S3A03	300	300
S3A04	200	100
S3A05	200	300
S3A06	200	100
S3A07	100	100
S3A08	100	100
S3A09	100	100
S3A10	300	100
S3A11	300	100
S3A12	100	100
S3A13	100	100
S3A14	100	200
S3A15	200	200
S3A16	300	100
S3A17	300	300
S3A18	100	200
S3A19	100	200



CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 4B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S4B01	300	100
S4B02	200	200
S4B03	200	100
S4B04	100	100
S4B05	200	100
S4B06	300	100
S4B07	300	200
S3A08	200	100
S4B09	100	100
S4B10	200	300
S4B11	400	400
S4B12	100	100
S4B13	200	200
S4B14	100	100
S4B15	200	100
S4B16	300	400
S4B17	700	300
S4B18	400	200
S4B19	400	200
S4B20	1500	200
S4B21	300	100
S4B22	100	100

LEVEL 3A-4B FLOOR PLAN

NOT TO SCALE

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK CONDITION SURVEY

Drawing

WEST END CAR PARK LEVEL 3A - 4B SOFIT AND UPSTAND DEFECTS LOCATION

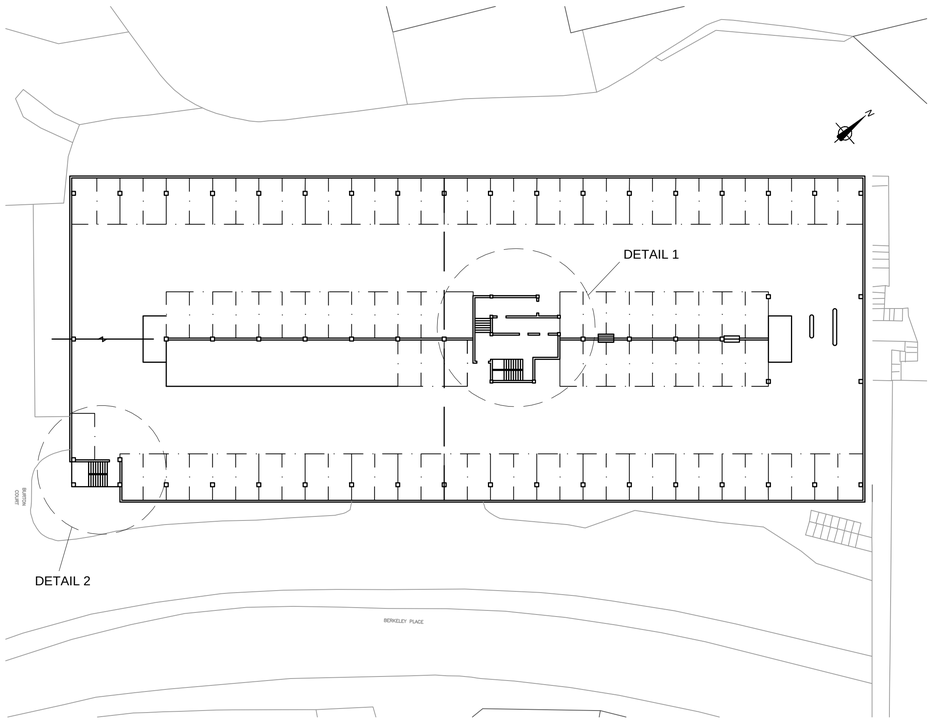
Drawn by:	FG	Date:	16/10/17
Checked by:		Date:	
Approved by:		Date:	

Drawing No.	Status	Revision
673846-WE- 113		

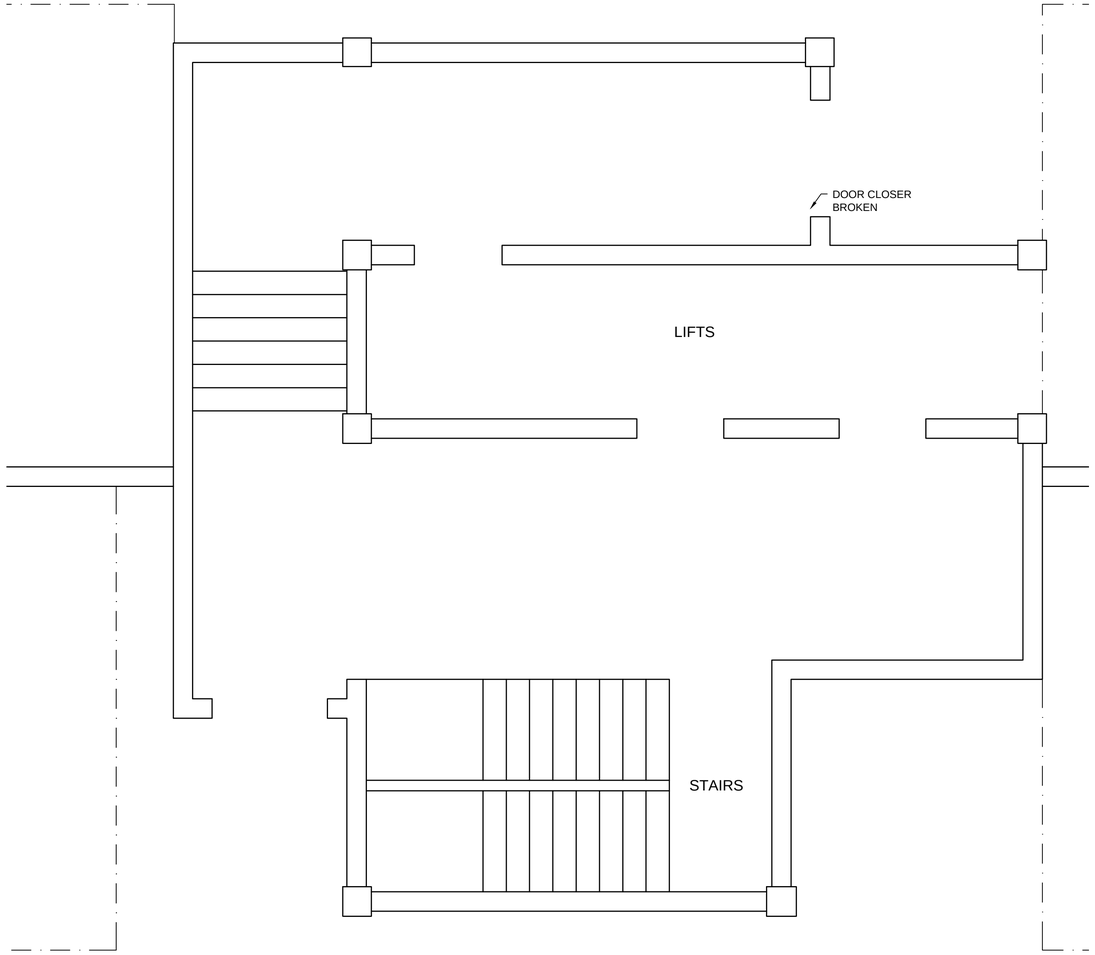
Drawing Scale: NOT TO SCALE

Drawing file path & name
Xreference file path
User and Plot Date

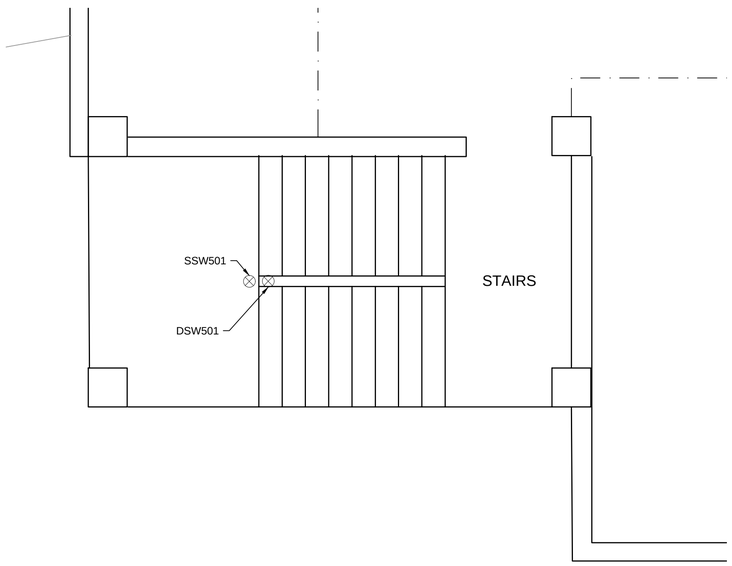
\\South-fs-2k01\transportation\TQ\MATERIALS\PROJ\AMEB\EC-MSCP\Drawings\West End - Floor Plans\673846-WE- 112 and 673846-WE- 113 West End Level 3A-4B Defects.dwg
\\South-fs-2k01\transportation\TQ\MATERIALS\PROJ\AMEB\EC-MSCP\Drawings\West End - Floor Plans\
POLAKS - 13.3.2018 - 2:3 pm



LEVEL 4A-5B FLOOR PLAN
NOT TO SCALE



DETAIL 1
NOT TO SCALE



DETAIL 2
NOT TO SCALE

CONCRETE REPAIR SCHEDULE - SOFFIT- STAIR WELLS		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
SSW501	50	200

CONCRETE REPAIR SCHEDULE - DECK- STAIR WELLS			
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)
DSW501	200	100	50

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK CONDITION SURVEY

Drawing

WEST END CAR PARK LEVEL 4A - 5B STAIRCASE DEFECTS LOCATION

Drawn by:	FG	Date:	16/10/17
Checked by:		Date:	
Approved by:		Date:	

Drawing No.	Status	Revision
673846-WE- 114		

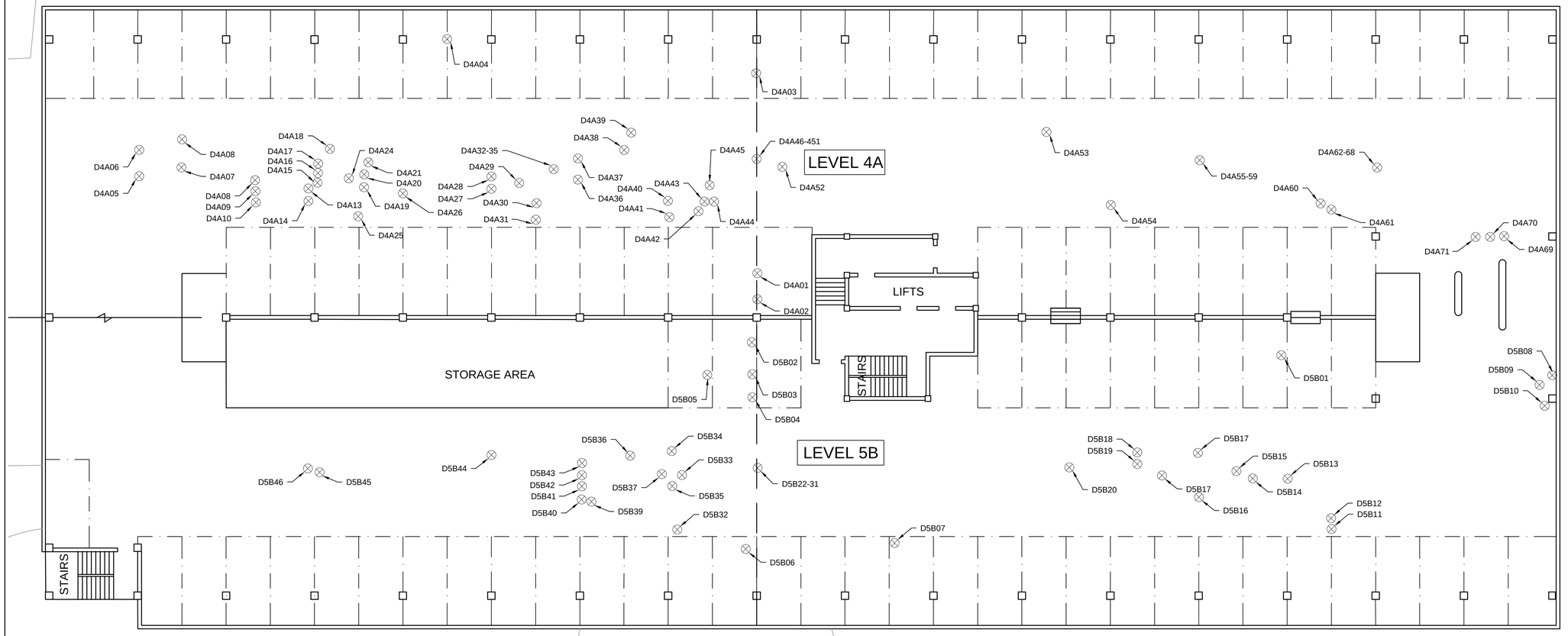
Drawing Scale: NOT TO SCALE

Drawing file path & name \\Swin-fs-001\Transportation\TQ\MATERIALS\PROJ\AMEE\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 114 West End Level 4A-5B Staircase Defects.dwg
Xreference file path \\Swin-fs-001\Transportation\TQ\MATERIALS\PROJ\AMEE\BCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date POLAKS - 13.3.2018 - 2:3 pm

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 4A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D4A01	400	300
D4A02	200	100
D4A03	100	200
D4A04	400	2000
D4A05	700	900
D4A06	2800	600
D4A07	200	200
D4A08	200	100
D4A09	200	100
D4A10	200	100
D4A11	200	200
D4A12	200	200
D4A13	600	200
D4A14	200	200
D4A15	300	200
D4A16	200	100
D4A17	300	300
D4A18	1200	1400
D4A19	200	200
D4A20	900	700
D4A21	200	600
D4A22	200	100
D4A23	200	100
D4A24	200	200
D4A25	100	100

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 4A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D4A26	500	300
D4A27	600	400
D4A28	400	200
D4A29	300	300
D4A30	1100	200
D4A31	1000	200
D4A32	300	200
D4A33	400	200
D4A34	300	200
D4A35	200	200
D4A36	200	300
D4A37	600	200
D4A38	200	100
D4A39	100	100
D4A40	400	200
D4A41	200	200
D4A42	400	200
D4A43	600	200
D4A44	200	100
D4A45	300	100
D4A46	100	200
D4A47	1100	800
D4A48	200	300
D4A49	500	500
D4A50	300	300

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 4A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D4A51	600	600
D4A52	200	100
D4A53	200	100
D4A54	800	500
D4A55	300	300
D4A56	800	300
D4A57	400	300
D4A58	200	200
D4A59	300	200
D4A60	1200	300
D4A61	200	100
D4A62	1200	700
D4A63	500	800
D4A64	1400	300
D4A65	1000	300
D4A66	200	100
D4A67	1000	400
D4A68	300	200
D4A69	1000	200
D4A70	2400	800
D4A71	400	300



CONCRETE REPAIR SCHEDULE - DECK- LEVEL 5B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D5B01	3300	700
D5B02	600	400
D5B03	300	200
D5B04	200	200
D5B05	100	100
D5B06	200	300
D5B07	200	100
D5B08	200	200
D5B09	800	150
D5B10	200	200
D5B11	200	300
D5B12	100	200
D5B13	2800	100
D5B14	500	300
D5B15	600	300
D5B16	1300	600
D5B17	1700	1100
D5B18	500	300
D5B19	500	200
D5B20	200	200
D5B21	600	250
D5B22	500	200
D5B23	200	150

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 5B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D5B24	200	100
D5B25	200	200
D5B26	200	200
D5B27	400	200
D5B28	200	200
D5B29	500	600
D5B30	300	200
D5B31	600	300
D5B32	150	150
D5B33	400	300
D5B34	800	500
D5B35	400	300
D5B36	700	700
D5B37	200	200
D5B38	200	200
D5B39	200	150
D5B40	800	600
D5B41	400	200
D5B42	900	400
D5B43	400	700
D5B44	1400	700
D5B45	500	200
D5B46	400	400

LEVEL 4A-5B FLOOR PLAN

NOT TO SCALE

BERKELEY PLACE

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK
CONDITION SURVEY

Drawing

WEST END CAR PARK
LEVEL 4A - 5B
DECK DEFECTS LOCATION

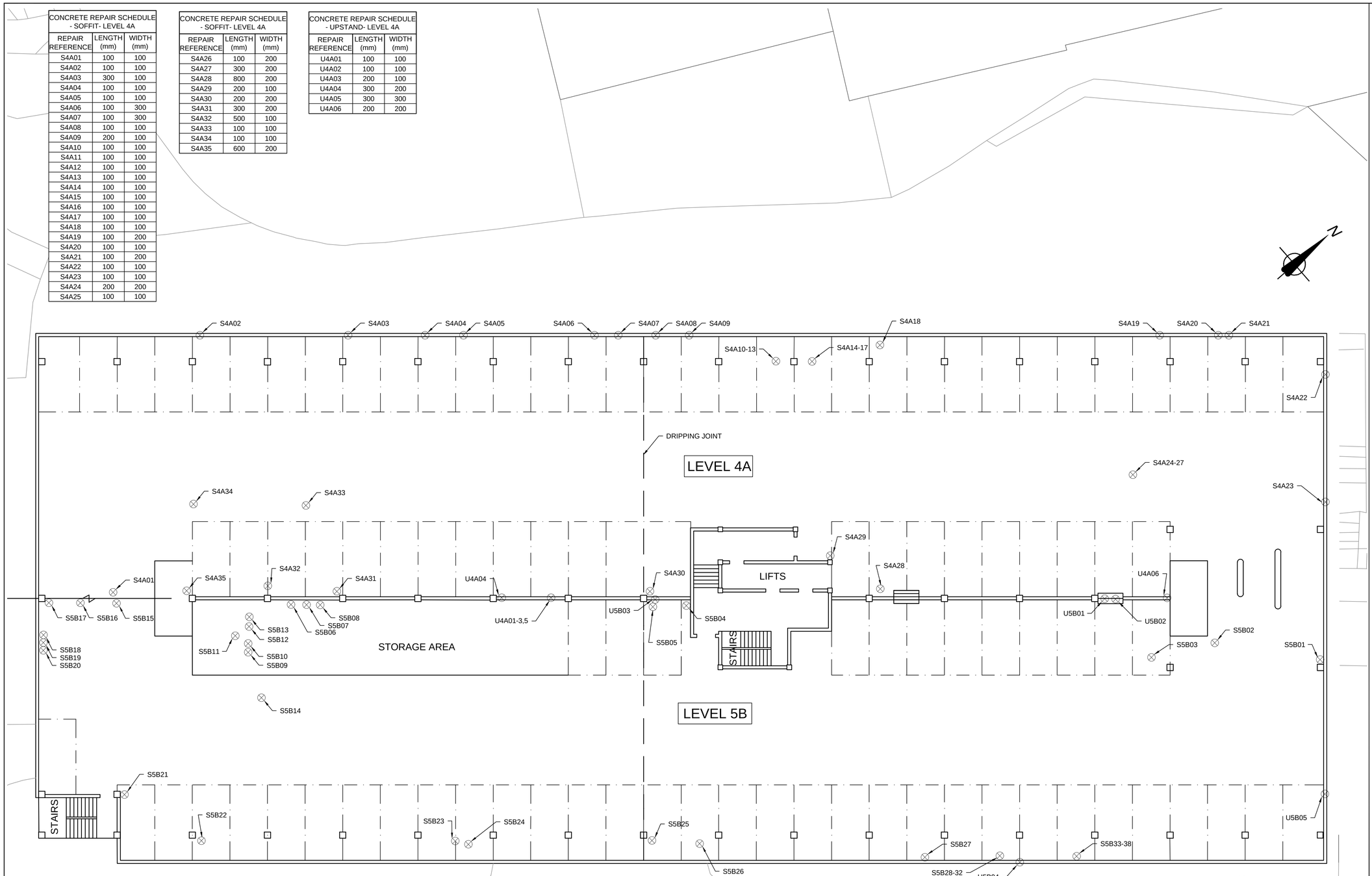
Drawn by: FG	Date: 16/10/17	
Checked by:	Date:	
Approved by:	Date:	
Drawing No. 673846-WE- 115	Status	Revision
Drawing Scale: NOT TO SCALE		

Drawing file path & name \\Sswin-fs-001\transportation\TQ\MATERIALS\PROJ\AM&E\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 115 and 673846-WE- 116 West End Level 4A-5B Defects.dwg
Xreference file path \\Sswin-fs-001\transportation\TQ\MATERIALS\PROJ\AM&E\BCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date POLARIS : 13.3.2018 - 2:3 pm

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 4A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S4A01	100	100
S4A02	100	100
S4A03	300	100
S4A04	100	100
S4A05	100	100
S4A06	100	300
S4A07	100	300
S4A08	100	100
S4A09	200	100
S4A10	100	100
S4A11	100	100
S4A12	100	100
S4A13	100	100
S4A14	100	100
S4A15	100	100
S4A16	100	100
S4A17	100	100
S4A18	100	100
S4A19	100	200
S4A20	100	100
S4A21	100	200
S4A22	100	100
S4A23	100	100
S4A24	200	200
S4A25	100	100

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 4A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S4A26	100	200
S4A27	300	200
S4A28	800	200
S4A29	200	100
S4A30	200	200
S4A31	300	200
S4A32	500	100
S4A33	100	100
S4A34	100	100
S4A35	600	200

CONCRETE REPAIR SCHEDULE - UPSTAND- LEVEL 4A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
U4A01	100	100
U4A02	100	100
U4A03	200	100
U4A04	300	200
U4A05	300	300
U4A06	200	200



CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 5B			
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)
S5B01	100	100	-
S5B02	2000	100	-
S5B03	400	100	-
S5B04	100	100	-
S5B05	200	200	-
S5B06	500	1300	-
S5B07	200	200	-
S5B08	200	200	-
S5B09	100	100	-
S5B10	100	100	-
S5B11	200	200	-
S5B12	200	200	-
S5B13	1000	300	-
S5B14	100	200	-
S5B15	200	500	-
S5B16	200	200	-
S5B17	100	200	-
S5B18	100	100	-
S5B19	400	200	-

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 5B			
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)
S5B20	200	200	-
S5B21	100	200	-
S5B22	100	100	-
S5B23	100	100	-
S5B24	100	100	-
S5B25	100	200	-
S5B26	100	100	-
S5B27	400	200	100
S5B28	400	300	-
S5B29	100	100	-
S5B30	200	100	-
S5B31	300	100	-
S5B32	100	100	-
S5B33	100	100	-
S5B34	100	100	-
S5B35	100	100	-
S5B36	100	100	-
S5B37	100	100	-
S5B38	100	100	-

CONCRETE REPAIR SCHEDULE - UPSTAND- LEVEL 5B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
U5B01	100	100
U5B02	100	100
U5B03	300	100
U5B04	50	50
U5B05	50	100

LEVEL 4A-5B FLOOR PLAN

NOT TO SCALE

BERKELEY PLACE

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK CONDITION SURVEY

Drawing

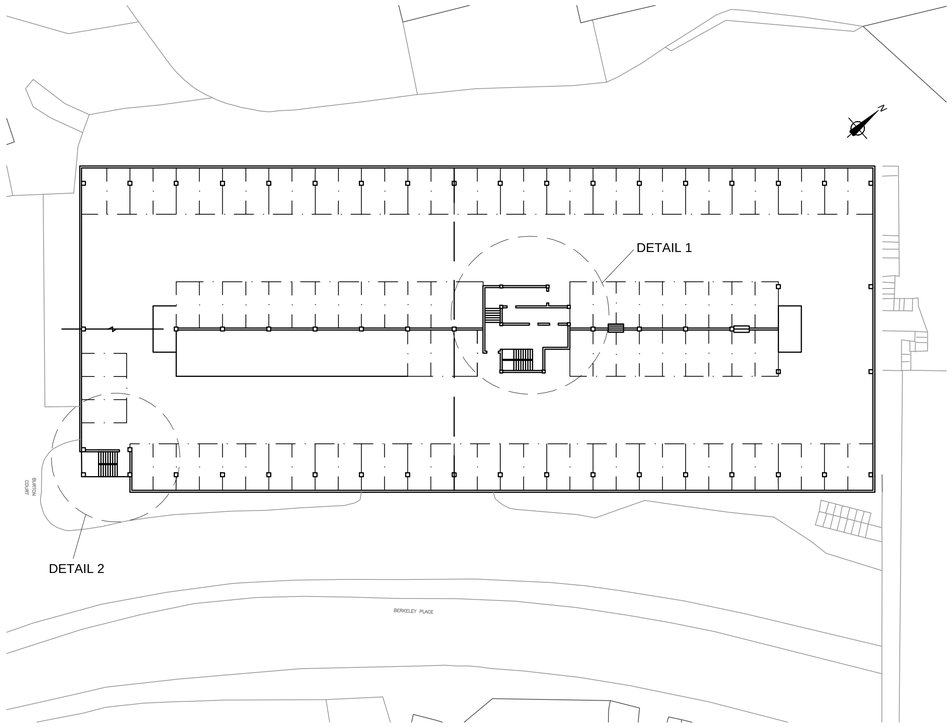
WEST END CAR PARK
LEVEL 4A - 5B
SOFIT AND UPSTAND
DEFECTS LOCATION

Drawn by:	FG	Date:	16/10/17
Checked by:		Date:	
Approved by:		Date:	

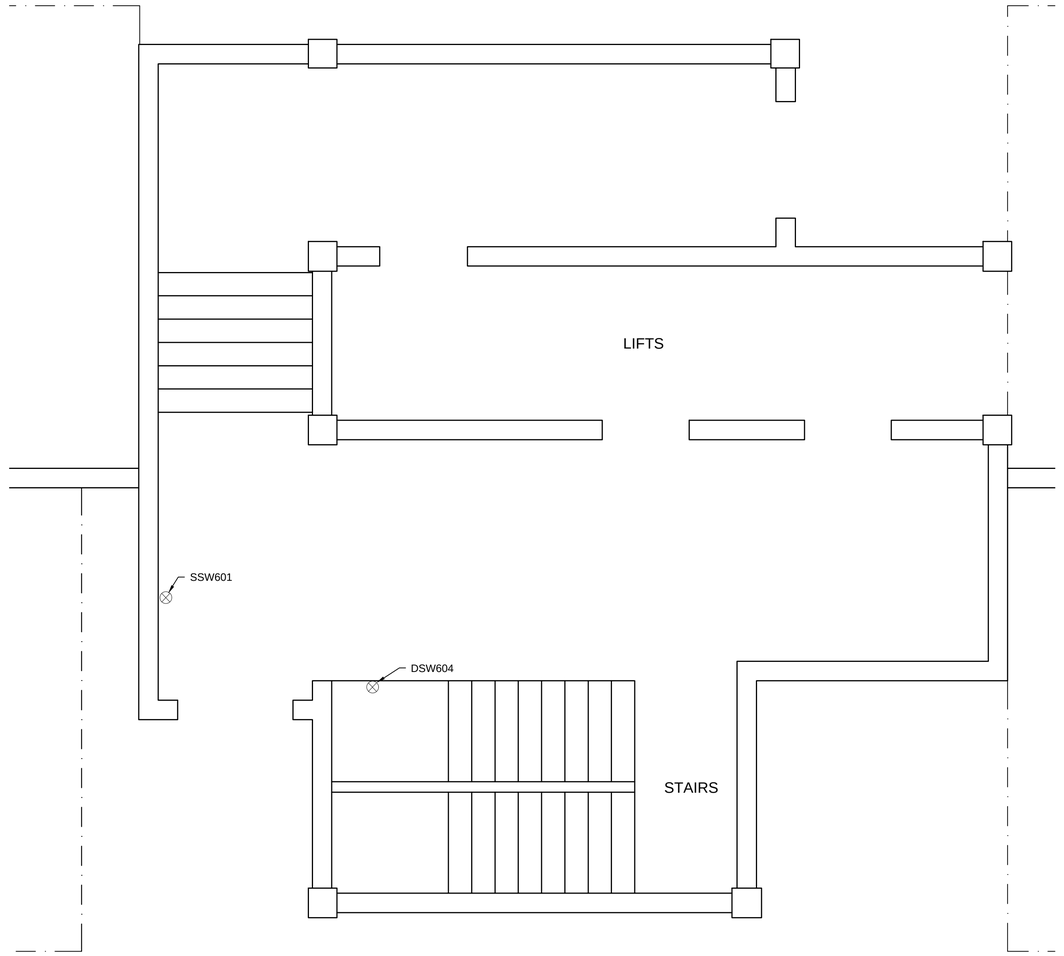
Drawing No.	Status	Revision
673846-WE- 116		

Drawing Scale: NOT TO SCALE

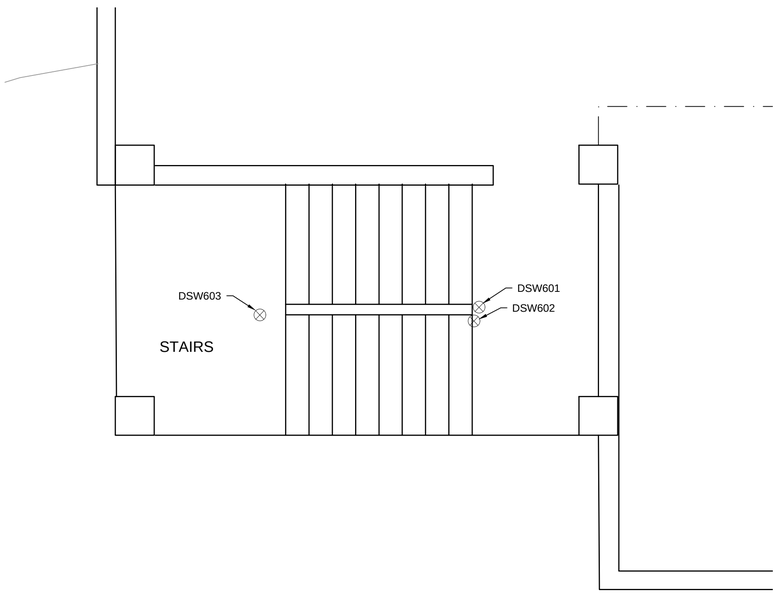
Drawing file path & name: \\Svsh-fs-06\Transportation\TQ\MATERIALS\PROJ\AM&E\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 115 and 673846-WE- 116 West End Level 4A-5B Defects.dwg
Xref/ence file path: \\Svsh-fs-06\Transportation\TQ\MATERIALS\PROJ\AM&E\BCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date: POLAKS - 13.3.2018 - 2:3 pm



LEVEL 5A-6B FLOOR PLAN
NOT TO SCALE



DETAIL 1
NOT TO SCALE



DETAIL 2
NOT TO SCALE

CONCRETE REPAIR SCHEDULE - SOFFIT- STAIR WELLS		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
SSW601	200	200

CONCRETE REPAIR SCHEDULE - DECK- STAIR WELLS		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
DSW601	150	100
DSW602	100	100
DSW603	150	50
DSW604	100	150

Rev	By	Chkd	App	Date	Description

Client

CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK
CONDITION SURVEY

Drawing

WEST END CAR PARK
LEVEL 5A - 6B
STAIRCASE
DEFECTS LOCATION

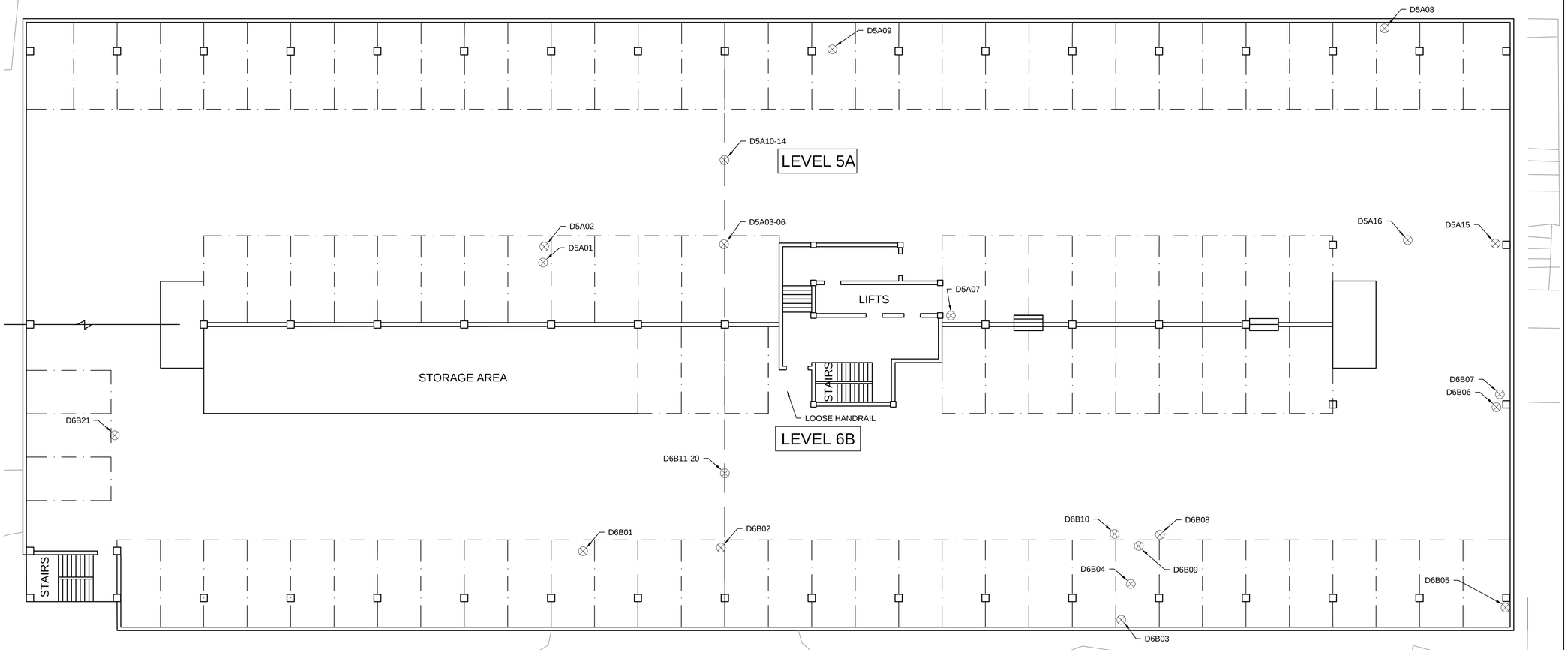
Drawn by:	FG	Date:	16/10/17
Checked by:		Date:	
Approved by:		Date:	

Drawing No.	Status	Revision
673846-WE- 117		

Drawing Scale: NOT TO SCALE

Drawing file path & name: \\Swin-fs-001\Transportation\TQM\MATERIALS\PROJ\AM&EBDC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 117 West End Level 5A-6B Staircase Defects.dwg
Xreference file path: \\Swin-fs-001\Transportation\TQM\MATERIALS\PROJ\AM&EBDC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date: POLAKS 13.3.2018 - 2:3 pm

CONCRETE REPAIR SCHEDULE - DECK- LEVEL 5A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D5A01	300	300
D5A02	300	300
D5A03	100	100
D5A04	200	200
D5A05	100	100
D5A06	400	300
D5A07	600	800
D5A08	700	200
D5A09	100	100
D5A10	500	300
D5A11	200	200
D5A12	200	200
D5A13	200	200
D5A14	200	200
D5A15	150	150
D5A16	400	300



CONCRETE REPAIR SCHEDULE - DECK- LEVEL 6B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
D6B01	150	100
D6B02	150	150
D6B03	400	200
D6B04	200	100
D6B05	150	500
D6B06	200	150
D6B07	200	200
D6B08	1900	900
D6B09	1500	400
D6B10	900	400
D6B11	900	500
D6B12	150	150
D6B13	100	100
D6B14	100	150
D6B15	200	150
D6B16	250	150
D6B17	300	250
D6B18	250	200
D6B19	300	200
D6B20	250	200
D6B21	250	300

LEVEL 5A-6B FLOOR PLAN

NOT TO SCALE

BERKELEY PLACE

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK
CONDITION SURVEY

Drawing

WEST END CAR PARK
LEVEL 5A - 6B
DECK DEFECTS LOCATION

Drawn by: FG	Date: 16/10/17	
Checked by:	Date:	
Approved by:	Date:	
Drawing No. 673846-WE- 118	Status	Revision
Drawing Scale: NOT TO SCALE		

Drawing file path & name \\Swin-fs-001\Transportation\T\QMATERIALS\PROJ\AM&EBDC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 118 and 673846-WE- 119 West End Level 5A-6B Defects.dwg
Xreference file path \\Swin-fs-001\Transportation\T\QMATERIALS\PROJ\AM&EBDC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date POLAKS - 13.3.2018 - 2:3 pm

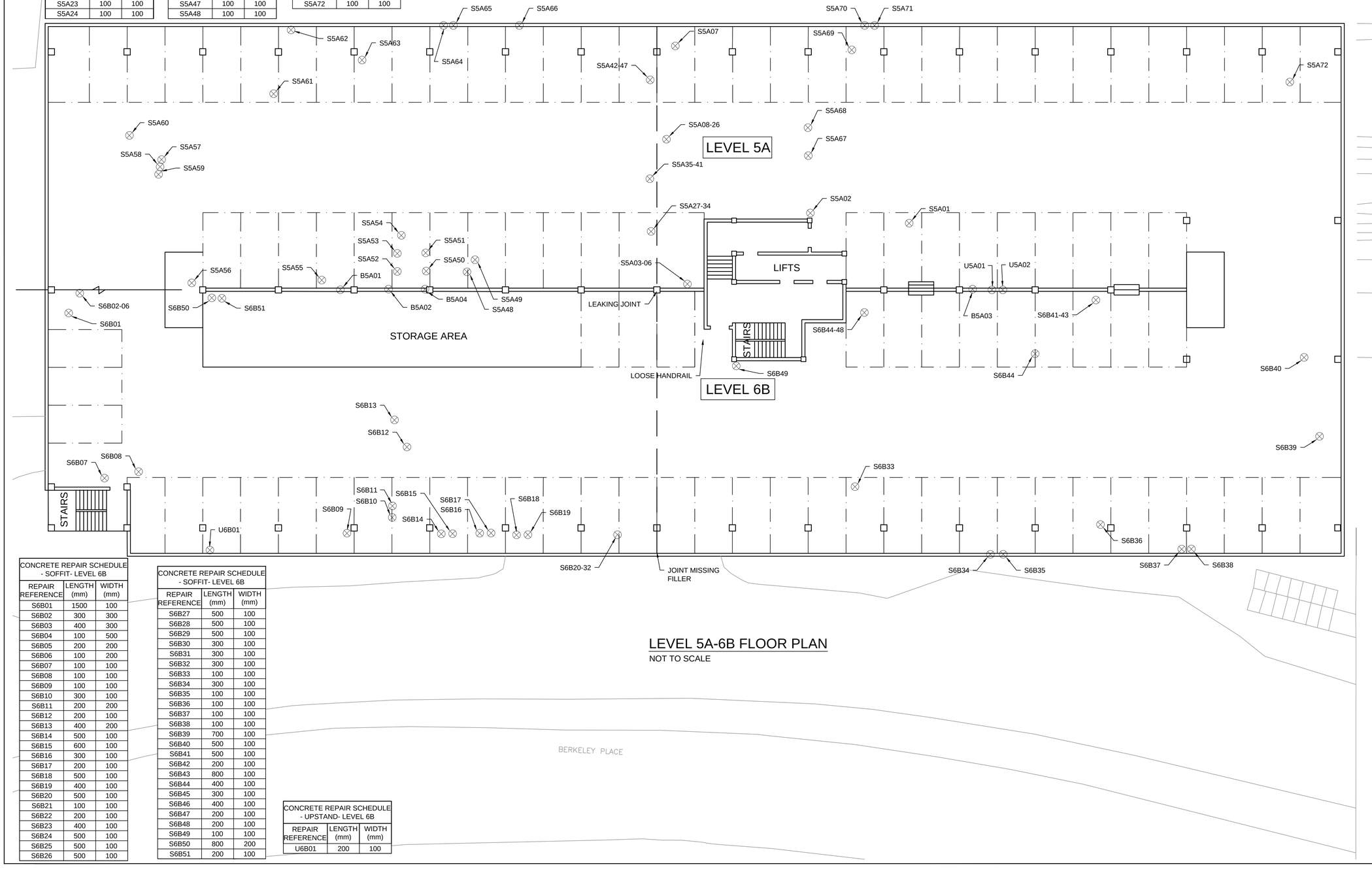
CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 5A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S5A01	200	100
S5A02	300	100
S5A03	100	100
S5A04	300	200
S5A05	300	100
S5A06	300	100
S5A07	100	100
S5A08	50	50
S5A09	50	50
S5A10	50	50
S5A11	100	200
S5A12	100	50
S5A13	100	100
S5A14	100	100
S5A15	100	100
S5A16	200	100
S5A17	50	50
S5A18	100	100
S5A19	100	100
S5A20	100	100
S5A21	200	100
S5A22	100	100
S5A23	100	100
S5A24	100	100

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 5A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S5A25	100	100
S5A26	300	100
S5A27	400	500
S5A28	400	100
S5A29	400	100
S5A30	100	100
S5A31	500	100
S5A32	100	100
S5A33	100	100
S5A34	100	100
S5A35	50	50
S5A36	50	50
S5A37	50	50
S5A38	50	50
S5A39	50	50
S5A40	50	50
S5A41	50	50
S5A42	100	200
S5A43	100	200
S5A44	100	200
S5A45	100	100
S5A46	100	100
S5A47	100	100
S5A48	100	100

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 5A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S5A49	500	100
S5A50	100	100
S5A51	200	100
S5A52	500	200
S5A53	200	100
S5A54	100	100
S5A55	200	200
S5A56	700	100
S5A57	300	300
S5A58	400	300
S5A59	500	300
S5A60	100	100
S5A61	50	50
S5A62	200	100
S5A63	50	50
S5A64	50	50
S5A65	100	100
S5A66	50	50
S5A67	50	50
S5A68	200	100
S5A69	50	500
S5A70	50	500
S5A71	50	500
S5A72	100	100

CONCRETE REPAIR SCHEDULE - BEAM- LEVEL 5A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
B5A01	200	200
B5A02	200	200
B5A03	1800	250
B5A04	300	200

CONCRETE REPAIR SCHEDULE - UPSTAND- LEVEL 5A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
U5A01	200	200
U5A02	200	200



LEVEL 5A-6B FLOOR PLAN

NOT TO SCALE

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 6B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S6B01	1500	100
S6B02	300	300
S6B03	400	300
S6B04	100	500
S6B05	200	200
S6B06	100	200
S6B07	100	100
S6B08	100	100
S6B09	100	100
S6B10	300	100
S6B11	200	200
S6B12	200	100
S6B13	400	200
S6B14	500	100
S6B15	600	100
S6B16	300	100
S6B17	200	100
S6B18	500	100
S6B19	400	100
S6B20	500	100
S6B21	100	100
S6B22	200	100
S6B23	400	100
S6B24	500	100
S6B25	500	100
S6B26	500	100

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 6B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S6B27	500	100
S6B28	500	100
S6B29	500	100
S6B30	300	100
S6B31	300	100
S6B32	300	100
S6B33	100	100
S6B34	300	100
S6B35	100	100
S6B36	100	100
S6B37	100	100
S6B38	100	100
S6B39	700	100
S6B40	500	100
S6B41	500	100
S6B42	200	100
S6B43	800	100
S6B44	400	100
S6B45	300	100
S6B46	400	100
S6B47	200	100
S6B48	200	100
S6B49	100	100
S6B50	800	200
S6B51	200	100

CONCRETE REPAIR SCHEDULE - UPSTAND- LEVEL 6B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
U6B01	200	100

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK CONDITION SURVEY

Drawing

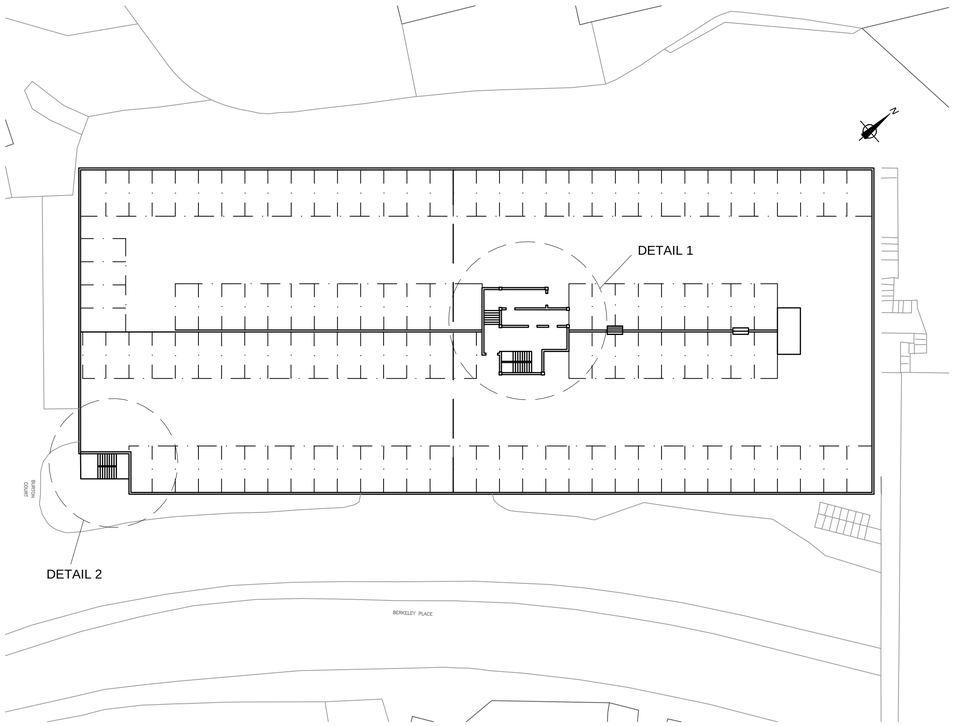
WEST END CAR PARK LEVEL 5A - 6B SOFIT AND UPSTAND DEFECTS LOCATION

Drawn by:	FG	Date: 16/10/17
Checked by:		Date:
Approved by:		Date:

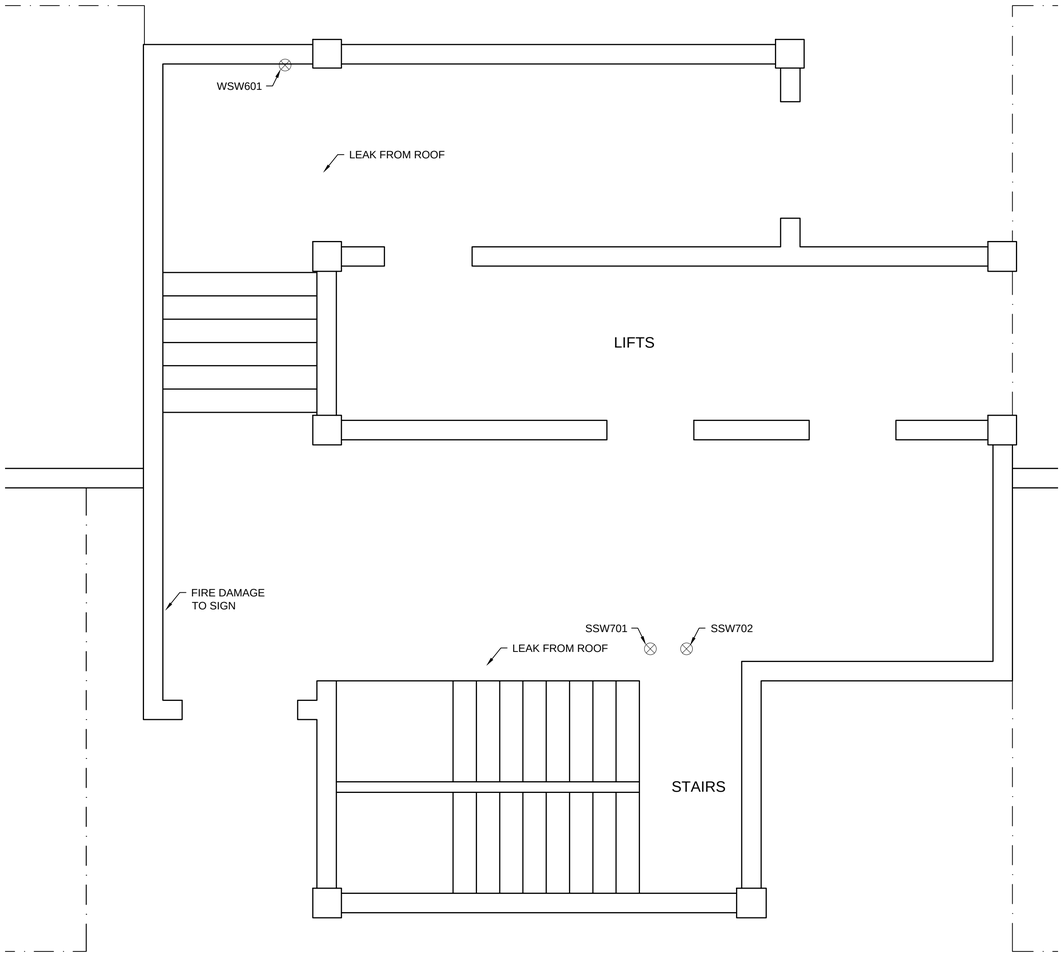
Drawing No.	Status	Revision
673846-WE- 119		

Drawing Scale: NOT TO SCALE

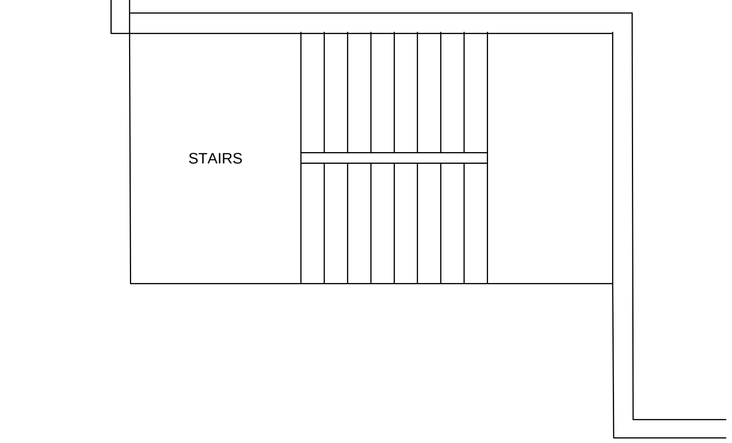
Drawing file path & name \\Swin-fs-001\Transportation\TQ\MATERIALS\PROJ\AMEB\CC-MSCP\Drawings\West End - Floor Plans\673846-WE- 118 and 673846-WE- 119 West End Level 5A-6B Defects.dwg
Xreference file path \\Swin-fs-001\Transportation\TQ\MATERIALS\PROJ\AMEB\CC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date POLAKS - 13.3.2018 - 2:3 pm



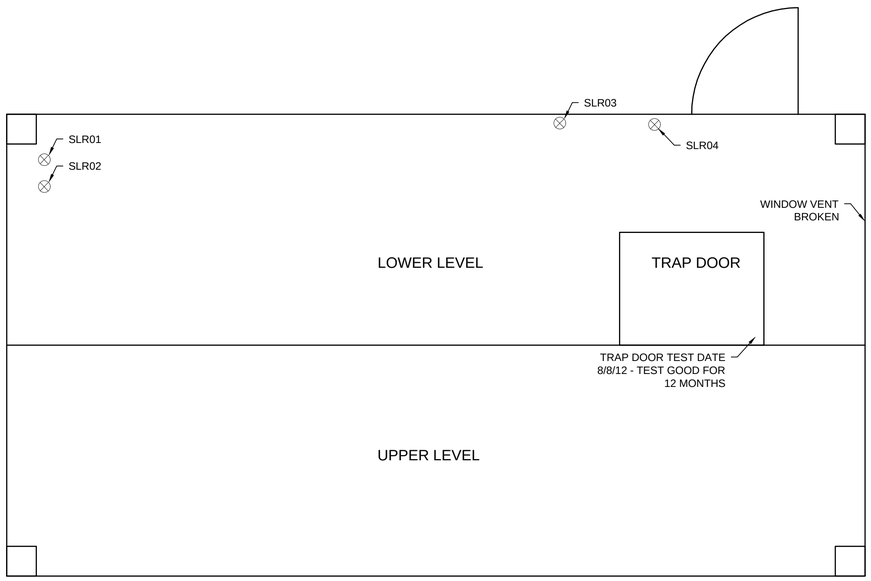
LEVEL 6A-7B FLOOR PLAN
NOT TO SCALE



DETAIL 1
NOT TO SCALE



DETAIL 2
NOT TO SCALE



LIFT ROOM FLOOR PLAN
NOT TO SCALE

CONCRETE REPAIR SCHEDULE - WALL- STAIR WELLS

REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
WSW601	400	400

CONCRETE REPAIR SCHEDULE - SOFFIT- STAIR WELLS

REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
SSW701	800	300
SSW702	400	300

CONCRETE REPAIR SCHEDULE - SOFFIT- LIFT ROOM

REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
SLR01	500	400
SLR02	1000	500
SLR03	400	200
SLR04	700	700

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK
CONDITION SURVEY

Drawing

WEST END CAR PARK
LEVEL 6A - 7B
STAIRCASE AND LIFT ROOM
DEFECTS LOCATION

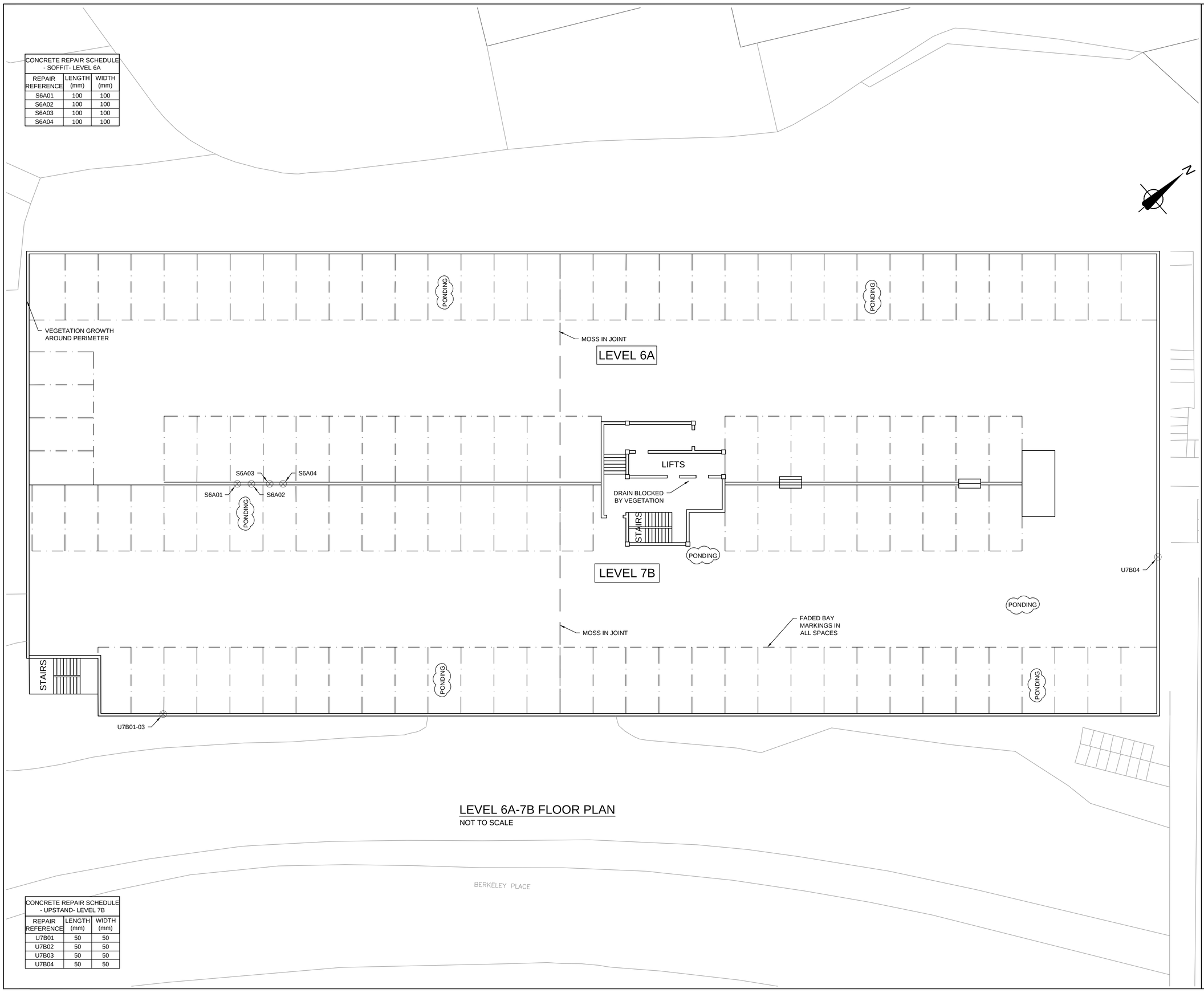
Drawn by: FG Date: 16/10/17
Checked by: Date:
Approved by: Date:

Drawing No. 673846-WE- 120
Status
Revision

Drawing Scale: NOT TO SCALE

Drawing file path & name \\Swin-fs-06\Transportation\TQMATERIALSPROJ\AM&EBDC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 110 West End Level 6A-7B Staircase Defects.dwg
Xreference file path \\Swin-fs-06\Transportation\TQMATERIALSPROJ\AM&EBDC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date POLAKS - 13-3-2018 - 2:3 pm

CONCRETE REPAIR SCHEDULE - SOFFIT- LEVEL 6A		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
S6A01	100	100
S6A02	100	100
S6A03	100	100
S6A04	100	100



LEVEL 6A-7B FLOOR PLAN

NOT TO SCALE

CONCRETE REPAIR SCHEDULE - UPSTAND- LEVEL 7B		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
U7B01	50	50
U7B02	50	50
U7B03	50	50
U7B04	50	50

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK
CONDITION SURVEY

Drawing

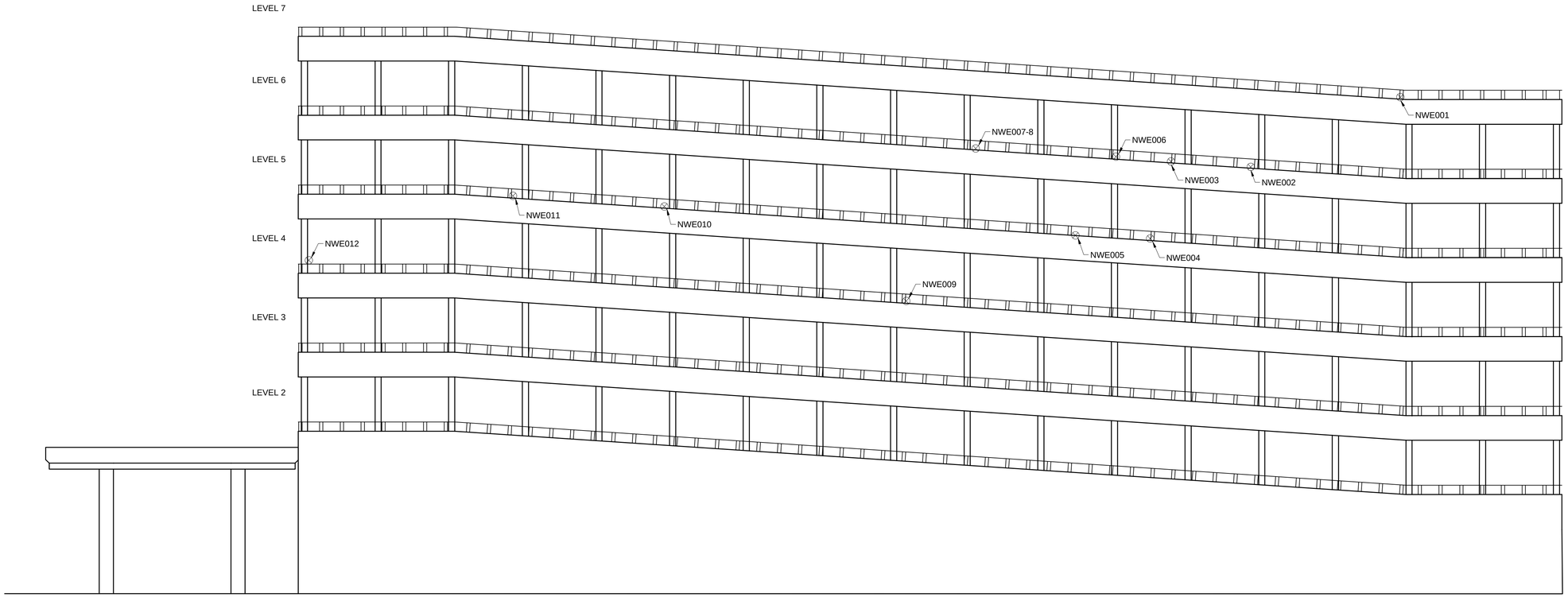
WEST END CAR PARK
LEVEL 6A - 7B
DEFECTS LOCATION

Drawn by:	FG	Date:	16/10/17
Checked by:		Date:	
Approved by:		Date:	

Drawing No.	Status	Revision
673846-WE- 121		

Drawing Scale: NOT TO SCALE

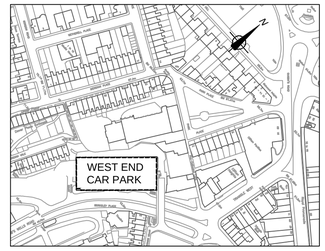
Drawing file path & name: \\Swin-fs-06\Transportation\TQ\MATERIALS\PROJ\AMEE\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 121 West End Level 6A-7B Defects.dwg
Xreference file path: \\Swin-fs-06\Transportation\TQ\MATERIALS\PROJ\AMEE\BCC-MSCP\Drawings\West End - Floor Plans\
User and Plot Date: POLAKS - 13.3.2018 - 2:3 pm



NORTH WEST ELEVATION

NOT TO SCALE

CONCRETE REPAIR SCHEDULE NORTH EAST ELEVATION		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
NWE001	300	100
NWE002	200	100
NWE003	100	100
NWE004	100	100
NWE005	100	100
NWE006	100	100
NWE007	100	100
NWE008	100	100
NWE009	100	100
NWE010	100	100
NWE011	100	100
NWE012	100	100



Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK CONDITION SURVEY

Drawing

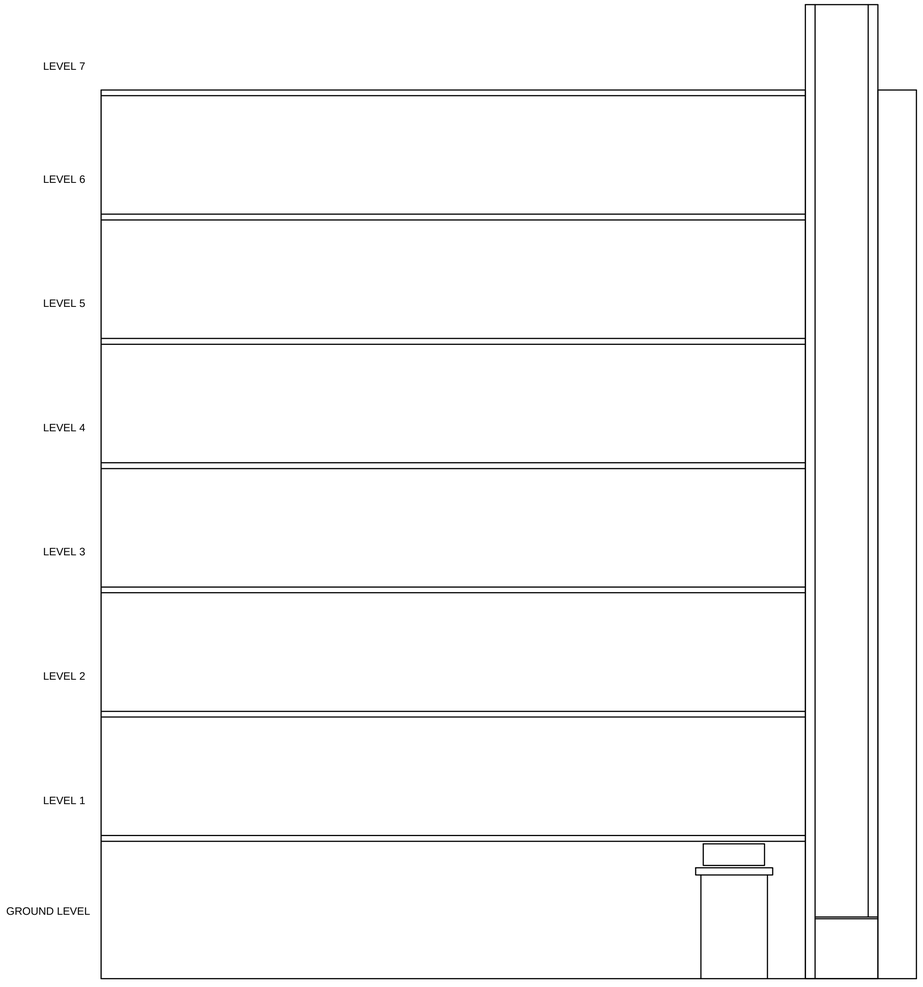
WEST END CAR PARK NORTH WEST ELEVATION DEFECTS LOCATION

Drawn by:	SP	Date:	07/03/18
Checked by:		Date:	
Approved by:		Date:	

Drawing No.	Status	Revision
673846-WE- 122		

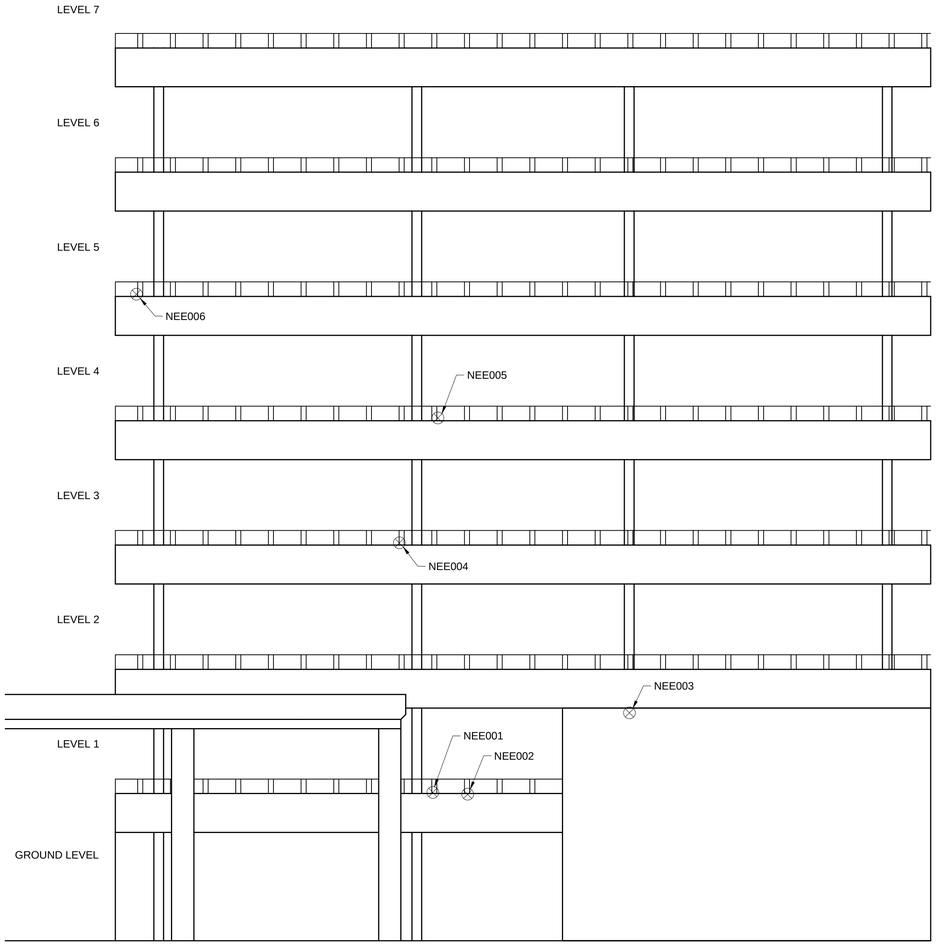
Drawing Scale: NOT TO SCALE

Drawing file path & name: \\Swin-fs-06\Transportation\TQM\TERHALS\PROJAM&E\BCC-MSCP\Drawings\West End - Elevations\ 673846-WE- 122 West End -North West Elevation Defects.dwg
Xreference file path: \\Swin-fs-06\Transportation\TQM\TERHALS\PROJAM&E\BCC-MSCP\Drawings\West End - Elevations\
User and Plot Date: POLAKS - 13.3.2018 - 2:3 pm



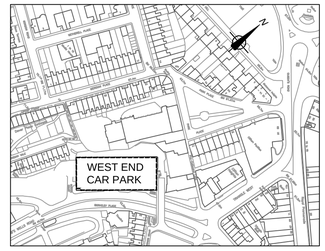
SOUTH WEST ELEVATION

NOT TO SCALE



NORTH EAST ELEVATION

NOT TO SCALE



CONCRETE REPAIR SCHEDULE
SOUTH EAST ELEVATION

REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
NEE001	100	100
NEE002	100	100
NEE003	200	200
NEE004	100	100
NEE005	100	100
NEE006	100	100

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

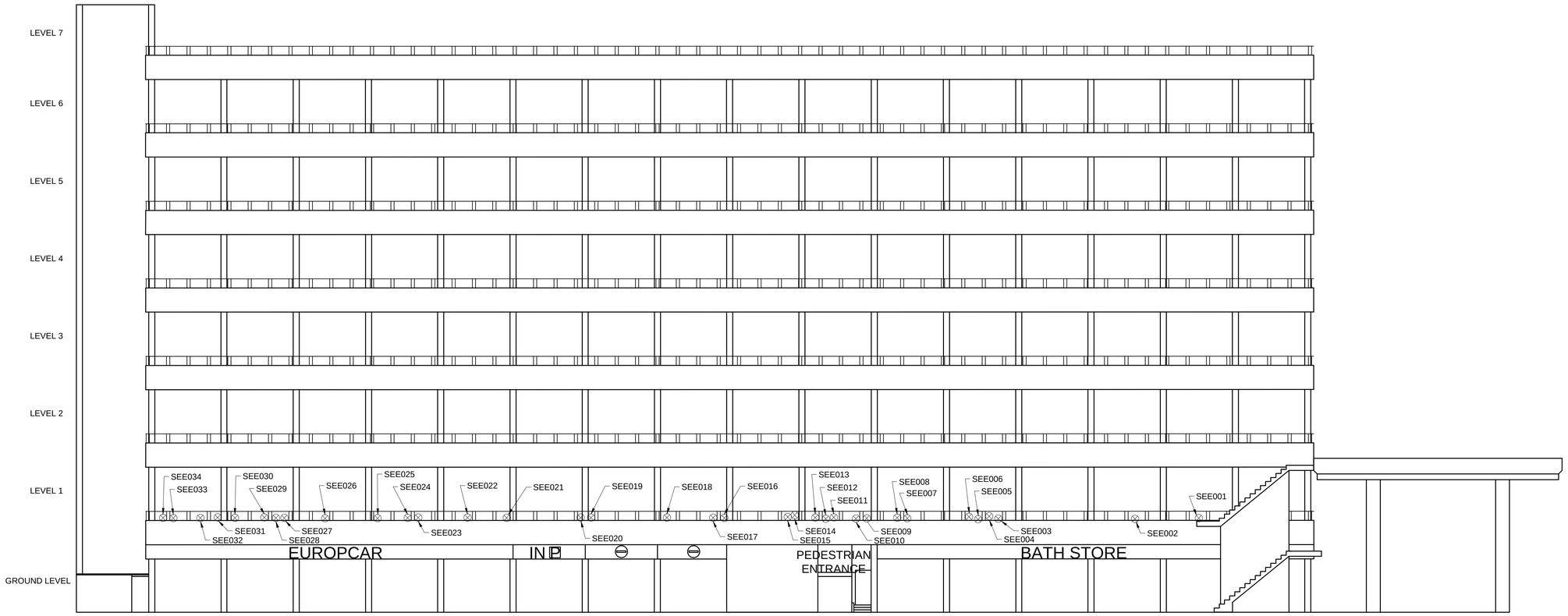
CAR PARK CONDITION SURVEY

Drawing

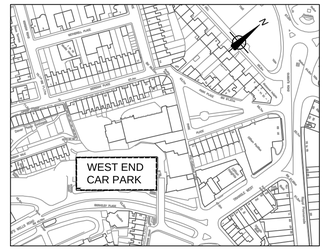
WEST END CAR PARK NORTH EAST ELEVATION DEFECTS LOCATION

Drawn by: SP	Date: 07/03/18		
Checked by:	Date:		
Approved by:	Date:		
Drawing No. 673846-WE- 123		Status	Revision
Drawing Scale: NOT TO SCALE			

Drawing file path & name \\Swin-fs-001\transportation\TQ\MATERIALS\PROJ\AMEB\CC-MSCP\Drawings\West End - Elevations\ 673846-WE - 123 West End - South West and North East Elevations Defects.dwg
Xreference file path \\Swin-fs-001\transportation\TQ\MATERIALS\PROJ\AMEB\CC-MSCP\Drawings\West End - Elevations\
User and Plot Date POLAKS - 13:3:2018 - 2:3 pm



SOUTH EAST ELEVATION
NOT TO SCALE



CONCRETE REPAIR SCHEDULE SOUTH WEST ELEVATION		
REPAIR REFERENCE	LENGTH (mm)	WIDTH (mm)
SEE001	100	100
SEE002	100	100
SEE003	100	100
SEE004	100	100
SEE005	100	100
SEE006	100	100
SEE007	100	100
SEE008	100	100
SEE009	100	100
SEE010	100	100
SEE011	100	100
SEE012	100	100
SEE013	300	100
SEE014	100	100
SEE015	100	100
SEE016	300	100
SEE017	200	100
SEE018	300	300
SEE019	100	100
SEE020	100	100
SEE021	100	100
SEE022	100	100
SEE023	100	200
SEE024	100	100
SEE025	100	100
SEE026	100	200
SEE027	100	100
SEE028	100	100
SEE029	100	100
SEE030	100	100
SEE031	100	100
SEE032	100	100
SEE033	100	100
SEE034	100	100

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK CONDITION SURVEY

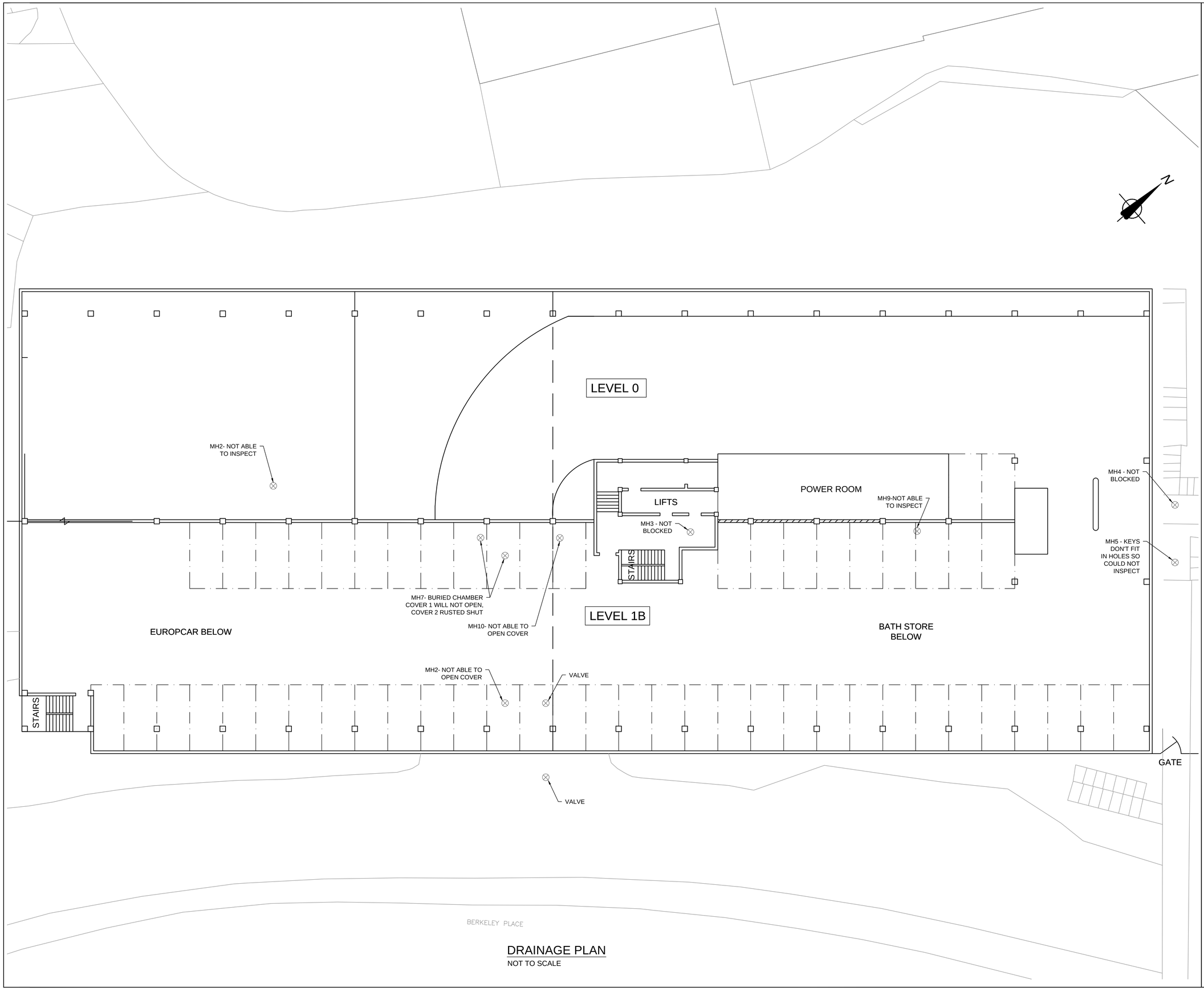
Drawing

WEST END CAR PARK SOUTH EAST ELEVATION DEFECTS LOCATION

Drawn by: SP	Date: 07/03/18	
Checked by:	Date:	
Approved by:	Date:	
Drawing No. 673846-WE- 124	Status	Revision

Drawing Scale: NOT TO SCALE

Drawing file path & name: \\Swin-fs-06\Transportation\TQM\AETERNAL\SPRO\AM&EBCC-MSCP\Drawings\West End - Elevations\673846-WE - 124 West End - South East Elevation Defects.dwg
Xreference file path: \\Swin-fs-06\Transportation\TQM\AETERNAL\SPRO\AM&EBCC-MSCP\Drawings\West End - Elevations\
User and Plot Date: POLAKS - 13.3.2018 - 2:3 pm



DRAINAGE PLAN
NOT TO SCALE

Rev	By	Chkd	App	Date	Description

Client

BRISTOL CITY COUNCIL

ch2m:
CH2M HILL, BURDEROP PARK, SWINDON, WILTS SN4 0QD
TEL: +44 (0)1793 812479

Project

CAR PARK
CONDITION SURVEY

Drawing

WEST END CAR PARK
LEVEL 0 - 1B
DRAINAGE INSPECTION

Drawn by:	FG	Date:	16/10/17
Checked by:		Date:	
Approved by:		Date:	

Drawing No.	Status	Revision
673846-WE- 125		

Drawing Scale: NOT TO SCALE

Drawing file path & name: \\Swin1s-061\Transportation\TQM\TERRALS\PROJ\AMEE\BCC-MSCP\Drawings\West End - Floor Plans\ 673846-WE- 125 West End Level 0-1B Drainage Plan.dwg
Xreference file path:
User and Plot Date: POLAKS - 13.3.2018 - 2:3 pm

Appendix B – Test certificates

Quartz Scientific

UKAS TESTING 1586

7G Dukes Yard, Shakespeare Industrial Estate, Watford WD24 5AL
Tel: 01923 213983 Fax: 01923 247732
e-mail: mail@quartz-scientific.co.uk www.quartz-scientific.co.uk

E.D.S
Marine & Civil Engineering Contractors
Dragon House, 17 Sir Alfred Owen Way
Pontygwindy Industrial Estate
Caerphilly CF83 3HU

27 November 2017
EDS/14314/isj

CERTIFICATE of ANALYSIS

A7125

Chloride content of concrete samples

Date received	:	22 November 2017
Mass received	:	3 to 12 g
Type of sample	:	concrete dust
Date of analysis	:	24 and 27 November 2017
Method of testing	:	B.S.1881:Part 124:2015.

Sample ref.	Client's ref.		Chloride content	
		mm	*% by mass of*	
			sample	cement
16900	TA1	5-20	0.10	0.68
16901		20-35	0.11	0.78
16902		35-50	0.05	0.33
16903	TA2	5-20	0.08	0.56
16904		20-35	0.10	0.75
16905		35-50	0.08	0.55
16906	TA3	5-20	0.06	0.42
16907		20-35	0.08	0.56
16908		35-50	0.05	0.35
16909	TA4	5-20	0.08	0.59
16910		20-35	0.16	1.14
16911		35-50	0.13	0.89
16912	TA5	5-20	0.06	0.45
16913		20-35	0.17	1.24
16914		35-50	0.11	0.78
16915	TA6	5-20	0.08	0.60
16916		20-35	0.13	0.92
16917		35-50	0.08	0.54
16918	TA7	5-20	0.05	0.39
16919		20-35	0.06	0.42
16920		35-50	0.04	0.30

Sample ref.	Client's ref.		Chloride content	
		mm	*% by mass of*	
			sample	cement
16921	TA8	5-20	0.11	0.76
16922		20-35	0.11	0.76
16923		35-50	0.30	2.15
16924	TA9	5-20	0.09	0.62
16925		20-35	0.16	1.13
16926		35-50	0.08	0.55
16927	TA10	5-20	0.30	2.13
16928		20-35	0.43	3.06
16929		35-50	0.30	2.16
16930	TA11	5-20	0.18	1.29
16931		20-35	0.16	1.13
16932		35-50	0.11	0.76
16933	TA12	5-20	0.08	0.58
16934		20-35	0.14	0.96
16935		35-50	0.14	1.02
16936	WE1	5-20	0.02	0.15
16937		20-35	0.01	0.11
16938		35-50	0.13	0.94
16939	WE2	5-20	0.10	0.68
16940		20-35	0.22	1.57
16941		35-50	0.18	1.29
16942	WE3	5-20	0.03	0.20
16943		20-35	0.06	0.43
16944		35-50	0.07	0.50
16945	WE4	5-20	0.04	0.31
16946		20-35	0.16	1.17
16947		35-50	0.16	1.15
16948	WE5	5-20	0.15	1.09
16949		20-35	0.10	0.68
16950		35-50	0.23	1.64
16951	WE6	5-20	0.03	0.19
16952		20-35	0.13	0.91
16953		35-50	0.11	0.78
16954	WE7	5-20	0.15	1.07
16955		20-35	0.19	1.38
16956		35-50	0.37	2.63
16957	WE8	5-20	0.17	1.22
16958		20-35	0.14	1.03
16959		35-50	0.34	2.42

Sample ref.	Client's ref.		Chloride content	
		mm	*% by mass of*	
			sample	cement
16960	WE9	5-20	0.06	0.45
16961		20-35	0.27	1.95
16962		35-50	0.64	4.60
16963	WE10	5-20	0.01	0.09
16964		20-35	0.02	0.13
16965		35-50	0.06	0.46

Note: 14 % cement content was assumed for the calculations.

End of results

Iren S. Jasko MSc EurChem CSci CChem FRSC
Technical Manager

SANDBERG

Sandberg LLP
5 Carpenter's Place
Clapham High Street
London SW4 7TD
Tel: 020 7565 7000
Fax: 020 7565 7101
email clapham@sandberg.co.uk
web www.sandberg.co.uk

UKAS TESTING 0262

61209/F

Certificate No
1

Date of Test
14/11/2017

CONCRETE TEST RESULTS
COMPRESSIVE STRENGTH AND DENSITY OF CORES
BS EN 12504-1:2009, BS EN 12390-3:2009 and BS EN 12390-7:2009

Sandberg Reference		F91942	F91943	F91944
Site Mark/Client Reference		Beam	Deck	Column
Details: - Location - Date of coring		Beam NA	Deck NA	Column NA
Date Received		7/11/2017	7/11/2017	7/11/2017
Presence of abnormalities		None	None	None
Reinforcement, (diameter/distance)[1]	mm	None	None	None
Aggregate, maximum nominal size	mm	16	12	14
Age at Test	days	NA	NA	NA
Method of end preparation		HAC	HAC	HAC
Surface Moisture Condition at test		Damp	Damp	Damp
Actual Core Lengths - Minimum length, as received - Maximum length, as received - Prepared length - Relation to length, as-received	 mm mm mm mm	 68 85 52 20-65	 85 90 54 25-70	 80 85 53 25-70
Mean Core Diameter (d)[m]	mm	44	44	44
Length/Diameter Ratio, λ		1.18	1.23	1.20
Density[2] - Saturated condition	kg/m³	2450	2430	2450
Saturation before Test	days	7	7	7
Maximum Load at Failure	kN	91.5	84.4	96.7
Mode of Failure[4]		Normal	Normal	Normal
Compressive Strength[3] (Measured Core Strength)	MPa (N/mm²)	60.2	55.5	63.6
Reinforcement Correction[5]		-	-	-
Compressive Strength[3] Corrected In-Situ Strength[5]	MPa (N/mm²)	64.0	60.1	68.2

1 Centre of bar to core end, before and after end preparation (e.g. 20/100/40 = 20mm diameter bar, 100mm from the core end as-received and 40mm from the end after preparation).
2 Volume by water displacement, densities given to nearest 10kg/m³.
3 Compressive strength values given to nearest 0.1MPa (N/mm²).
4 'Normal' (symmetrical failure) or otherwise as described.
5 BS EN 12504-1, National Annex NA - equivalent in-situ cube (no adjustment for direction of drilling)

ND = Not determined. NA = Not applicable.

Client	Edwards Diving Services Ltd Dragon House Sir Alfred Owen Way Pontygwindy Industrial Estate Caerphilly CF83 3HU For the attention of Mr Steve Richings	**Signed**	For Sandberg LLP
		Name	John Gallagher
		Position	Deputy Quality Manager
Reference	Order No. P8092/SR dated 2/11/2017	**Date**	16 November 2017

Materials, samples and test specimens are retained for a period of 2 months from the issue of this test certificate.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. CON 106 rev01