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Flood Risk Assessment

Site Address: 17 Billett Avenue, Waterlooville, Hants, PO7 7SZ.

Date: 14th November 2023

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1. Site Location Plan

The site is located on Billett Avenue, 17 Billett Avenue, Waterlooville, Hants, PO7 7SZ. A site plan is provide in Appendix A.

2. Site Development Description

The site is located at the eastern end of Billett Avenue, adjacent the Grove housing development. Originally developed in 1996, the site has since had the Hermitage stream culvert added circa 2006. This has covered the majority of the stream and significantly increased the garden ground level. The properties foundations were constructed for the stream and large gradient to it. Because of this a large void is present under the kitchen and utility rooms. The voids are open to external access via an open archway at the rear of the property; this access route will be removed during the development. The site is formed of a broken slope towards the rear property boundary, where there is a large sudden gradient increase to the properties on Roundway. The Hermitage stream crosses the site at the rear of the property, with the stream exiting the site at the southern boundary. The site consists of three distinct levels, the house, driveway and garages are at the highest elevation, then the rear garden is at a significantly lower elevation, followed by the stream bed which is the lowest elevation onsite.

3. Topology

Topological information is included in Appendix B and referenced site sections drawings. The site slopes from north-west to south-east.

4. Planning Application Elements

The planning application have been subdivided into the following elements.

- I. Garage Extension. The planning application seeks a small increase in ground footprint for additional garage space, the garage is located at the driveway height, with a floor level continuous with the existing garages.
- II. Basement Conversion. Repurpose of an existing cavity under the property to create a basement space. Technically not a basement by definition as the delta between floor level and ground level is significantly less than 1.2m, basement is used throughout for colloquial ease.
- III. A second floor extension added above the utility room. Utilising the existing foundations.

5. EA Flood Zones

The EA Flood Map is included in Appendix C, with site section plan provided in Appendix E.

6. Hermitage Stream Culvert

Appendix B details the culvert onsite, including levels and dimensions to existing property footprint. Note the site already discharges rainwater to the culvert via saddle connection (not shown). This is detailed in Appendix E, approved culvert drawings.

7. Third Party Agreements

Landwise Limited, the developers of the Grove development have agreed by formal agreement to:

“12.5.1 At the expense of the Transferor, the Transferor shall construct, lay and install a D400 class drain across the road in front of the Adjoining Land the location of which shall first be agreed in writing with the Transferee (not to be unreasonably withheld or delayed).

12.5.2 The Transferor shall use reasonable endeavours for the flow of the elements along the drain to be constructed under clause 12.5.1 to be taken into account by the drainage provisions relating to the proposed development on the Retained Land.”

This extract is taken from a TP1 transfer form, as drawn up by Moore & Barlow solicitors. Transferor refers to Landwise Limited. This document can be provided on requested to appropriate parties.

The result of this agreement is improved drainage to Billet Avenue, by capturing surface water run off at the entrance to the Grove development.

8. Risk Assessment

Additional flood risk on site due to the development.

The basement conversion and additional floor above the utility, do not affect flood risk for the site. There is no decrease in permeable surface area; the development exists within the buildings original foot print. There is no effect on surface water flow across the site from these additions. Therefore there is no additional risk from development.

Additional flood risk off site due to the development.

Due to the natural topology of the site, flow traverses the site approximating the streams route. All flow onsite exits on the southern boundary. The proposed developments do not change the course of this flow path or add any additional flow or flow rate intensity. Therefore there are no additional risks to offsite flooding from this development.

Surface Water Risk

The single garage extension does increase the buildings foot print. Previous flood risk assessment [1], previously reviewed the risk of flooding for the impact of additional non-permeable driveway surface area. It is believed this assessments applicability remains unchanged for the single garage extension element of the application. The garage floor level will be the same as the existing garages, the surface area the garage foot print covers is already a non-permeable surface and therefore there is no additional risk. Surface water from Billett Avenue spilling onto the site is

managed by linear slot drains across the driveway entrance. These drains are connected to the foul line. The existing garages have large F900 grate drains across their entrance which also feeds into the foul line. Calculation [2] estimates the surface water flow and shows that for 1 in 100 year 6hr intensity storm flows are within drainage capacity providing drains are not blocked. Therefore there is no additional risk from the development. Grate channel drains will be provided in front of the new garage entrance and around the perimeter, providing a storm water flow path for surface water that does not utilise foul lines. This maintains the waters flow down the driveway in a channel rather than on the surface (applicable for new garage foot print). This strategy prevents alteration to flow path and any additional loading on combined drains. The assessments undertaken above are highly conservative, due to the full flow run off assumed at one location and still shown to meet design requirements. In addition to this there is additional drainage to capture road run off being added by Landwise, capturing surface water prior to houses 17, 18, 19 & 20. In addition to this there are planned improvements to the privately owned road (by residential committee), to reinstate existing road drainage that was accidentally blocked some years previous.

Flood Risk to Basement Conversion

The basement conversion requires an FRA, with respect to flood risk from fluvial flood. Flooding from Hermitage stream on the site is not possible due to the culvert, flooding would occur from upstream. Work provided for the adjacent Grove development [3] has shown a 1 in 100 year flow rate of $2.45\text{m}^3/\text{sec}$, this requires a 40% uplift to account for climate change and provides a maximum flow rate of $3.43\text{m}^3/\text{sec}$.

The culverts maximum flow rate before the water level reaches ground level at the Grove site inlet is $5.2\text{m}^3/\text{sec}$ [3], this rate is significantly greater than the $3.43\text{m}^3/\text{sec}$ peak rate required. Therefore, there is no flood risk from the Grove site for the basis of 1 in 100 year case. Looking further upstream, the stream is restricted by the Highfield culvert, with a diameter of 1.05m, this restriction will choke flow downstream and limit debris blockage. The culvert does go through an open section on entrance to the Grove site before entering the 1.2m diameter culvert.

The Grove report [3] also looked at a scenario with a probability of 1 in 100 flows coupled with a 50% blockage of the Grove culvert entrance. The probability of these scenarios occurring simultaneously are unknown, historical records from the EA can be reviewed to define a probabilistic model if deemed required. This case and a 1 in 1000 coupled with 50% blockage are reviewed for information in [4] where overland flows are reviewed. Appendix D provides details of these highly conservative assessments in terms of site levels. It is not believed that these scenarios form part of the mandatory requirements; however their output will be included in the basement design. The basement waterproofing is applied to a significantly high level, providing a freeboard well in excess of >1m for the worst case. Therefore there is no risk to the structure or persons using the structure even at the extremes reviewed. The conversion of the raft space will prevent flooding of the space, by removing the arch access and fully waterproofing the structure to a suitable level for all foreseeable future cases.

Basements are considered vulnerable structures and can present significant risks if not managed correctly. The conversion proposed is only slightly below GL, will have entry and egress through stairs into the main house, the basement lining will be a fully water proof structure providing significant freeboard against all hypothetical cases reviewed. Full structural assessment will be conducted as part of the submission to building control ensuring no detrimental effects to the existing structure.

Sea Level Rise

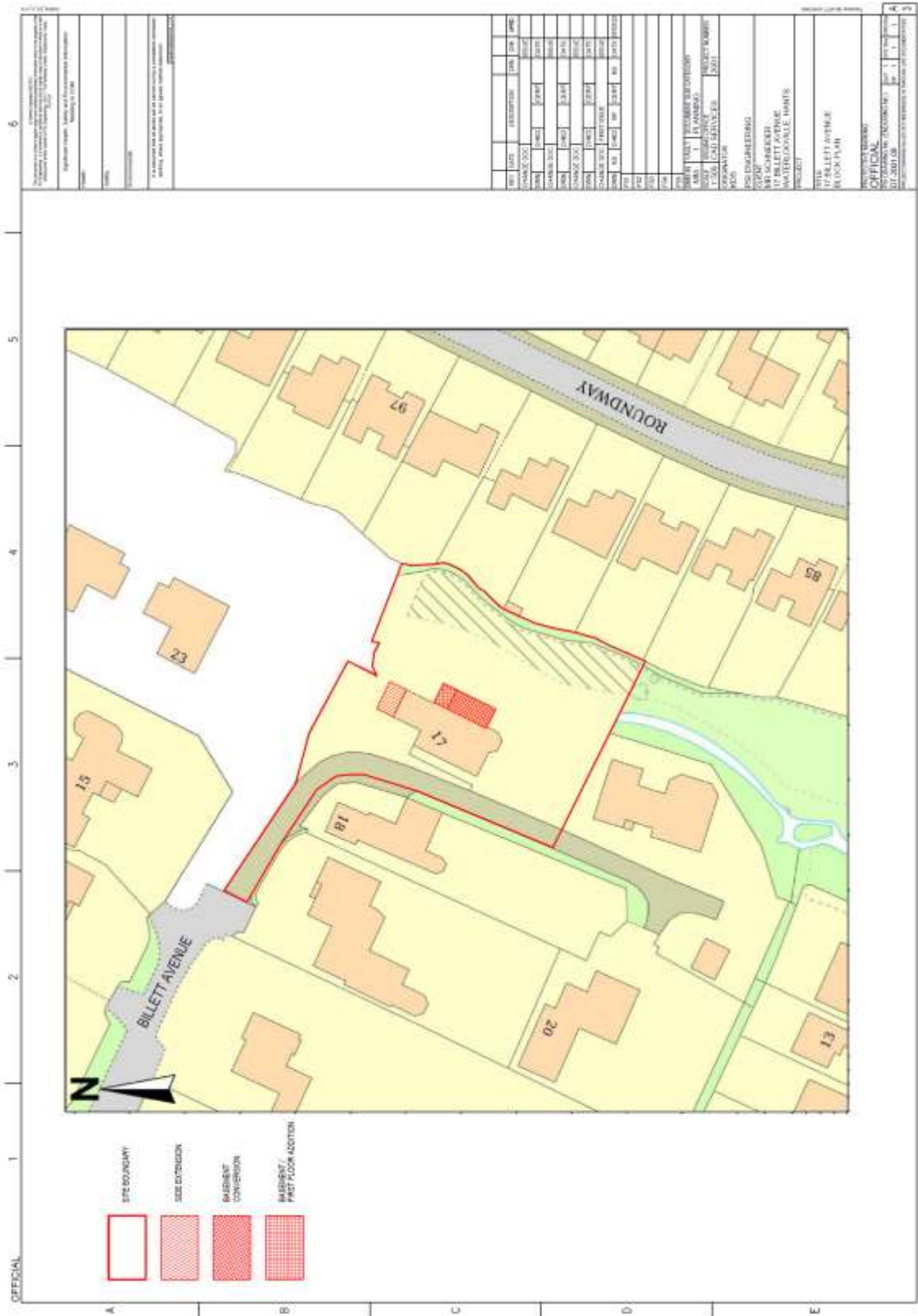
Sea rise is not a problem for the site, with net rise to year 2115 in the south east predicted to be 15m and a site low point of the stream exit of 33.96m.

9. References

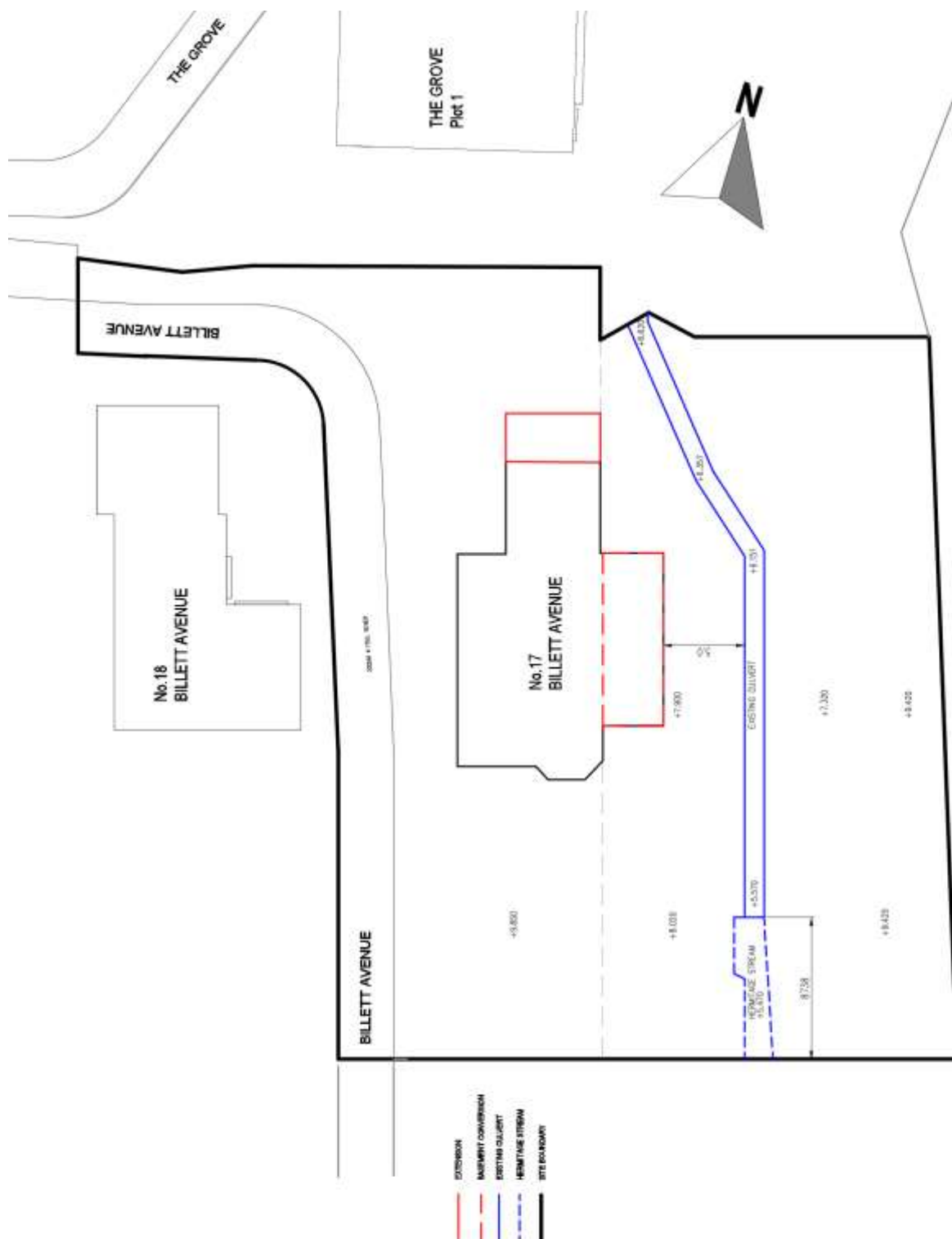
- [1] APP_19-00936-FLOOD_RISK_ASSESSMENT-1362994 (Available on Havant Planning Portal) (Also provided in Appendix H)
- [2] Engineering Assessment – SURFACE FLOW – 108991 (Appendix F)
- [3] APP_18_00109-FLOOD-RISK-ASSESSMENT-ADDENDUM (Available on Havant Planning Portal)
- [4] Engineering Assessment – FLUVIAL FLOOD– 108992 (Appendix G)

10.Appendices

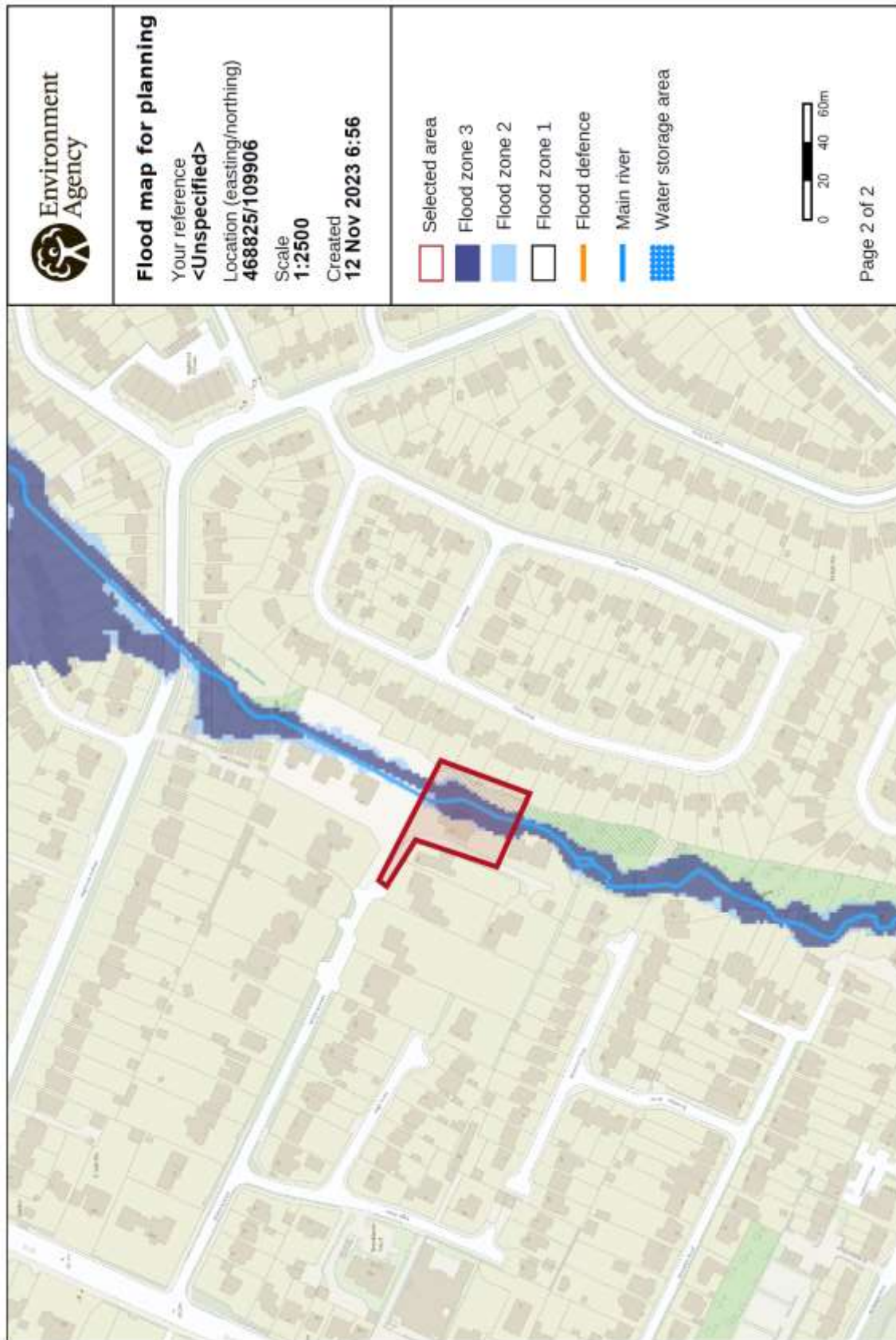
Appendix A- Location Plan



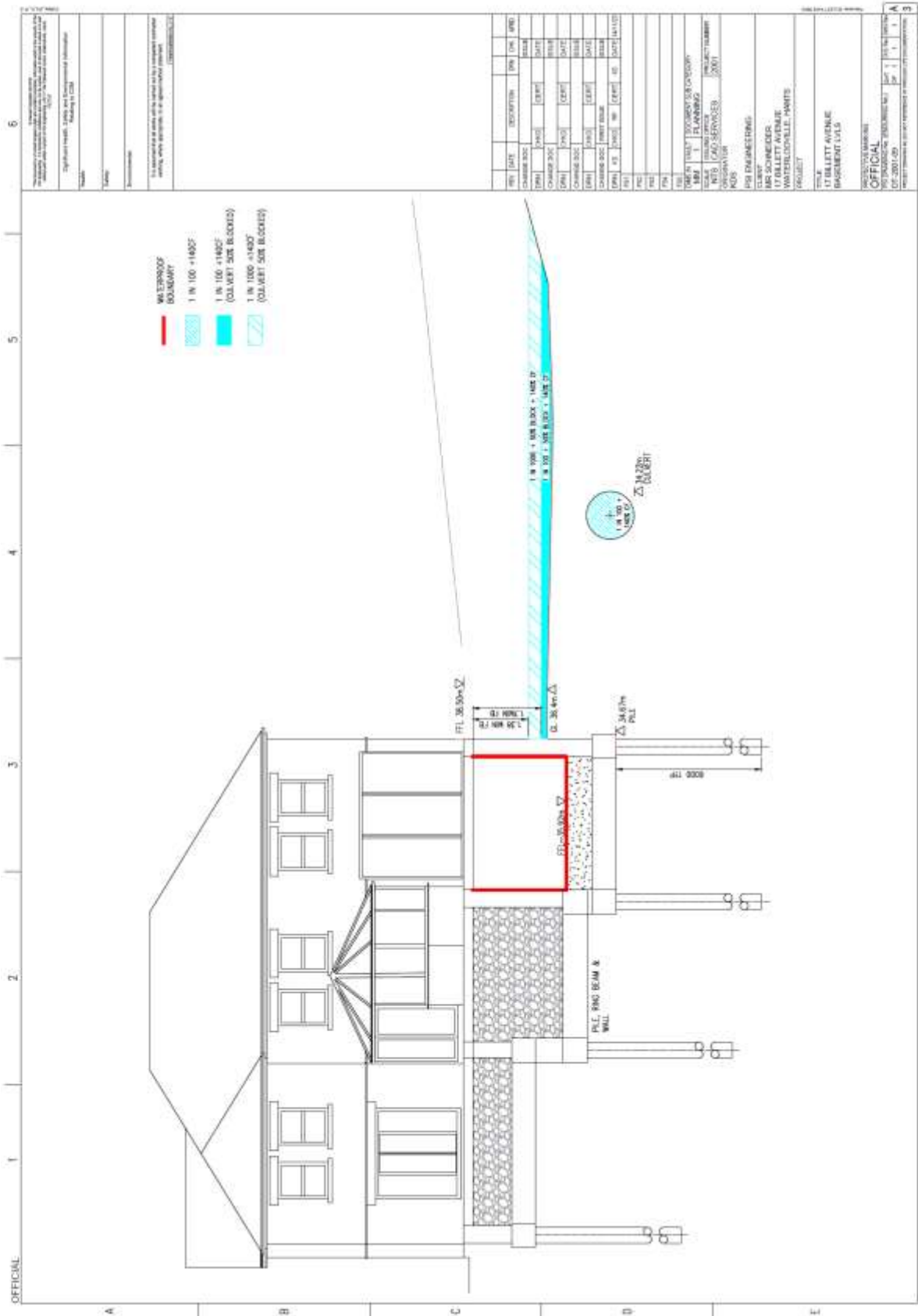
Appendix B – Topology



Appendix C – EA Flood Map



Appendix D – Site Section Plan (Basement Levels)



Appendix F – Engineering Assessment – SURFACE FLOW – 108991

Reference No:
108991

ENGINEERING ASSESSMENT
SURFACE FLOW

Issue No:
02

Issue Date:
13/11/23

Prepared By: Kieren Schneider
Checked By: R Khan
Authorised By:

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**ENGINEERING ASSESSMENT
SURFACE FLOW
17 BILLETT AVENUE**

Reference No:
108991

ENGINEERING ASSESSMENT
SURFACE FLOW

Issue No:
02
Issue Date:
13/11/23

Prepared By: Kieren Schneider
Checked By: R Khan
Authorised By:

Document Approval

	Name	Title	Signature	Date
Originator	Kieren Schneider	CEng MiMechE		
Engineering Review / Approval	Riz Khan	CEng MiMechE		

Document Issue Record

Issue	Description Of Amendment	Date	Originator	Checked	Approved
01 Draft A	Initial Draft	-	-	-	
02	Update	13/11/23	KS	RK	

Previous issues of this document are to be destroyed or marked **Superseded**

Distribution / Notification

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Reference No:
108991

ENGINEERING ASSESSMENT
SURFACE FLOW

Issue No:
02
Issue Date:
13/11/23

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Checked By: R Khan
Authorised By:

1.0 BACKGROUND

This calculation is to determine the flood risk flow from surface water runoff at 17 Billett Avenue, Waterlooville. Data from the adjacent Grove development [1] is used as this dataset has already been approved by Havant BC in sanctioning the Grove development. The calculation uses the British standards [2] & [3] to determine the current drainage capacity, what is required to meet regulation and what is required to meet standard design life. Contingency recommendations are made based on good design practice and adding margin against the theoretical calculations.

2.0 SCOPE

This calculation shall assess surface water flow from Billett Avenue non-permeable areas and where applicable to a common flow orifice roof runoff is included.

3.0 LOAD CASE DESCRIPTIONS

The site's driveway boundary includes existing slot drains, that are linked in a single linear channel that connects directly to the existing sewer line via a DN100 soil pipe. In front of the existing garages are large grate drains with a silt trap that also feeds into the sewer via a separate DN100 soil pipe. Surface water flow from the Avenue, if entering the site will be by the driveway and over the slot drains. The garage grate drains capture run off from the drive way and excess flow if greater than the slot drains capacity.

Load cases are:

1. Surface flow applied to slot drains, excess over capacity applied to garage grates
1. Combined applicable roof surface area loading and applicable road surface area loading (up to last public drainage)

Against the following probabilities of flooding:

1. 1/100 year storm 5 min interval
2. 1/100 year storm 15 min interval
3. 1/100 year storm 1hr min interval
4. 1/100 year storm 6hr min interval

4.0 ASSUMPTIONS

The following assumptions are used within this calculation:

- Pipe surface roughness of 1mm
- Fluid viscosity of 1.31×10^{-6}

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5.0 INPUT DATA

5.1 ROAD SURFACE AREAS

AutoCAD is used to determine the road dimensions used for the road surface area. The image has been scaled to replicate the 1:1 environment in AutoCAD. This provides measures of suitable accuracy for this purpose. Figure 1 details the scaled map.

Road Length
(Figure 1)

$$Rd_L := 182m$$

$$Rd_{LS} := 59m$$

Ratio
between road
lengths

$$\frac{Rd_L}{Rd_{LS}} = 3.085$$

Road Width
(average section)

$$Rd_W := 5m$$



Figure 1 - Billett Avenue Scaled Map (units=m)

The 182m dimension starts at the end of the adopted road, with mains drainage and runs to the garage entrance at 17 Billett Avenue.

In addition to this a topology map (Figure 2) is used to determine the applicable road surface area that will contribute to flooding. Surface water will run from high to low areas with the greatest flow associated with the greatest gradient.

As shown there is a continued gradient from the entrance to Billett avenue all the way to the bottom. This gradient also is common for the entrance to the Grove development. This gradient results approximately to the velocity plot provided in Figure 3

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Figure 2 shows that flow will traverse along the right hand side of Billett Avenue, down both Billett Avenue and the Grove development, with the Billett Avenue flow further subdividing between No. 17, 19 & 20.

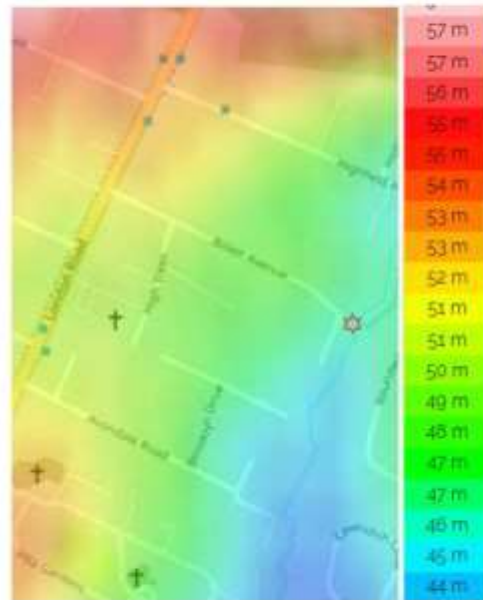


Figure 2 - Billett Avenue Topology Map (units=m)



Figure 3 - Surface Flow Velocity Map (arrows define flow direction)

Figure 3 is somewhat commensurate with what is witnessed on Billett Avenue with periods of high rain fall intensity, the flow on the unadopted part of Billett Avenue is from the unadopted part of the road, with flows prior to this point running into High Trees and main sewer lines. What is not shown on Figure 3 is the flow running around the corner and flowing towards No. 19 & 20

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5.2 ROOF SURFACE AREAS

The roof surface area is calculated in accordance with [1], where the projected surface area of the roof is used to determine the total flow. Figure 4 details this method.

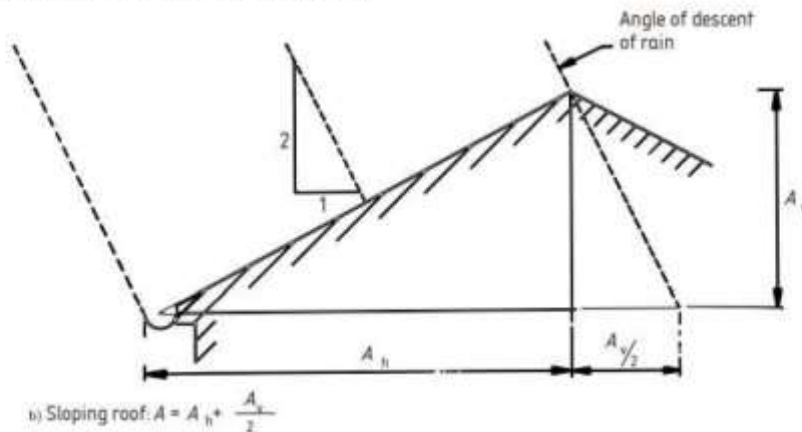


Figure 4 - Sloped Roof Area

Garage Roof Dimensions

Length of existing garage	$\text{Gr}_L := 5.7\text{m}$
Width of existing garage (front aspect)	$\text{Gr}_W := 5.86\text{m}$
Garage Apex Height	$\text{Gr}_{A,V} := 2.5\text{m}$

House Roof Dimensions

Length of house	$H_L := 12.64\text{m}$
Width of house (front aspect)	$H_W := 6.5\text{m}$
Roof Apex Height	$H_{A,V} := 2.5\text{m}$

5.3 OTHER PARAMETERS

Global Warming Factor (140%)	$C_E := 1.4$
Runoff coefficient	$C := 1$

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5.4 RAIN FALL INTENSITY

Rain intensities calculated are for the 100 year storm, the 6hr basis is used to define design minimums, while more intense durations over shorter periods are used for comparison to actual occurrences witnessed.

$$M5 - 60(\text{mm}) = 1 \cdot 20^{\frac{1}{3}}$$

$$t := 0.4$$

Rainfall Intensity Waterlooville Area

$$\text{Rain}_{\text{Fall}} := \begin{pmatrix} 127.38 \\ 96.72 \\ 41 \\ 10.98 \end{pmatrix} \frac{\text{mm}}{\text{hr}} \begin{pmatrix} 5\text{min interval} \\ 15\text{min interval} \\ 1\text{hr interval} \\ 6\text{hr interval} \end{pmatrix} 1\text{in}100 \text{ YEAR}$$

Note 10.98mm/hr (lowest load case) is taken from [1]

5.5 PIPE CAPACITY

[2 NB.1 - 5]

Pipe maximum flow capacity is taken from [2]-Table C.1] and shown in Figure 5 below. The table has been reduced in size to show pipe sizes 8" and below for clarity.

Slope	DN 100		DN 125		DN 150		DN 200	
	Q_{max}	v	Q_{max}	v	Q_{max}	v	Q_{max}	v
cm/m	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s
0.50	2.9	0.5	4.8	0.6	9.0	0.7	16.7	0.8
1.00	4.2	0.8	6.8	0.9	12.8	1.0	23.7	1.2
1.50	5.1	1.0	8.3	1.1	15.7	1.3	29.1	1.5
2.00	5.9	1.1	9.6	1.2	18.2	1.5	33.6	1.7
2.50	6.7	1.2	10.8	1.4	20.3	1.6	37.6	1.9
3.00	7.3	1.3	11.8	1.5	22.3	1.8	41.2	2.1
3.50	7.9	1.5	12.8	1.6	24.1	1.9	44.5	2.2
4.00	8.4	1.6	13.7	1.8	25.8	2.1	47.6	2.4
4.50	8.9	1.7	14.5	1.9	27.3	2.2	50.5	2.5
5.00	9.4	1.7	15.3	2.0	28.8	2.3	53.3	2.7

Figure 5 - Drain Pipe Capacity

Applicable drain pipe diameter

$$D := 100\text{mm}$$

Drain Slope

$$i := 3$$

Maximum Pipe Flow

$$Q_{\text{pipeMAX}} := 7.3 \frac{\text{l}}{\text{s}}$$

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6.0 CALCULATIONS

6.1 ROAD SURFACE AREAS

Road Area

$$A_{\text{Road}} := Rd_W \cdot Rd_L$$

$$A_{\text{Road}} = 910 \text{ m}^2$$

6.2 ROOF SURFACE AREAS

Garage Roof Area

Garage front aspect roof area

$$Gr g_A := \left(Gr g_W + \frac{Gr g_{A,v}}{2} \right) \cdot Gr g_L$$

$$Gr g_A = 40.527 \text{ m}^2$$

Total roof area

$$A_{\text{Roof}} := Gr g_A$$

$$A_{\text{Roof}} = 40.527 \text{ m}^2$$

6.3 ROOF RAINFALL QUANTITY

The total quantity of rain is calculated in accordance with [1][2] & [3].

Quantity of rainwater runoff from applicable roof area

$$Q_{\text{Roof}} := \text{Rain}_{\text{Fall}} \cdot A_{\text{Roof}} \cdot C$$

$$Q_{\text{Roof}} = \begin{pmatrix} 1.434 \\ 1.089 \\ 0.462 \\ 0.124 \end{pmatrix} \cdot \frac{1}{s}$$

Quantity of rainwater runoff from applicable road areas.

$$Q_{\text{Road}} := \text{Rain}_{\text{Fall}} \cdot A_{\text{Road}} \cdot C$$

$$Q_{\text{Road}} = \begin{pmatrix} 32.199 \\ 24.449 \\ 10.364 \\ 2.776 \end{pmatrix} \cdot \frac{1}{s}$$

Total surface water flow including applicable roof and road area, with climate factor included. Assuming all flow is captured in single location. A highly conservative assumption.

$$Q_{\text{Total}} := (Q_{\text{Road}} + Q_{\text{Roof}}) \cdot C_E$$

$$Q_{\text{Total}} = \begin{pmatrix} 47.086 \\ 35.752 \\ 15.156 \\ 4.059 \end{pmatrix} \cdot \frac{1}{s}$$

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6.3 CURRENT DRAIN PERFORMANCE

While only a fraction of the surface water will enter no.17, calculations are based on full flow for 1 in 100 yr intensities.

Slot drain capacity (based on pipe maximum flow)

Minimum Factor of safety against
minimum loading
(SAFETY >1)

$$FOS_{SlotcurrentMIN} := \frac{Q_{pipeMAX}}{Q_{total3}}$$

$$FOS_{SlotcurrentMIN} = 1.799 \quad 6hr1in100\text{ YEAR}$$

Therefore Slot drainage capacity is satisfactory to meet factored design requirements.

Garage grate drain (based on orifice maximum flow)

Minimum Factor of safety against
minimum loading
(SAFETY >1)

$$FOS_{F900currentMIN} := \frac{Q_{pipeMAX}}{Q_{total3}}$$

$$FOS_{F900currentMIN} = 1.799 \quad 6hr1in100\text{ YEAR}$$

Therefore existing garage grate drainage capacity is satisfactory to meet factored design requirements.

Site maximum flow FOS

Once the slot drains reach capacity flow would enter the site and a portion will be collected by the garage grate. Some flow would bypass due to drive topology, travel past the side of the garage and into the gardens naturally.

Minimum Factor of safety against
maximum loading
(SAFETY >1)

$$FOS_{17Billett} := FOS_{F900currentMIN} + FOS_{SlotcurrentMIN}$$

$$FOS_{17Billett} = 3.597 \quad 6hr1in100\text{ YEAR}$$

Therefore significant factor of safety is shown against surface water flow, when assessing against highly conservative assessment, by including full surface flow from Billett Avenue.

The above in theory shows that the drainage is more than adequate for No.17 as the calculation has used the 1in100 year storm flow, evaluated all non permeable surface flow onto the property boundary and shown for the 6hr case that the possible flow will meet the flow requirements when combined. However flow over the slot drains has been witnessed due to debris blockage. A similar occurrence has been witnessed on the garage grates where silk traps have become blocked with leaves. With the extension of the garage, an opportunity to provide additional drainage across the entrance can be realised. A separate grate drain, that is piped to divert flow around the property with an DN200 bore, will provide full future proofing under all rain intensities. It is believed that due to the slope of the avenue there is immediate flow from the 5min intensity and therefore short duration high flows.

DN200 pipe flow rate

$$Q_{Max200} := 41.2 \frac{1}{s}$$

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Minimum Factor of safety against
maximum loading
(SAFETY > 1)

$$FOS_{17Billet.Plan} = \frac{Q_{Max200}}{Q_{road}} = \left(\begin{array}{c} 1.28 \\ 1.685 \\ 3.975 \\ 14.844 \end{array} \right) \left(\begin{array}{c} 5min \\ 10min \\ 1hr \\ 6hr \end{array} \right) 1in100\text{ YEAR}$$

6.4 FUTURE DRAIN PIPE RECOMMENDATIONS

A consent for storm surface water to be discharged into the Hermitage stream will be requested. The storm water eventually makes its way to the stream, but piping the surface water, less pollution and debris will be collected prior to discharge.

7.0 CONCLUSION

Using rainfall intensity that sanctioned the Grove development applied to the whole of the unadopted segment of Billett Avenue, the current drainage provisions are shown to be theoretically adequate. Recommendations are made to improve drainage on the site, should topology change. The recommendations will aid short duration rain intensities, which will effect the site due to the site gradient.

8.0 REFERENCES

Reference No.	Document Title	Reference	Issue
1	Land adjacent 15 Billett Avenue, Waterloo, PO77SZ Assessment of Fluvial Flood Risk, APP/18/00109 & HA/2018/120240/03-L01	1849	-
2	Drain and sewer systems outside buildings - Part 4 hydraulic design and environmental considerations	BS EN 12056-3	2000
3	Gravity drainage systems inside buildings - Part 3: Roof drainage layout and calculation	BS EN 752-4	1997

Appendix G – Engineering Assessment – FLUVIAL FLOOD– 108992

Reference No:
108992

ENGINEERING ASSESSMENT
FLUVIAL FLOOD

Issue No:
01
Issue Date:
14/11/23

Prepared By: Kieren Schneider
Checked By: R Khan
Authorised By:

0.1

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ENGINEERING ASSESSMENT
OVER FLOW
17 BILLETT AVENUE

Reference No:
108992

ENGINEERING ASSESSMENT
FLUVIAL FLOOD

Issue No:
01

Prepared By: Kieren Schneider
Checked By: R Khan
Authorised By:

Issue Date:
14/11/23

Document Approval

	Name	Title	Signature	Date
Originator	Kieren Schneider	CEng MiMechE		
Engineering Review / Approval	Riz Khan	CEng MiMechE		

Document Issue Record

Issue	Description Of Amendment	Date	Originator	Checked	Approved
01	Initial Draft	14/11/23	KS	RK	

Previous issues of this document are to be destroyed or marked **Superseded**

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Name	Company / Location	Method (email, hard copy, notification)

Reference No:
108992

ENGINEERING ASSESSMENT
FLUVIAL FLOOD

Issue No:
01
Issue Date:
14/11/23

Prepared By: Kieren Schneider
Checked By: R Khan
Authorised By:

1.0 BACKGROUND

This calculation is to determine the fluvial flood risk flow the Hermitage Stream at 17 Billett Avenue, Waterloooville. Data from the adjacent Grove development [1] is used as this data set has already been approved by in sanctioning the Grove development. An increased climate factor of 40% is used, along with the previously requested 50% blockage assessment.

2.0 SCOPE

This calculation shall assess 1 in 100, 1 in 100 flow cases for the Hermitage Stream culvert, in conjunction with Climate Change Factor and a 50% blockage scenario.

3.0 LOAD CASE DESCRIPTIONS

The following cases are assessed:

1. 1/100 year storm + 40% increase for CF (Design Basis)
2. 1/100 year storm + 40% increase for CF + 50% culvert blockage
3. 1/1000 year storm + 40% increase for CF
4. 1/1000 year storm + 40% increase for CF + 50% culvert blockage

4.0 ASSUMPTIONS

The following assumptions are used within this calculation;

- Manning CoEf for site is conservatively set at 0.1
- Assessments are made at the sites most constrained location

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ENGINEERING ASSESSMENT
FLUVIAL FLOOD

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5.0 INPUT DATA

This section has the calculation input data, flows are taken from [1], cross-sectional data is extracted from [2].

Hermitage Stream flows	$Q := \begin{pmatrix} 1.82 \\ 2.45 \\ 4.47 \end{pmatrix} \frac{\text{m}^3}{\text{s}} \begin{pmatrix} Q_{30} \\ Q_{100} \\ Q_{1000} \end{pmatrix} \begin{pmatrix} 30\text{year} \\ 100\text{year} \\ 1000\text{year} \end{pmatrix} [1]$
Climate Factor	$C_F := 1.4$
Culvert maximum flow (before GL overflow)	$Q_{\text{Culvert}} := 5.2 \frac{\text{m}^3}{\text{s}} [1]$
Blockage factor	$\text{Block}_M := 50\% [1]$
Manning roughness coefficient	$n := 0.1$
Channel slope height Δ	$H := 0.180\text{m} [2]$
Channel length	$x := 23\text{m}$
Water flow depth 1 in 100 year + 50% + CF	$y := 0.145 \text{ meters} [2]$
Water flow depth 1 in 1000 year + 50% + CF	$y_{1000} := 0.46 \text{ meters}$
Water flow width	$W := 12.08 \text{ meters} [2]$
Area below G.L	$A_{\text{GL}} := 0.891 \frac{\text{m}^2}{\text{m}} [2]$
Additional area associated with 1 in 1000 +CF +50% Blockage	$A_{1000e} := 0.43076$
Additional perimeter associated with 1 in 1000 +CF +50% Blockage	$P_{1000e} := 0.733$

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ENGINEERING ASSESSMENT
FLUVIAL FLOOD

Issue No:
01
Issue Date:
14/11/23

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Checked By: R Khan
Authorised By:

6.0 CALCULATIONS

6.1 ADJUSTED FLOWS

Adjusted flows
(Increased to account for climate change)

$$Q_{Cf} := C_F \cdot Q$$

$$Q_{Cf} = \begin{pmatrix} 2.548 \\ 3.43 \\ 6.258 \end{pmatrix} \frac{\text{m}^3}{\text{s}} \begin{pmatrix} Q_{30} \\ Q_{100} \\ Q_{1000} \end{pmatrix} \quad \begin{matrix} \text{No overflow} \\ \text{No overflow} \end{matrix}$$

Over land flows
(ignoring losses)
CF+50% blockage

$$Q_{\text{land}} := Q_{Cf} - (Q_{\text{Culvert}} \cdot \text{BlockM})$$

$$Q_{\text{land}} = \begin{pmatrix} -0.052 \\ 0.83 \\ 3.658 \end{pmatrix} \frac{\text{m}^3}{\text{s}} \begin{pmatrix} Q_{30} \\ Q_{100} \\ Q_{1000} \end{pmatrix} \quad \begin{matrix} \text{No overflow} \end{matrix}$$

There is no flow above ground level for the design basis, including climate change factor. The calculation will now focus on the 50% blockage cases for 1 in 100 year +CF & 1 in 1000 year +CF.

6.2 FLOW RATES

Assessment is made against the 1 in 100 year with 40% CF and a 50% blockage of the Culvert at the Grove Development.

Site slope

$$S := \frac{H}{x}$$

$$S = 0.783\%$$

Cross sectional Area
(channel section)

$$A := y \cdot W + A_{GL}$$

$$A = 2.643 \text{ m}^2$$

Wetted perimeter

$$P := 2 \cdot y + W$$

$$P = 12.37 \text{ m}$$

Channels hydraulic radius

$$R := \frac{A}{P}$$

$$R = 0.214$$

Velocity

$$V_m := \frac{1}{n} \cdot R^{\frac{2}{3}} \cdot S^{\frac{1}{2}}$$

$$V_m = 0.31 \left(\frac{\text{m}}{\text{s}} \right)$$

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Volumetric Flow Rate
(1 in 100 +40%CF +50% Blockage)

$$Q_{100} := V_m \cdot A$$

$$Q_{100} = 0.836 \frac{\text{m}^3}{\text{s}}$$

Assessment is made against the 1 in 1000 year with 40% CF and a 50% blockage of the Culvert at the Grove Development.

Cross sectional Area

$$A_{1000} := y_{1000} \cdot W + A_{GL} + A_{1000e}$$

$$A_{1000} = 6.875 \text{ m}^2$$

$$A_{1000e} := 0.43076$$

Wetted perimeter

$$P_{1000} := 2 \cdot y_{1000} + W + P_{1000e}$$

$$P_{1000} = 13.73 \text{ m}$$

$$P_{1000e} := 0.733$$

Channels hydraulic radius

$$R_{1000} := \frac{A_{1000}}{P_{1000}}$$

$$R_{1000} = 0.501$$

Velocity

$$V_{m,1000} := \frac{1}{n} \cdot R_{1000}^{\frac{2}{3}} \cdot S^{\frac{1}{2}}$$

$$V_{m,1000} = 0.558 \frac{\text{m}}{\text{s}}$$

Volumetric Flow Rate

$$Q_{1000} := V_{m,1000} \cdot A_{1000}$$

$$Q_{1000} = 3.838 \frac{\text{m}^3}{\text{s}}$$

Flow matrix

$$Q_{\text{Matrix}} := \begin{pmatrix} -2.6 \\ Q_{100} \\ Q_{1000} \end{pmatrix}$$

Design check, calculated flows with defined channel height, against factored flows

$$\frac{Q_{\text{land}}}{Q_{\text{Matrix}}} = \begin{pmatrix} 0.02 \\ 0.993 \\ 0.953 \end{pmatrix} \frac{\text{m}^3}{\text{s}}$$

Utilisation against maximum loading
(SAFETY <1)

Therefore heights defined for flow cases are acceptable

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7.0 CONCLUSION

Factored flows have been reviewed to determine flow height across 17 Billett Ave. Design basis events for 1 in 100 year, factored to account for climate change remain within the culverts capacity. When a 50% blockage is applied to the Grove Development, flow above ground is expected for the 1 in 100 and 1 in 1000 year cases with climate change factor. The estimated flow for these scenarios is used to determine flow heights across the site. Note in these cases it is believed the probability of these occurring simultaneously is greater than the 1 in 100 and 1 in 1000 year basis. It is recommended the EA is contacted to determine blockage history of the culvert in this region, such that a probability model can be defined and the scenario better understood. It is believe for a standard design case all flow is captured within the culvert and therefore the flow heights provided are for information.

8.0 REFERENCES

Reference No.	Document Title	Reference	Issue
1	Land adjacent 15 Billett Avenue, Waterloooville, PO77SZ Assessment of Fluvial Flood Risk, APP/18/00109 & HA/2018/120240/03-L01	1849	-
2	17 Billett Avenue - Basement Levels Drawing	DT-2001-09	1

Flood Risk Assessment .

1133 -17 Billet Avenue Waterloo PO7 7SZ -
Rev 01

Introduction

The Flood Risk Assessment has been prepared on behalf of my client as part of the planning application for a retrospective application for an increased block paved driveway. The client contacted the Havant Council who advised them that a planning application was not required however, the property has had its permitted development rights removed when originally approved and constructed.

Planning Proposal

Under the retrospective planning application, we are looking to maintain the current *insitu* installation. The property had a previous tarmac driveway with a grass area. The new driveway has replaced the previous block driveway and a proportion of the grass area. The increase of driveway area is approx. 83.5 Sq M.

We are unable to install a soakaway into the rear garden of the property, as the soakaway would be positioned within the suggested flood risk 3 zone. We believe that due to the site levels the size of the garden and grass areas as well as the mature trees and the drop in level within Hermitage Stream at the lowest point in the site is easily capable of holding and dealing with this minor additional area of hard landscaping area.

Flood risk summary for the area

The site is shown to be in a Flood Risk three zone due to a stream on the eastern edge of the site. However it is important to note that the driveway installation is not within the flood risk 3 zone and this will be discussed further.

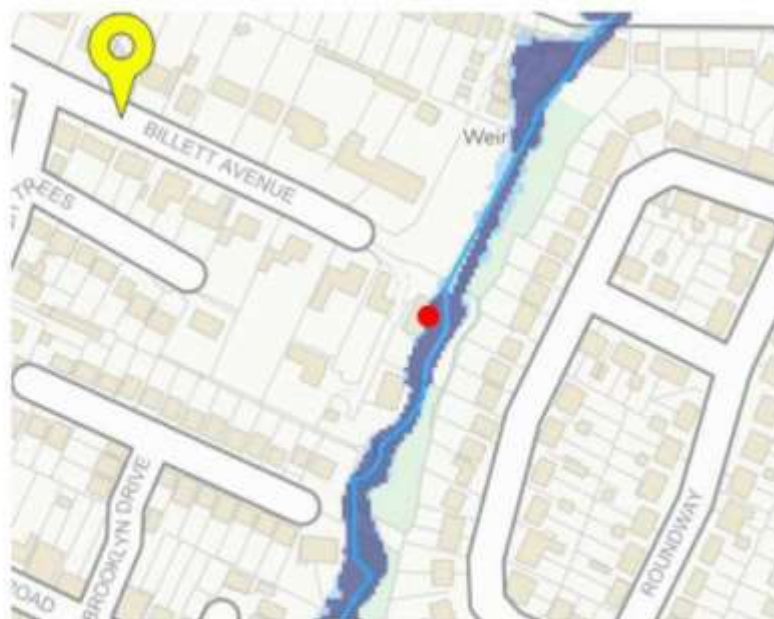
The flood warning information notes the area is within a High risk area. However the Hermitage Stream has been previously culverted and is at a much lower level in the site.

Location and site

The site is within a well-established residential area and forms part of a private road at the end of Billet Avenue. As seen in the aerial image is the shape of the previous driveway. The driveway lies at a higher level with a flat rear garden with sloped banks. The site is bound by a number of mature trees and hedgerows.

The property surrounding the house and within the red line boundary has a number of different levels. The western side of the property is the highest. The house echoes a change of level from north to south where the house and a retaining wall creates a distinct high and low point between

the West (High) and East (Low) side. The Flood 3 zone is contained to this lower level edge and is seen in the flood risk map. Continuing through the site to the South East corner the site falls away again dramatically to the Hermitage Stream. All of which creating huge areas within the plot of land to hold any water generated by the increased driveway.



Existing Photographs

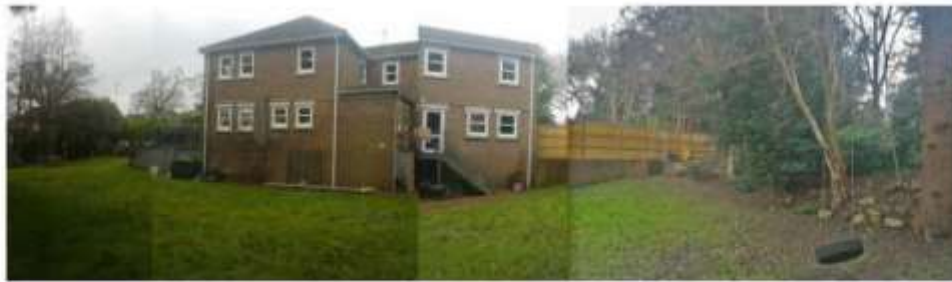


View of the front of the existing property prior to the new driveway.



View of the front of the renewed driveway.

The site has multiple levels. As previously mentioned the new driveway area is outside of the flood risk 3 zone. This is due to the fact that the existing property is raised above the rear garden level (flood risk 3 zone). The existing property is approx. 2015mm above the rear garden level. The driveway area sits behind a retaining wall which has a height varying from 1650mm tall to its low point of 900mm tall above this ground level. The site has the Hermitage stream running through it, the previous owners culverted the stream. This at the lowest point of the garden sits lower by as much as 2540mm from this rear garden level. Any water generated by the additional hard landscaping will be easily managed and retained on site with the site levels alone. The following photographs and section have been prepared to assist in allowing an understanding of the various levels of the site and ultimately concluding that there is little to no impact generated by the installed driveway.



The house as seen in the photograph is at a higher level with the retaining wall and fence to the right hides the driveway at the higher level outside of the flood risk 3 zone.



The Hermitage Stream has been previously culverted through the centre of the grass area. Note the steep bank side and mature trees.



Here we can still see the higher level of the house and to the left is the access/ egress to the culverted area.



View of the culverted area looking back towards the house.



The Hermitage Stream at a much lower level than the garden.

Development proposals

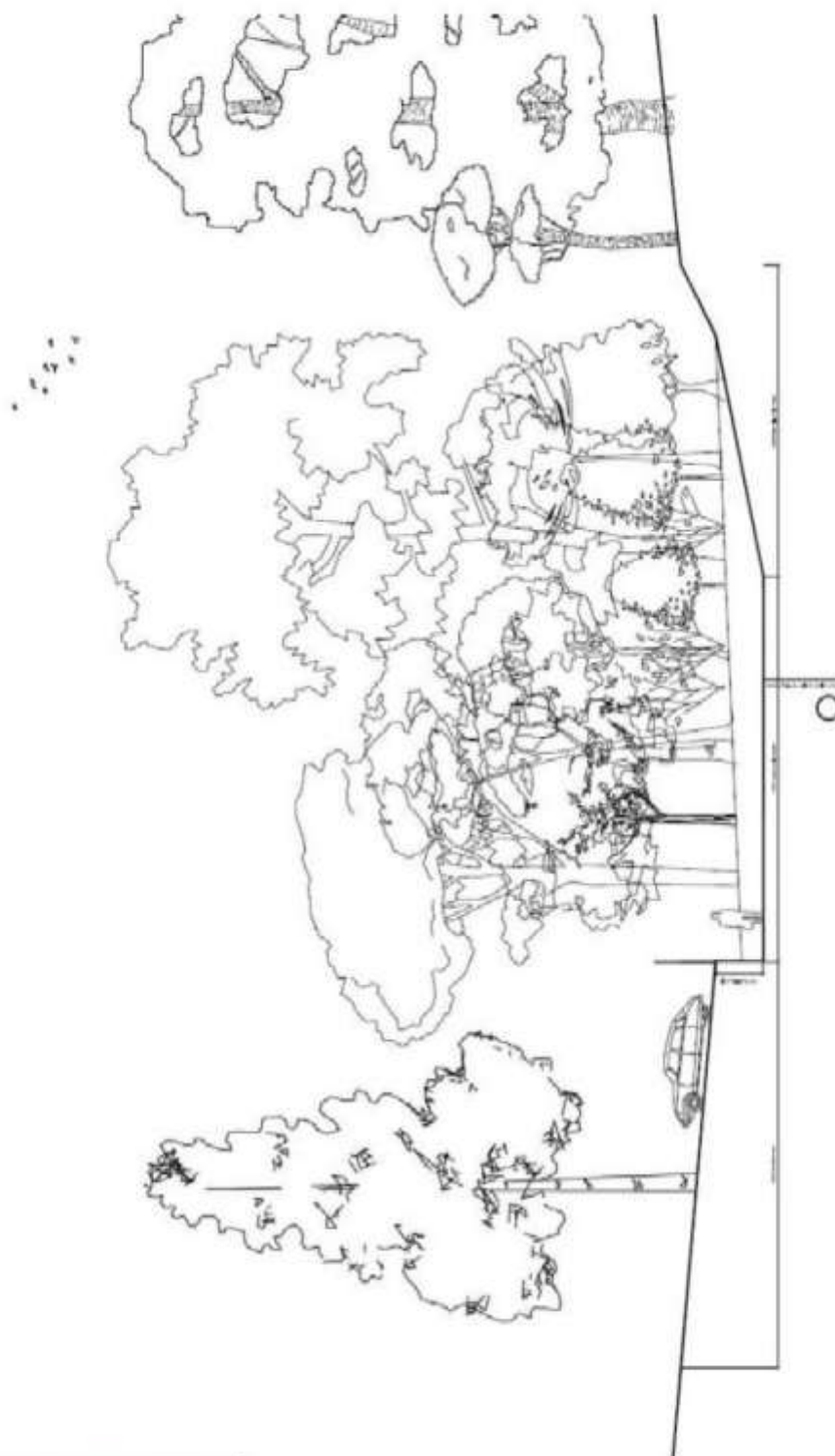
The proposal will not change the nature and use of the site as a domestic dwelling. The additional parking spaces will assist in preventing congestion on the narrow Billet Avenue road/ Lane. This should be seen as a minor development as noted on the gov.uk website.

The additional hard landscaped driveway is unlikely to affect the current or future flooding within the area. This is because the additional hard surfaced area will continue to flow into/ onto the rear grass garden area. This is the current situation and the rear garden will continue to soak up any surface water generated from the increased driveway.

The water is likely to be held on site in the lower level Hermitage Stream found on site. This is unlikely to increase the flood elsewhere.

The need for any other measures to manage any perceived risks are unnecessary as all the immediate houses in the area are at a higher level than the flood risk three zone and the water either in its original state as grass or as the new hard landscaped driveway area will find its way into the existing water course.

There will be no access or egress issues from any house within the immediate area as all the houses are at the higher level than the flood risk 3 zone.



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Conclusion

The proposal is for a small increase in hard landscaped area to increase the effective size of the driveway for the domestic property. This is a minor development and the impact is not going to increase concern due to the ability of the site to hold and retain the surface water run off from the additional driveway area.