Technical Note for Surface Water Drainage Condition Discharge

Prepared for:
Mr Martin Reece

February 2024

Location:
14 Caverleigh Way
Worcester Park
Surrey
KT4 8DG

Our reference:
93249-Reece-CaverleighWy_CD

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Document Issue Record

Location:	14 Caverleigh Way, Worcester Park, Surrey, KT4 8DG				
Application:	Erection of a single storey rear extension and provision of a raised decking with steps to the rear.				
Prepared for:	Mr Martin Reece				
Title:	Surface Water Drainage Technical Note				
Project No.:	93249_CD	**Date:**	21st February 2024	**Issue No.:**	1.0
Written By:	E. Webb, BSc (Hons) A. Rousou BSc (Hons)	**Checked By:**	E. Bouet, BSc (Hons)	**Authorised By:**	E. Bouet, BSc (Hons)

1. Introduction

1.1. This Surface Water Drainage Technical Note has been prepared by Unda Consulting Limited on behalf of Mr Martin Reece, to address Condition 3 of a planning application.

1.2. The planning application relates to erection of a single storey rear extension and provision of a raised decking with steps to the rear. These works are proposed to be undertaken at 14 Caverleigh Way, Worcester Park, Surrey, KT4 8DG.

1.3. Post development the increase in built footprint will amount to approximately 12m^2.

1.4. This report assesses the surface water drainage arrangement for the proposed development, which forms Condition 3 of a planning application. Condition 3 states the following:

Condition 3:

(3) Prior to the commencement of development, a SuDS strategy must be submitted to the Local Planning Authority and approved in writing in order to manage surface water run-off as close to its source as possible in accordance with the Mayor's drainage hierarchy in London Plan Policy SI 13. The submitted scheme must:

- *(i) Provide full details of all proposed SuDS measures to delay and control the rate of surface water discharged from the site in line with the Mayor's drainage hierarchy;*
- *(ii) Include calculations carried out by an appropriately qualified professional to show that the peak run-off rate for the 1 in 100 year 6-hour rainfall event (plus 40% for climate change) will be as close as reasonably practicable to the greenfield run-off rate; and*
- *(iii) Demonstrate that the 1 in 30 year rainfall event (plus 40% for climate change) can be contained without flooding; any flooding occurring between the 1 in 30 and 1 in 100 year event (plus 40% for climate change) will be safely contained on site; and that rainfall in excess of the 1 in 100 year event is managed to minimise risks.*

1.5. This Technical Note provides the information required to address the surface water elements of planning application Condition 3.

2. Existing Site:

2.1. The existing site consists of an existing residential dwelling. The site is understood to have lawful planning permission for residential use.

2.2. The surrounding area is characterised by residential developments.

Figure 1: Aerial View of Site Location (Source: Google Earth)

Figure 2: Existing Plans and Elevations (Source: Applicant)

Figure 3: Photograph of Existing Rear Elevation (Source: Rightmove)

Site Topography:

2.3. Environment Agency LiDAR has been used to assess the topography across the site and wider area. Light Detection and Ranging (LiDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground surface. Up to 100,000 measurements per second are made of the ground, allowing highly detailed terrain models to be generated at high spatial resolutions. The EA's LiDAR data archive contains digital elevation data derived from surveys carried out by the EA's specialist remote sensing team. Accurate elevation data is available for over 70% of England. The LiDAR technique records an elevation accurate to +0.3m every 2m. This dataset is derived from a combination of the EA's full dataset which has been merged and re-sampled to give the best possible coverage. The dataset can be supplied as a Digital Surface Model (DSM) produced from the signal returned to the LiDAR (which includes heights of objects, such as vehicles, buildings and vegetation, as well as the terrain surface) or as a Digital Terrain Model (DTM) produced by removing objects from the Digital Surface Model. 1.0m horizontal resolution DTM LiDAR data has been used for the purposes of this study.

2.4. EA 1.0m LiDAR remotely sensed digital elevation data suggests that the ground topography on site ranges approximately between 19.2m AOD at the front (north west) of the site to 19.0m AOD at the rear (south west). The topographic area of the proposed rear extension ranges from 19.7m AOD to 19.3m AOD.

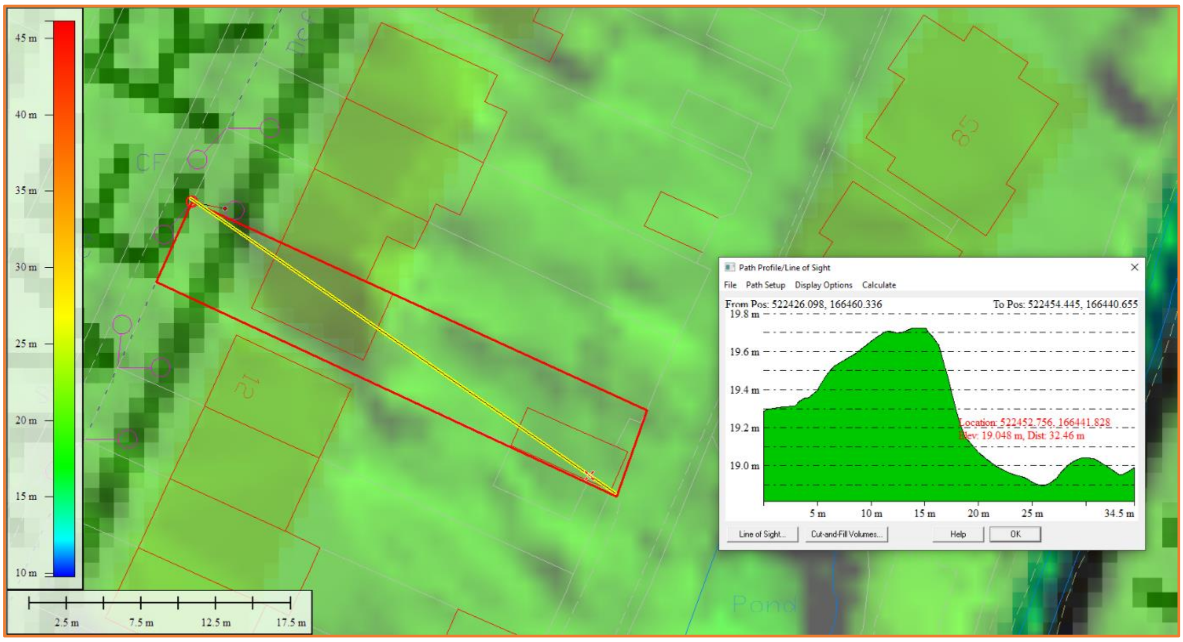


Figure 4: LiDAR DTM Showing Topographic Levels Across the Site (transect runs northwest to southeast) (Source: EA 1m LiDAR)

Existing Ground Conditions:

2.5. The 1:50,000 BGS map shows the site to be located directly upon the bedrock of London Clay Formation – Clay and Silt.

2.6. According to BGS mapping the site is underlain by Kempton Park Gravel Member – Sand and Gravel superficial deposits.

2.7. There are no BGS borehole logs within the site area.

2.8. The published Environment Agency Groundwater Source Protection Zone map shows the site is not located within a Groundwater Source Protection Zone.

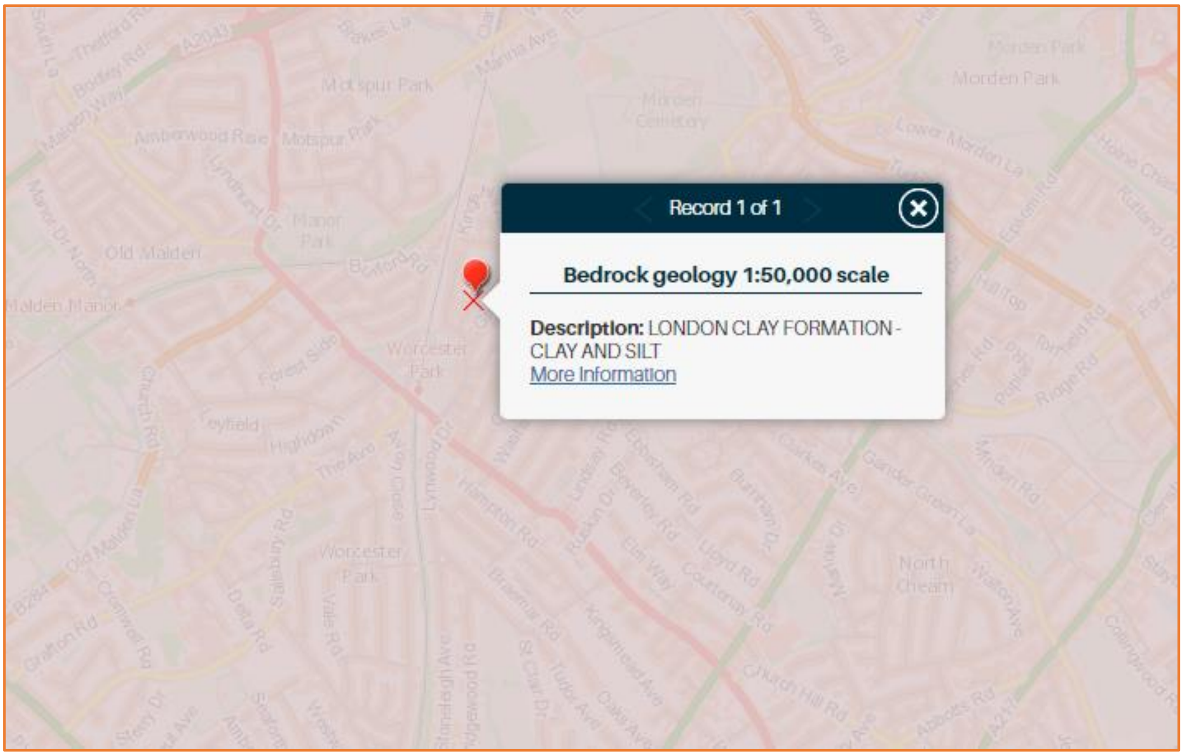


Figure 5: BGS Bedrock Geology (Source: BGS)

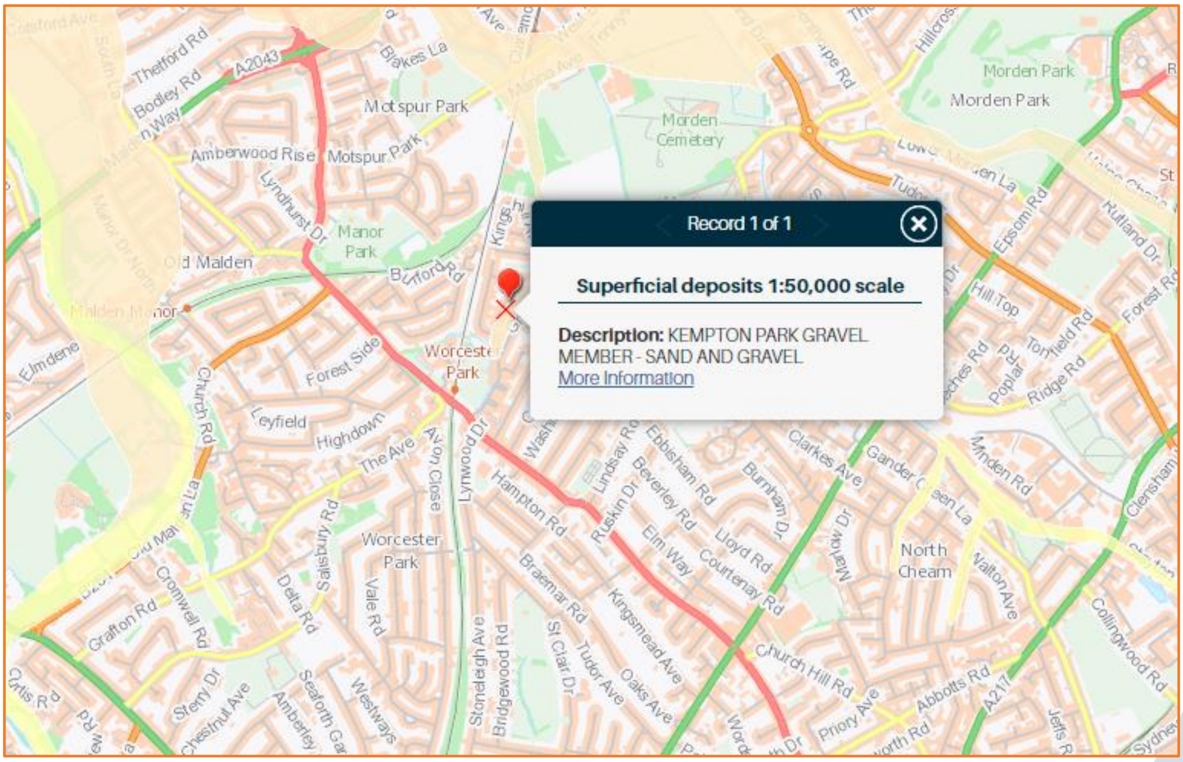


Figure 6: BGS Superficial Deposits (Source: BGS)

Nearby Watercourses / Drainage Features:

2.9. The nearest watercourse if the Beverley Brook, located 25m to the southeast of the site.

Existing Drainage:

2.10. It is understood that surface water from the rear of the house currently discharges to sewer at an unattenuated rate.

3. Development Proposals:

Proposed Development:

3.1. Discharge of Surface Water Planning Condition 3 is for erection of a single storey rear extension and provision of a raised decking with steps to the rear at 14 Caverleigh Way, Worcester Park, Surrey, KT4 8DG. Post development the increase in built footprint will amount to approximately 12m^2.

3.2. Therefore, the attenuation within this strategy has been based on the increase in built footprint.

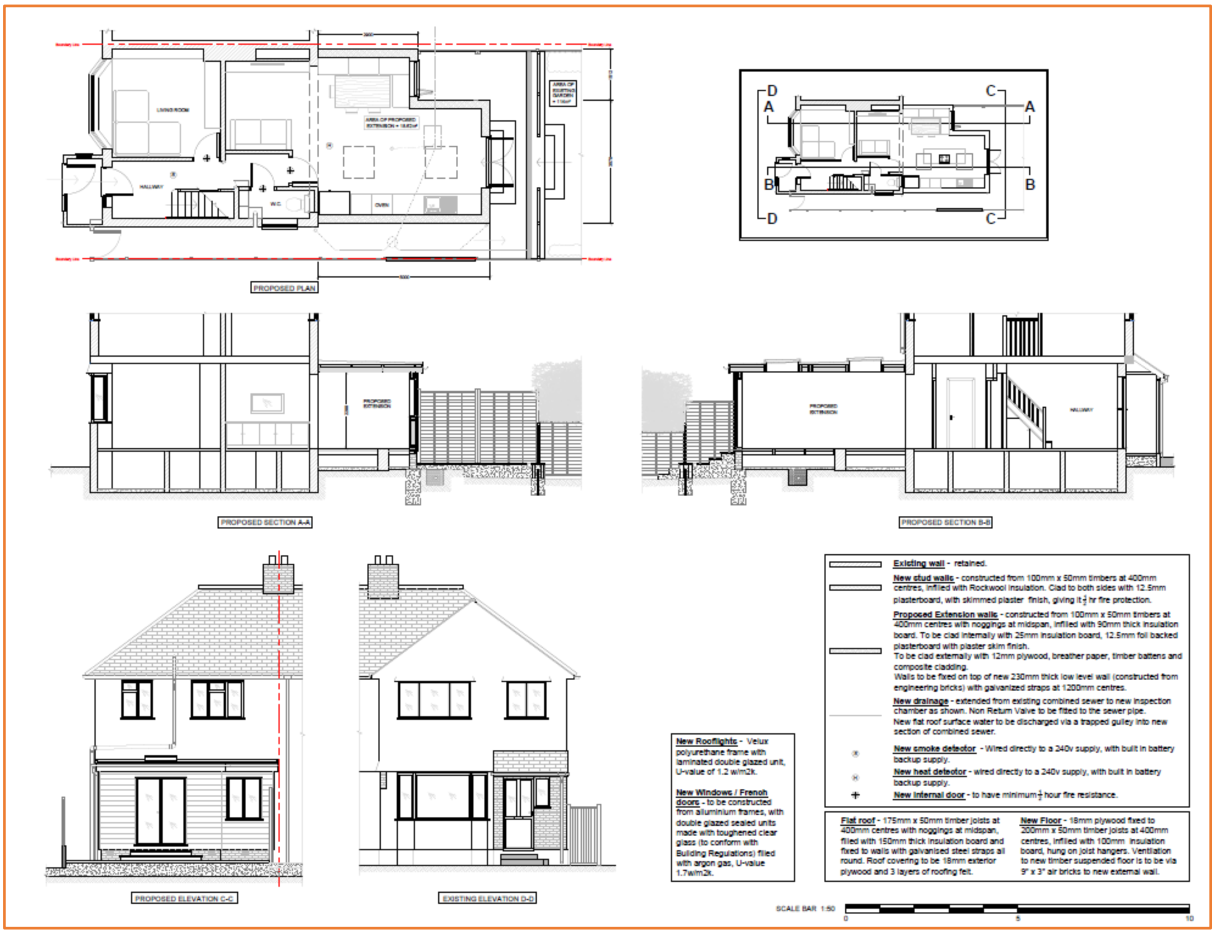


Figure 7: Proposed Floor Plan (Source: Mass Architecture)

4. Surface Water Drainage Strategy:

4.1. In order to mitigate flood risk posed by post development runoff, adequate control measures will need to be considered within the site. This will ensure that surface water runoff is dealt with at source and flood risk is not increased elsewhere.

Drainage Hierarchy:

4.2. The drainage strategy for the site has been prepared according to the drainage discharge hierarchy from CIRIA C753 The Suds Manual, as follows:

- Infiltration to the maximum extent that is practical;
- Discharge to surface waters;
- Discharge to surface water sewer.

Infiltration Potential:

4.1. The 1:50,000 BGS map showed the site to be located directly upon the bedrock of London Clay Formation – Clay and Silt. Therefore due to the aforementioned geology and site constraints, infiltration SuDS are not viable at the site.

Proposed Discharge Rate:

4.2. The greenfield runoff rates for the area of the sites being attenuated have been calculated as 0.0 l/s for the 1:1 annual runoff event, 0.0 l/s for the 1:30 year event and 0.0 l/s for the 1:100 year event. Refer to calculations in the report Appendix.

4.3. Runoff from the increase in built footprint will be directed into the raingarden located in the rear garden. This will then discharge into the sewer at an attenuated rate of 0.1 l/s via an orifice plate.

4.4. All new ground surfaces will be of permeable construction.

Raingarden:

4.5. The proposed area to be directed into the raingarden amounts to approximately 12m^2. The attenuation within the raingarden will be provided by cellular storage crates located beneath the topsoil.

4.6. In order to comply with CIRIA C753 The SuDS Manual, a 10% allowance will be added to the impermeable areas to take into account future urban creep. Applying a 10% allowance to the area being attenuated, including the raingarden (13m^2), gives a value of 14.3m^2. Therefore, all drainage calculations within this assessment have been made based on a total impermeable area of 14.3m^2.

4.7. Preliminary calculations indicate that cellular storage attenuation with dimensions of 1m^2 x 0.66m deep x 0.95 (voids) will be sufficient to accommodate all runoff from 14.3m^2 of impermeable areas arising from the critical 1:100 year + 40% climate change event.

4.8. Preliminary calculations indicated that some 0.63m^3 of storage is required to attenuate the runoff for all storms up to and including the 1 in 100 year + 40% climate change event. The cellular storage will discharge to sewer at an attenuated rate using the sites existing surface water connection.

4.9. Please note that the levels and locations of the cellular storage within the Causeway calculations are arbitrary for modelling purposes.

4.10. All preliminary surface water drainage calculations have been undertaken using Causeway software. Refer to the report Appendix.

Water Quality:

4.11. Water quality has been assessed in line with the Simple Index approach from Chapter 26 of CIRIA C753 The SuDS Manual:

Step 1 – Allocate suitable pollution hazard indices for the proposed land use.
Step 2 – Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index.

4.3. Roof water and runoff from the un-trafficked garden will contain negligible contaminant concentrations and does not warrant treatment. Nevertheless, it is suggested to include debris / sediment traps on any new drainage.

Design Exceedance:

4.12. Should the onsite drainage system fail under extreme rainfall events or blockage, flooding may occur within the site. In the event of the drainage system failure, the runoff flow can be managed through detailing the new external levels to direct water away from structures.

Adoption and Maintenance:

4.13. It is proposed that the cellular storage will be privately maintained by the end users.

4.14. A draft Maintenance Schedule is outlined in the Table below.

Cellular Storage

4.15. It is not envisaged that silt build up within the cellular crate systems will require a rigorous maintenance regime so long as silt is removed from upstream catch pits and inspection chambers on a regular basis. Notwithstanding this, a suitable maintenance regime for the systems will comprise of routine inspection and silt removal (as necessary). Inspection should be undertaken using CCTV equipment offered up the inspection tunnels located within the crate system. Camera access can be gained via inspection chambers and inlet pipework located at each end of the tunnels.

4.16. Silt removal can be achieved by jetting the inspection tunnels. Jetting should be undertaken in accordance with current jetting guidelines, in particular the Code of Practice for Sewer Jetting published by The Water Research Centre. Jetting at 150bar at 300l/min should be more than adequate in removing any build-up of material within the tunnel. The crate system will take higher pressures. However, unlike regular jetting which relies heavily on high pressure to remove hardened deposits on the inner bore of pipes, effective cleansing of a crate system relies more on the delivery flow rate to flush solids back through the system.

4.17. A standard jet head with rear facing nozzles should be used. The head should be fed to the far end of the crate tunnel via the nearest inspection chamber, activated and retracted. As the nozzle is removed, debris will be swept back into the inspection chamber where it can then be removed with the use of a standard gully sucker. This method will ensure the effective removal of gross solids (carrier bags, cans, leaf litter etc.) from the system. Whilst 100% removal cannot be guaranteed, it has been shown that this jetting method will also remove an element of finer material which would otherwise be 'lost' within the system.

Proposed Surface Water Drainage Pipework and Catchpits

4.18. It is not envisaged that silt build up within the pipework systems will require a rigorous maintenance regime so long as silt is removed from upstream catch pits on a regular basis. A suitable maintenance regime for the systems will comprise of routine inspection (every six months) and silt removal (as necessary).

Drainage Element	Maintenance Requirement	Frequency
Gutters & downpipes	Inspect and remove silt/ debris	To be inspected every three months and silt/ debris removed as necessary.
Inspection Chambers and Catch Pits	Inspect and remove silt	To be inspected every three months and silt/ debris removed as necessary. Flow control to be checked for blockages.
Cellular Storage	Inspect and remove debris	CCTCV inspection following first storm event. Monthly CCTV inspections for first 3 months. 6 monthly CCTV inspections thereafter. Jetting to remove silt as necessary.
Flow Controls	Inspected for blockage and blockage / debris build up removed	Every six months

Table 1: Suggested Maintenance Regime for Elements of the Drainage Infrastructure

Note: In addition to the above maintenance requirements, it is recommended that all drainage elements are inspected:

- Following the first storm event;
- Monthly for the first 3 months following commissioning.

5. Discussion and Conclusions:

5.1. This Surface Water Drainage Technical Note has been prepared by Unda Consulting Limited on behalf of Mr Martin Reece, to address Condition 3 of a planning application.

5.2. The Planning application relates to erection of a single storey rear extension and provision of a raised decking with steps to the rear. These works are proposed to be undertaken at 14 Caverleigh Way, Worcester Park, Surrey, KT4 8DG.

5.3. Post development the increase in built footprint will amount to approximately 12m^2.

5.4. This report assesses the surface water drainage arrangement for the proposed development, which forms Condition 3 of a planning application. Condition 3 states the following:

Condition 3:

(3) Prior to the commencement of development, a SuDS strategy must be submitted to the Local Planning Authority and approved in writing in order to manage surface water run-off as close to its source as possible in accordance with the Mayor's drainage hierarchy in London Plan Policy SI 13.

5.5. The existing site consists of an existing residential dwelling. The site is understood to have lawful planning permission for residential use. The surrounding area is characterised by residential developments.

5.6. EA 1.0m LiDAR remotely sensed digital elevation data suggests that the ground topography on site ranges approximately between 19.2m AOD at the front (north west) of the site to 19.0m AOD at the rear (south west). The topographic area of the proposed rear extension ranges from 19.7m AOD to 19.3m AOD.

5.7. Discharge of Surface Water Planning Condition 3 is for erection of a single storey rear extension and provision of a raised decking with steps to the rear at 14 Caverleigh Way, Worcester Park, Surrey, KT4 8DG. Post development the increase in built footprint will amount to approximately 12m^2.

5.8. Therefore, the attenuation within this strategy has been based on the increase in built footprint.

5.9. The 1:50,000 BGS map shows the site to be located directly upon the bedrock of London Clay Formation – Clay and Silt.

5.10. According to BGS mapping the site is underlain by Kempton Park Gravel Member – Sand and Gravel superficial deposits. There are no BGS borehole logs within the site area.

5.11. The published Environment Agency Groundwater Source Protection Zone map shows the site is not located within a Groundwater Source Protection Zone.

Surface Water Drainage Discussion

5.12. The 1:50,000 BGS map showed the site to be located directly upon the bedrock of London Clay Formation – Clay and Silt. Therefore due to the aforementioned geology and site constraints, infiltration SuDS are not viable at the site.

5.13. It is understood that surface water from the site currently discharges to sewer at an unattenuated rate. Thus, we propose to utilise the existing connections.

5.14. The greenfield runoff rates for the area of the sites being attenuated have been calculated as 0.0 l/s for the 1:1 annual runoff event, 0.0 l/s for the 1:30 year event and 0.0 l/s for the 1:100 year event. Refer to calculations in the report Appendix.

5.15. Runoff from the increase in built footprint will be directed into the raingarden located in the rear garden. This will then discharge to sewer at an attenuated rate of 0.1 l/s via an orifice plate.

5.16. All new ground surfaces will be of permeable construction.

5.17. The proposed area that will be directed into the raingarden amounts to approximately 12m^2. The attenuation within the raingarden will be provided by cellular storage crates located beneath the topsoil.

5.18. In order to comply with CIRIA C753 The SuDS Manual, a 10% allowance will be added to the impermeable areas to take into account future urban creep. Applying a 10% allowance to the area being attenuated, including the raingarden (13m^2), gives a value of 14.3m^2. Therefore, all drainage calculations within this assessment have been made based on a total impermeable area of 14.3m^2.

5.19. Preliminary calculations indicate that cellular storage attenuation with dimensions of 1m^2 x 0.66m deep x 0.95 (voids) will be sufficient to accommodate all runoff from 14.3m^2 of impermeable areas arising from the critical 1:100 year + 40% climate change event.

5.20. Preliminary calculations indicated that some 0.63m^3 of storage is required to attenuate the runoff for all storms up to and including the 1 in 100 year + 40% climate change event. The cellular storage will discharge to sewer at an attenuated rate using the sites existing surface water connection.

5.21. Water quality has been assessed in line with the Simple Index approach from Chapter 26 of CIRIA C753 The SuDS Manual. Roof water and runoff from the un-trafficked garden will contain negligible contaminant concentrations and does not warrant treatment. Nevertheless, it is suggested to include debris / sediment traps on any new drainage.

5.22. Should the onsite drainage system fail under extreme rainfall events or blockage, flooding may occur within the site. In the event of the drainage system failure, the runoff flow can be managed through detailing the new external levels to direct water away from structures.

5.23. This drainage strategy has been undertaken in accordance with the principles set out in NPPF. We can conclude that providing the development adheres to the conditions advised above, the said development proposals can be accommodated without increasing flood risk within the locality in accordance with objectives set by Central Government and the EA.

Unda Consulting Limited

February 2024

6. Appendix

A - Plans by others:

- Location/Existing Layout Site Plan – Martin Reece;
- Proposed Plans – Martin Reece.

B – Causeway Calculations:

- IH124 Pre-Development Greenfield Runoff Calculations for the area of the site being attenuated;
- Raingarden (Depth/Area/Inf Area Storage Structure) Calculations.

C - Plans:

- Proposed Drainage Layout [93249-01].

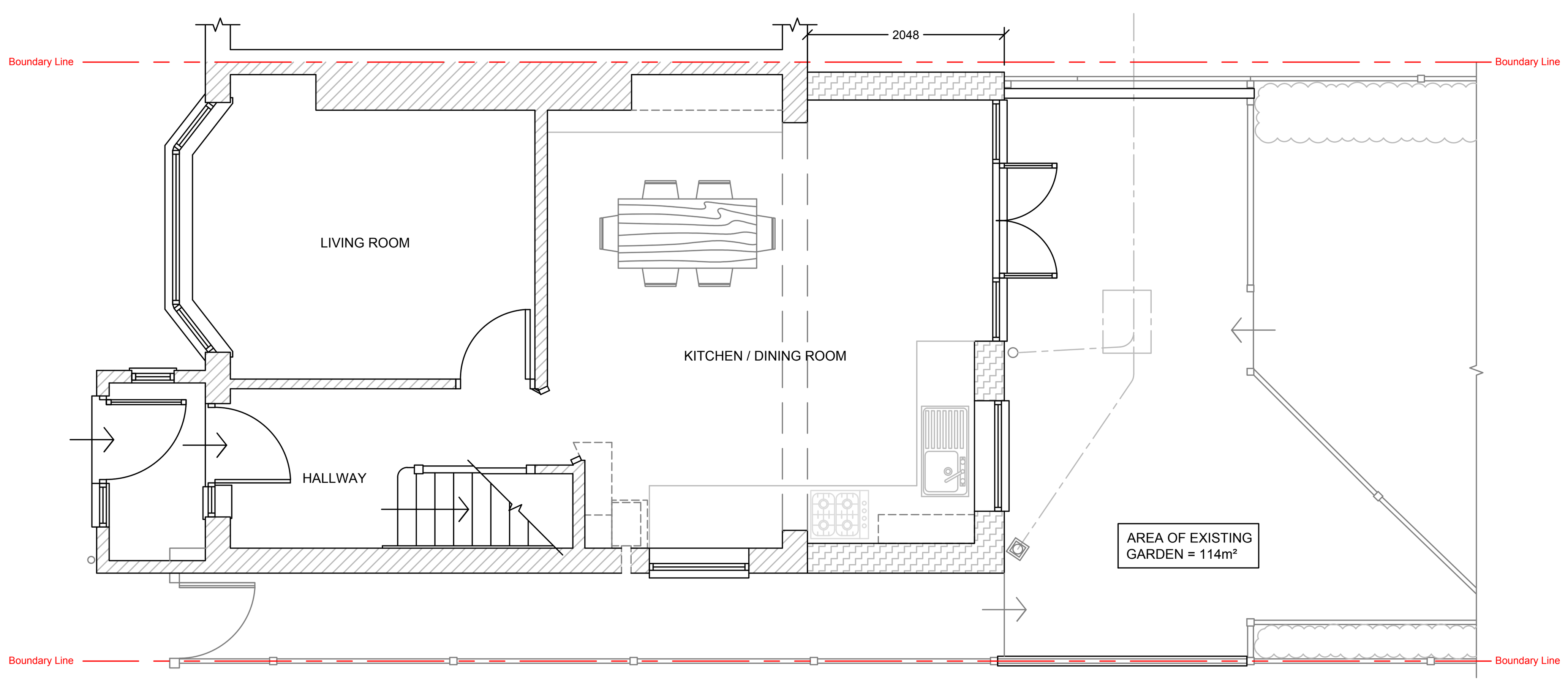
14 Caverleigh Way, Worcester Park, KT4 8DG

Scale 1:1250

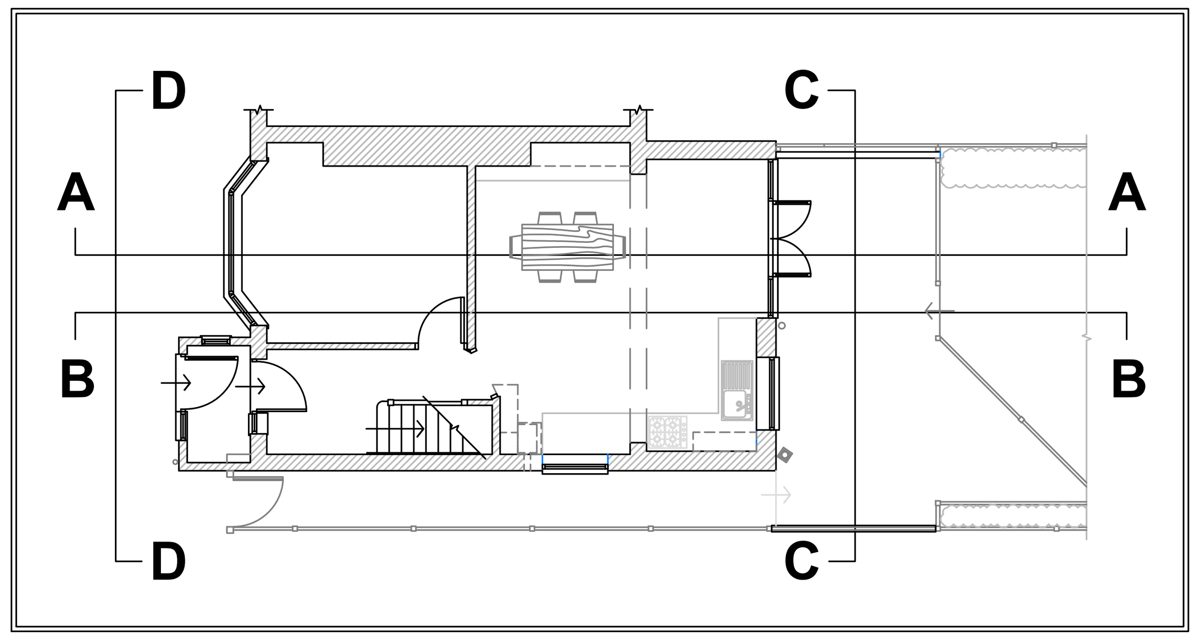
Licensed Mapping

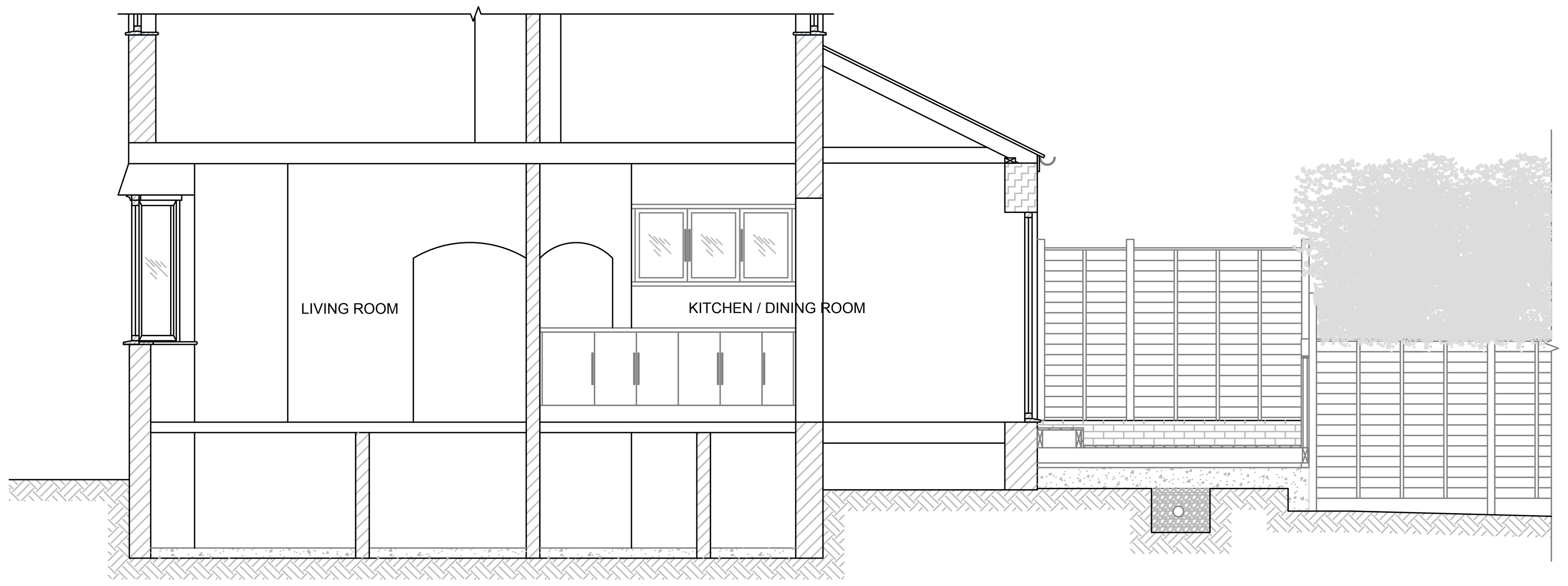
All Dimensions to be checked on site and discrepancies advised immediately to Martin Reece prior to the commencement of any works.

Any variations or supplementary drawings are to be approved by Martin Reece

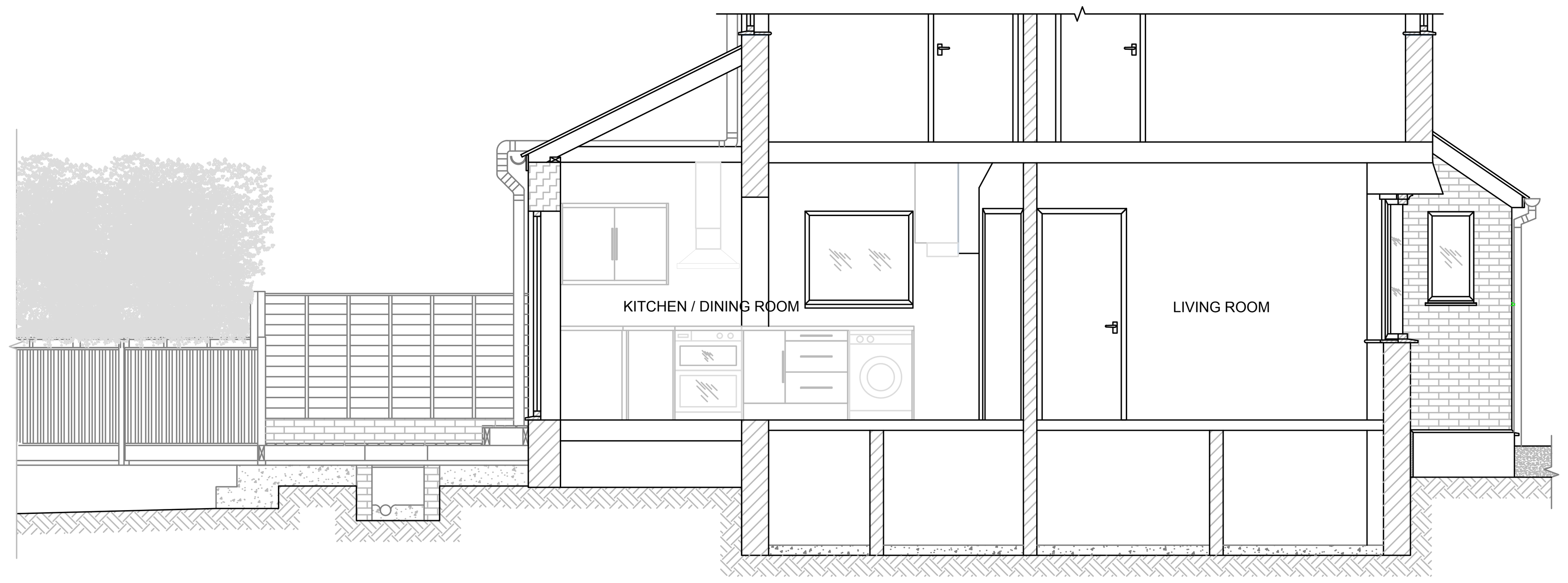


EXISTING PLAN





EXISTING SECTION A-A



EXISTING SECTION B-B

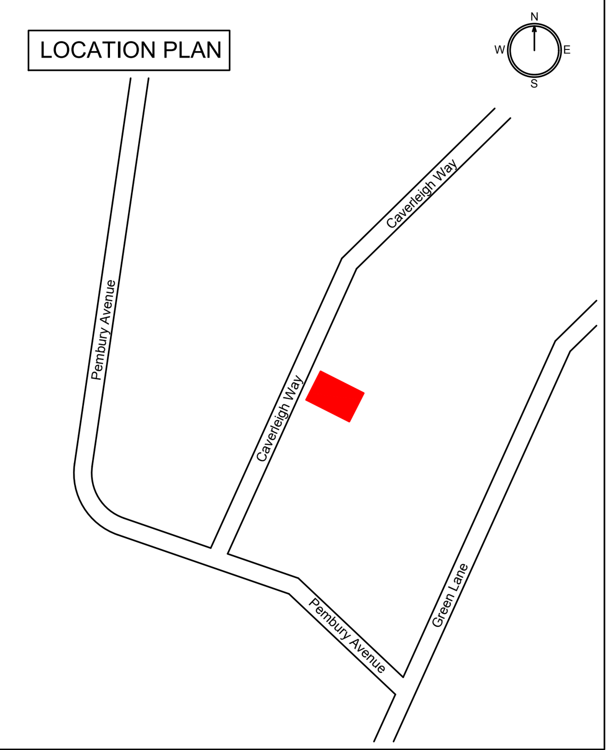
EXISTING ELEVATION C-C

EXISTING ELEVATION D-D

Existing wall to be retained.

Existing wall to be demolished.

LOCATION PLAN



ISSUE	REVISION	INIT	DATE
D	FENCE ADDED TO SECTION B-B	MR	28/07/2023
C	TITLEBLOCK NOTES AMMENDED	MR	13/05/2023
B	BOUNDARY LINE ADDED	MR	13/04/2023
A	EXISTING EXTENSION TO BE DEMOLISHED	MR	13/03/2023

Job
14 CAVERLEIGH WAY
WORCESTER PARK
KT4 8DH

Client
KIRSTEN BROADWAY
& JAMIE REECE

martin reece design & build

31 Leyton Road
South Wimbledon
London SW19 1DJ

Telephone: 07748513059
Email: mreece.67@gmail.com

Title
EXISTING PLANS, SECTIONS & ELEVATIONS

Scale at A1	Date
1:50	13/04/2023
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MR	--
Job No	Drawing No
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Revision
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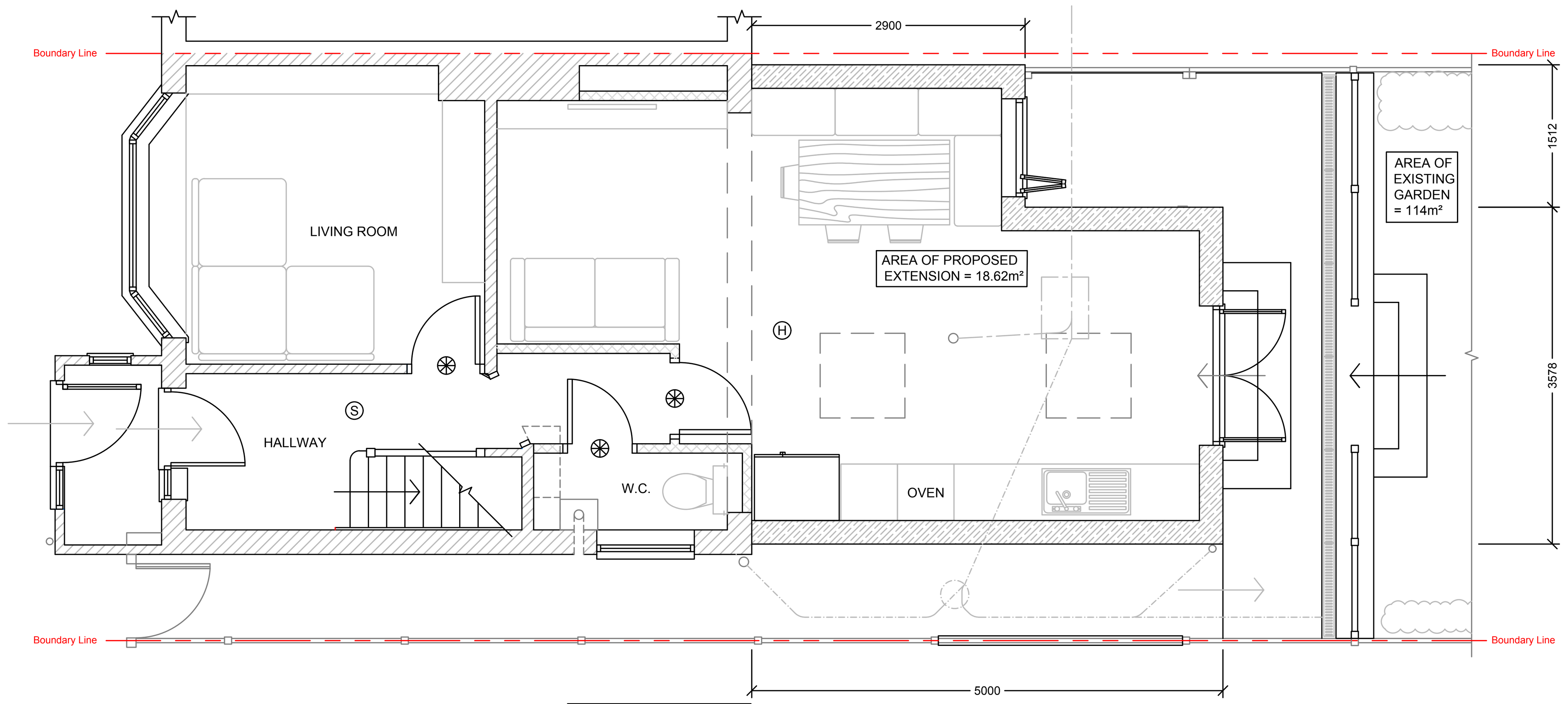
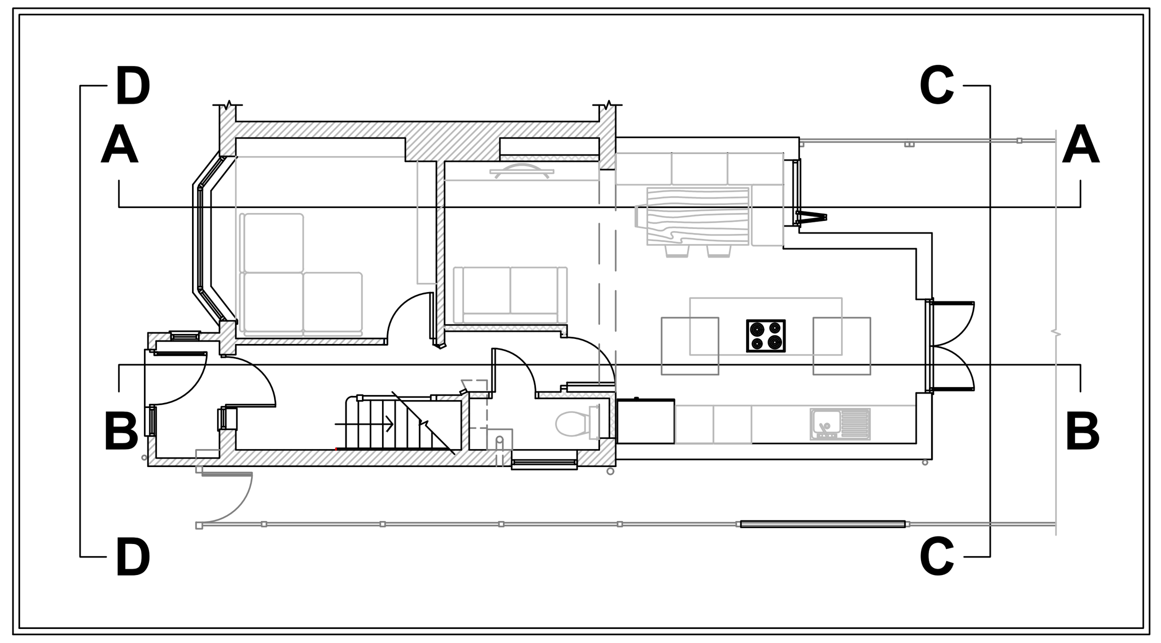
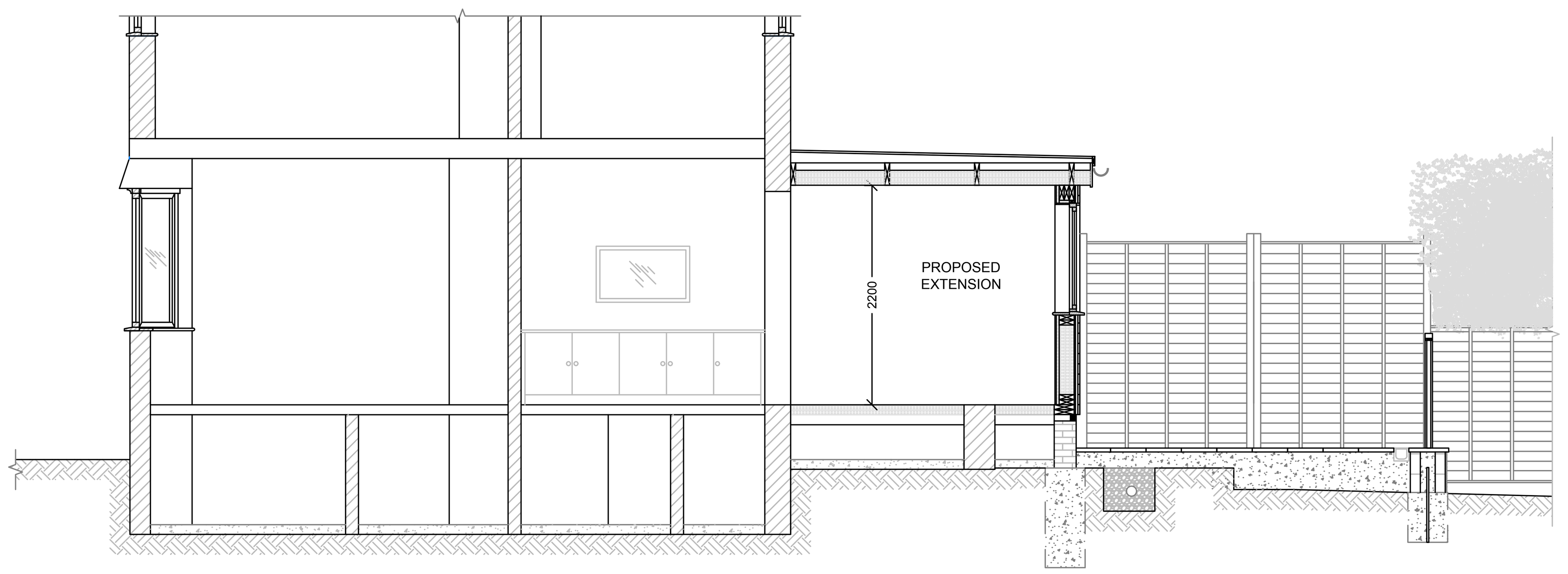
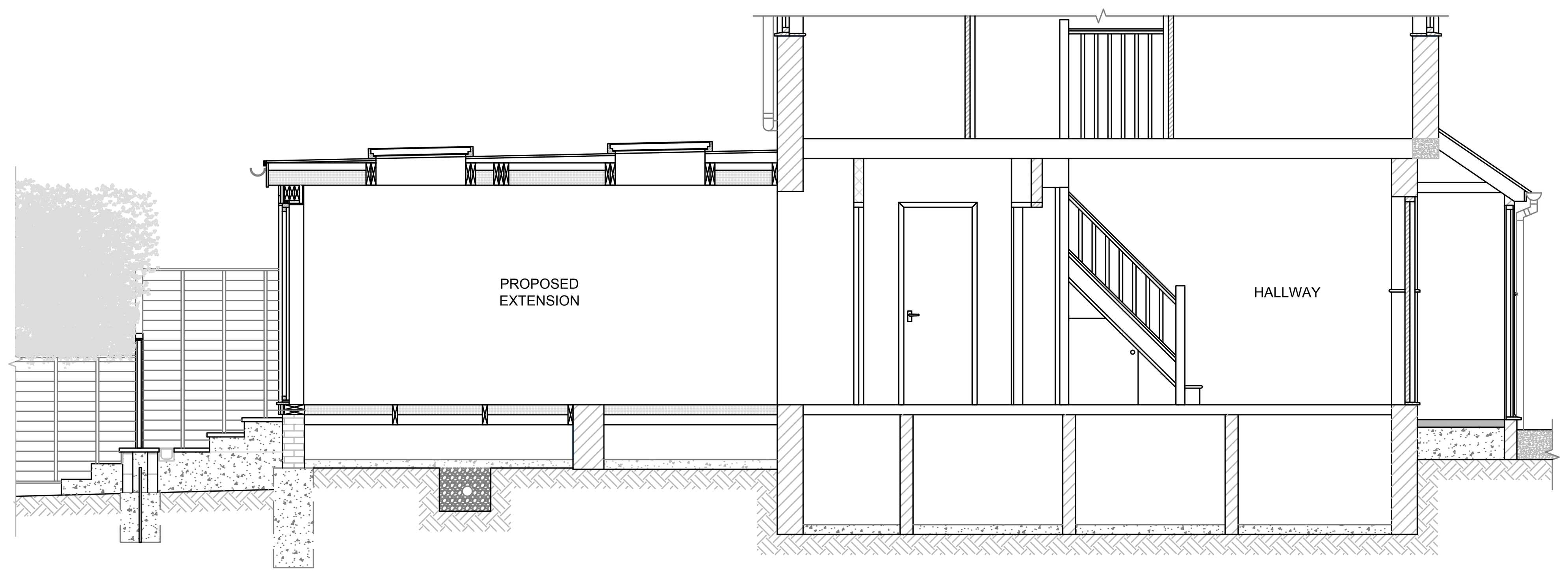


PROPOSED PLAN





PROPOSED SECTION A-A



PROPOSED SECTION B-B

PROPOSED ELEVATION C-C

EXISTING ELEVATION D-D

New Rooflights - Velux polyurethane frame with laminated double glazed unit, U-value of 1.2 w/m2k.

New Windows / French doors - to be constructed from alluminium frames, with double glazed sealed units made with toughened clear glass (to conform with Building Regulations) filled with argon gas, U-value 1.7w/m2k.

Existing wall - retained.

New stud walls - constructed from 100mm x 50mm timbers at 400mm centres, infilled with Rockwool insulation. Clad to both sides with 12.5mm plasterboard, with skimmed plaster finish, giving it ½ hr fire protection.

Proposed Extension walls - constructed from 100mm x 50mm timbers at 400mm centres with noggings at midspan, infilled with 90mm thick insulation board. To be clad internally with 25mm insulation board, 12.5mm foil backed plasterboard with plaster skim finish.
To be clad externally with 12mm plywood, breather paper, timber battens and composite cladding.
Walls to be fixed on top of new 230mm thick low level wall (constructed from engineering bricks) with galvanized straps at 1200mm centres.

New drainage - extended from existing combined sewer to new inspection chamber as shown. Non Return Valve to be fitted to the sewer pipe.
New flat roof surface water to be discharged via a trapped gulley into new section of combined sewer.

Ⓢ **New smoke detector** - Wired directly to a 240v supply, with built in battery backup supply.

Ⓗ **New heat detector** - wired directly to a 240v supply, with built in battery backup supply.

New internal door - to have minimum ½ hour fire resistance.

Flat roof - 175mm x 50mm timber joists at 400mm centres with noggings at midspan, filled with 150mm thick insulation board and fixed to walls with galvanised steel straps all round. Roof covering to be 18mm exterior plywood and 3 layers of roofing felt.

New Floor - 18mm plywood fixed to 200mm x 50mm timber joists at 400mm centres, infilled with 100mm insulation board, hung on joist hangers. Ventilation to new timber suspended floor is to be via 9" x 3" air bricks to new external wall.

SCALE BAR 1:50
0 5 10

All Dimensions to be checked on site and discrepancies advised immediately to Martin Reece prior to the commencement of any works.

Any variations or supplementary drawings are to be approved by Martin Reece

ISSUE	REVISION	INIT	DATE
D	Proposed patio & steps detail changed		
	Proposed new fence added to section		
	B-B and Elevation C-C	MR	31/07/2023
C	Titleblock notes ammended	MR	13/05/2023
B	Boundary line added	MR	13/04/2023
A	Existing extension demolished.		
	Proposed extension layout changed	MR	18/03/2023

Job
14 CAVERLEIGH WAY
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Client
KIRSTEN BROADWAY
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Title
PROPOSED PLANS, SECTIONS & ELEVATIONS

Scale at A1: 1:50	Date: 13/04/2023
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Job No: -------	Drawing No: 200
Revision: D	

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
MH1	0.002	4.00	10.000	100.000	100.000	0.661

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m³/ha)	0.0
M5-60 (mm)	20.000	Check Discharge Rate(s)	✓
Ratio-R	0.400	1 year (l/s)	0.0
Summer CV	0.750	30 year (l/s)	0.0
Winter CV	0.840	100 year (l/s)	0.0
Analysis Speed	Normal	Check Discharge Volume	x
Skip Steady State	x		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	2.40
Greenfield Method	IH124	Growth Factor 100 year	3.19
Positively Drained Area (ha)	0.001	Betterment (%)	0
SAAR (mm)	620	QBar	0.0
Soil Index	2	Q 1 year (l/s)	0.0
SPR	0.30	Q 30 year (l/s)	0.0
Region	6	Q 100 year (l/s)	0.0
Growth Factor 1 year	0.85		

Node MH1 Online Orifice Control

Flap Valve	x	Invert Level (m)	9.339	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Diameter (m)	0.009		

Node MH1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	9.339
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	84

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1.0	0.0	0.660	1.0	0.0	0.661	0.0	0.0

Results for 100 year +40% CC 15 minute summer. 255 minute analysis at 1 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	MH1	17	9.787	0.448	1.3	0.4259	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
15 minute summer	MH1	Orifice	0.1	0.5

Results for 100 year +40% CC 15 minute winter. 255 minute analysis at 1 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	MH1	17	9.843	0.504	1.3	0.4789	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
15 minute winter	MH1	Orifice	0.1	0.6

Results for 100 year +40% CC 30 minute summer. 270 minute analysis at 1 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
30 minute summer	MH1	28	9.871	0.532	1.2	0.5054	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
30 minute summer	MH1	Orifice	0.1	0.7

Results for 100 year +40% CC 30 minute winter. 270 minute analysis at 1 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	MH1	30	9.954	0.615	1.0	0.5838	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
30 minute winter	MH1	Orifice	0.1	0.8

Results for 100 year +40% CC 60 minute summer. 300 minute analysis at 1 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	MH1	45	9.908	0.569	0.8	0.5404	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
60 minute summer	MH1	Orifice	0.1	0.8

Results for 100 year +40% CC 60 minute winter. 300 minute analysis at 1 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	MH1	49	9.987	0.648	0.7	0.6155	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
60 minute winter	MH1	Orifice	0.1	0.9

Results for 100 year +40% CC 120 minute summer. 360 minute analysis at 2 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
120 minute summer	MH1	80	9.921	0.582	0.5	0.5532	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
120 minute summer	MH1	Orifice	0.1	1.1

Results for 100 year +40% CC 120 minute winter. 360 minute analysis at 2 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	MH1	86	9.984	0.645	0.4	0.6127	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
120 minute winter	MH1	Orifice	0.1	1.2

Results for 100 year +40% CC 180 minute summer. 420 minute analysis at 4 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
180 minute summer	MH1	112	9.871	0.532	0.4	0.5053	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
180 minute summer	MH1	Orifice	0.1	1.0

Results for 100 year +40% CC 180 minute winter. 420 minute analysis at 4 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	MH1	124	9.984	0.645	0.3	0.6127	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	MH1	Orifice	0.1	1.4

Results for 100 year +40% CC 240 minute summer. 480 minute analysis at 4 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
240 minute summer	MH1	144	9.811	0.472	0.3	0.4480	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
240 minute summer	MH1	Orifice	0.1	1.0

Results for 100 year +40% CC 240 minute winter. 480 minute analysis at 4 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
240 minute winter	MH1	152	9.826	0.487	0.2	0.4629	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
240 minute winter	MH1	Orifice	0.1	1.2

Results for 100 year +40% CC 360 minute summer. 600 minute analysis at 8 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute summer	MH1	208	9.743	0.404	0.2	0.3834	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
360 minute summer	MH1	Orifice	0.1	1.0

Results for 100 year +40% CC 360 minute winter. 600 minute analysis at 8 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	MH1	208	9.774	0.435	0.2	0.4134	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
360 minute winter	MH1	Orifice	0.1	1.2

Results for 100 year +40% CC 480 minute summer. 720 minute analysis at 8 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute summer	MH1	264	9.721	0.382	0.2	0.3633	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
480 minute summer	MH1	Orifice	0.1	1.1

Results for 100 year +40% CC 480 minute winter. 720 minute analysis at 8 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	MH1	336	9.639	0.300	0.1	0.2854	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
480 minute winter	MH1	Orifice	0.1	1.2

Results for 100 year +40% CC 600 minute summer. 840 minute analysis at 15 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	MH1	375	9.612	0.273	0.1	0.2592	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
600 minute summer	MH1	Orifice	0.1	0.9

Results for 100 year +40% CC 600 minute winter. 840 minute analysis at 15 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute winter	MH1	405	9.646	0.307	0.1	0.2915	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
600 minute winter	MH1	Orifice	0.1	1.3

Results for 100 year +40% CC 720 minute summer. 960 minute analysis at 15 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute summer	MH1	435	9.612	0.273	0.1	0.2592	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
720 minute summer	MH1	Orifice	0.1	0.9

Results for 100 year +40% CC 720 minute winter. 960 minute analysis at 15 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
720 minute winter	MH1	480	9.657	0.318	0.1	0.3020	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
720 minute winter	MH1	Orifice	0.1	1.4

Results for 100 year +40% CC 960 minute summer. 1200 minute analysis at 15 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute summer	MH1	570	9.631	0.292	0.1	0.2776	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
960 minute summer	MH1	Orifice	0.1	1.1

Results for 100 year +40% CC 960 minute winter. 1200 minute analysis at 15 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	MH1	600	9.657	0.318	0.1	0.3020	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
960 minute winter	MH1	Orifice	0.1	1.4

Results for 100 year +40% CC 1440 minute summer. 1680 minute analysis at 30 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	MH1	810	9.626	0.287	0.1	0.2727	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
1440 minute summer	MH1	Orifice	0.1	1.1

Results for 100 year +40% CC 1440 minute winter. 1680 minute analysis at 30 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	MH1	810	9.626	0.287	0.1	0.2727	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
1440 minute winter	MH1	Orifice	0.1	1.1

Results for 100 year +40% CC 2160 minute summer. 2400 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute summer	MH1	1140	9.553	0.214	0.1	0.2031	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
2160 minute summer	MH1	Orifice	0.1	0.7

Results for 100 year +40% CC 2160 minute winter. 2400 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute winter	MH1	60	9.339	0.000	0.0	0.0000	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
2160 minute winter	MH1	Orifice	0.0	0.0

Results for 100 year +40% CC 2880 minute summer. 3120 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2880 minute summer	MH1	60	9.339	0.000	0.0	0.0000	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
2880 minute summer	MH1	Orifice	0.0	0.0

Results for 100 year +40% CC 2880 minute winter. 3120 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2880 minute winter	MH1	60	9.339	0.000	0.0	0.0000	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
2880 minute winter	MH1	Orifice	0.0	0.0

Results for 100 year +40% CC 4320 minute summer. 4560 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
4320 minute summer	MH1	60	9.339	0.000	0.0	0.0000	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
4320 minute summer	MH1	Orifice	0.0	0.0

Results for 100 year +40% CC 4320 minute winter. 4560 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
4320 minute winter	MH1	60	9.339	0.000	0.0	0.0000	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
4320 minute winter	MH1	Orifice	0.0	0.0

Results for 100 year +40% CC 5760 minute summer. 6000 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
5760 minute summer	MH1	60	9.339	0.000	0.0	0.0000	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
5760 minute summer	MH1	Orifice	0.0	0.0

Results for 100 year +40% CC 5760 minute winter. 6000 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
5760 minute winter	MH1	60	9.339	0.000	0.0	0.0000	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
5760 minute winter	MH1	Orifice	0.0	0.0

Results for 100 year +40% CC 7200 minute summer. 7440 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
7200 minute summer	MH1	60	9.339	0.000	0.0	0.0000	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
7200 minute summer	MH1	Orifice	0.0	0.0

Results for 100 year +40% CC 7200 minute winter. 7440 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
7200 minute winter	MH1	60	9.339	0.000	0.0	0.0000	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
7200 minute winter	MH1	Orifice	0.0	0.0

Results for 100 year +40% CC 8640 minute summer. 8880 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
8640 minute summer	MH1	60	9.339	0.000	0.0	0.0000	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
8640 minute summer	MH1	Orifice	0.0	0.0

Results for 100 year +40% CC 8640 minute winter. 8880 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
8640 minute winter	MH1	60	9.339	0.000	0.0	0.0000	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
8640 minute winter	MH1	Orifice	0.0	0.0

Results for 100 year +40% CC 10080 minute summer. 10320 minute analysis at 60 minute timestep. Mass balance: 100.00%

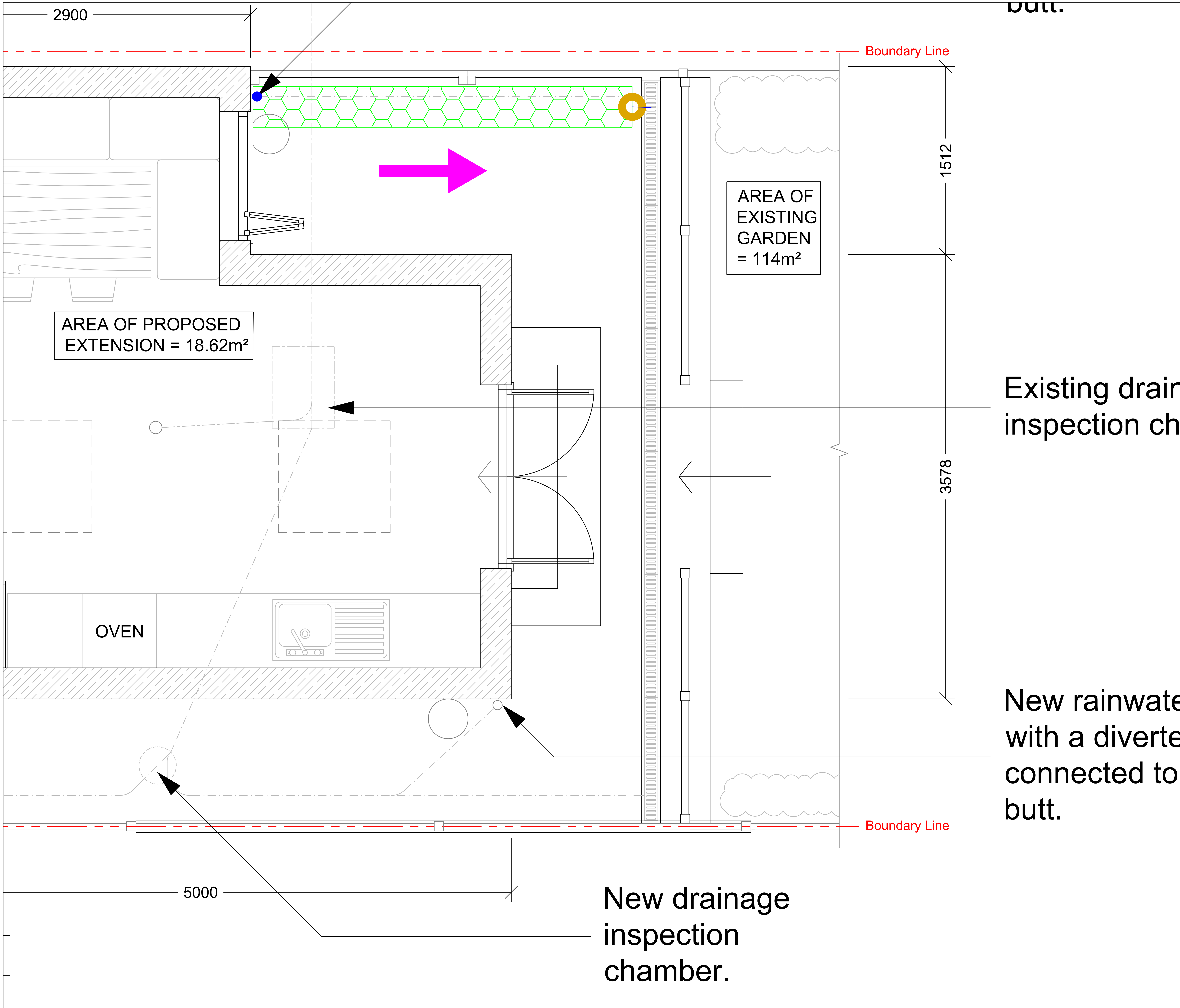
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
10080 minute summer	MH1	60	9.339	0.000	0.0	0.0000	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
10080 minute summer	MH1	Orifice	0.0	0.0

Results for 100 year +40% CC 10080 minute winter. 10320 minute analysis at 60 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
10080 minute winter	MH1	60	9.339	0.000	0.0	0.0000	0.0000	OK

Link Event	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
10080 minute winter	MH1	Orifice	0.0	0.0



Notes:

1. Discharge of surface water via a raingarden. Preliminary calculations indicate that sufficient storage required to attenuate runoff arising from the proposed increase in impermeable areas, during the critical 1 in 100 year + 40% Climate Change event, can be provided within a raingarden of dimensions $1m^2$ x 0.66m deep x 0.95 (voids).

Legend

- Proposed Raingarden
- Proposed Surface Water Pipework
- Proposed Downpipe
- Proposed Orifice Plate
- Design Exceedance Route

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Designed by:	Drawn by:	Checked by:
AR	AR	EB

Scale: 1:20@A2

Disclaimer: The drawings provided are for planning purposes only.