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FLOOD RISK ASSESSMENT

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Date: MAY 2014

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REPORT REF:	BMW/2025/FRA
STATUS:	Rev B

REVISION STATUS

REV. NO.	DESCRIPTION:	AUTHOR	CHECKED	APPROVED	DATE
Draft	First Internal Draft	BK	RG	SN	30/10/13
Draft Issue	First External Draft Issue	BK	RG	SN	31/10/13
A	Issue for site allocation	BK	RG	SN	21/11/13
B	Issue for Outline Planning	RG	BF	SN	19/05/14

EXECUTIVE SUMMARY

This Flood Risk Assessment (FRA) has been produced to support an outline application for a mixed use development at Ellesmere Marina (approximate grid reference: 339588, 333994).

The development site is currently shown to be located partially within Flood Zone 3 according to the EA indicative flood maps. Hydraulic flood modelling has confirmed that the site in its existing form is at risk of fluvial flooding from the Tetchill Brook and the Newnes Brook. No other significant forms of flood risk to the site have been identified, although groundwater, pluvial runoff and the adjacent canal could pose a residual risk to the site.

The development proposals include for the day-lighting (de-culverting) of the Tetchill Brook within the site. A new watercourse will be created within a floodplain corridor to add significant ecological, geomorphological, and amenity benefits to the site and riparian environment. The floodplain corridor will be designed to accommodate the 1 in 100 year plus climate change floodplain thus removing the built development from Flood Zone 3.

Minimum ground levels have been recommended to reduce the out of bank flooding, which is predicted to occur at a 1 in 1000 year event, to acceptable levels – shallow flooding of external areas and of a low hazard rating. It has been recommended that a flood management plan is formulated so that the occupier(s) are prepared in the event of this occurring. Minimum finished floor levels have been recommended which would raise buildings above all fluvial flood events including the 1 in 1000 year event.

In addition to the minimum requirements, a more robust flood risk strategy has also been recommend which arranges the development sequentially. The More Vulnerable development is raised out of the 1 in 1000 year floodplain, while the Less Vulnerable development is set to a lower level and allowed to flood in a 1 in 1000 year event (while still being a low flood hazard rating). Given the outline nature of the application, the earthworks balance in the site is not yet known and so the final approach to mitigating the flood risk posed by the 1 in 1000 year event will be determined at the detailed design stage.

The sources of residual flood risk will be mitigated by: the creation of the new watercourse corridor; setting finished floor levels a minimum of 150mm above surrounding ground levels and by profiling ground levels to direct any overflows which may develop within the site away from the built development, towards the nearest drainage point.

A surface water drainage strategy is proposed which restricts runoff from the development at the existing greenfield annual average runoff rate (QBAR). Attenuated storage will be provided within the development up to the 1 in 100 year event including an allowance for future climatic change. The site will continue to drain to the Tetchill Brook watercourse, and runoff will be passed through appropriate levels treatment prior to leaving the site.

In compliance with the requirements of National Planning Policy Framework, and subject to the mitigation measures proposed, the development could proceed without being subject to significant flood risk, or resulting in increased flood risk in the wider catchment.

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APPENDICES

1.0 INTRODUCTION

Summary Information

1.1 This Flood Risk Assessment (FRA) is compliant with the requirements set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance. The FRA has been produced on behalf of Burbury Investments Ltd in respect of an outline planning application for the mixed use development 'Ellesmere Marina', in Ellesmere, Shropshire.

Site Name	Ellesmere Marina, Shropshire
Location	SY12 0DU
NGR (approx)	339588, 333994
Application Site Area (Ha)	31 (approx.)
Development Type	Commercial & Residential
NPPF Vulnerability	More Vulnerable
EA Flood Zone	Flood Zones 3
EA Office	Midlands (West)
Local Planning Authority	Shropshire Council

Table 1.1 – Site Summary

Sources of Data

1.2 The report is based on the following information*:*

- (i) Site Layout Plan
- (ii) OS Explorer Series mapping
- (iii) Environment Agency consultation
- (iv) County Council Consultation
- (v) Shropshire Council Strategic Flood Risk Assessment
- (vi) Site visit undertaken by BWB Consulting Ltd
- (vii) Hydraulic modelling of Tetchill Brook undertaken by BWB Consulting (Ref: BMW/2025/TN2/REVC) – **Appendix E**
- (viii) BWB Phase I Geo-Environmental Assessment (BMW2025/01/V2)
- (ix) Web Based Soil Mapping
- (x) Severn Trent Water Sewer Records – **Appendix D**
- (xi) British Geological Survey Drift & Geology Maps
- (xii) Canal and River's Trust Consultation

Existing Site

1.3 The application site (identified within **Figure 1.1**) is located on the southern fringe of Ellesmere, Shropshire (NGR: 339345, 334055 - *SJ393340*). The site's southern boundary is delimited by the Shropshire Union Canal (Llangollen branch), the north western boundary follows the Newnes Brook, and the north eastern boundary follows an open reach of the Tetchill Brook.

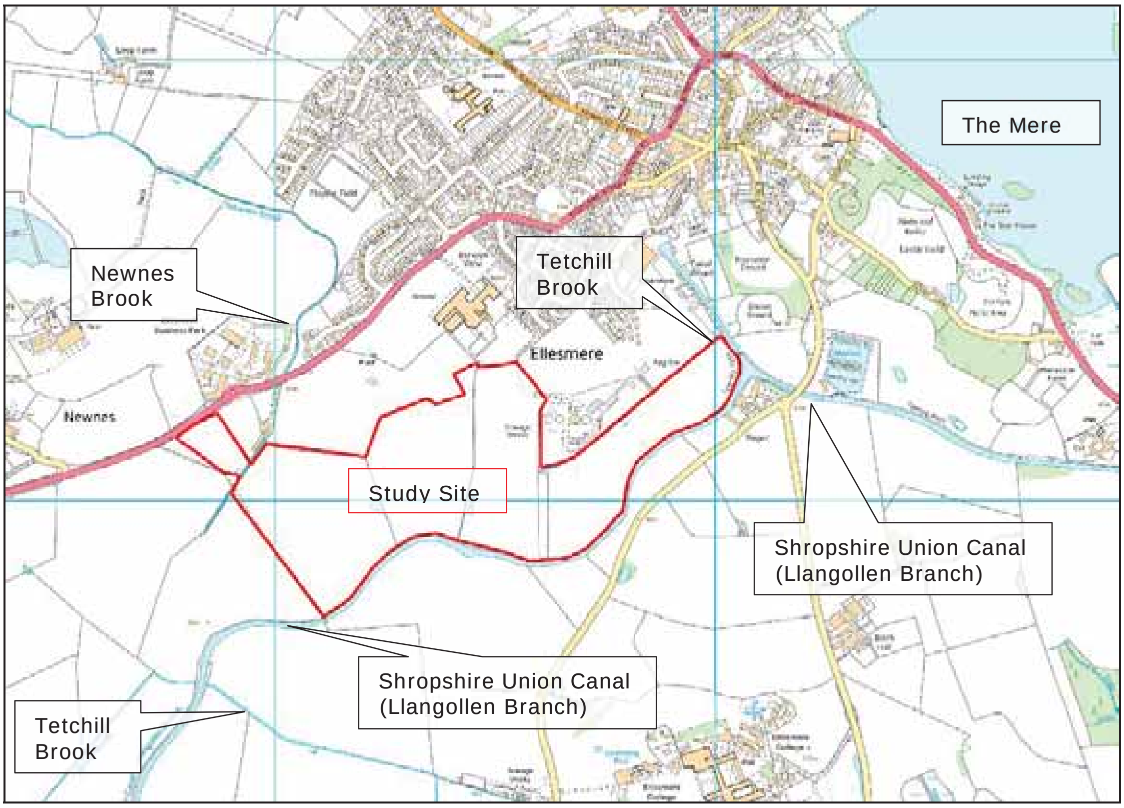


Figure 1.1 – Site Location

1.4 The Tetchill Brook is fed from 'The Mere', a large lake to the east of Ellesmere. It is culverted from the lake and through the town, before outfalling to a reach of open channel on the eastern boundary of the site. The brook re-enters culvert just downstream of an adjacent sewage works where it remains until outfalling 1.2km further downstream. Approximately 700m of the Tetchill Brook is culverted through the site. The Newnes Brook joins the Tetchill Brook culvert just downstream of the site's western boundary.

1.5 The site can be accessed from the north off Canal Way via the existing vehicular bridge crossing the Tetchill Brook, by foot from the east via the Llangollen Canal Wharf towpath, or from the west from the A495 and a bridge over the Newnes Brook.

1.6 Ground levels within the site range from approximately 84mAOD to 94mAOD based on the topographical survey information obtained. Ground levels generally fall from the site boundary towards the centre of the site (see **Appendix A**).

1.7 The bedrock underlying the site is reported to be a sandstone with glacial till deposits atop.

Proposed Development

1.8 The proposed development is for mixed use development, to incorporate a new marina, leisure spa, 120 bed hotel and restaurant/pub facilities.

1.9 It is also proposed that approximately 4ha be used to construct log cabins and touring caravans. Directly adjacent to this area, it is proposed that a garden centre with restaurant and associated parking be included.

1.10 It is also proposed that the northern section of land be developed for residential use.

1.11 In line with the SFRA requirements, as well as the objectives of the Water Framework Directive and the River Severn Basin Management Plan, it is proposed to day-light (de-culvert) the Tetchill Brook within the site. A new 'open channel' will be created to add significant ecological, geomorphological, and amenity benefits to the site and riparian environment. The new channel will be located within a floodplain corridor which will relocate the existing floodplain in to a formalised area.

1.12 An illustrative masterplan is included as **Appendix B**.

Flood Risk Planning Policy

National Planning Policy Framework

1.13 The NPPF[1] sets out the Government's national policies on different aspects of land use planning in England in relation to flood risk. Supporting Planning Practice Guidance (NPPG) is also available.

1.14 The NPPG sets out the vulnerability to flooding of different land uses. It encourages development to be located in areas of lower flood risk where possible, and stresses the importance of preventing increases in flood risk off site to the wider catchment area.

1.15 The NPPG also states that alternative sources of flooding, other than fluvial (river flooding), should also be considered when preparing a Flood Risk Assessment.

1.16 This Flood Risk Assessment is written in accordance with the NPPF and NPPG.

NPPF Flood Zones

1.17 Flood Zone mapping prepared by the Environment Agency identifies areas potentially at risk of flooding from fluvial or tidal sources without taking into account the presence of flood defences. An extract from the mapping is included as **Figure 1.2**.

1.18 The Environment Agency Flood Zone mapping shows the site to be located partially within Flood Zone 3 (High Probability). This Flood Zone is defined in the NPPF as land assessed as having a 1 in 100-year or greater annual probability of river flooding and/or a 1 in 200 year probability of flooding from tidal sources.

[1] National Planning Policy Framework, CLG, March 2012

1.19 The NPPF also defines Flood Zones 2 and 1. These zones are identified as land assessed as having between a 1 in 100-year (1 in 200-year tidal) and a 1 in 1000-year or greater annual probability of river/tidal flooding, and land assessed as having a less than 1 in 1000-year annual probability of river/tidal flooding, respectively.

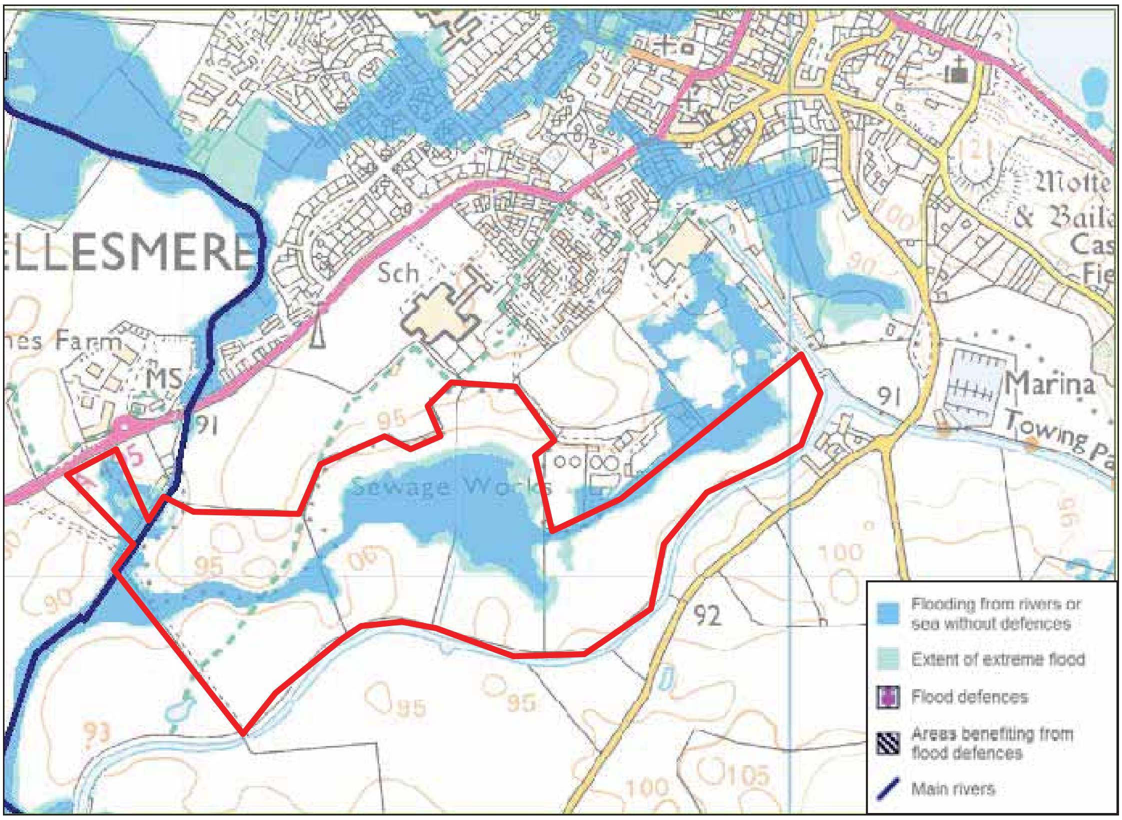


Figure 1.2 – Environment Agency Indicative Flood Zones

Other Relevant Policy and Guidance

North Shropshire Level 1 Strategic Flood Risk Assessment (2007)

1.20 The North Shropshire SFRA includes information on flooding history from all forms of flooding for the district council area.

1.21 The SFRA outlines that all new developments with culverts running through their site should seek to de-culvert rivers for flood risk management and conservation benefit.

North Shropshire Level 1 Updated Strategic Flood Risk Assessment (2012)

1.22 The document outlines that in the north west of the District, a number of properties in and around Ellesmere are shown to be at risk of flooding from the Tetchill Brook and its tributaries.

1.23 In terms of the application of SuDS in the area, the updated SFRA demonstrates that infiltration is the preferred option where appropriate but that discharge to watercourse should be sought where required. Due to the agricultural nature of the land, the level of nitrate contamination will have an impact on the choice of SuDS and will have to be assessed for specific sites.

2.0 POTENTIAL SOURCES OF FLOOD RISK

2.1 The table below identifies the potential sources of flood risk to the site, and the impacts which the development could have in the wider catchment. These are discussed in greater detail in the forthcoming section. The mitigation measures proposed to address flood risk issues and ensure the development is appropriate for its location are discussed within **Section 3.0.**

Flood Source	Potential Risk				Description
	High	Medium	Low	None	
Fluvial	X				The site is shown to be located within Flood Zone 3 of the Tetchill Brook & the Newnes Brook.
Canals		X			The site is situated alongside the Shropshire Union Canal (Llangollen Branch).
Groundwater		X			The site is believed to be freely draining with no history of groundwater flooding, but this could pose a residual risk.
Reservoirs and waterbodies			X		The site is shown to fall outside of the area at risk of reservoir failure.
Sewers			X		There are sewers present to the north of the site, but any overland flows generated during exceedance events would be intercepted before reaching the site.
Pluvial runoff			X		The site is shown by EA mapping to be at a 'low' to 'very low' risk of surface water flooding.
Effect of Development on Wider Catchment		X			The development could increase surface water runoff from the site.
		X			The proposals include day-lighting a significant length of culvert which could affect flooding in the wider catchment

Table 2.1 – Potential Pre-Mitigation Sources of Flood Risk

Fluvial Flood Risk

2.2 A schematic of the fluvial system within the vicinity of the site is illustrated within **Figure 2.1**. A hydraulic model of this system has been produced and has been used to identify the current floodplain extents and flooding mechanisms affecting the site. This exercise is documented within the technical note in **Appendix E**. Floodplain mapping from this exercise is includes as **Appendix E**, **Annex E**. The key events and flood mechanisms are summarised within **Figure 2.2**.

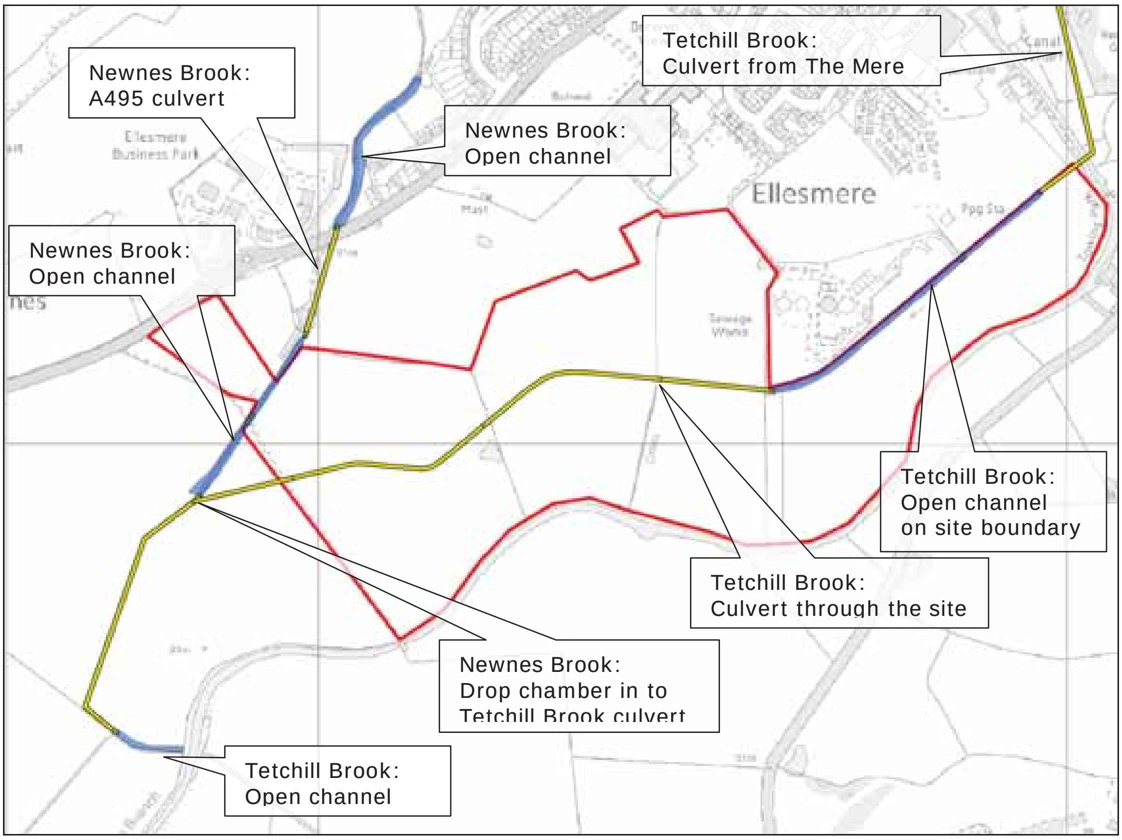


Figure 2.1 – Schematic of Tetchill and Newnes Brook

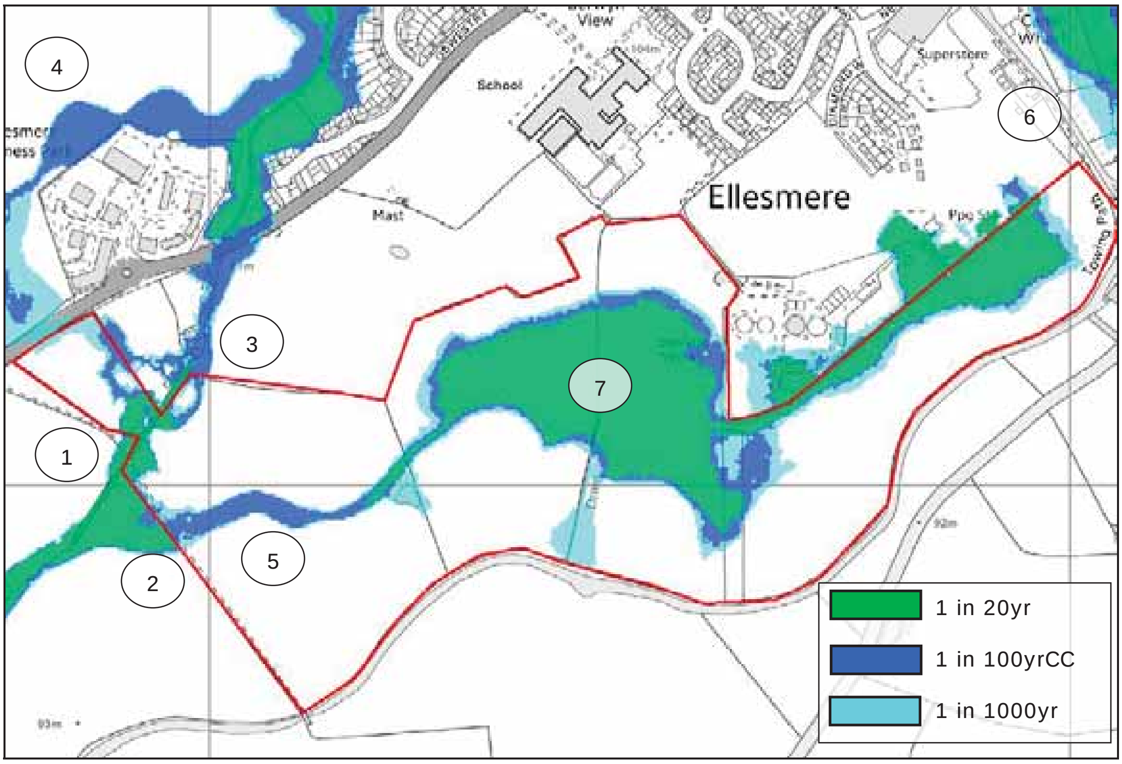


Figure 2.2 – Existing Floodplain Extents

2.3 The modelling has identified the following fluvial flooding mechanisms (see **Figure 2.2** for numeric reference points):

1. The modelling has shown that the inlet to the Tetchill Brook culvert on the Newnes Brook is overwhelmed at all simulated events. This leads to flows backing up into the study site resulting in a relatively small amount of out of bank flooding. The extent of flooding this mechanism causes within the site is limited by flow overtopping the inlet structure and flowing overland into the downstream floodplain.

2. At the 1 in 75 year event and above, the flows overtopping the inlet structure are such that they can reach the study site's southwest boundary. The topography here falls upstream into the centre of the site, and consequently a proportion of the overland flows are directed into the site.

3. The A495 culvert upstream of the site is shown to have capacity for up to the 1 in 100 year event, but it is overtopped in the 1 in 100 year climate change event. This leads to two relatively small flow routes entering the study site from the northern boundary either side of the channel. These routes join the Newnes Brook floodplain at the inlet to the Tetchill Brook.

4. In the 1 in 100 year climate change event a flow route around Ellesmere Business Park begins to develop. In a 1 in 1000 year event this flow route is sufficient to overtop the A495 and enter the site from the north-western boundary.

5. Due to the relatively flat gradient of the Tetchill Brook culvert, a proportion of the inflows from the Newnes Brook are directed up into the site. This contributes additional flood volume to the site.

6. Flows entering the site from the Tetchill Brook are limited by the restrictive upstream culverted system.

7. The flows on the Tetchill Brook combine with the surcharging flows from the Newnes Brook leading to extensive flooding within the site. The floodplain here is not able to drain until the Newnes flood peak has passed allowing the flows in the downstream culvert to reverse.

2.4 The controls on fluvial flood risk at the site have been identified as:

- The restrictive nature of the culvert leaving the site - whose capacity is largely occupied by the negative flow generated by the Newnes Brook.

- The elevated ground levels on the western boundary (between 87.75 and 87.80mAOD) which prevent overland flows leaving the site - flows below this elevation can only leave via the culvert.

2.5 As flooding in the area of the site proposed for de-culverting is largely a product of flood volume, it is believed that a scheme can be formulated whereby a day-lighted channel and floodplain corridor can be designed to return the same volume underneath the existing flood levels.

2.6 The built development will also need to provide sufficient mitigation for residual risk events, such as blockages as well as for more extreme events such as the 1 in 1000 year event. This is discussed within **Section 3.0**.

Flood Risk From Canals

2.7 The site is located directly adjacent to the Shropshire Union Canal (Llangollen Branch).

2.8 A water level of 90.24mAOD was taken when the site was surveyed in November 2010. Ground levels along the bank adjacent to the site are surveyed between approximately 90.5 and 90.8mAOD along the site boundary, indicating that there was an approximate freeboard of a 0.3m in place at the time of surveying.

2.9 The bank levels are higher than ground levels on site, implying that should water levels in the canal exceed the freeboard, floodwater could be directed onto site. However, the Canal and Rivers Trust were contacted for information on this section of canal and confirmed that there have been no breach or overtopping events.

2.10 It is reported that the water level in the canal is controlled by a number of weirs and sluice gates located along its pound length. Therefore the risk of the canal overtopping into the site is considered to be low. However, given the close proximity of the canal this residual flood risk should be considered within the development proposals (discussed with Section 3.0).

2.11 The CCTV and site topographic survey has identified two sluice gates within the vicinity within of the site (see **Appendix E**, **Annex D**). The first is located to the east of the site and discharges to the Tetchill Brook upstream of the site. The second is located on the southern boundary and discharges to a ditch within the site, which in turns outfalls to the Tetchill Brook (see **Figure 2.3**). There also appears to be two possible overflow structures/weirs on the south-eastern boundary which may enter the site within culvert, however no corresponding outfall structures on the Tetchill Brook are shown on the survey (see **Figure 2.3**).

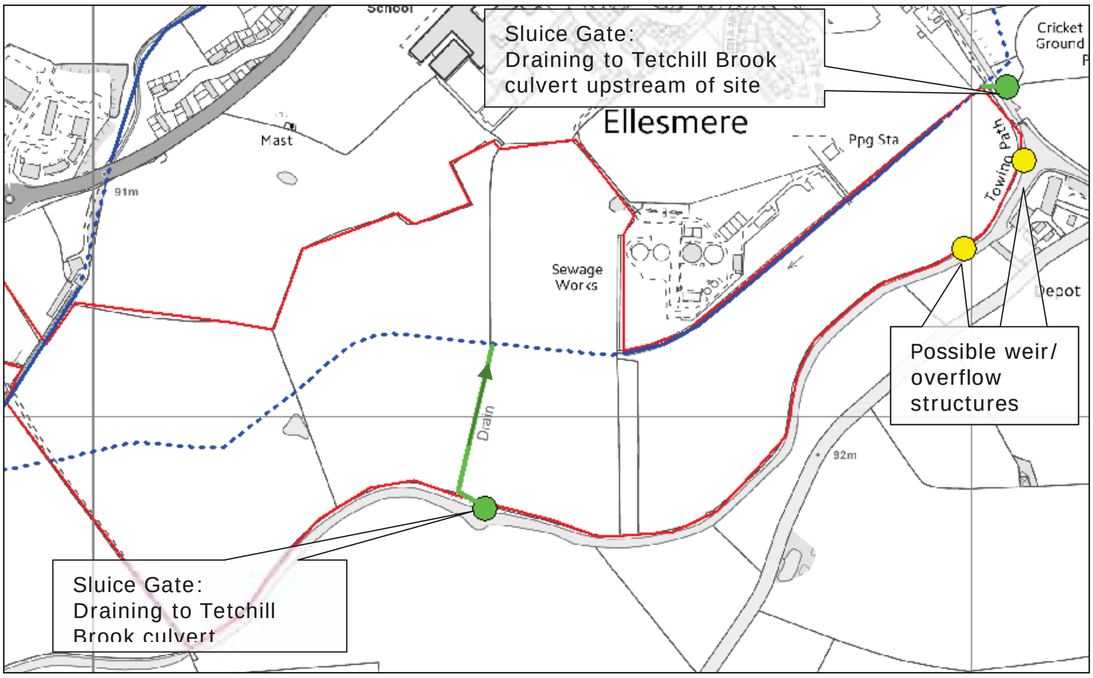


Figure 2.3 – Canal Sluice / Wier Locations

2.12 The fluvial flood modelling includes for the contributing runoff from the catchment upstream of the canal, therefore the flood risk posed by these potential overflows has been incorporated into the fluvial flood risk investigations.

2.13 The operation and downstream connectivity of the sluice gates and weirs should be maintained within the development, either by diverting or preserving the culverts/ditches.

Groundwater Flood Risk

2.2 The site is identified to be within an area of freely draining soil material as shown on BGS geology and soil maps. The underlying bedrock is understood to be Wilmslow Sandstone and forms part of a Principal (Major) Aquifer system capable of storing large quantities of water within bedrock. Superficial till deposits have also been identified at site.

2.3 The Phase I Geo-Environmental Assessment undertaken by BWB identified that there could be shallow groundwater conditions on site. However, no specific records on the site area being affected by groundwater flooding historically have been discovered or obtained.

2.4 Although there is no history of groundwater emergence on the site, due to the shallow nature of the water table, there is a risk that this could pose a residual flood risk during prolonged or multiple storm events.

Flood Risk From Reservoirs/Waterbodies

2.14 Reservoir failure flood risk mapping has been prepared by the Environment Agency, this shows the largest area that might be flooded if a reservoir were to fail and release the water it holds. The map displays a worst case scenario and is only intended as a guide.

2.15 The site is not shown to be risk of flooding from a reservoir failure on the EA reservoir flood risk mapping.

Flood Risk from Surface Water

2.16 Surface water flood risk maps prepared by the Environment Agency show that the majority of the site is at a very low to low risk of surface water flooding, as shown in **Figure 2.4**.

2.17 The areas of the site which are shown to be at a low risk are generally associated with the fluvial floodplain.

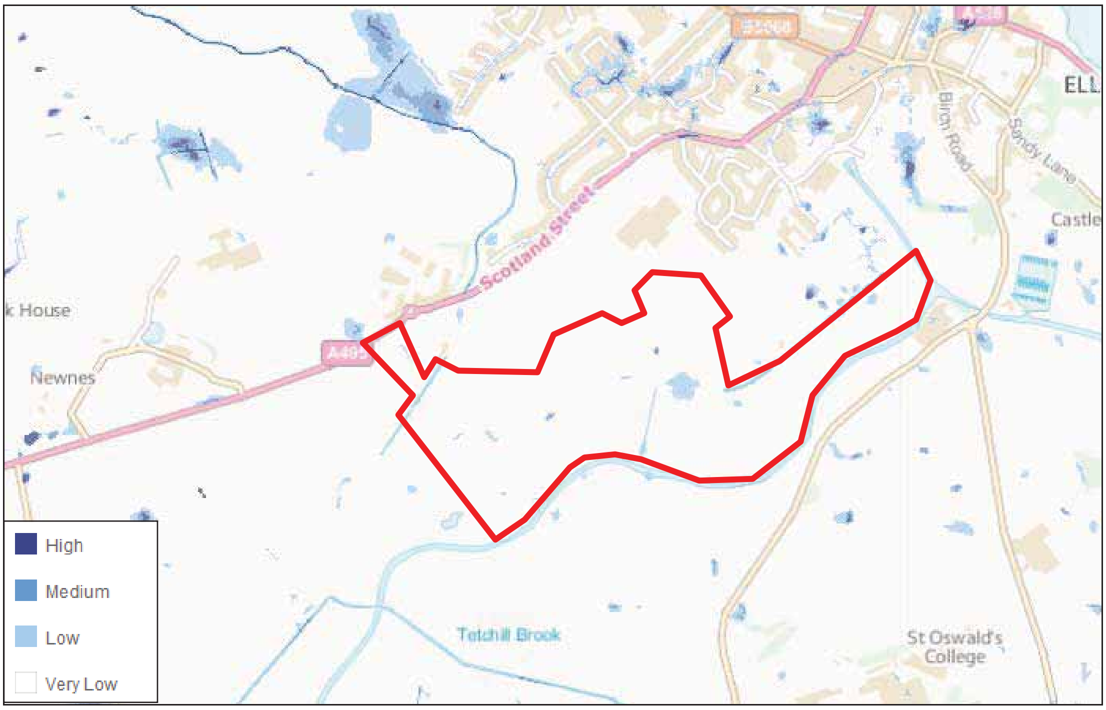


Figure 2.3 Environment Agency Surface Water Flood Risk Maps

Flood Risk from Sewers

2.18 Severn Trent sewer records show that there are adopted surface and foul water networks to the north of the site (as shown in **Appendix D**).

2.19 Although the land to the north of the site is generally higher than site, it is likely that in the event that the sewers should surcharge, the resultant overland flows would be intercepted before they reach the site, either by the highway drainage systems or by the Tetchill or Newnes Brook fluvial systems.

2.20 The sewer records also that a 100mm diameter rising main crosses the site. This is subject to a 5.0m protection zone, but could be diverted if necessary.

Effect of Development on Wider Catchment

Tetchill Brook De-Culverting

2.21 De-culverting approximately 700m of the Tetchill Brook within the site could result in an increase in pass-on flows into the downstream floodplain, or it could allow more flows to surcharge into the site from the Newnes Brook. This will need to be mitigated as part of the development proposals.

2.22 The proposed formalised watercourse corridor through the site will need to provide the same flood volume as existing otherwise flood levels on the site, and in the upstream catchment, could be increased.

Development Drainage

2.23 The development will result in an increase in impermeable surfacing when compared to the existing situation. This is likely to have a significant impact upon surface water runoff from site if unmitigated.

3.0 FLOOD RISK MITIGATION

3.1 Section 2.0 has identified the sources of flooding which could potentially pose a risk to the site and the proposed development. This section of the FRA sets out the mitigation measures which are to be incorporated within the proposed development to address and reduce the risk of flooding to within acceptable levels.

Newnes Brook

3.2 It is understood that the development will largely be located outside of the Newnes Brook floodplain to avoid displacing its floodplain.

3.3 Further to this, the ground levels of the adjacent development will be set a minimum of 300mm above the neighbouring 1 in 100 year plus climate change flood level (between 88.25 and 88.97mAOD due to the sloping water profile through the site).

3.4 Adjacent finished floor levels will be set a minimum of 600mm above the neighbouring 1 in 100 year plus climate change flood level (between 88.55 and 89.27mAOD).

3.5 The access road crossing the Newnes Brook will either be at existing levels and designed to be floodable, or will clear span the floodplain. In either scenario there would be no impedance of flood flows or loss in floodplain storage. If this is found to not be achievable as the development progresses then an assessment of the impact will be undertaken.

Tetchill Brook - Floodplain Corridor

3.6 The primary flood risk mitigation measure on the Tetchill Brook is to day-light the culvert within the ownership of site and formalise the 1 in 100 year plus climate change floodplain within a designated ‘corridor’.

3.7 This also provides an opportunity to improve the aesthetic value and appearance of the watercourse to the benefit of local wildlife and of the proposed development. It will also help restore a more natural hydrological and geomorphological regime to the Tetchill Brook.

3.8 The hydraulic model of watercourses was used as a design tool to develop a parameters plan for the watercourse corridor, which:

- removes the Tetchill Brook culvert within the site,
- preserve the flow entering/surcharging from the remaining downstream culvert and
- recreates the existing floodplain volume within a formalised area.

3.9 The parameters plan of the floodplain corridor is included as **Appendix E**, **Annex H**. At this outline stage the corridor has been formulated to address flood risk issues. As the development proposals progress it is envisaged that the designs will be updated to include ecological and geomorphological features – while still preserving the flood risk design criteria.

3.10 The proposed floodplain corridor was simulated in the model and compared against the baseline (existing) conditions. This has shown that it has sufficient capacity for the 1 in 100 year plus climate change event (the design event) and that it does not impact flood risk in the wider catchment.

3.11 Further to this, the floodplain corridor is also shown to be sufficient to accommodate the flood volumes generated during blockage scenarios of the upstream and downstream culverts.

3.12 Post de-culverting floodplain maps are summarised in **Figure 3.1**, with flood levels from key events shown in **Table 3.1**. Full mapping included as **Appendix E**, **Annex F.**

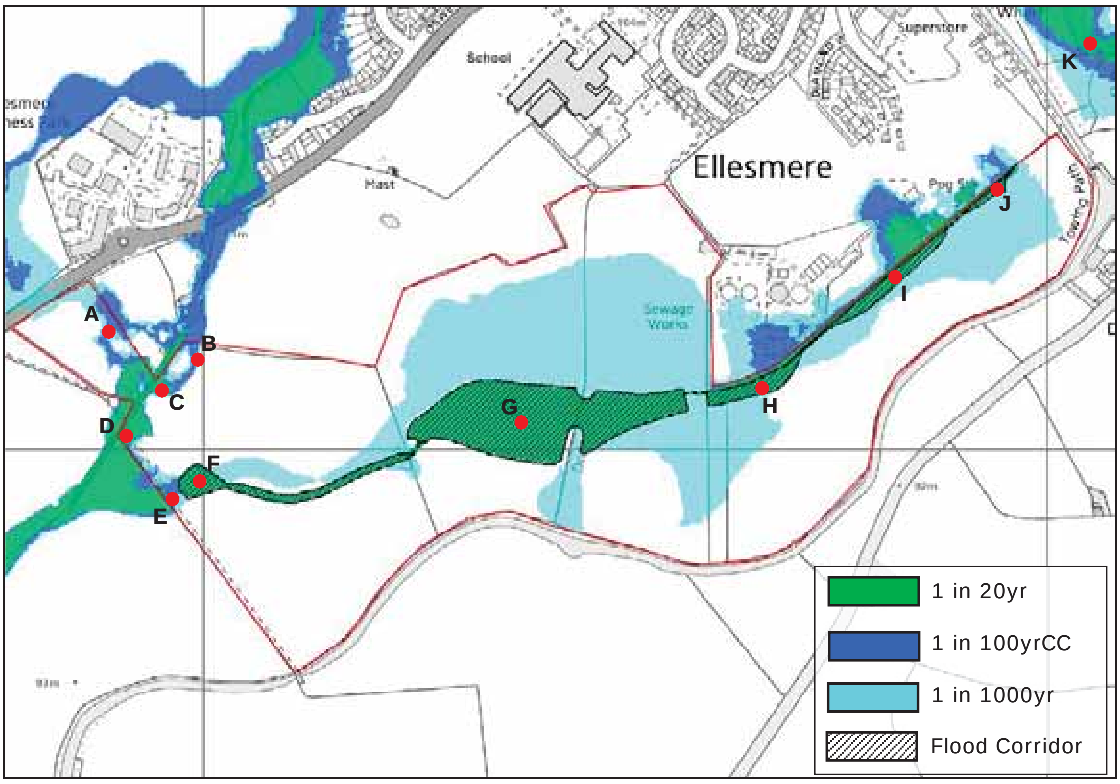


Figure 3.1 – Flood Level Interrogation Locations

	Design Events (Return Period - yrs)			
	1 in 20	1 in 100	1 in 100 + CC	1 in 1000
A	-	-	88.00	88.23
B	-	-	88.67	88.80
C	87.99	88.05	88.11	88.23
D	87.83	87.88	87.95	88.06
E	-	87.78	87.86	87.96
F	86.71	86.96	87.17	87.63
G	86.71	86.96	87.17	87.63
H	86.72	86.96	87.17	87.63
I	86.72	86.96	87.17	87.63
J	86.72	86.98	87.19	87.63
K	86.89	87.29	87.59	88.15

Table 3.1 – Peak Design Flood Levels (mAOD)

Tetchill Brook - 1 in 1000 Year Floodplain

3.13 The volumes and flow rates are such that in a 1 in 1000 year event the storage capacity of the proposed floodplain corridor would be exceeded and flood water would spill into the external areas of the development.

3.14 The extent and magnitude of the 1 in 1000 year floodplain will ultimately be controlled by the final development elevations which are yet to be set. These will be determined through an earthworks exercise and may need to meet a number of constraints, as well as mitigating flood risk.

3.15 Two examples of how the 1 in 1000 year floodplain could be managed are summarised within the forthcoming section.

The Minimum Mitigation Thresholds

3.16 Firstly the *minimum* requirements to mitigate flood risk to an acceptable level have been identified. This includes raising ground levels across the development to a minimum elevation of 87.50mAOD (300mm above the 1 in 100 year + 20% flood level).

3.17 Finished floor levels are set to a minimum level of 87.80mAOD (600mm above the 1 in 100 year + 20% flood level).

3.18 This approach has been tested with the hydraulic model, and the results are presented within **Figure 3.1** and **Table 3.1**, and are mapped within **Appendix E**, **Annex F**.

3.19 The results show that flood depths of up to 126mm could occur within external areas of the development (car parks, roads, gardens, etc.). This is representative of a ‘low’ flood hazard (signifying shallow flooding and low velocities).

3.20 Under these conditions the minimum finished floor level would be 170mm above the 1 in 1000 year flood level.

The Sequential Arrangement of the Floodplain

3.21 In addition to identifying the *minimum* acceptable requirements, as discussed above, a preliminary assessment of the possible sequential arrangement the development within Flood Zone 1 and 2 has been undertaken.

3.22 This follows a sequential approach by setting the 'More Vulnerable' development areas (hotel, residential properties, log cabins and caravans) as well the spine road through the development above the 1 in 1000 year flood level (i.e.: within Flood Zone 1) – an elevation of 87.80mAOD.

3.23 While the 'Less Vulnerable' areas (commercial land use, car parks, and landscape areas) are set a lower level to continue to flood in a 1 in 1000 year event (i.e.: within Flood Zone 2) – at an elevation of 87.50mAOD

3.24 Finished floor levels would be set at a minimum elevation of 87.95mAOD, to allow a 150mm freeboard to the elevated ground levels on the western boundary site boundary (which controls the overland flow into the downstream floodplain).

3.25 This indicative strategy is illustrated within **Appendix F**, **Annex I,** which shows that flood depths within the less vulnerable areas are shown to be in the region of 185mm, but the Flood Hazard is still classified as 'low'.

3.26 It is recommended that the Sequential Approach is adopted wherever feasible, when setting development elevations, subject to the other constraints on the site.

3.27 The 1 in 1000 year flood level will be influenced by the final development elevations; therefore it is recommended that the modelled analysis is repeated as the development design progresses to ensure that the flood management strategy is still robust.

Surface Water & Overland Flows

3.28 To mitigate any residual risk posed by pluvial runoff and overland flows within the vicinity of the site it is recommended that ground levels are profiled to direct overland flows away from the development and towards the nearest drainage point or into the watercourse corridor.

3.29 Floor levels should also be set a minimum of 150mm above surrounding ground levels to further mitigate the residual risk of the canal overtopping, groundwater emergence and surface water runoff.

3.30 This will also help mitigate the residual flood risk posed by the canal overtopping as well as groundwater emergence (although this is most likely to occur in the low lying watercourse corridor).

Safe Access and Egress

3.31 The development of the site will include a number of bridge crossing over the Tetchill Brook and the new floodplain corridor. It is understood that these will clear span over the 1 in 100 year plus climate change floodplain, and will therefore be dry during the design flood event, and will also result in no impedance of flood flows or loss in floodplain storage.

3.32 Dry access/egress outside of the 1 in 100 year plus climate change floodplain from the site to the wider catchment will be available from the north-eastern access road on to Canal Way.

Surface Water Drainage

3.33 The development of the site will be accompanied by a surface water drainage network which will intercept, attenuate and store on-site runoff up to and including the 1 in 100 year plus climate change storm event. The surface water strategy is discussed in greater detail within **Section 4.0**.

Existing On-Site Infrastructure

3.34 The development will seek to preserve or divert the canal sluice and weir drainage routes through the site so that their operation in not affected (subject to the necessary agreements).

3.35 Further to this, the development will observe the 5.0m protection strip around the Severn Trent Water rising main, or seek to have it diverted.

Flood Management Strategy

3.36 As previously discussed in a 1 in 1000 year event some of the external areas of the development could be become inundated. Although the flood hazard this would pose has been calculated to be ‘low’, it is recommended that a suitable flood management strategy is prepared for such an occurrence.

4.0 OUTLINE DRAINAGE ASSESSMENT

Outline Surface Water Drainage Assessment

Existing Site Runoff

4.1 The site is currently greenfield in nature, covering approximately 31 hectares. The land use is largely pasture which either infiltrates into the surrounding ground or runs overland to the Tetchill and/or Newness Brook.

4.2 No existing downstream flooding issues have been identified, therefore the existing runoff rate from the greenfield site are not believed to initiate any flood risk.

4.3 Greenfield runoff rates have been estimated using the IH124 approach as recommended in the latest interim Environment Agency guidance[2]. Estimated runoff rates are detailed within **Table 4.1**.

Return Period (yrs)	Existing Runoff (l/s)	Proposed Development Discharge Rates (l/s)
QBAR	156	156
30	306	156
100	400	156
100+climate change	480	156

Table 4.1 – Existing and Proposed Runoff Rates

Proposed Site Runoff

4.4 The potential use of soakaways is yet to be investigated and it is advised that this be undertaken prior to the detailed design stage. If deemed viable it is suggested that full use is made of this option.

4.5 However, the Phase I Geo-Environmental Assessment undertaken indicates that there are shallow groundwater conditions present on parts of site, so soakaways may not be appropriate across the entirety of the site.

4.6 For the purposes of this report it is therefore assumed that soakaway is not appropriate or limited – this represents a worst-case scenario of the drainage conditions in terms of storage and associated costs. The actual potential application of soakaways will be further considered during detailed design.

4.7 It is proposed that the development therefore continue to drain to the Tetchill Brook.

4.8 It is proposed that discharge rates form the development be limited to the greenfield QBAR rate for all events up to and including for the 100 year plus climate change event, as illustrated in **Table 4.1**. This approach will ensure that

[2] Environment Agency, 2013. Rainfall Runoff Management for Developments. Report – SC030219.

the existing site surface water runoff conditions are maintained whilst also providing betterment for the higher return period events.

4.9 It is envisaged that the total allowable runoff rate from the site will be split between each development parcel at the detailed design stage, so that storage volumes are distributed to the plots with most available space.

Attenuation Volumes and Sustainable Drainage Systems

4.10 Attenuated surface water storage will be provided within the development area of the site (i.e.: outside of the floodplain corridor) for storms up to and including the 1 in 100 year plus climate change critical event.

4.11 For the purposes of this report it is assumed that 65% of the development area will be made impermeable – 20ha. This area has been used to estimate the potential storage requirements at key events using FEH rainfall profiles within Micro Drainage's 'Source Control', see **Table 4.2**.

Return Period (yrs)	Storage Estimates (m^3)		
	Lower Bound	Upper Bound	Mean
30	4299	6297	7448
100	6462	10048	8255
100 + climate change	9029	14901	11965

Table 4.2 – Indicative Storage Volumes

4.12 For the purposes of this outline assessment a universal +30% provision has been applied to account for the potential impacts of climate change in consideration to the anticipated lifetime of the residential development (2085 - 2115). In detailed design the required volumes can be reduced in the non-residential areas by utilising a climate change value of +20%.

4.13 The exact storage requirements and surface water strategy will be determined during the detailed design stage.

4.14 It is recommended that where space allows above ground Sustainable Drainage Systems (SuDS) such as swales and/or ponds are utilised on site to provide the required attenuation volumes. However, as much of the site is given over to a new watercourse corridor (with its associated sustainability, ecological and amenity benefits) it should be acceptable to use cellular storage or underground storage where other constraints make the use of above ground SuDS unfeasible.

4.15 The use of permeable materials, such as permeable paving and gravel caravan plots, should be considered to reduce the impermeable areas and required storage volumes.

4.16 Due to the developments position above a principle aquifer, in addition to attenuating and storing surface water runoff, SuDS techniques should be used to provide a minimum of three levels of treatment to runoff from trafficked areas prior to leaving the site. At least one level of treatment will be required for roof water). This could include the use of filter drains, permeable paving, bio retention area, and other source control techniques.

4.17 The creation of small wetlands, ponds and swales within the floodplain corridor will also be considered to provide additional levels of treatment, as well increased amenity and ecological gains.

Exceedance Events

4.18 In the event of storms in excess of the 1 in 100 year plus climate change event occurring, it is recommended that the final layout uses the proposed road infrastructure to provide drainage exceedance (overland flood flow) routes through the development and towards the attenuation structures or watercourse corridor.

Outline Foul Water Drainage Assessment

4.19 Correspondence with Severn Trent Water has been undertaken in respect to the development, as included within **Appendix D.**

4.20 Correspondence has confirmed that the Wharf Meadow Treatment Works would have capacity to accept the flows from such a development.

4.21 The site will discharge to the mains foul sewer system, to the gravity sewers before the inlet to the treatment works. It may be necessary to include a pumping station on site according to the topography.

5.0 WATER FRAMEWORK DIRECTIVE ASSESSMENT

Legislative Background

5.1 The Water Framework Directive (WFD) (2000/60/EC) encompasses all surface waters and groundwater in England and Wales. The EU WFD was transposed into law in England and Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003.

5.2 A waterbody is a manageable unit of surface water, being the whole (or part) of a stream, river or canal, lake or reservoir, transitional water (estuary) or stretch of coastal water. A 'body of groundwater' is a distinct volume of groundwater within an aquifer or aquifers.

5.3 The waterbody encompasses the entire stream network draining the river catchment, as classified for the purposes of the WFD. Water bodies designated as highly modified aim to achieve good ecological potential; while water bodies without this designation aim to achieve good ecological status.

5.4 The Directive requires that Environmental Objectives be set for all surface and ground waters in England and Wales to enable them to achieve Good Status (or Good Ecological Potential for Heavily Modified and Artificial Water Bodies) by a defined date.

5.5 The WFD sets a number of Environmental Objectives for all surface water and groundwater bodies that must be met in order for the proposed scheme to be compliant with the WFD. Article 4.1 of the WFD outlines the Environmental Objectives as follows:

- Member States shall implement the necessary measures to prevent deterioration of the status of all bodies of surface water (Article 4.1(a)(i)).
- Member States shall protect, enhance and restore all bodies of surface water, subject to the application of subparagraph (iii) for artificial and heavily modified bodies of water, with the aim of achieving good surface water status by 2015 (Article 4.1(a)(ii)).
- Member States shall protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status by 2015 (Article 4.1(a)(iii)).
- Progressively reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazard substances (Article 4.1(a)(iv)).
- Prevent Deterioration in Status and prevent or limit input of pollutants to groundwater (Article 4.1(b)(i).

5.6 These Environmental Objectives are also detailed as the following listed below:

- prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters;

- aim to achieve at least “good status” for all water bodies by 2015. Where this is not possible and subject to the criteria set out in the Directive, aim to achieve good status by 2021 or 2027;
- meet the requirements of Water Framework Directive Protected Areas;
- promote sustainable use of water as a natural resource;
- conserve habitats and species that depend directly on water;
- progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment;
- progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants; and
- contribute to mitigating the effects of floods and droughts.

Artificial or Heavily Modified Waterbodies

5.7 The River Severn Basin Management Plan[3] identifies that some surface water bodies are designated as ‘artificial’ or ‘heavily modified’. This is because they may have been created or modified for a particular use such as water supply, flood protection, navigation or urban infrastructure. By definition, artificial and heavily modified water bodies are not able to achieve natural conditions. Instead the classification and objectives for these water bodies, and the biology they represent, are measured against ‘ecological potential’ rather than status.

5.8 For an artificial or heavily modified water body to achieve good ecological potential, the chemistry of the water body must be good. In addition, there must be no structural or physical changes that could impact upon biology other than those that are essential to maintain the valid uses of the water body. All non-essential modifications have had to be removed or changed so that there is potential for biology to be as close as possible to that of a similar natural water body.

The Tetchill Brook

5.9 The Tetchill Brook falls within the site boundary of the proposed development discussed in this report. As the development will influence this waterbody, it must be ensured that any works comply with the Water Framework Directive legislation.

5.10 The Tetchill Brook is culverted for the majority of its 2.6km course between The Mere and the culvert outfall, 380m downstream of its confluence with the Newnes Brook. As such it is believed that these upper reaches would be classified as a Heavily Modified Water Body (HMWB), however, according to Environment Agency mapping, the catchment is not currently classified. The only significant length of open channel along this reach is on the site’s northern boundary,

[3] 2009. River Basin Management Plan, Severn River Basin District. Environment Agency

adjacent to the sewage works, which is canalised and is considered to be of a low quality.

5.11 The Environment Agency's River Basin Management Plan Mapping shows that the Tetchill Brook is located within the 'Shropshire Middle Severn' Management Catchment. Key indicators for the Tetchill Brook are detailed within **Table 5.1**.

Water Body ID	GB109054055000
Waterbody Name	Tetchill Brook - source to confluence with River Perry
Management Catchment	Shropshire Middle Severn
Hydromorphological Designation	Not designated A/HMWB
Current Ecological Quality	Poor Status
Current Chemical Quality	Does Not Require Assessment
Overall Status	Poor

Table 5.1 – Summary of RBMP Information

5.12 A biological investigation into the Tetchill Brook was undertaken by the Environment Agency in 2012[4]. This identified that the water body was failing due to low invertebrate populations. It was reported that this was a result of morphological condition and potentially sedimentation – both a direct result of the extensive modifications to the watercourse (resectioning and culverting). The report recommends that improvements should be undertaken within the waterbody that could assist the macro-invertebrate fauna achieve Good status.

5.13 An ecological investigation into the Tetchill Brook was undertaken by the Environment Agency in 2014[5]. This identified that fish populations are poor, which is partly a result of barriers to movements and hydromorphology. The investigation identified, amongst other recommendations, that a programme of river restoration work should be undertaken to improve the ecological and chemical status of the brook.

Impact of the Proposed Development

5.14 The proposed development will include the removal of approximately 700m of culvert from the Tetchill Brook within the site boundary. A new 'naturalised' open channel will be created within a formalised floodplain corridor.

5.15 This could provide substantial local improvements to sedimentation and morphology, as well as ecology through the introduction of new aquatic and riparian habitats (e.g. water vole).

5.16 An integral part of the Water Framework Directive, The River Severn Basin Management Plan, as well as the North Shropshire Strategic Flood Risk Assessment, is for culverted watercourses to be 'day-lighted' and restored to a

[4] 2012. Fenn, M. Water Framework Directive Biological Investigation. GB109054055000. Environment Agency
[5] 2012. Cowley, J. Water Framework Directive Ecological Investigation – Fish. GB109054055000. Environment Agency

more natural state. Therefore it is believed that the development has the potential to offer significant positive benefits to the status of the local watercourse.

Conclusion

5.17 To ensure the proposed development is compliant with the Water Framework Directive, consideration must be given to the Environmental Objective of Article 4 of the WFD.

5.18 The development shall be compliant with Article 4.1(a)(i-iii) as it seeks to prevent the ecological deterioration of the watercourse by de-culverting the channel within the ownership of the site to create a new open channel with associated improvements to aquatic and riparian habitats.

5.19 As such, the proposals would be conducive to the surface water body achieving at least good ecological status by 2015. It is therefore compliant with the Water Framework Directive.

5.20 Moreover the scheme would not be prejudicial to the remaining culverted reaches being day-lighted in the future.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 This Flood Risk Assessment (FRA) is compliant with the requirements set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance. The FRA has been produced on behalf of Burbury Investments Ltd in respect of an outline planning application for the mixed use development ‘Ellesmere Marina’, in Ellesmere, Shropshire.

6.2 The development proposal include the day-lighting (de-culverting) of the Tetchill Brook within the site. A new open watercourse will be created within a formalised floodplain corridor which will add significant ecological, geomorphological, and amenity benefits to the site and riparian environment. This also meets the objectives of the Water Framework Directive, River Severn Basin Management Plan, and the Strategic Flood Risk Assessment.

6.3 The new floodplain corridor will be designed to relocate Flood Zone 3a and accommodate the 1 in 100 year plus climate change floodplain.

6.4 The 1 in 1000 year floodplain will exceed the capacity of the of the floodplain corridor. The minimum requirements to mitigate flood risk to an acceptable level at the 1 in 1000 year event have been identified. However, it is recommended that a sequential approach is adopted where feasible, to raise the more vulnerable elements of the development into Flood Zone 1.

6.5 The 1 in 1000 year flood level and floodplain extent will be influenced by the final development elevations which are still to be determined, therefore it is recommended that the 1 in 1000 year analysis is repeated once levels are known to ensure that the flood management strategy is still robust.

6.6 Dry access/egress outside of the 1 in 100 year plus climate change floodplain from the site to the wider catchment will be available from the north-eastern access road on to Canal Way.

6.7 This report demonstrates that the proposed development is at an acceptable level of flood risk, subject to the recommended flood mitigation strategies being implemented. The identified risks and mitigation measures are summarised within **Table 6.1**.

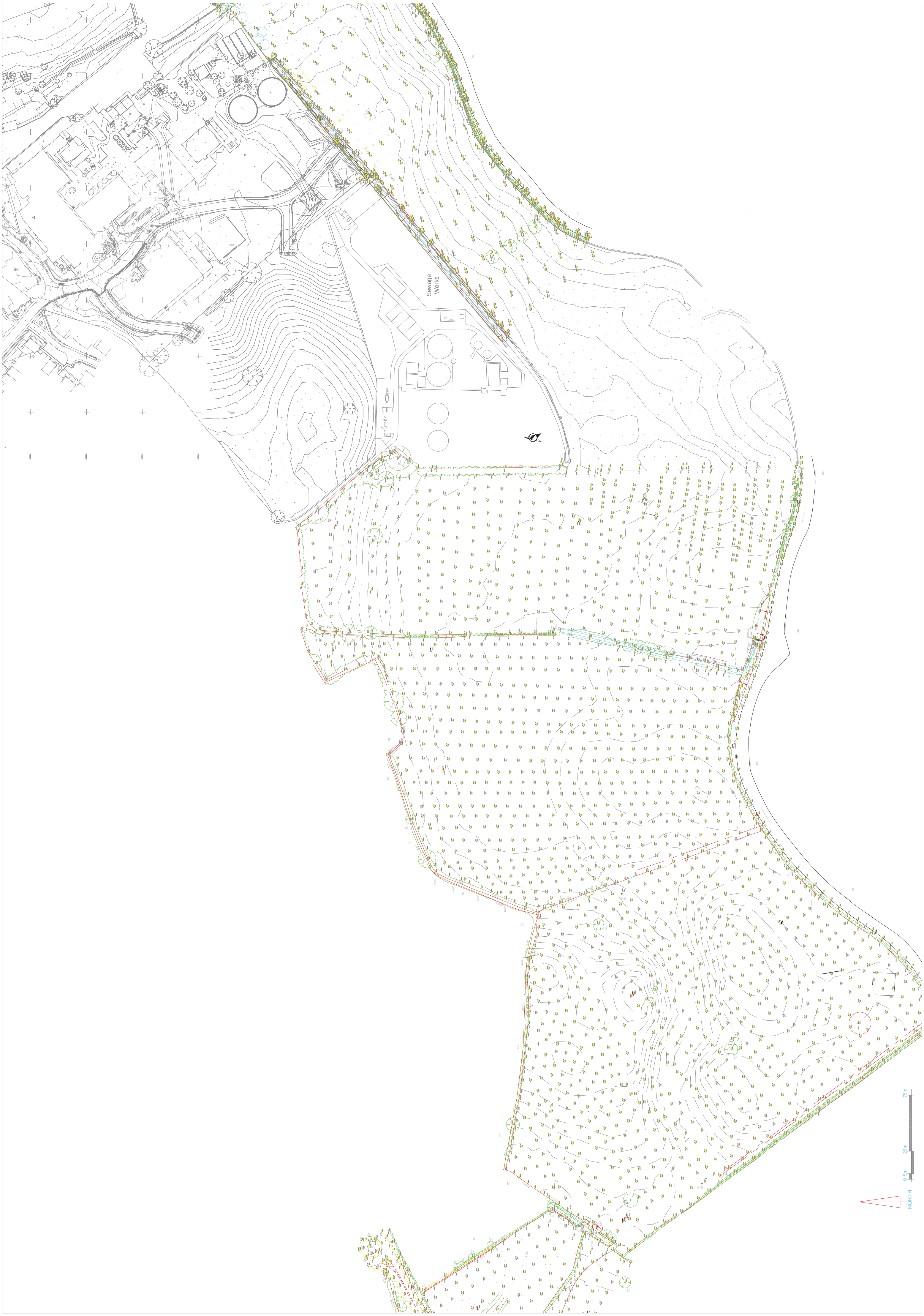
6.8 In compliance with the requirements of National Planning Policy Framework, and subject to the mitigation measures proposed, the development could proceed without being subject to significant flood risk. Moreover, the development will not increase flood risk to the wider catchment area as a result of suitable management of surface water runoff discharging from the site.

Flood Source	Proposed Mitigation Measure
Fluvial	The development will remain outside of the Newnes Brook floodplain (with the exception of a floodable access road). A new floodplain corridor will be created on the Tetchill Brook to accommodate the 1 in 100 year plus climate change event. Development ground levels (roads, car parks, gardens, etc.) will be set a minimum of 300mm above the adjacent 1 in 100 year plus climate change flood level. Finished flood and threshold levels will be set a minimum of 600mm above the adjacent 1 in 100 year plus climate change flood level A flood management strategy should be prepared for the potential risk of extreme flood events overtopping the watercourse corridor and inundating external areas of the development.
Canals	Finished floor levels will be set a minimum of 150mm above surrounding ground levels. Ground levels will be profiled to encourage any overland flows away from the built development and towards the nearest drainage point. Existing infrastructure and drainage routes associated with the canal within the site are to be preserved or diverted (subject to the necessary agreements).
Groundwater	Any residual flood risk from groundwater sources will be mitigated by raising the development areas and through the creation of a new watercourse corridor.
Sewers	Finished floor levels will be set a minimum of 150mm above surrounding ground levels. Ground levels will be profiled to encourage any overland flows away from the built development and towards the nearest drainage point. The protection zone around existing on-site infrastructure will be observed, or alternatively a diversion of the rising main will be sought.
Pluvial runoff	Finished floor levels will be set a minimum of 150mm above surrounding ground levels. Ground levels will be profiled to encourage any overland flows away from the built development and towards the nearest drainage point.
Impact of the Development	Runoff from the site is to be restricted to the existing QBAR rate, up to and including for the 100-year plus climate change event. The floodplain corridor will be sized to return the same flood volume as existing, and to preserve the existing flow regime in the downstream culvert. New bridges over the Tetchill Brook will clear span the 1 in 100 year climate change floodplain. New bridges over the Newnes Brook will either be at existing levels and designed to be floodable, or will clear span the 1 in 100 year climate change floodplain.

Table 6.1 - Summary of FRA

APPENDIX A

Topographical Survey


Sewage Works
75m
25m
0 5m
NORTH

BWB

CONSULTANCY | ENVIRONMENT
INFRASTRUCTURE | BUILDINGS

APPENDIX B

Proposed Development

Canalside Tourist Develpment

The Carriage Building, Bruton Way, Gloucester, GL1 1DG T:03333 405 500 E:mail@robertslimbrick.com
This drawing is the copyright of Roberts Limbrick Ltd and should not be reproduced in whole or in part or used in any manner whatsoever without their written permission

Ellesmere Development

PROPOSED MASTER PLAN

Date: June 2014 Scale: 1/1250 @ A0 Drawing No: 5614 PRSK25 M
Do Not scale off this drawing. For Illustrative purposes only

Roberts Limbrick
ARCHITECTS

APPENDIX C

Environment Agency Correspondence

Ms Beth Kendrick
BWB Consulting Limited
Livery Place (35) Livery Street
Birmingham
West Midlands
B3 2PB

Our ref: SV/2013/107194/01-L01
Your ref: BMW/2025/FRS

Date: 06 August 2013

Dear Ms Kendrick

FLOOD RISK STRATEGY REVIEW - PROPOSED MIXED-USE DEVELOPMENT INCLUDING: A NEW MARINA (200 BOAT SPACES), LEISURE SPA, 120 BED HOTEL, RESTAURANT/PUB FACILITIES, 4 HA. FOR LOG CABINS AND TOURING CARAVANS, GARDEN CENTRE WITH ASSOCIATED PARKING AND RESIDENTIAL DEVELOPMENT (250 DWELLINGS) AT ELLESMERE MARINA, ELLESMERE, SHROPSHIRE

I refer to the Flood Risk Strategy (FRS), ref: BMW/2025/FRS, for the above proposed mixed-use development at Ellesmere Marina, which we received on 30 July 2013. The FRS has been prepared as a follow on from the site walk-over held on 18 July 2013.

It is noted that the site has also been included within the 'Revised Preferred Options' stage of the Shropshire Council Site Allocations and Management of Development Plan (SAMDev) document that is currently in consultation until 23 August 2013. Therefore, in consideration of the above and in line with the two-tier pre-planning application advice process introduced 08 July 2013, I wish to provide the following preliminary comments:

Current Flood Risk

According to our current ‘indicative’ Flood Zone Map the site has a significant area; particularly the proposed residential area, within Flood Zone 3 (1% annual probability of fluvial flooding), with a small extended area in Flood Zone 2 (0.1% annual probability of fluvial flooding). The Flood Zone 3 area runs from east to west through the centre of the site following the line of the Tetchill Brook (ordinary watercourse), that is an open channel in the east but culverted in the west. Towards the north-west corner of the site the Flood Zone 3 area is extended as it links up with the Newnes Brook (Main River) and its floodplain.

In consideration of the above we would therefore hold the view that parts of the site could be at high risk of fluvial flooding from both the Tetchill Brook and Newnes Brook watercourses.

National Planning Policy Framework (NPPF)

<u>Vulnerability Classification</u>

The Technical Guidance to the NPPF (March 2012) would class the proposed mixed-use development within the following vulnerability classifications (Table 2):
- More vulnerable use: Log cabins and touring caravans, residential dwellings and hotel;
- Less vulnerable use: Leisure spa, restaurant, pub and garden centre;
- Water-compatible development: the marina.

Proposals for ‘more vulnerable’ and ‘less vulnerable’ development within Flood Zone 2 and 3a would require the Sequential Test to be passed. ‘More vulnerable’ use development in Flood 3a requires the Exception Test to be undertaken (Technical Guidance, Table 1).

For ‘more vulnerable’ and ‘less vulnerable’ development, if the Flood Risk Assessment (FRA) confirms that the development is within Flood Zone 3b (functional floodplain, as defined in Table 1 of the Technical Guidance to the NPPF), depending on the site specifics, for example the potential impact upon flows, the proposal may be inappropriate. This is in accordance with Table 3 of the Technical Guidance to the NPPF which states that such development “should not be permitted” in Zone 3b functional floodplain.

Water-compatible use development is considered appropriate across all flood zones.

Sequential Test (ST)

The NPPF details the requirement for a risk-based ST in determining planning applications. See paragraphs 100–104 of the NPPF and paragraphs 3-5 of the accompanying Technical Guidance.

Paragraph 101 of the NPPF requires decision-makers to steer new development to areas at the lowest probability of flooding by applying a ST. It states that ‘Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding’.

Prior to investing resources in completing a detailed FRA, I would recommend that you contact the Local Planning Authority (LPA) and discuss how the flood risk ST as set out in the NPPF and the accompanying Technical Guidance will affect the proposed development. It is possible that the development will be inappropriate and be refused planning permission irrespective of any detailed Flood Risk Assessment (FRA).

We do however recognise that the proposed development is being put forward within the SAMDev ‘Revised Preferred Options’ stage. To inform the SAMDev decision making process, we would expect an assessment to give a reasonable degree of certainty on the principle of development being appropriate sequentially.

Flood Risk Strategy (FRS)

Flood Risk

As highlighted in the FRS, we accept that due to the indicative nature of our indicative Flood Zone maps, and the extent of the culverted watercourse (which could be opened up), the proposed development has the opportunity to offer flood risk betterment in line with the NPPF.

In the conclusion the FRS notes that the proposed works will be able to address flood risk issues and enable the more and less vulnerable use developments to be considered appropriate on site. This is to be achieved through the following measures:

- Opening up of the culverted section of the Tetchill Brook on site and enable it to contain the 1 in 100 year return event with an allowance for climate change factored in;
- Manage the flood zone extent of the watercourse corridor by providing a constrained 15 metre corridor for flood flows. This will particularly ensure that the more vulnerable use developments will be sited safely and allow for safe access from the site; and,
- Restrict flow into the existing culvert downstream to current levels.

We can agree with the above mentioned points subject to the detail mentioned within the FRS (pages 5 – 6). In going forward we would advise that the further work proposed in relation to developing the existing Weetwood baseline model (for comparative purposes and to demonstrate no downstream impacts etc) and updating it into ISIS; are undertaken and are provided within the FRA (page 6).

Water Ecology

It is noted that in opening up the culvert on site, ecological betterment will be achieved through an increase in channel and bank side habitats for flora and fauna.

In the first instance an Ecological Survey (ES) will need to be conducted and then used to inform a Habitat Management Plan (HMP). The HMP should then detail how the proposed channel and bank side habitats will be managed and contribute towards improving the watercourse environment with consideration also given to reducing flood risk.

The current Water Framework Directive (WFD) status for the Tetchill Brook is 'Poor' with the objective to achieve 'Good' status by 2027. The above proposed dual flood risk enhancement and ecological betterment will help contribute towards this objective.

Flood Risk Assessment (FRA)

The NPPF paragraph 103 requires that all development proposals in Flood Zones 2 and 3 should be accompanied by a flood risk assessment (Table 1). The FRA should "...identify and assess the risks of all forms of flooding to and from the development and demonstrate how these flood risks will be managed so that the development remains safe throughout its lifetime, taking climate change into account" (Technical Guidance to the NPPF, Paragraph 9).

However for completeness, the FRA should develop the from the scope detailed in the FRS and provide a benchmark assessment of the current flood risks on site; impact on flood risk from the proposals to the development and users (floor levels and safe access); and the impact on flood risk elsewhere including opportunities for flood risk betterment.

For further information I would also recommend that you refer to our FRA Guidance Note (attached to email).

Flood Defence Consent

Main River

Cont/d..

For information, the Newnes Brook located in the north-west of the site, is classed as a main river. Under the terms of the Water Resources Act 1991, and existing byelaws, prior written consent of the Environment Agency is required for any proposed works or structures, in, under, over or within 8 metres of the top of the bank of the Newnes Brook.

Ordinary Watercourse

Any proposed works or structures associated with the Tetchill Brook, classed as an ordinary watercourse, would require consent from the Lead Local Flood Authority (LLFA - Shropshire Council).

Drainage

Due to the scale and nature of the proposed development and in line with our status as a statutory consultee for Environmental Impact Assessment applications, we will be making strategic comments with regards to surface water drainage.

However, the LLFA will be leading on surface water drainage matters and therefore for further advice, including the use of sustainable drainage systems (SUDS), you should consult with the Shropshire Council Flood and Water Management Team at: flood@shropshire.gov.uk.

For further guidance on foul drainage please see our ‘Foul Drainage Assessment Form’ (attached to email).

Going Forward

I trust the above is useful for informing any future stages of development. I would particularly advise, as mentioned above, that in order to inform the SAMDev an assessment needs to be provided i.e. to assist Shropshire Council with the Sequential Test and their decision on whether to allocate this site.

As also mentioned previously; we would only provide more detailed advice, including a review of a FRA, as part of our charged service. The charged service is based on a rate of £84 per hour and in consideration of the report/assessment to be reviewed.

If you wish to enquiry about our pre-application charged service then please contact me for more information on or a member of the Midlands West Sustainable Places team at: westareaplanning@environment-agency.gov.uk.

Please note that our pre-application advice does not comprise any formal decision made by the Local Planning Authority and cannot pre-empt or bind in anyway the eventual decision on any subsequent planning application.

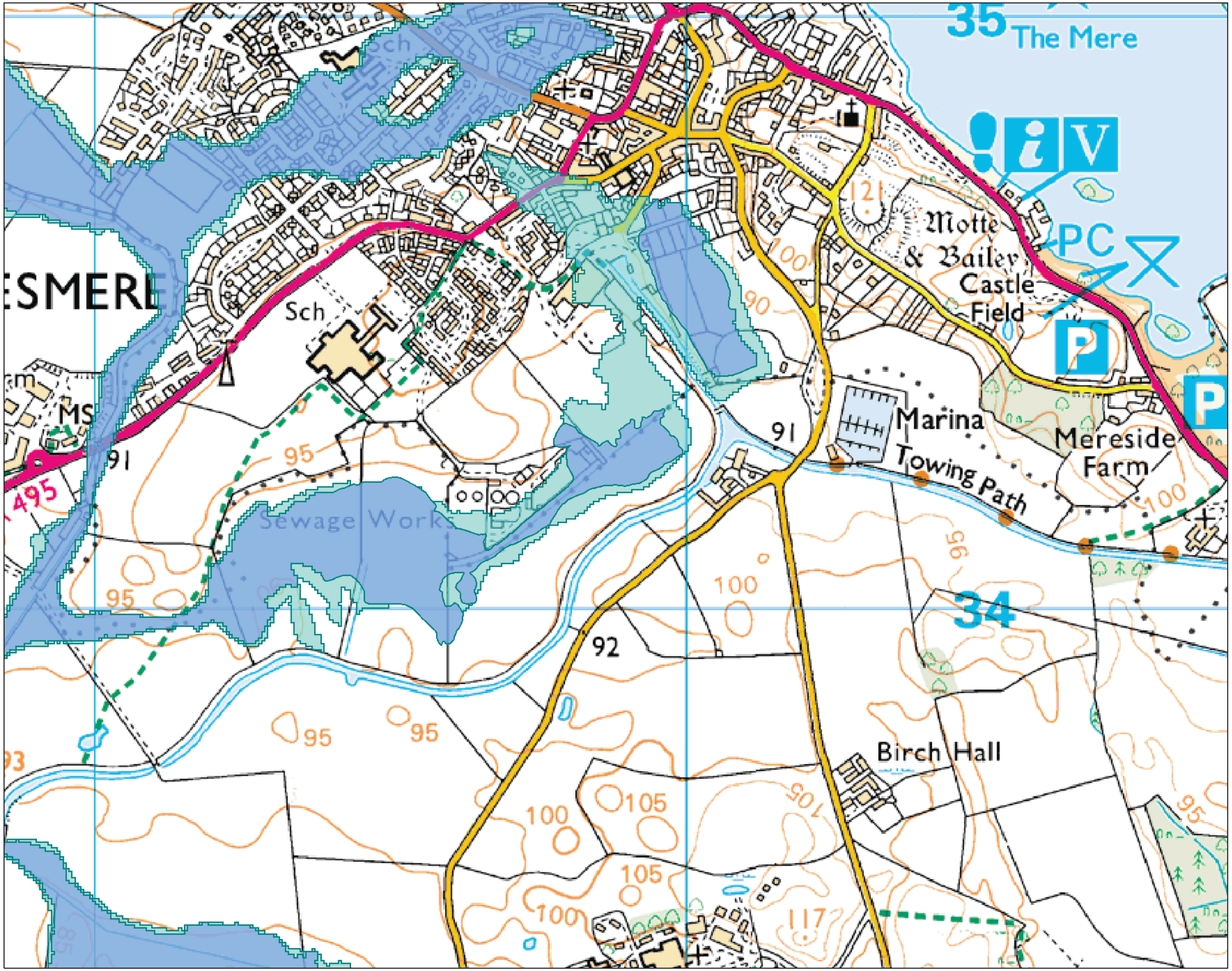
Yours sincerely

Mr Robert Gilmore
Senior Planning Advisor

Direct dial 01743 283505
Direct e-mail robert.gilmore@environment-agency.gov.uk

End

Flood Zone Map centred on Ellesmere Marine, Ellesmere - created 20 March 2012 [ERW1555]



Scale 1:10,001

- Flood Map - Defences
- Areas Benefiting from Flood Defences
- Flood Map - Flood Storage Areas
- Flood Map - Flood Zone 3
- Flood Map - Flood Zone 2

Flood Map Areas (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

APPENDIX D

Severn Trent Water Correspondence

Severn Trent Water

BWB Consulting Ltd
5^{th} Floor
Waterfront House
Station Street
Nottingham
NG2 3DQ
FAO Josephine Green

Severn Trent Water Ltd
Regis Road
Wolverhampton
WV6 8RU

Tel: 01902 793871
Fax: 01902 793971

www.stwater.co.uk
net.dev.west@severntrent.co.uk

Contact: Dave Hadley

Your ref:
Our ref: WT33231/SAP8118198

01 July 2013

Dear Miss Green,

Proposed Mixed Development at Berwyn View, Ellesmere Marina, Ellesmere, Shropshire SY12 0DU

I refer to your 'Development Enquiry Request' in respect of the above site. Please find enclosed the sewer records that are included in the fee together with the Supplementary Guidance Notes which refer to surface water disposal from development sites.

Foul Water Drainage

As you can see from the sewer records there is a 100mm diameter rising main crossing the site just south of the sewage treatment works. This pipe has a protection zone of 5.0 metres centred over it. A diversion may well be necessary to avoid the marina and application forms can be found on our website www.stwater.co.uk under the developers heading.

Any connections from the development must be to the gravity sewers before the inlet to the treatment works. As you can see from the larger scale sewer record plan there is a 225mm diameter sewer running down the access road to the works and an incoming sewer from the east. Looking at the contours it may be necessary to pump flows from part of the site. The pumping station should form part of the sewer adoption S104 submission the design of which must be in accordance with sewers for adoption standards.

It is estimated that the average dry weather flow from the entire development equating to an equivalent of 800 dwellings would be approximately 18 to 20 litres per second. According to the figures we have the Wharf Meadow Treatment Works has capacity to

Severn Trent Water

accept flows from such a development. The connections will be subject to formal S106 approval (see later).

Surface Water Drainage

The enclosed sewer record extract shows a number of local watercourses running through and close to the site. In the event that soakage is not possible for surface water disposal (see SGN1), a connection to a suitable watercourse should be pursued with consultation required with the Environment Agency and /or relevant Local Drainage Authority.

New Connections

For any new connections (including the re-use of existing connections) to the public sewerage system, the developer will need to submit Section 106 application forms. Our New Connections department are responsible for handling all such enquiries and applications. To contact them for an application form and associated guidance notes please call 0800 7076600 or download from www.stwater.co.uk.

Please quote WT33231/SAP8118198 in any future correspondence (including e-mails) with STW Limited. Please note that 'Development Enquiry' responses are only valid for 6 months from the date of this letter.

Yours sincerely

D J Hadley
Waste Water Services - Asset Protection (West)

SUPPLEMENTARY GUIDANCE NOTES

In 2006 the Government issued national advice in the form of "Planning Policy Statement 25: Development and Flood Risk" that seeks to reduce the impact of development on surface water runoff. This advice is generally followed by Local Authorities through both the Building Regulations (Approved Document H) and the imposition of appropriate planning conditions. Severn Trent welcomes this advice and supports such planning conditions that impose flow restrictions. It is considered that in accordance with current guidance disposal of storm runoff from the development should be dealt with as follows:

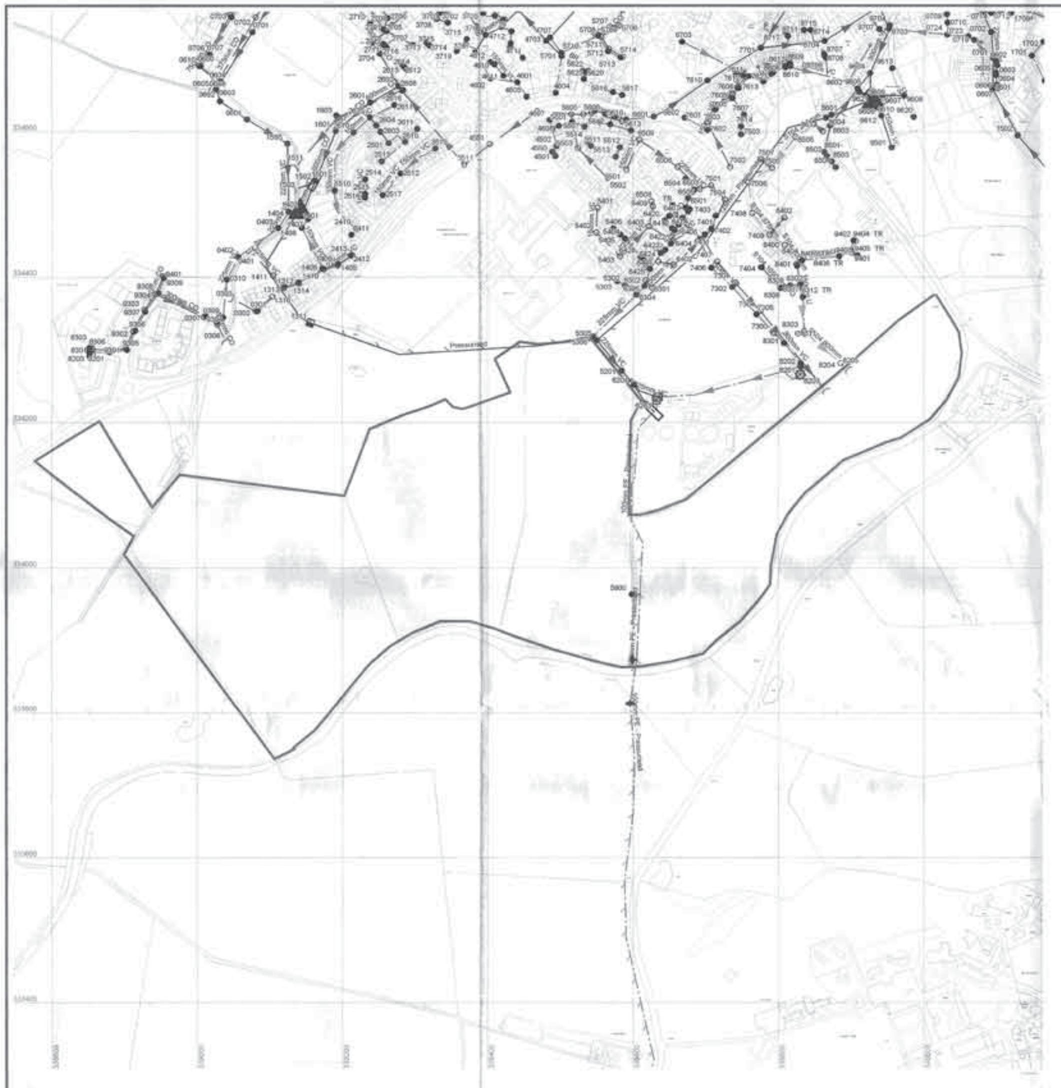
1. By soakage into the site's subsoil, subject to suitable ground soakage capacity and any contamination present. If ground soakage proves inadequate, evidence should be submitted to Severn Trent Water. The evidence should be either percolation test results or a statement from the SI consultant (extract from report or a supplementary letter) stating that soakaways would be ineffective. **A connection to public sewerage (existing or adoptable) would then be considered reasonable with flows as:**

2. Brown field development site: If storm runoff from the existing development is connected to the public sewerage system, then peak storm flows from the proposed development up to that generated from the previous connected impermeable area may be connected to the network subject to the details of the existing storm connection arrangements being submitted to Severn Trent Water. Existing flows should be assessed as the lower of $Q=2.78x50xA_{imp}$ l/s (A_{imp} ha), based on a 2 year storm return period, and the unsurcharged capacity of the outfall pipe(s).

   In addition to this restriction, for Brownfield developments, the Company would also suggest a reduction in surface water flow to the public sewerage systems of 20%. It should be noted that the Company would like to see any flow attenuation based on a 30 year critical duration storm design in accordance with 'Sewers for Adoption' current edition.

   For existing storm connections to the public foul sewerage system, any new storm connection to the public storm sewerage system (if available) should be limited to 5 litres/sec/ha (option A) OR a peak flow to be determined by the Company from its developer-funded hydraulic modelling of the public storm sewerage system (option B). The developer may choose either option.

3. Green field development site: If the site is a green field development i.e. not involving any demolition of buildings or paved areas connected to the public sewerage system, then the storm runoff from the proposed development may be connected to the public sewerage system subject to peak storm flows (30 year storm return period) being limited to a green field runoff of 5 litres/sec/ha (subject to a minimum of 5 litres/sec for Adoptable systems), applied to the gross area of the site, subject to sufficient capacity in the network.



Sewer Node / **Sewer Pipe Data**

REFERENCE	COVER LEVEL	INV LEVEL UPSTR	INV LEVEL DWNSTR	PURP	MATL	SHAPE	MAX SIZE	MIN SIZE	GRADIENT	YEAR LAID
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- Private Foul Gravity Sewer
- Private Surface Water Gravity Sewer
- Public Combined Gravity Sewer
- Public Foul Gravity Sewer
- Public Surface Water Gravity Sewer
- Trunk Combined Gravity Sewer
- Trunk Foul Use Gravity Sewer
- Trunk Surface Water Gravity Sewer
- Combined Use Pressurised Sewer
- Foul Use Pressurised Sewer
- Surface Water Pressurised Sewer
- Highway Drain
- Combined Lateral Drain (SS)
- Foul Lateral Drain (SS)
- Surface Water Lateral Drain (SS)
- Cable, Earthing
- Cable Junction
- Cable, Optical Fibre/Instrumentation
- Cable, Low Voltage
- Cable, High Voltage
- Cable, Other
- B Housing, Building
- K Housing, Kiosk
- Disposal Site
- Sewage Treatment Works
- Housing, Other
- Pipe Support Structure
- Sewage Pumping Facility
- Sewer Facility Connection Inlet / Outlet
- Blind Shaft
- Combined Use Manhole
- Flushing Chamber
- Foul Use Manhole
- Grease Trap
- Head Node
- Hydrobrake
- Lamphole
- Outfall
- Overflow
- Penstock
- Petrol Interceptor
- Sewer Chemical Injection Point
- Sewer Junction
- Sewerage Air Valve
- Sewerage Hatch Box Point
- Sewerage Isolation Valve
- Soakaway
- Surface Water Manhole
- Vent Column
- Waste Water Storage
- Culverted Watercourse
- Pre-1937 Properties

MATERIALS

AC - ASBESTOS CEMENT
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N
W E
S

SEVERN TRENT WATER

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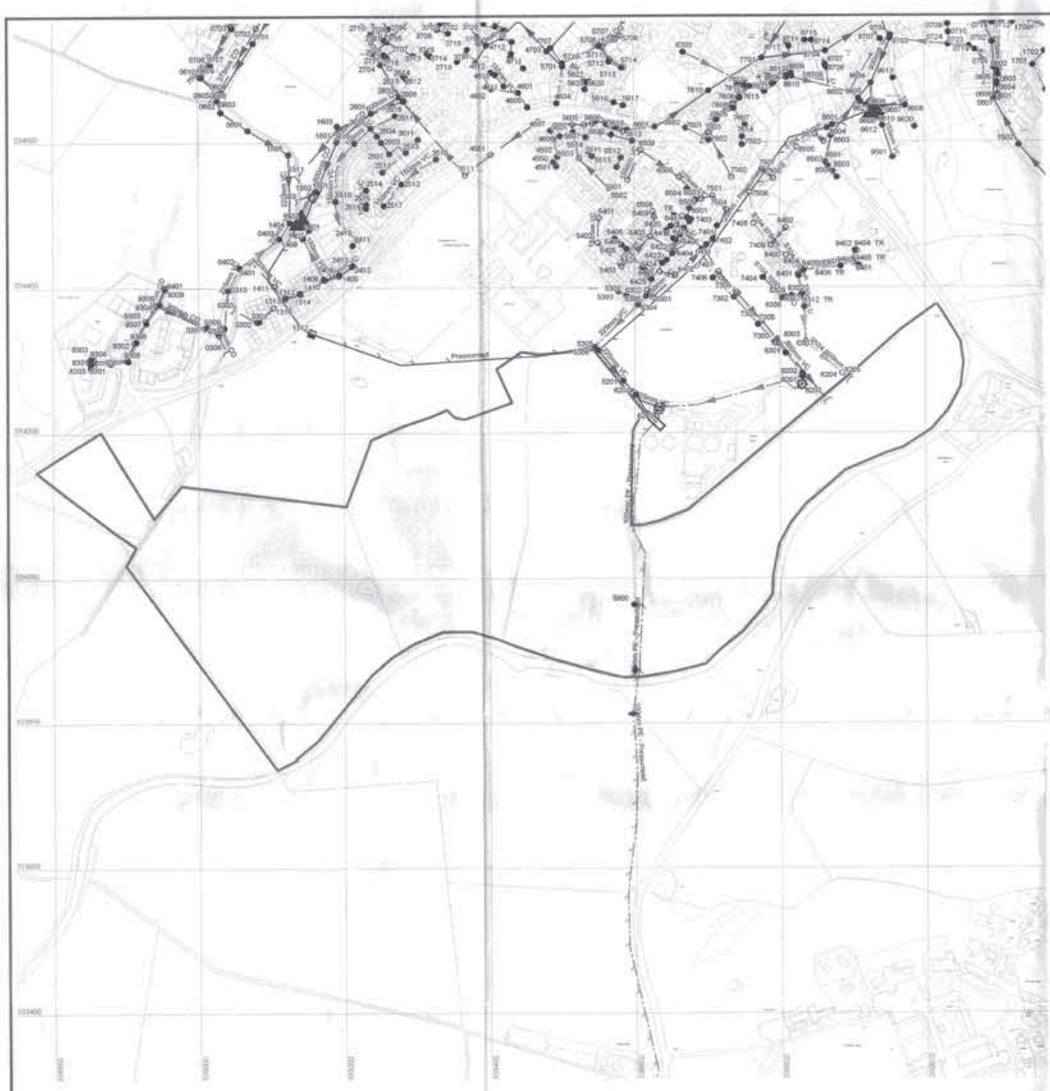
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
Telephone: 0845 601 6616

SEWER RECORD (TABULAR)

O/S Map scale:	1:3500	This map is centred upon: O / S Grid reference:	
Date of Issue:	21.06.13	X:	339456
Sheet No.	1 of 2	Y:	334037

Disclaimer Statement:



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REFERENCE	COVER LEVEL	INV LEVEL UPSTR	INV LEVEL DOWNSTR	PURP	MATL	SHAPE	MAX SIZE	MIN SIZE	GRADIENT	YEAR LAID
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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Combined Lateral Drain (SS)
Foul Lateral Drain (SS)
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Cable Junction
Cable, Optical Fibre/Instrumentation
Cable, Low Voltage
Cable, High Voltage
Cable, Other
Housing, Building
Housing, Kiosk
Disposal Site
Sewage Treatment Works
Housing, Other
Pipe Support Structure
Sewage Pumping Facility
Sewer Facility Connection Inlet / Outlet

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All section 104 sewers are shown in green
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N
W
E
S

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SEWER RECORD (TABULAR)

O/S Map scale: 1:3500
Date of Issue: 21.06.13
Sheet No. 2 of 2

This map is centred upon:
O / S Grid reference:
X: 339456
y: 334037

Sewer Node / Sewer Pipe Data

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[illegible]	nil	nil	nil	F	nil	nil	nil	nil	0.00	nil
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Housing, Kiosk
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Sewage Treatment Works
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Pipe Support Structure
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SEWER RECORD (TABULAR)

O/S Map scale: 1:1250
Date of issue: 01.07.13
Sheet No. 1 of 1

This map is centred upon O / S Grid reference:
X: 339633
Y: 334276

APPENDIX E

Hydraulic Modelling Technical Note

CONSULTANCY | ENVIRONMENT
INFRASTRUCTURE | BUILDINGS

ENVIRONMENT - WATER0

BURBURY INVESTMENTS LTD
ELLESMERE MARINA

TECHNICAL NOTE: HYDRAULIC MODELLING

Ref: BMW/2025/TN2

REVISION STATUS

REV. NO.	DESCRIPTION:	AUTHOR	CHECKED	APPROVED	DATE
Draft	First Internal Draft	RG	JON	SN	30/10/13
A	First External Issue to Project Team	RG	JON	SN	31/10/13
B	Baseline Conditions Issued to EA for Review	RG	JON	SN	13/11/13
C	Updated Following EA Review of Baseline Model	RG	JC	SN	08/05/14
D	General Update following EA Approval	RG	JC	SN	04/07/14

1.0 INTRODUCTION

1.1 BWB were commissioned to undertake a hydraulic modelling assessment of the Tetchill Brook and Newnes Brook at Ellesmere, Shropshire. The exercise aimed to confirm the existing fluvial flood risk at a future development site (the study site), and confirm the impacts de-culverting a significant length of the Tetchill Brook from within the site would have on flood risk.

1.2 The results of the exercise will be used to inform the masterplanning of a future development, and will be used to inform a Flood Risk Assessment of the site.

The Study Site

1.3 The study site (identified within **Figure 1.1**) is located on the southern fringe of Ellesmere, Shropshire (NGR: 339345, 334055 - *SJ393340*). The site's southern boundary is delimited by the Shropshire Union Canal (Llangollen branch), the north western boundary follows the Newnes Brook, and the northern boundary follows an open reach of the Tetchill Brook.

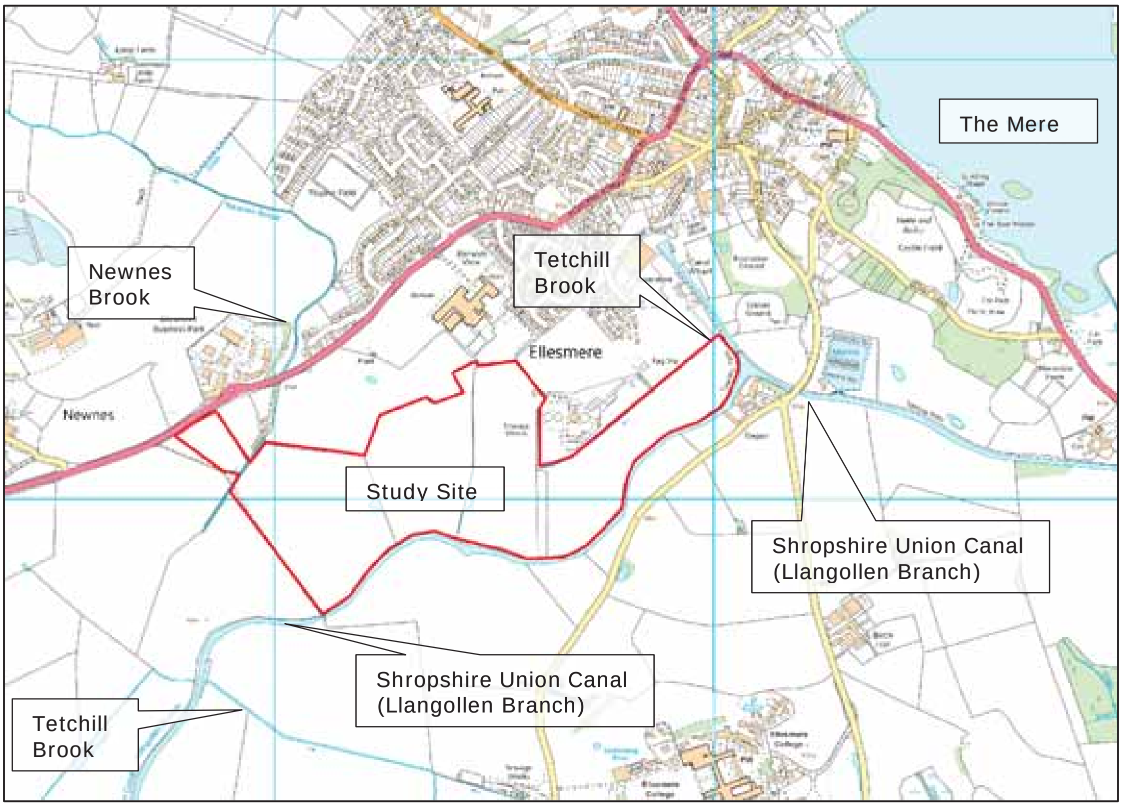


Figure 1.1 – Site Location

1.4 The Tetchill Brook is fed from 'The Mere', a large lake to the east of Ellesmere. It is culverted from the lake and through the town, before outfalling to a reach of open channel on the eastern boundary of the site. The brook re-enters culvert just downstream of the sewage works where it remains until outfalling 1.2km further downstream. The Newnes Brook joins the Tetchill Brook culvert just downstream of the site's western boundary.

1.5 A large proportion of the study site is shown by the Environment Agency indicative Flood Zone maps to fall within Flood Zone 3a (land at risk of the 1 in 100 year flood or greater) and Flood Zone 2 (land at risk of events between a 1 in 100 year and 1 in 1000 year floods). This is illustrated within **Figure 1.2**.

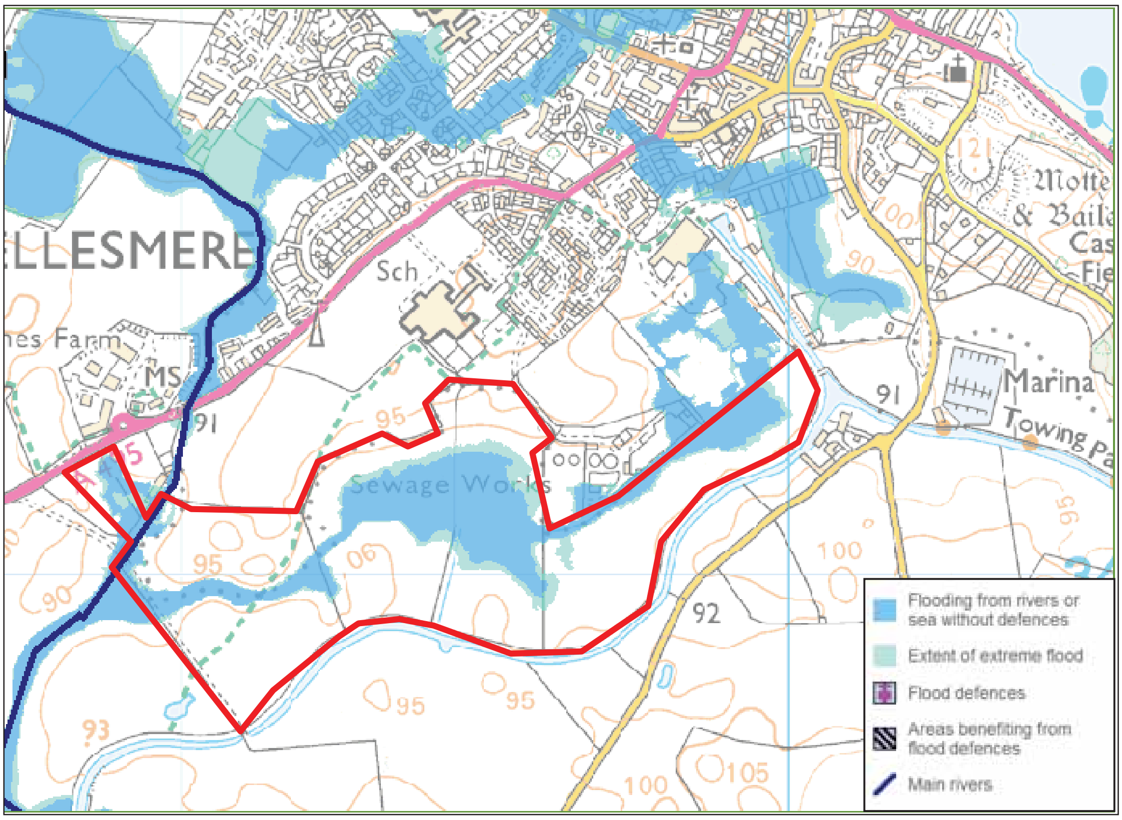


Figure 1.2 – Environment Agency Indicative Flood Zones

1.6 The Flood Zones within the site are believed to have been derived from strategic level 'JFLOW' modelling which is not suitable for a detailed site specific assessment.

1.7 There is no known significant history of flooding on the site, other than accumulated rainwater following storm events.

1.8 The Tetchill Brook within the site is to be day-lighted to offer ecological and sustainability benefits, as well as to enable the floodplain to be rearranged to make the site more amenable for future development opportunities.

Previous Studies & Assessments

1.9 In 2006 Wheetwood Consulting Ltd undertook a hydraulic assessment of the site within a 1D Hec-Ras model, this has been made available for the purposes of this reappraisal of the site. It is understood that the 2006 assessment was reviewed and approved by the Environment Agency.

1.10 At the end of 2013 BWB Consulting Ltd completed an updated baseline hydraulic assessment of the watercourses and floodplain within a bespoke 1D-2D (ESTRY-TUFLOW) model. This identified the existing flood mechanisms and was used to set out parameters which a future development should meet to mitigate flood risk. This assessment, along with a preliminary Flood Risk Assessment, secured the site's position in the Local Development Framework in January 2014.

1.11 In preparation for a an outline planning application on the site the model domain was expanded further upstream and the Tetchill Brook hydrology was revisited, at the request of the Environment Agency. In June 2014 the Environment Agency approved the hydraulic model during a pre-application review (ref: SV/2013/107421/05).

Aim & Objectives

1.12 The aim of the modelling exercise was twofold: to re-establish the existing floodplain on the study site; and to identify the potential impact of day-lighting the culvert within the study site.

1.13 The following objectives have been identified:

- (i) Review the existing model data of the Tetchill and Newnes Brook and update where necessary
- (ii) Review and verify the previous flood hydrology on the Tetchill and Newnes Brook
- (iii) Construct a dynamically linked 1D and 2D model of the study site and Newnes-Tetchill confluence and simulate the design flood events
- (iv) Assess flood risk mechanisms and identify the current floodplain on the site
- (v) Develop a de-culverted flood corridor through the site and test it within the flood model
- (vi) Undertake a comparative analysis between the day-lighted and baseline conditions to identify impacts within the wider catchment
- (vii) Undertake tests of key hydraulic parameters to identify the sensitivity of flood levels within the site

Data Sources

1.14 The following data sources were used in the exercise:

- (i) Environment Agency 1m LiDAR Digital Terrain Model
- (ii) Ordnance Survey 1:10,000 series mapping
- (iii) 1D Hec-Ras Model of Tetchill Brook (Weetwood Consulting, 2006)
- (iv) 1D Hec-Ras Model of Newnes Brook (Weetwood Consulting, 2006)
- (v) A hydrological study of Tectchill and Newnes Brook (Weetwood Consulting, 2006)
- (vi) A supplementary CCTV survey of the Tetchill Brook culvert (BWB, 2013)
- (vii) A supplementary watercourse survey of the Newnes Brook (BWB, 2013)

2.0 HYDROLOGICAL REVIEW

2.1 During the 2006 assessment of the Newnes Brook and Tetchill Brook, it was reported that the Revitalised Flood Hydrograph (ReFH) rainfall-runoff model was used to derive peak flows and hydrographs for both catchments.

2.2 However, given the time which has passed since this assessment it was considered prudent to reappraise the likely flood flows using the latest data and methodologies.

2.3 Both the Tetchill Brook and Newnes Brook are un-gauged catchments, therefore there are no hydrometric records of river flows or levels on which a hydrological assessment can be made. Therefore it was necessary to undertake a hydrological analysis of the likely flood flows using the industry standard methodologies: the FEH (Flood Estimation Handbook) Statistical Analysis; and the ReFH rainfall-runoff model. Other methodologies such as IoH124, and the Modified Rational method were dismissed due to the size and rural nature of the catchments. The FEH rainfall-runoff hydrological model was not utilised as this has been superseded by the ReFH.

The Tetchill Brook

Tetchill Brook Catchment Descriptors

2.4 The flow estimation methodologies make use of the FEH catchment descriptors; these were extracted at the downstream extent of the site, using the FEH-CDROM version 3.

2.5 Key catchment descriptors for the Tetchill Brook can be found in **Table 2.1** below, and a map of the catchment is available in **Figure 2.1.**

Descriptor	Value
AREA (km^2)	5.78
BFIHOST – *Base Flow Index*	0.588
FARL – *Flood attenuation from reservoirs & lakes*	0.781
FPEXT – *Floodplain extent*	0.3089
PROPWET – *Proportion of time that soils are wet*	0.36
SAAR – *Standard Average Annual Rainfall*	710
SPRHOST – *Standard Percentage Runoff (Host soils classification)*	29.62
$URBEXT_{2000}$ – *Fraction of Urban Extent*	0.0497

Table 2.1 – Key Tetchill Brook Catchment Descriptors

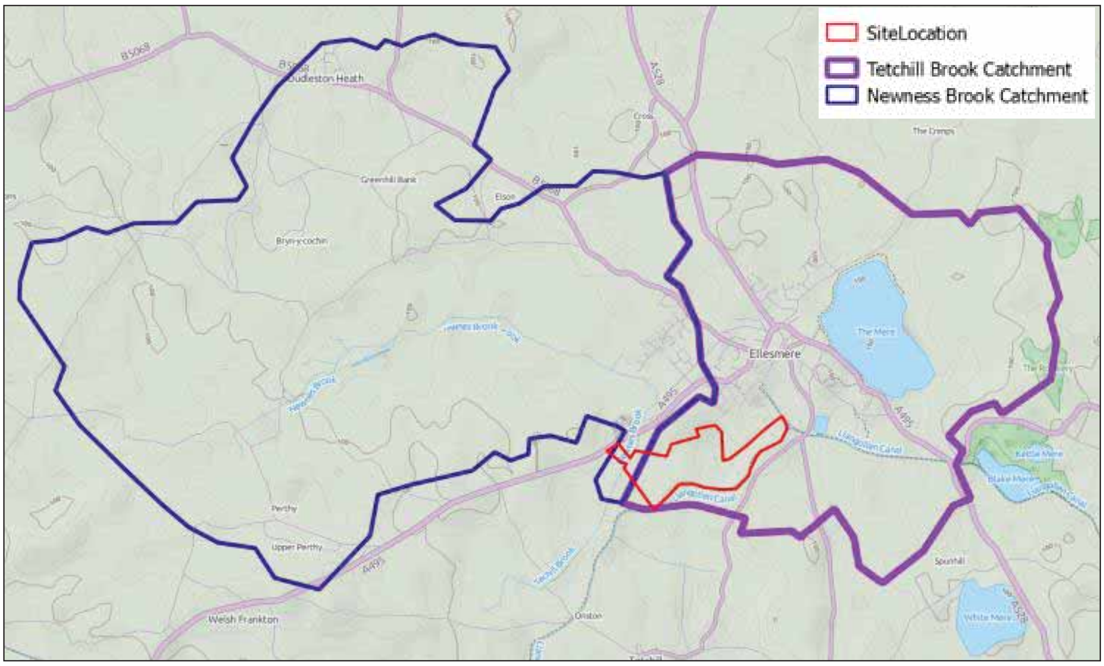


Figure 2.1 - Catchment areas for Tetchill and Newnes Brook

Tetchill Brook FEH-Statistical Analysis

2.6 WINFAP version 3 was utilised to undertake a statistical analysis of the Tetchill Brook using a hydrometric record of gauged catchments with similar catchment descriptors. **Annex A** contains extracts from WINFAP procedure illustrating the methodology and detailing the pooling group.

2.7 A group of hydrologically similar gauged sites was generated by the software from the 'OK for Pooling' dataset. This was identified as 'strongly heterogeneous' - this does not mean that it is inappropriate, just that it should be reviewed.

2.8 The group was reviewed to identify sites which may be inappropriate due to inaccuracies, uncertainties or limitations in their data record. However, all stations were considered to be acceptable: they were all identified as having sufficient record length and to be of sufficient hydrological similarity for the purpose of this study.

2.9 Although the pooling group was classified as strongly heterogeneous the 'Generalised Logistic' distribution was identified as giving an acceptable fit.

2.10 The record length totalled 522 years, which meets the recommended guidelines.

2.11 The $URBEXT_{2000}$ value (0.0497) was updated using the national average model of urban growth to estimate the 2013 urban extent (0.0512 – slightly urbanised).

2.12 The latest Hi-Flows dataset was used to generate a list of potential donor sites from the "Ok for QMED & Pooling" dataset. However, the QMED derived from the catchment descriptors (0.389 cumecs) was used in preference to the recommended donor site (Station 54020 Parrry @ Yeaton: 0.358 cumecs) as it provided a more conservative estimate.

2.13 The software generated a growth curve from the selected distribution, and an urban adjustment factor (UAF) of 1.092 was applied using the method documented by Kjelden (2009). The resultant peak flows are summarised within **Table 2.2**.

Tetchill Brook ReFH Analysis

2.14 The ReFH unit within ISIS 3.7 was utilised to undertake an estimate of the peak flows from the catchment. The critical duration of the Tetchill Brook at the study site was identified as 5.85 hours at a time step of 0.45 hours.

2.15 Due to the rural nature of the catchment a winter storm profile was adopted; all other parameters were left as default. The resultant peak flows are summarised within **Table 2.2**.

Tetchill Brook Catchment Results

2.16 The results in Table 2.2 show that the ReFH analysis produces the more conservative estimates, therefore it is believed that this is the most appropriate flow estimation method for use in this exercise.

Return Period (yrs)	Peak Flows	
	FEH Statistical Analysis	ReFH
1 in 20	0.85	2.0
1 in 100	1.19	2.8
1 in 1000	1.87	4.7

Table 2.2 - Peak flows on the Tetchill Brook

Tetchill Brook Sub-Catchment Analysis

2.17 The previous assessment undertaken by Wheetwood Consulting Ltd identified that a significant portion of the Tetchill Brook catchment drains to The Mere ($2.52km^2$), which attenuates flows before outflowing via a 300mm diameter pipe to the local surface water sewers (i.e., there is no natural watercourse leaving The Mere). Their hydraulic assessment established that the maximum contributing flows from The Mere is <u>$0.2m^3/s$</u>.

2.18 Given the influence of The Mere, and the need to generate point inflows to the hydraulic model, the Tetchill Brook catchment was split into three sub-catchments using the area weighting method (as described in FEH 7.2, Vol. 5) - this is detailed within **Annex B**. The extents of the three sub-catchments are illustrated within **Figure 2.2**.

2.19 The ReFH approach was then used to generate flood hydrographs from each sub-catchment based on the critical duration at the study site (5.85hrs under a storm winter profile). The resultant peak flows are detailed within **Table 2.3**, with an example composite hydrograph illustrated within **Figure 2.3**.

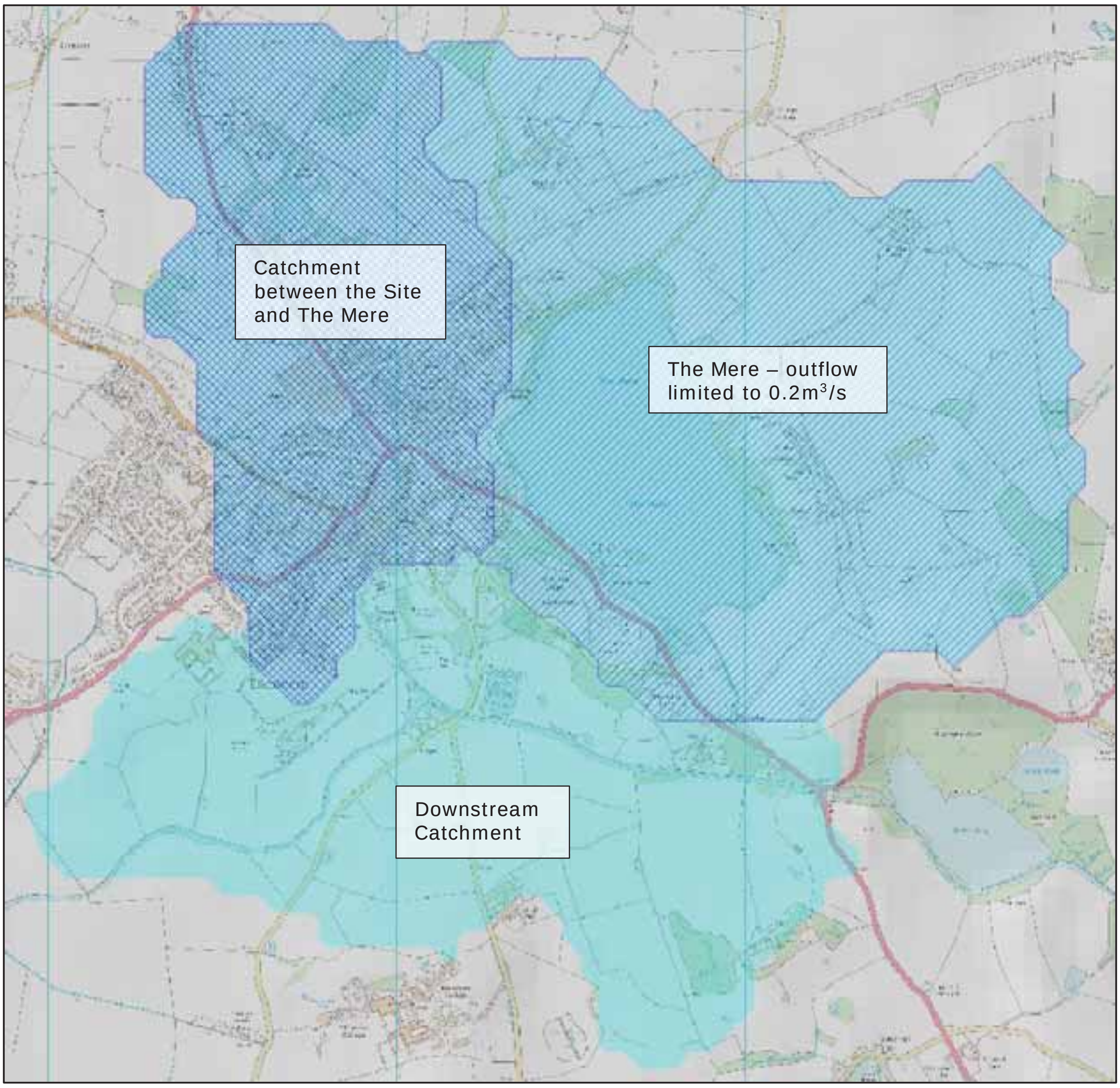


Figure 2.2 – Tetchill Brook Sub-Catchments

Return Period (yrs)	Peak Flows (Cumecs)			
	The Mere	Catchment between the Site & The Mere	Downstream Catchment	Total
1 in 20	0.20	1.33	0.2	1.69
1 in 75	0.20	1.73	0.29	2.16
1 in 100	0.20	1.83	0.31	2.29
1 in 100+20%	0.20	2.19	0.38	2.70
1 in 1000	0.20	3.10	0.69	3.86

Table 2.3 – Tetchill Brook Sub-Catchment Peak Flows

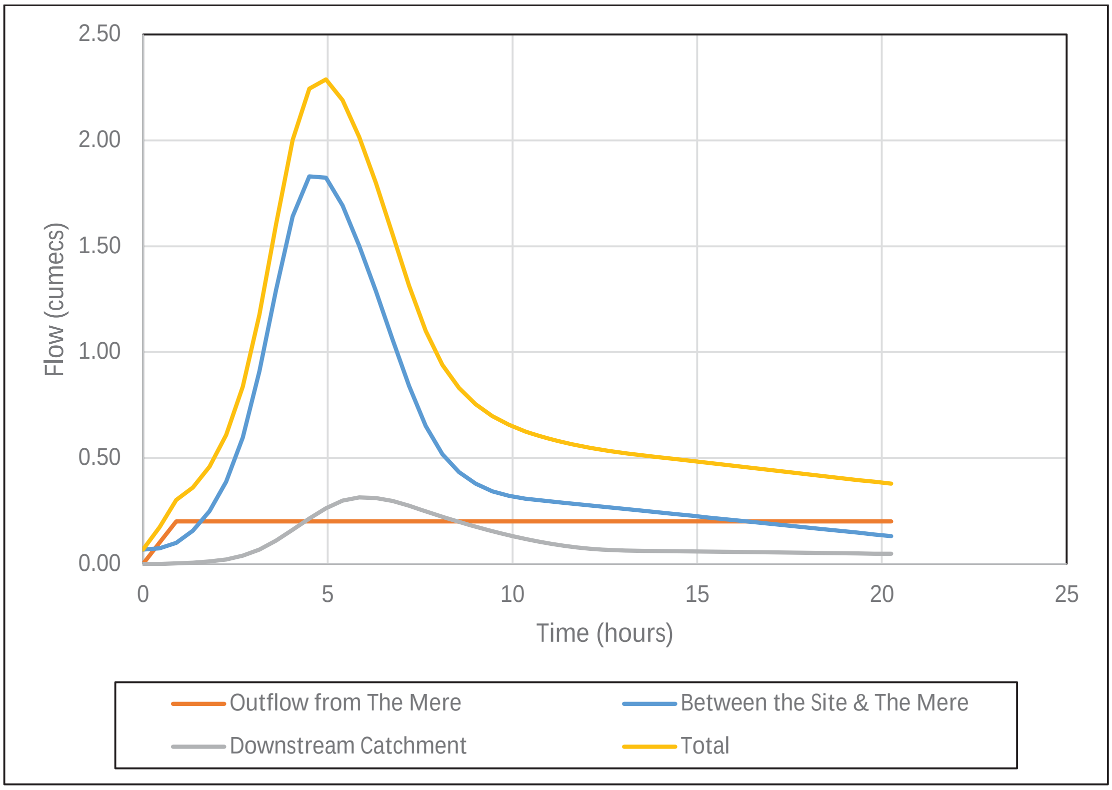


Figure 2.3 – 1 in 100 year Example Hydrograph from Tetchill Brook Sub-Catchments

Newnes Brook

2.20 The Newnes Brook catchment descriptors were extracted at the confluence with the Tetchill Brook. Key catchment descriptors for the Newnes can be found in **Table 2.4** below and a map of the catchment is available in **Figure 2.1**

Descriptor	Value
AREA (km^2)	11.44
BFIHOST – *Base Flow Index*	0.394
FARL – *Flood attenuation from reservoirs & lakes*	0.988
FPEXT – *Floodplain extent*	0.1989
PROPWET – *Proportion of time that soils are wet*	0.51
SAAR – *Standard Average Annual Rainfall*	734
SPRHOST – *Standard Percentage Runoff (Host soils classification)*	39.05
URBEXT$_{2000}$ – *Fraction of Urban Extent*	0.0145

Table 2.4- Key Newnes Brook Catchment Descriptors

Newnes Brook FEH-Statistical Analysis

2.21 Similarly to the Tetchill Brook analysis, WINFAP version 3 was utilised to undertake a statistical analysis of the Newnes Brook. **Annex C** contains extracts from WINFAP procedure illustrating the methodology and detailing the pooling group.

2.22 A group of hydrologically similar gauged sites was generated by the software from the ‘OK for Pooling’ dataset. This was identified as ‘strongly heterogeneous’.

2.23 The group was reviewed to identify sites which may be inappropriate due to inaccuracies, uncertainties or limitations in their data record. Station 73015 (Keer @ High Keer Weir) was removed from the pooling group due to its high discordancy, and because some of the record has been rejected in the Hi-Flows dataset. Station 203049 (Clady @ Clady Bridge) was introduced to the pooling group to increase the number of years in the record to 513, therefore meeting the recommended guidelines.

2.24 Although the pooling group was still classified as strongly heterogeneous the ‘Generalised Logistic’ distribution was identified as giving an acceptable fit.

2.25 The $URBEXT_{2000}$ value (0.0145) was updated using the national average model of urban growth to estimate the 2013 urban extent (0.0149 – essentially rural).

2.26 The latest Hi-Flows dataset was used to generate a list of potential donor sites from the “Ok for QMED & Pooling” dataset. However, the QMED derived from the catchment descriptors (3.06 cumecs) was used in preference to the recommended donor site adjusted QMED (Station 54020 Parrry @ Yeaton: 2.812 cumecs) as it provided a more conservative estimate.

2.27 The software generated a growth curve from the selected distribution, and an urban adjustment factor (UAF) of 1.018 was applied using the method documented by Kjelden (2009). The resultant peak flows are summarised within **Table 2.5**.

Newnes Brook ReFH Analysis

2.28 The ReFH unit within ISIS 3.7 was utilised to undertake an estimate of the peak flows from the catchment. The critical duration of the Newnes was identified as 5.5 hours at a time step of 0.5 hours.

2.29 Due to the rural nature of the catchment a winter storm profile was adopted; all other parameters were left as default. The resultant peak flows are summarised within **Table 2.5**.

Newnes Brook Catchment Results

2.30 Similarly to the Tetchill Brook, the results in **Table 2.5**, show that the ReFH analysis produces the more conservative estimates, therefore it is believed that this is the most appropriate flow estimation method for use in this exercise.

Return Period (yrs)	Peak Flows	
	FEH Statistical Analysis	ReFH
1 in 20	6.34	7.4
1 in 100	8.88	10.1
1 in 1000	13.7	16.8

Table 2.5 - Peak flows on the Newnes Brook

3.0 HYDRAULIC MODELLING

3.1 The indicative Flood Zone maps show that the study area could be subject to extensive out of bank flooding.

3.2 A one-dimensional (1D) approach to modelling is generally acknowledged as an excellent tool for representing the in-channel conditions and hydraulic structures, but it can struggle to successfully represent complex floodplain interactions and overflow flow routes.

3.3 Therefore the 1D model of the in-channel environment was supplemented with a two-dimensional (2D) representation of the floodplain. 2D modelling allows for multiple flow directions and complex routing to be captured and provided a more accurate representation of the flooding mechanism within the area.

1D In-Channel Domain

3.4 As previously stated, a historic 1D HEC-RAS model of the Newnes and Tetchill Brook was provided by the client. Upon review it was found that each watercourse was modelled separately, so any potential interactions will not have been fully represented. It was found that the Tetchill Brook culvert was based on a number of coarse assumptions and that the coverage on the Newnes Brook was limited.

3.5 To supplement this model data a CCTV survey of the Tetchill Brook culvert through the study site and a cross-sectional survey of the Newnes Brook were commissioned and completed in 2013 – this data is included as **Annex D**.

3.6 The HEC-RAS model geometry and additional survey were used to create a single 1D ESTRY model of the Newnes and Tetchill Brook confluence within the vicinity of the site. ESTRY was chosen in favour of HEC-RAS as it more ready links to 2D modelling software and offers a robust solution to modelling significant lengths of culvert.

Newnes Brook

3.7 The model includes a 650m reach of the Newnes Brook, which extends from its confluence with the Tetchill Brook (NGR: 338210, 332808) to 240m upstream of the A495 (NGR: 339133, 334486). It includes 12 river sections and the following 3 structures:

- the inlet to the Tetchill culvert (3 no. 0.925x1.0m orifices);
- a farm access track culvert bridge (1.5m diameter);
- the A495 culvert (2.0m diameter).

3.8 The sections were trimmed at top of bank where the interface with the 2D domain occurs.

3.9 A Manning's 'n' value of 0.040 was adopted for the fairly clean channel with moderate bank vegetation which was observed during a site visit – this is illustrated within **Figure 3.1**.

Figure 3.1 – A Typical Reach of the Newnes Brook

Tetchill Brook

3.10 The model included a 2.2km reach of the Tetchill Brook, which extends from a culvert under the canal 600m downstream of the site (NGR: 338824, 333592) to a manhole, of another culverted reach, 325m upstream of the site (NGR: 339959, 334687). It is understood that there is no readily available data of the culverted system further upstream, and given that this would only throttle flows it was not considered necessary to include it.

3.11 The model included 13 river sections and the following 3 structures:

- A 400m reach of culvert upstream of the study site (brick arch of unknown dimensions transitioning to a 900mm diameter brick culvert within the site)
- an access bridge near to the sewage treatment works (flat concrete deck).
- and, a 1.2km stretch of culvert (brick arch culvert varying between 1.1x1.3m, 1.4x1.2m, and 1.32x2.13m);

3.12 The 900mm diameter culvert was observed to transition into an arch culvert upstream of the site, but the dimensions of the arch could not be measured during the survey. Therefore the culvert was modelled as a 900mm diameter along its entire length. Given that the capacity of culverts should typically increase as they move downstream, this approach should be conservative as it would allow more flow into the site.

3.13 The model includes a significant length of arch culvert within and downstream of the site. However, ESTRY is unable to directly model arch culverts. They can be represented as irregular culverts (using a height-width relationship), however in this instance it was found to be more stable to model them as rectangular culverts. The height of the culverts was set so that the bore area of the arch was recreated. This minor reduction in the height of the soffit is not believed to significantly affect the results as the modelling demonstrated that the flow area and friction losses are the controlling factors on the capacity of the culverts.

3.14 CCTV survey of the culvert through the site was available and was used to inform the model geometry. The CCTV finishes on the downstream boundary of the site where the culvert is of a 1.4x1.27m size. The change in gradient and size between here and the outfall (where the culvert size increases to a 1.32x2.13m) is unknown. The Newnes Brook flows into the Tetchill Brook via what appears to be a drop chamber on this reach. It was assumed that the culvert size increases downstream of the confluence, and the gradient of the reach was assumed to be linear.

3.15 The Tetchill Brook culverts include 5 manholes, 3 of which are in the site. These were modelled as open structures thereby allowing water to freely surcharge onto the floodplain with no restriction from the manhole covers.

3.16 In the same manner as the Newnes Brook, the Tetchill Brook open channel sections were deactivated at top-of bank in preparation for linking with the 2D model domain.

3.17 A Manning's 'n' value of 0.035 was adopted for the fairly clean channel with moderate bank vegetation which was observed during a site visit – this is illustrated within **Figure 3.2**.

3.18 A Manning's 'n' value of 0.030 was adopted for the culverted reaches which is representative of fairly rough stone in mortar, and which was observed during the CCTV survey – as illustrated within **Figure 3.3**.

Figure 3.2 – A Typical Reach of the Tetchill Brook

Figure 3.3 – The Typical Condition of the Tetchill Brook Culvert

Boundary Conditions

3.19 The flood hydrographs discussed in Section 2.0 were used as the inflows to the Newnes and Tetchill Brooks. A ‘lumped’ approach was adopted for the Newnes Brook where the entire hydrograph is applied at the upstream extent of the model.

3.20 Due to the potentially restrictive nature of the culvert upstream of the site a lumped approach was not considered suitable for the Tetchill Brook, as flood flows could be unrealistically attenuated upstream of the site. Instead the inflows were applied to the model in line with the identified sub-catchments, i.e.: the flows from ‘The Mere’ and the ‘Catchment between the Site and The Mere’ were combined and applied to the upstream extent of the model; and the flows from the ‘Downstream Catchment’ were applied to the open reach of watercourse within the site.

3.21 The available survey ends on the upstream face of a large culvert under the canal. This is significantly larger than the upstream culverted reach at 1.52x3.1m, and so should not represent a major restriction to flows. Therefore a head-time (HT) downstream boundary based on the surveyed water level was adopted. Given its distance from the study site this approach is considered to be acceptable, but to confirm its suitability it was tested as part of the sensitivity analysis (discussed in Section 5.0).

2D Floodplain Domain

3.22 A 3m cell resolution was adopted for the floodplain; this is considered to be of sufficient detail given the rural nature of much of the floodplain. Its size was largely influenced by the narrow channel and the need to achieve a stable interface with the 1D domain.

3.23 The floodplain elevations were set using a LiDAR DTM. Bank levels were ‘reinforced’ using a ‘z-line’ derived primarily from survey data (i.e., the river section's top of bank level). LiDAR data was used to supplement the survey data where there was substantial distance between sections. The bank lines were digitised so they coincided with the bank positions within ESTRY – thereby preventing floodplain capacity from being double counted.

3.24 A HX (eXternal Head) boundary was digitised on top of the banks and was used to dynamically link the ESTRY open channel and TUFLOW model environments. A SX (eXternal Source) boundary was used to link the ESTRY culverts to the TUFLOW floodplain at the manhole locations.

3.25 The floodplain through the site and in the surrounding area is largely pasture, therefore it was considered to be sufficiently representative to adopt a universal Manning’s ‘n’ value of 0.035 for the entire floodplain.

3.26 Initial simulations identified that unrealistic flow patterns were being generated upstream of the A495 on the Newnes Brook. Analysis of the results showed that the area was subject to relatively large depths which were generating circulating flows across the HX boundaries. To resolve this an elevated roughness patch was applied along the 1D-2D interface. As the flooding here is controlled by the A495 culvert, and is not a product of floodplain conveyance, this approach should not significantly affect the results at the study site.

3.27 A schematic of the baseline ESTRY-TUFLOW model is illustrated within **Figure 3.4**.

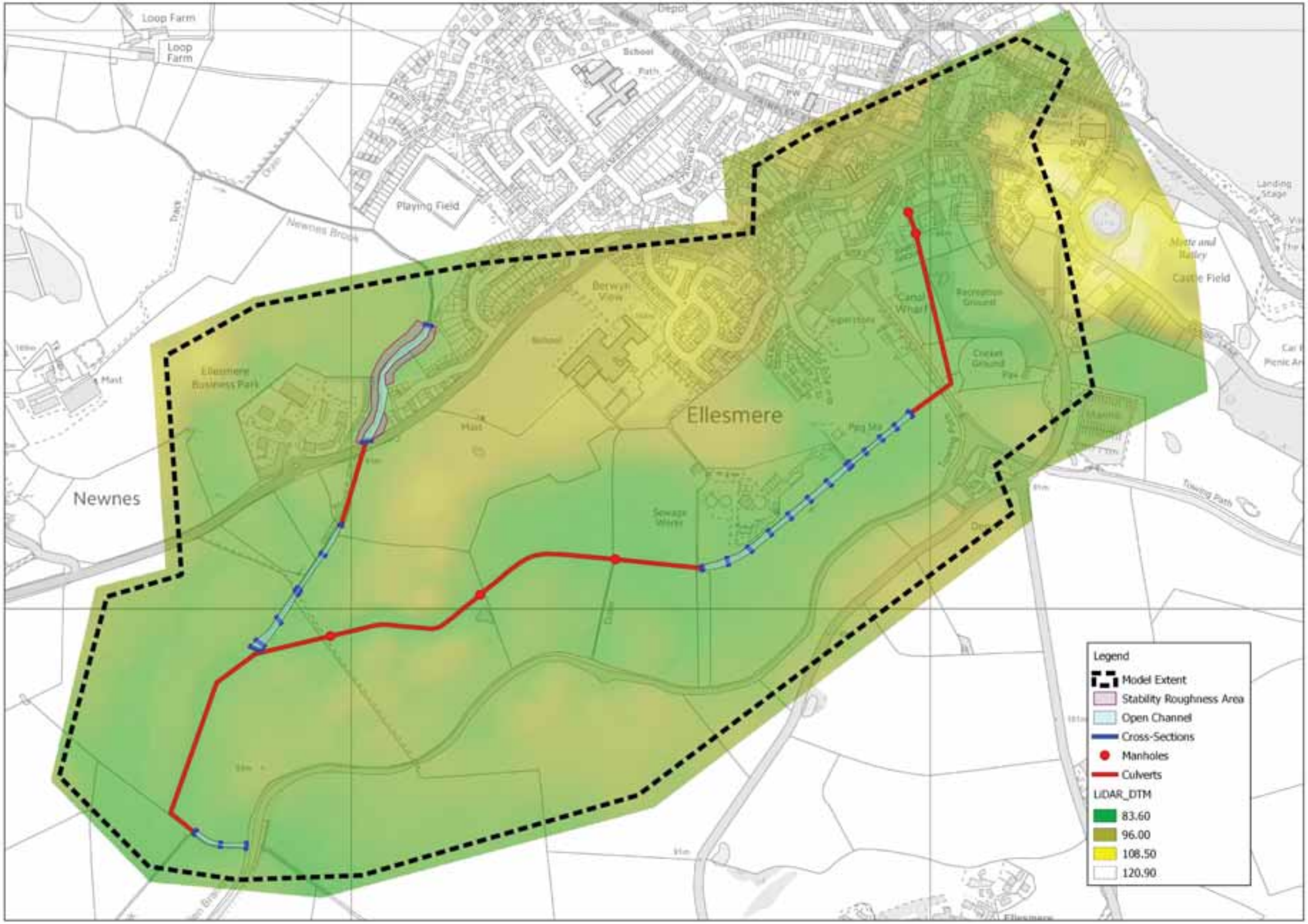


Figure 3.4 – Model Schematic

Results Parameters

3.28 TUFLOW maximum results were output for water levels, depths, velocities, and UK Hazard Rating. UK Hazard rating was derived from the following equation[1]:

$$Hazard\ Rating = D * (V+0.5) + DF$$

Where:
D = depth
V = velocity
DF = Debris Factor

3.29 **Table 3.1** identifies the recommended debris factors from FD2321/TR1. The debris factor has been set at 'Conservative', which is considered suitable for informing a Flood Risk Assessment of the study site.

Depths	Pasture/Arable	Woodland	Urban	Conservative*
0 to 0.25 m	0	0	0	0.5
0.25 to 0.75 m	0	0.5	1	1
d>0.75 m and/or v>2	0.5	1	1	1

*an additional category in TUFLOW

Table 3.1 - Guidance Debris Factors (REF: FD2321/TR1 Table 3.1)

Threshold for Flood Hazard Rating	Degree of Flood Hazard	Description
< 0.75	Low	**Caution** - " Flood zone with shallow flowing water or deep standing water"
0.75 - 1.25	Moderate	**Danger for some (i.e.: children)** - "Danger: Flood Zone with deep or fast flowing water"
1.25 - 2.0	Significant	**Danger for most people** - "Danger: Flood Zone with deep fast flowing water"
2.0 >	Extreme	**Danger for all** - "Extreme Danger: Flood Zone with deep fast flowing water"

Table 3.2 - Hazard to People (REF: Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose. DEFRA, 2008)

3.30 **Table 3.2** identifies the thresholds of the flood hazard categories as identified within DEFRA guidance document FD2320 and the "*Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose*" (DEFRA, 2008) which have been adopted within this exercise.

[1] DEFRA R&D Outputs: Flood Risks to People Phase Two Draft FD2321/TR1 and TR2

Model Stability & Parameters

TUFLOW

3.31 Version 2013-12-AB-iDP-W64 of TUFLOW was utilised within the exercise. This is the latest version of the software at the time of writing.

3.32 The TUFLOW domain was run at a time step of 1 second which is representative of 1/3 of the cell size and therefore falls within the recommended range. All TUFLOW simulation parameters were left as default.

3.33 No negative depths were reported during the simulations. The cumulative Mass Error for the simulations was in the region of 0.50%, which is within the acceptable limits.

3.34 Analysis of the 1D-2D interface shows a smooth exchange of flows - this is illustrated within **Figure 3.6**.

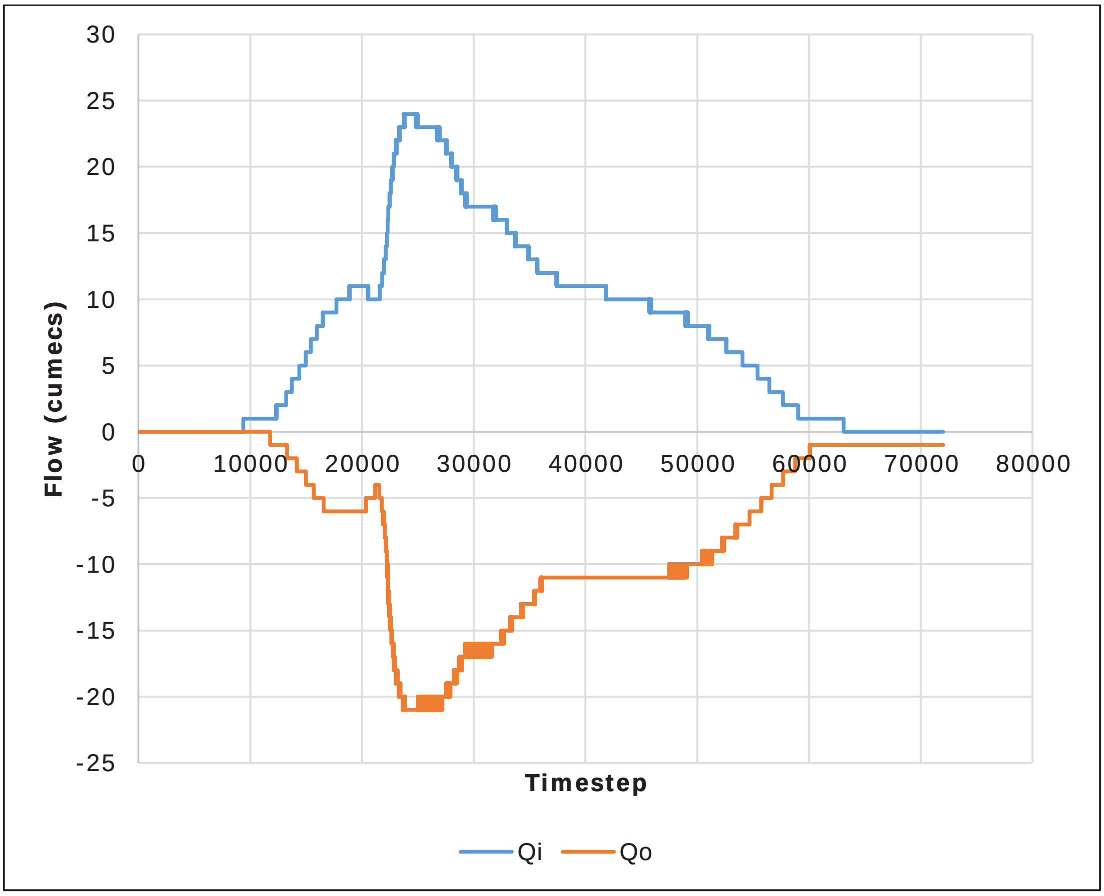


Figure 3.6 – 1 in 100 Year + 20% Time Series of Flow in (Qi) and Flow Out (Qo) of TUFLOW Model Domain

ESTRY

3.35 The ESTRY domain was run at a 1 second fixed timestep to mirror that of TUFLOW and promote a smooth exchange of data. All simulation parameters were left as default.

3.36 No negative depths were reported during the simulations and the cumulative Mass Error was in region of 0.50% and well within the acceptable limits.

Limitations

3.37 The modelling exercise has made use of the available data at the time of construction and simulation.

3.38 The model contains no formal representation of the conveyance within minor watercourses or ditches other than that captured by the model grid.

3.39 As no hydrometric data or recorded flood levels were available the model has not been verified or calibrated. However, a series of sensitivity tests have been undertaken to compensate for the absence of calibration.

3.40 The 3.0m resolution of the model may negate any small scale topographic features, although all the significant features are believed to have been captured.

3.41 The floodplain levels are derived from LiDAR which has a vertical precision of +/-0.15m. This is considered to be sufficient for this exercise.

3.42 Some glass walling of the floodplain occurs in the downstream extent of the model. This is significantly removed from the study site and so should not affect the aim of the exercise.

4.0 BASELINE RESULTS – EXISTING CONDITIONS

4.1 The baseline model was simulated against the 1 in 20, 1 in 75, 1 in 100, 1 in 100 with an allowance for climate change, and the 1 in 1000 year flood hydrology to generate a set of existing floodplain conditions. The results are mapped within **Annex E**, with the key events summarised within **Figure 4.1**.

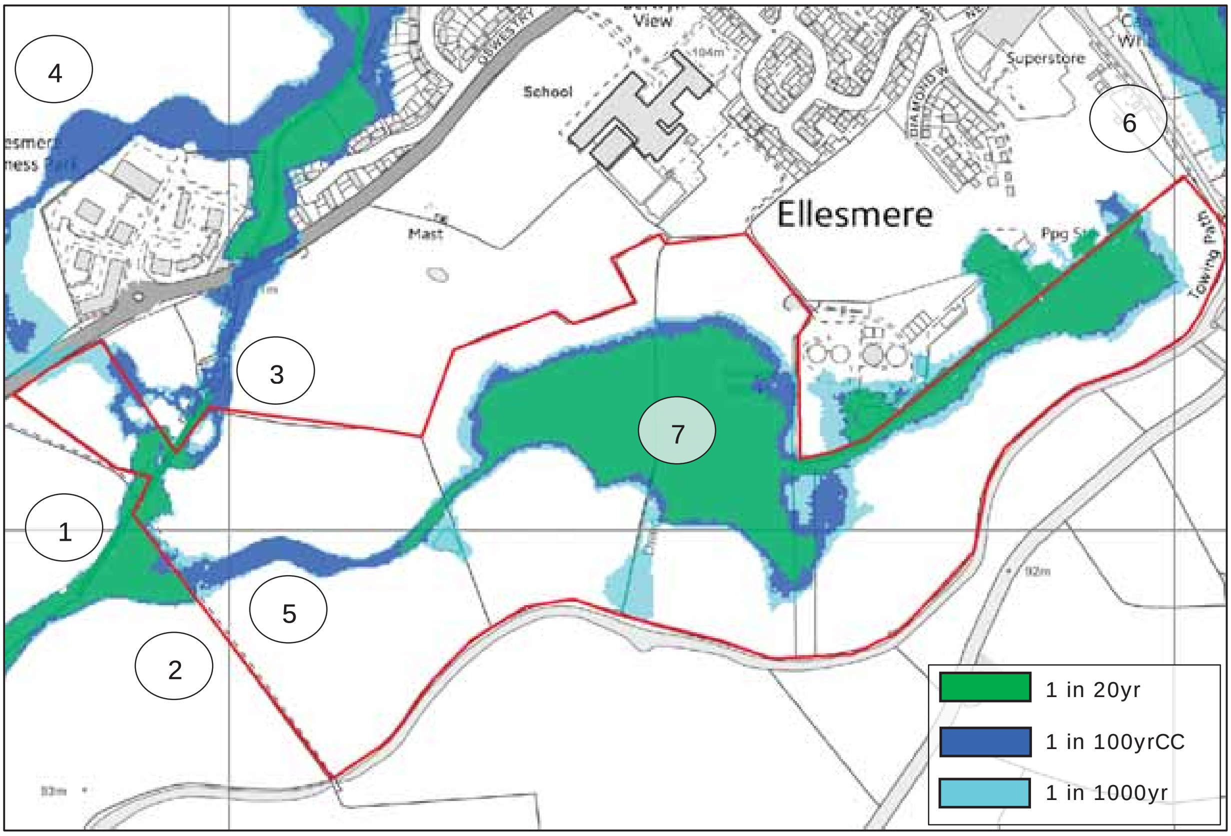


Figure 4.1 – Existing Floodplain Extents

4.2 The modelling has identified the following fluvial flooding mechanisms (see **Figure 4.1** for numeric reference points):

1. The modelling has shown that the inlet to the Tetchill Brook culvert on the Newnes Brook is overwhelmed at all simulated events. This leads to flows backing up into the study site resulting in a relatively small amount of out of bank flooding. The extent of flooding this mechanisms causes immediately upstream within the site is limited by flow overtopping the inlet structure and flowing overland into the downstream floodplain.

2. At the 1 in 75 year event and above, the flows overtopping the inlet structure are such that they can reach the study site’s southwest boundary. The topography here falls upstream into the centre of the site, and consequently a proportion of the overland flows are directed into the site.

3. The A495 culvert upstream of the site is shown to have capacity for up to the 1 in 100 year event, but it is overtopped in the 1 in 100 year climate change event. This leads to two relatively small flow routes entering the

study site from the northern boundary either side of the channel. These routes join the Newnes Brook floodplain at the inlet to the Tetchill Brook.

4. In the 1 in 100 year climate change event a flow route around Ellesmere Business Park begins to develop. In a 1 in 1000 year event this flow route is sufficient to overtop the A495 and to enter the site from the north-western boundary.

5. Due to the relatively flat gradient of the Tetchill Brook culvert, a proportion of the inflows from the Newnes Brook are directed up into the site. This contributes additional flood volume to the site.

6. Flows entering the site from the Tetchill Brook are limited by the restrictive upstream culverted system.

7. The flows on the Tetchill Brook combine with the surcharging flows from the Newnes Brook leading to extensive flooding within the site. The floodplain here is not able to drain until the Newnes flood peak has passed allowing the flows in the downstream culvert to reverse.

4.3 The controls on fluvial flood risk at the site have been identified as:

- The restrictive nature of the culvert leaving the site - whose capacity is largely occupied by the negative flow generated by the Newnes Brook.
- The elevated ground levels on the western boundary (in the region of 87.75-87.80mAOD) preventing overland flows leaving the site - flows can only leave by the culvert.

4.4 The impact of these controls is illustrated by the relatively flat water surface profile which occurs across the central and eastern areas of the site, which results from flood water pooling within the site until capacity becomes available within the downstream culvert.

4.5 As flooding in the area of the site proposed for de-culverting is largely a product of flood volume, it is believed that a scheme can be formulated whereby a day-lighted channel and watercourse corridor can be designed to return the same floodplain volume underneath the existing flood levels.

4.6 Peak water levels through the site and surrounding area in key locations are summarised with Figure 4.2 and Table 4.1.

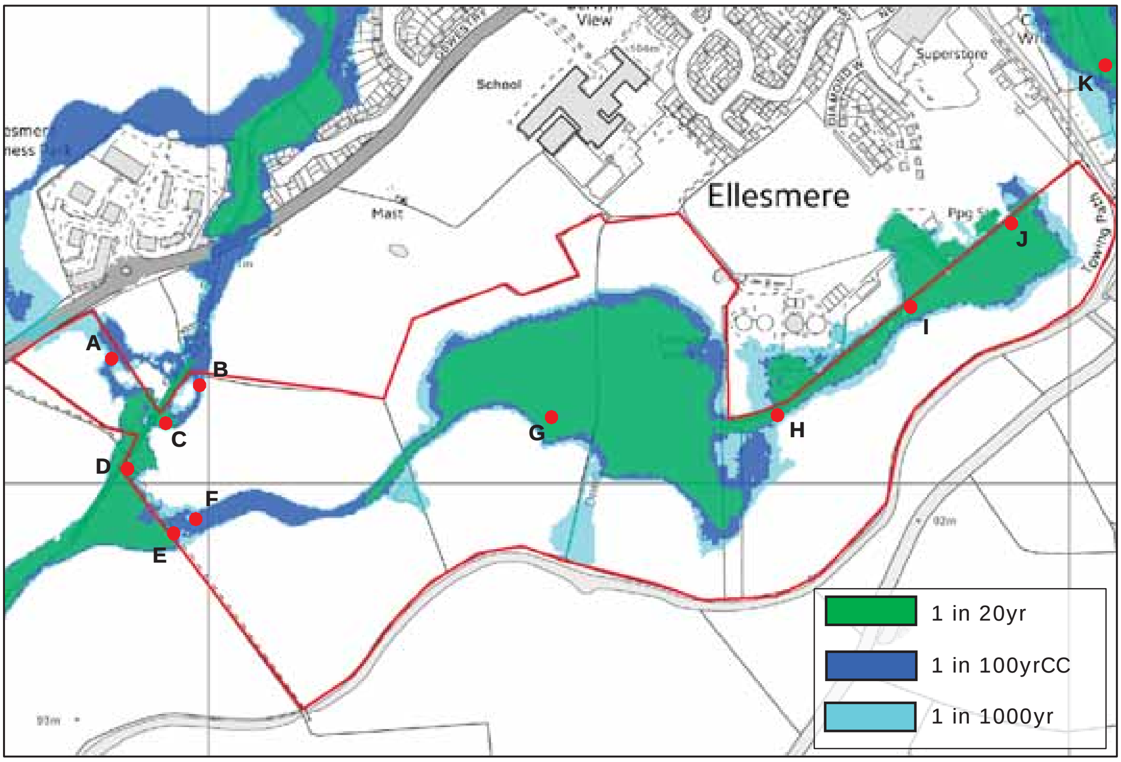


Figure 4.2 – Flood Level Interrogation Locations

	Return Period (yrs)				
	1 in 20	1 in 75	1 in 100	1 in 100 + 20%	1 in 1000
A	-	-	-	88.00	88.23
B	-	-	-	88.67	88.80
C	87.99	88.04	88.05	88.11	88.24
D	87.83	87.88	87.88	87.95	88.08
E	-	87.77	87.78	87.86	88.02
F	-	87.36	87.63	87.82	88.01
G	86.89	87.04	87.06	87.19	87.50
H	87.10	87.11	87.12	87.19	87.50
I	87.10	87.11	87.12	87.19	87.50
J	87.10	87.11	87.12	87.19	87.50
K	87.08	87.38	87.45	87.70	88.16

Table 4.1 – Baseline (Existing) Peak Water Levels (mAOD)

5.0 PROPOSED DE-CULVERTING & FLOOD CORRIDOR

5.1 As part of the development it is proposed to day-light the culvert within the ownership of the site. This provides the opportunity to re-arrange the floodplain within a formalised corridor, thus making development of the site more feasible.

5.2 To understand the implications of this in the wider catchment and to ensure that sufficient floodplain is allowed for within the development plan, the proposed de-culverting was tested within the hydraulic model.

5.3 At this outline stage the site layout and development elevations are not yet set, but it is understood that the main development area within the site will be to the east of the Newnes Brook, although an access road across the Newnes Brook to the A495 could be included. The proposals are also expected to include a number of bridge crossings over the Tetchill Brook.

5.4 It is understood that the future development will be kept outside of the Newnes Brook floodplain, and that the access road crossing the brook will either be at existing levels and designed to be floodable, or will clear span the floodplain. In either scenario there would be no impedance of flood flows or loss in floodplain storage. If this is found to not be achievable as the development progresses then an assessment of the impact will be undertaken.

5.5 Similarly, at this stage it is assumed that any bridges crossing the Tetchill Brook will be clear span above the floodplain and will therefore result in no impedance of flood flows or loss in floodplain storage. If this is found to not be achievable as the development progresses then an assessment of the impact will be undertaken.

5.6 The ground profile and elevations of the development are not yet set and will be determined as the design progresses, therefore at this outline stage minimum elevations from a flood risk perspective have been proposed. Ground levels within the development area should be set a minimum of 300mm above the adjacent 1 in 100 year plus climate change flood level:

- a minimum level of 87.50mAOD alongside the Tetchill Brook flood corridor in the central and eastern areas of the site.
- and, between 88.25 and 88.97mAOD adjacent to the Newnes Brook (due to the sloping water profile through the site).

5.7 Finished floor and threshold levels should be set at a minimum of 600mm above the adjacent 1 in 100 year plus climate change flood level, and also set to be above the 1 in 1000 year flood level:

- a minimum level of 87.80mAOD alongside the Tetchill Brook flood corridor in the central and eastern areas of the site.
- and, between of 88.55 and 89.27mAOD adjacent to the Newnes Brook (due to the sloping water profile through the site).

5.8 These parameters are summarised within **Annex H**.

Amendments to Baseline Model

5.9 The ESTRY culverts and manholes within the site were removed, and a 600mm diameter pipe was added as a new inlet structure to the remaining culverted reach. This restriction ensures that a similar rate of surcharge from the Newnes Brook into the site is retained.

5.10 A series of ‘Z–Shapes’ were used to create a new watercourse corridor through the site within the 2D TUFLOW domain. Due to the width of the corridor it was not considered necessary to model the day-lighted channel within the 1D domain, instead the upstream Tetchill Brook HX boundary was adjusted to allow the existing 1D channel to flow directly into a new 2D flood corridor.

5.11 The new channel has been sized to accommodate the necessary flood volume, small scale features to maximise ecological benefit at low flows will be determined at the detailed design stage.

5.12 Ground levels with the development area were set to the minimum level of 87.50mAOD (i.e.: 300mm above the 1 in 100 year plus climate change flood level). Ground levels above 87.50mAOD were left as existing. As the site layout and earthworks strategy is not yet set, the inclusion of individual ‘units’ within the model is not yet feasible.

Results and Comparative Analysis

5.13 The proposed day-lighted model geometry was simulated against the flood hydrology. The results are mapped within **Annex F**, and summarised within **Figure 5.1**.

5.14 The results show that the proposed flood corridor is sufficient to accommodate up to the 1 in 100 year + climate change event flood event, and a comparative analysis has shown that it results in no detriment to flood levels within the wider catchment (as illustrated within **Annex F**).

5.15 The volumes and flow rates are such that in a 1 in 1000 year event the storage capacity of the flood corridor would be exceeded, and flood levels within the site would be driven up to 87.63mAOD. This is 170mm below the minimum recommended floor level, but it would lead to flooding of external areas. Flood depths would be in the region of 126mm and of a ‘Low’ hazard rating (signifying shallow flooding and low velocities), therefore it should not pose a significant risk. However, it is recommended that a suitable flood warning and management strategy is prepared for such an occurrence.

5.16 An alternative sequential arrangement of the 1 in 1000 year floodplain within the development is discussed within **Section 6.0**.

5.17 The 1 in 1000 year flood level will be influenced by the final development levels, therefore this analysis should be repeated once final elevations are known to ensure that the flood management strategy is still robust.

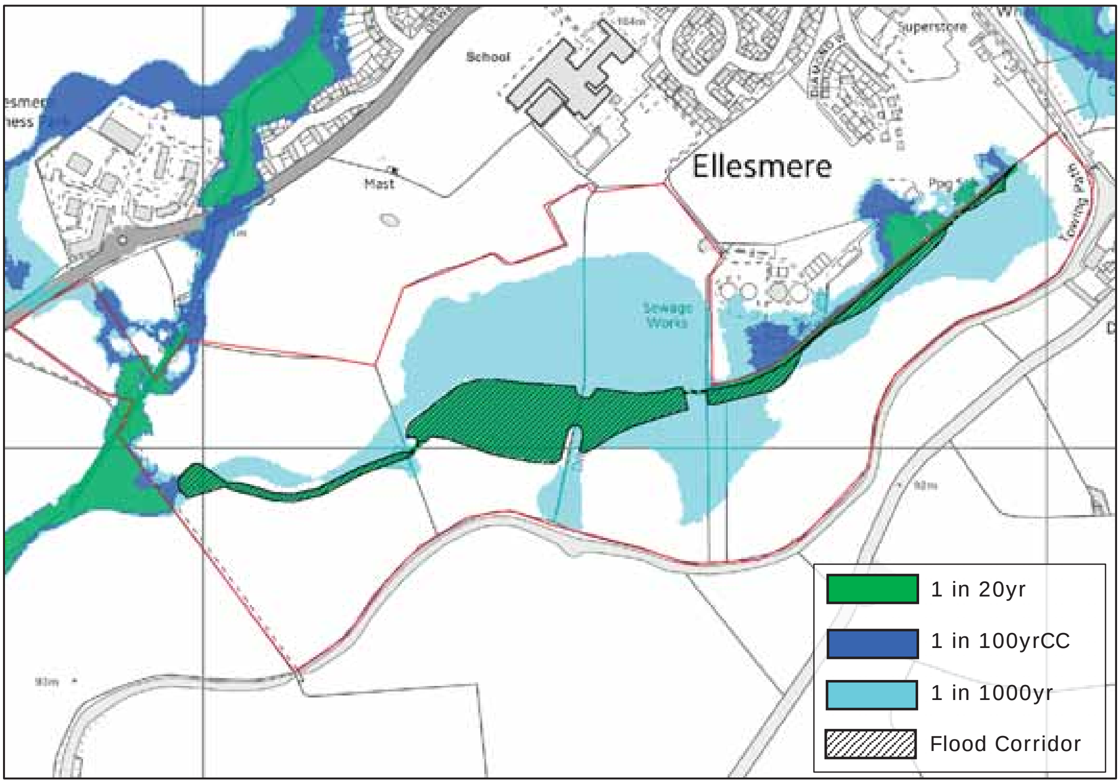


Figure 5.1 – Post De-Culverting Floodplain Extents

Sensitivity Tests

5.18 To account for the current predictions for future climate change, the seasonal variations in vegetation, uncertainties in the downstream boundary, as well as the potential risk of blockages, a series of sensitivity tests were conducted using the 1 in 100 year flows.

Climate change:

- 1 in 100 Year Flows + 20% (completed as part of the design events)

Seasonal variation in vegetation:

- Channel and floodplain roughness – Manning's 'n' + 20%
- Channel and floodplain roughness – Manning's 'n' – 20%

Downstream Boundary:

- Head-time boundary + 0.5m

*Blockage Scenarios (see **Figure 5.2** for locations):*

- BL1 – a 75% blockage of the remaining culvert downstream of the site

- BL2 – a 75% blockage of the inlet to the Tetchill Brook culvert from the Newnes Brook
- BL3 – a 75% blockage of the current bridge of the Newnes Brook within the study site
- BL4 – a 75% blockage of the A495 culvert
- BL5 – a 75% blockage of the culvert upstream of the study site.

5.19 The results of the sensitivity tests are mapped within **Annex G**; where peak water levels are compared against the baseline 1 in 100 year event to identify the impact of each test.

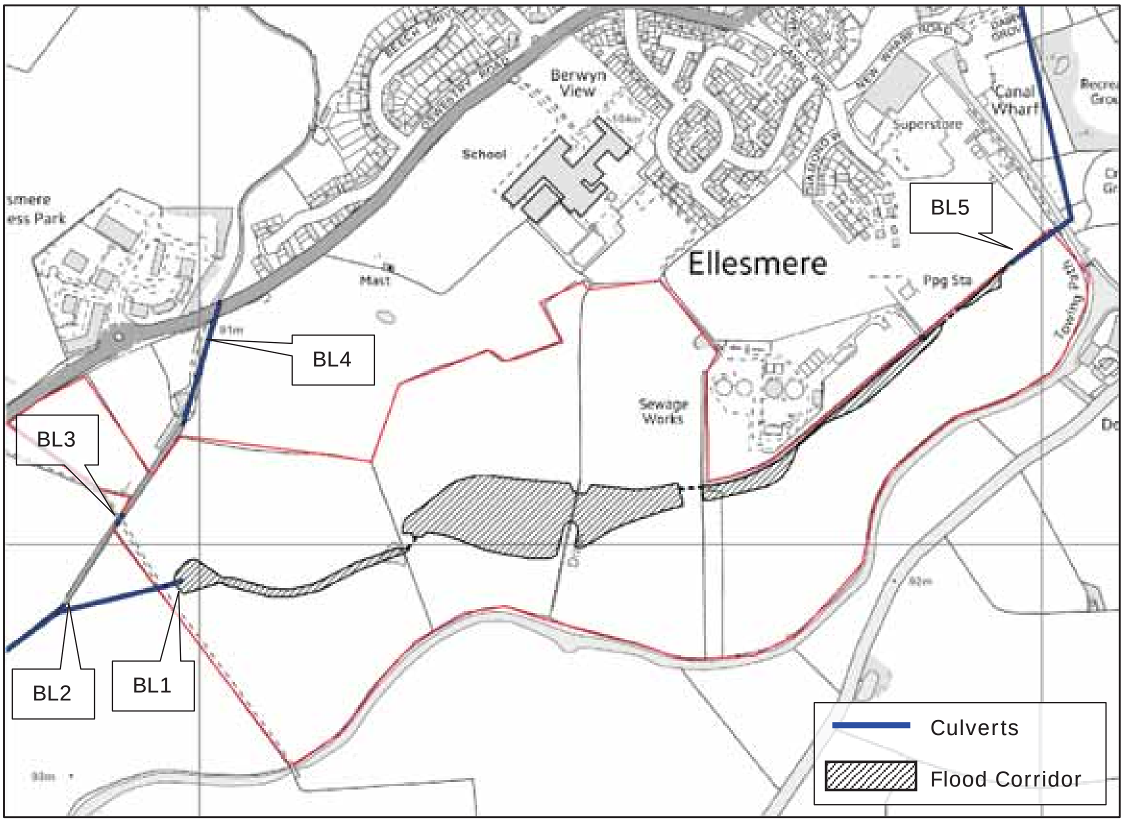


Figure 5.2 – Blockage Locations

Sensitivity Tests – Manning's $'n'$

5.20 The modelling has shown that a reduction in channel and floodplain roughness (representative of winter seasonal conditions, or following maintenance) does not result in a significant change in flood levels within the flood corridor. This is because water levels here are largely controlled by the available floodplain storage rather than conveyance. Whereas flood levels on the Newnes Brook within the site are decreased by between 10-50mm due to the increased conveyance.

5.21 An increase in Manning's $'n'$ (representative of summer seasonal conditions, or a period without maintenance) is also shown to result in no significant change in flood levels within the flood corridor. Water levels on the Newnes Brook (in the western area of the site) are shown to increase between 10-100mm, due to the reduced conveyance.

Sensitivity Tests – Climate Change

5.22 The modelling has shown that a 20% increase in flows (representative of climate change) results in an increase of up to 210mm within the flood corridor. As previously demonstrated, the flood corridor has been sized to accommodate this event.

5.23 Flood levels on the Newnes Brook are increased by up to 150mm within the site.

Sensitivity Tests – Downstream Boundary Conditions

5.24 An increase of 0.5m in the downstream boundary conditions is shown to affect water levels in the downstream reach by between 10-500mm, although the floodplain extents are unaffected.

5.25 The change has no effect on flood levels within the site adding confidence that the downstream boundary is sufficiently removed from the study area.

Sensitivity Tests – Blockage BL1

5.26 A 75% blockage of the inlet to the remaining culvert downstream of the flood corridor is shown to reduce flood levels within the site by approximately 286mm. This is because less flow is able to surcharge into the site from the Newnes Brook inflow.

5.27 Consequently flood levels downstream of the site are shown to increase as a result of more flood water overtopping the inlet to the Tetchill Brook culvert from the Newnes Brook. Flood levels on the Newnes Brook within the site are not significantly affected.

Sensitivity Tests – Blockage BL2

5.28 A 75% blockage of the inlet to the Tetchill Brook culvert from the Newnes Brook is shown to reduce flood levels within the flood corridor by approximately 240mm. This is because less flow is able to enter the Tetchill Brook culvert and surcharge into the site.

5.29 Instead, flood levels on the Newnes Brook within the site are shown to increase by between 10-117mm.

Sensitivity Tests – Blockage BL3

5.30 A 75% blockage of the existing access bridge across the Newnes Brook is shown to result in an increase in flood levels of between 10-150mm within the site. Flood levels on the Tetchill Brook, or elsewhere in the site, are not significantly affected.

Sensitivity Tests – Blockage BL4

5.31 A 75% blockage of the A495 culvert is shown to significantly attenuate more flows upstream of the site. This leads to a 56mm reduction in flood levels within the flood corridor.

5.32 However, two flood routes are created which overtop the A495 either side of the Newnes Brook and flow into the site via the northern boundary resulting in an increase in flood levels of between 10-337mm.

Sensitivity Tests – Blockage BL5

5.33 A 75% blockage of the Tetchill Brook culvert upstream of the site significantly attenuates more flows upstream of the site. This leads to a 506mm reduction in flood levels within the flood corridor. The Newnes Brook floodplain is unaffected within the site.

Post De-Culverting Summary

5.34 A summary the peak water levels from the design and sensitivity events is included within **Table 5.1**, with interrogation locations illustrated within **Figure 5.3**

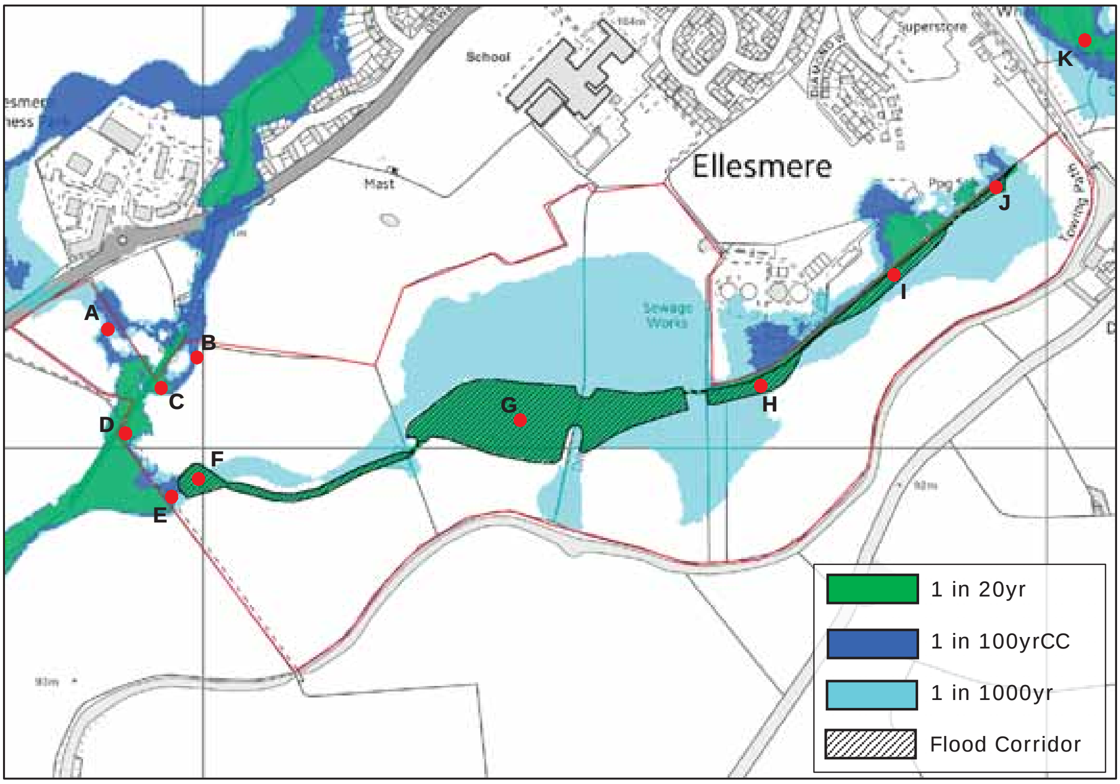


Figure 5.3 – Flood Level Interrogation Locations

5.35 A comparison of flood levels shows out of the sensitivity tests, in the majority of the site, the increased flows and volumes which are predicted to occur in a climate change event would have the greatest impact within the site. The exception to this is are points 'A' and 'B' in the Newnes floodplain which are more adversely affected by blockages of the A495 culvert (BL4) and the existing access track within the site (BL3).

5.36 It has been recommended that ground levels of the development (i.e.: pedestrian and trafficked routes, car parks, etc) are set a minimum of 300mm above the 1 in 100 year plus climate change event. A comparison against the flood levels in **Table 5.1** shows that this would be sufficient to defend the external areas development against all modelled events within the exception of the 1 in 1000 year event. In a 1 in 1000 year event there will be some shallow flooding to external areas.

5.37 It is has been recommended that finished floor and threshold levels of the development be set a minimum of 600mm above the 1 in 100 year plus climate change level. A comparison against the levels in **Table 5.1** show that this would be sufficient to defended against all of the modelled events.

	Design Events (Return Period - yrs)			Sensitivity Test (at the 1 in 100 year event)								
	1 in 20	1 in 100	1 in 1000	Climate Change	BL1	BL2	BL3	BL4	BL5	Downstream Boundary	Manning's 'n' + 20%	Manning's 'n' - 20%
A	-	-	88.23	88.00	-	-	88.07	88.29	-	-	-	-
B	-	-	88.80	88.67	-	-	-	88.82	-	-	88.62	-
C	87.99	88.05	88.23	88.11	88.05	88.06	88.09	88.09	88.05	88.05	88.07	88.03
D	87.83	87.88	88.06	87.95	87.89	87.93	87.93	87.88	87.88	87.88	87.91	87.87
E	-	87.78	87.96	87.86	87.81	87.86	87.78	87.78	87.78	87.78	87.82	87.74
F	86.71	86.96	87.63	87.17	86.68	86.72	86.95	86.91	86.46	86.96	86.97	86.97
G	86.71	86.96	87.63	87.17	86.68	86.72	86.95	86.91	86.46	86.96	86.97	86.97
H	86.72	86.96	87.63	87.17	86.68	86.72	86.96	86.91	86.46	86.96	86.97	86.97
I	86.72	86.96	87.63	87.17	86.68	86.73	86.96	86.91	86.46	86.96	86.97	86.97
J	86.72	86.98	87.63	87.19	86.68	86.73	86.97	86.92	86.46	86.97	86.98	86.98
K	86.89	87.29	88.15	87.59	87.22	87.26	87.29	87.26	88.09	87.29	87.49	87.09

Table 5.1 – Summary of Peak Flood Levels (mAOD)

6.0 PRELIMINARY ASSESSMENT OF THE POTENTIAL SEQUENTIAL ARRANGEMENT OF THE DEVELOPMENT

6.1 In addition to identifying the *minimum* requirements of a flood risk strategy, as discussed in Section 5.0, a preliminary assessment of the possible sequential arrangement the development within Flood Zone 1 and 2 has been undertaken.

6.2 This follows a sequential approach by setting the ‘More Vulnerable’ development areas (hotel, residential properties, log cabins and caravans) as well the spine road through the development above the 1 in 1000 year flood level (i.e.: within Flood Zone 1) – an elevation of 87.80mAOD.

6.3 While the ‘Less Vulnerable’ areas (commercial land use, car parks, and landscape areas) are set a lower level to continue to flood in a 1 in 1000 year event (i.e.: within Flood Zone 2) – at an elevation of 87.50mAOD. These less vulnerable areas would still be outside of the 1 in 100 year + 20% floodplain.

6.4 Finished floor levels would be set at a minimum elevation of 87.95mAOD, to allow a 150mm freeboard to the elevated ground levels on the western boundary site boundary (which controls the overland flow into the downstream floodplain).

6.5 In this illustrative strategy flood depths would not exceed 185mm in the less vulnerable areas, and the Flood Hazard would remain ‘low’.

6.6 This indicative strategy is illustrated within **Annex I**.

6.7 This test was prepared as an example to illustrate that the development could be arranged sequentially (subject to other constraints). The final development layout, elevations and floodplain extents will be determined at the detailed design stage.

7.0 CONCLUSIONS

7.1 It is believed that the aim of the modelling exercise has been achieved and a good hydrological and hydraulic representation of the existing fluvial flooding mechanisms and floodplain extents within the site has been produced. This has been used to test the proposed de-culverting of the Tetchill Brook within the application site.

7.2 The modelling exercise has been reviewed and approved by the Environment Agency.

7.3 An ESTRY-TUFLOW model has been used to create a dynamically linked 1D-2D model of the study site and the confluence of the Tetchill and Newnes Brooks.

7.4 The controls on fluvial flood risk at the site have been identified as:

- The restrictive nature of the culvert leaving the site (the capacity of which is largely occupied by the negative flows generated by the Newnes Brook).
- The elevated ground levels on the western boundary preventing overland flows into the downstream catchment (meaning that flood flows can only leave by the culvert).

7.5 A theoretical flood corridor has been created within the model which:

- removes the Tetchill Brook culvert within the site,
- preserve the flow entering/surcharging from the remaining downstream culvert, and
- recreates the existing floodplain volume within a formalised area.

7.6 The corridor has been tested within the model which has shown that it has capacity to accommodate the 1 in 100 year plus climate change event, and that the proposed works would not cause a detriment to flood risk within the wider catchment.

7.7 Development elevations and layout are not yet set so it has not been possible at this stage to include the built development within the flood model. However, minimum elevations from a flood risk perspective have been identified.

7.8 The development ground levels will be set a minimum of 300mm above the 1 in 100 year plus climate change level. It has been shown that this would be sufficient to defend the development against all modelled events, with the exception of the 1 in 1000 year event.

7.9 During a 1 in 1000 year event the capacity of the flood corridor is exceeded which will lead to flooding within some external areas of the development. The extent of this will be determined at the detailed stage once cut/fill volumes and development elevations are being set.

7.10 It is recommended that a sequential approach is undertaken and the ‘More Vulnerable’ areas of the development, and access egress routes, are raised out of the 1 in 1000 year floodplain wherever possible.

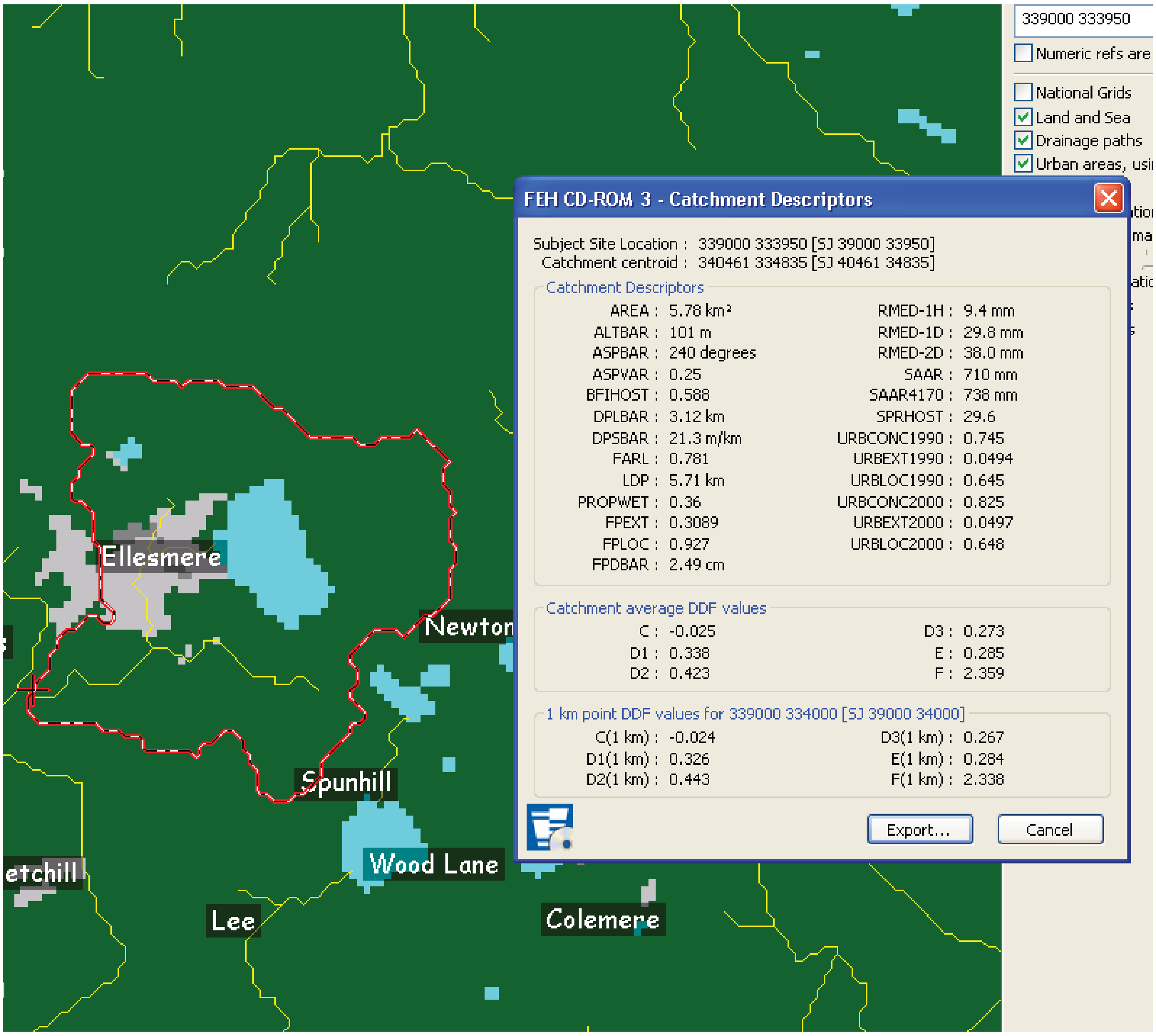
7.11 Flooding of external areas in a 1 in 1000 year event would be of a ‘Low’ flood hazard. It is recommended that a suitable flood warning and management strategy is prepared for such an occurrence.

7.12 It has been recommended that finished floor and threshold levels are set 600mm above the 1 in 100 year plus climate change flood level. It has been shown that this would be sufficient to defend the development against all modelled events including the 1 in 1000 year flood.

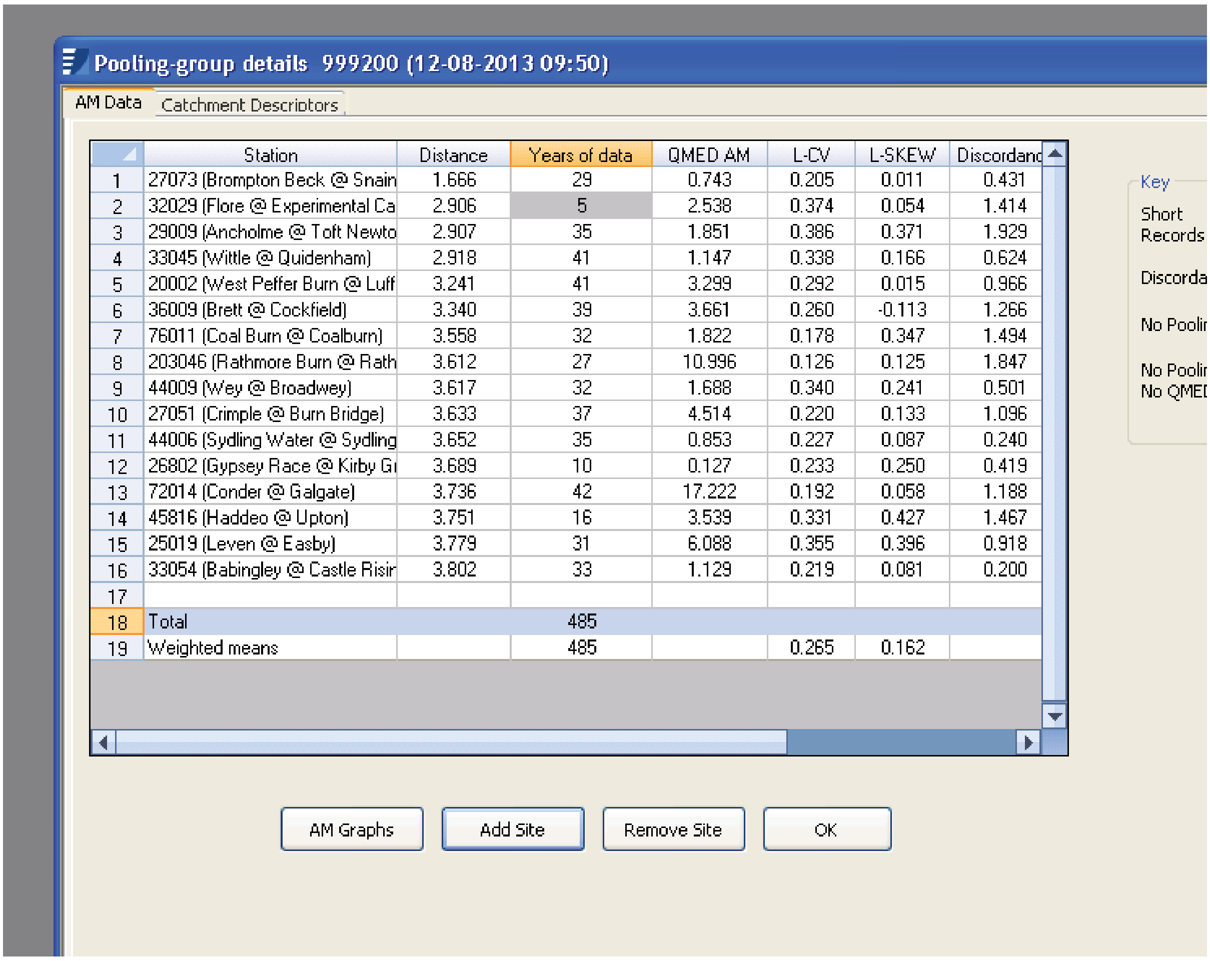
7.13 The 1 in 1000 year flood level will be influenced by the final development elevations, therefore it is recommended that the 1 in 1000 year analysis is repeated once final levels are known to ensure that the flood management strategy is still robust.

ANNEX A

Tetchill Brook FEH Statistical Analysis

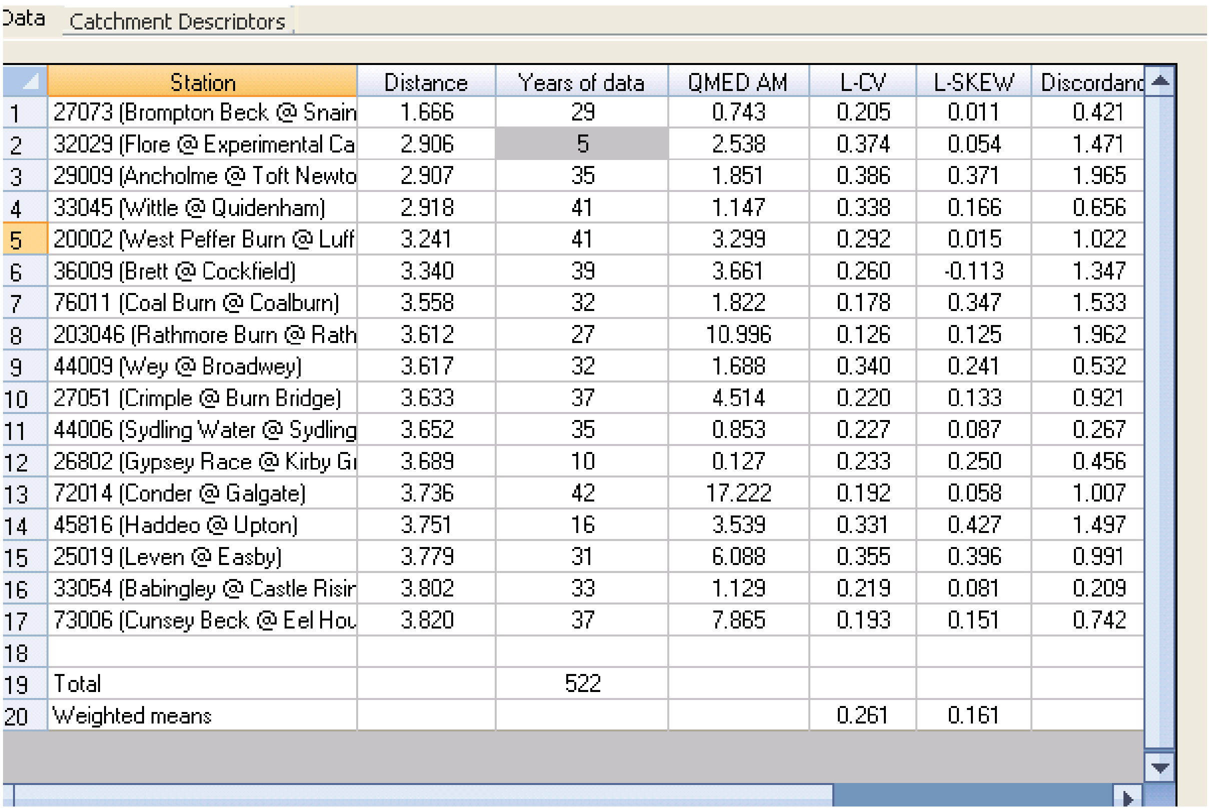


Tetchill Catchment at Descriptors



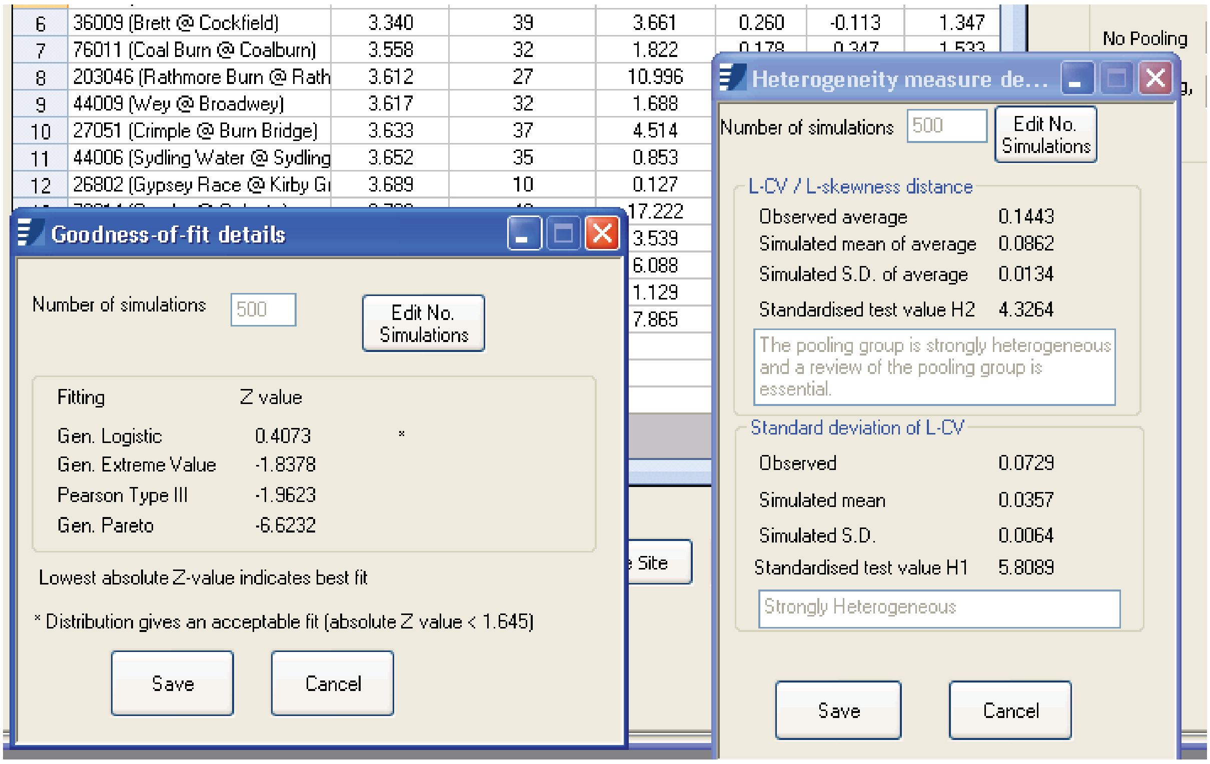
	Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordanc
1	27073 (Brompton Beck @ Snain	1.666	29	0.743	0.205	0.011	0.431
2	32029 (Flore @ Experimental Ca	2.906	5	2.538	0.374	0.054	1.414
3	29009 (Ancholme @ Toft Newto	2.907	35	1.851	0.386	0.371	1.929
4	33045 (Wittle @ Quidenham)	2.918	41	1.147	0.338	0.166	0.624
5	20002 (West Peffer Burn @ Luff	3.241	41	3.299	0.292	0.015	0.966
6	36009 (Brett @ Cockfield)	3.340	39	3.661	0.260	-0.113	1.266
7	76011 (Coal Burn @ Coalburn)	3.558	32	1.822	0.178	0.347	1.494
8	203046 (Rathmore Burn @ Rath	3.612	27	10.996	0.126	0.125	1.847
9	44009 (Wey @ Broadwey)	3.617	32	1.688	0.340	0.241	0.501
10	27051 (Crimple @ Burn Bridge)	3.633	37	4.514	0.220	0.133	1.096
11	44006 (Sydling Water @ Sydling	3.652	35	0.853	0.227	0.087	0.240
12	26802 (Gypsey Race @ Kirby Gı	3.689	10	0.127	0.233	0.250	0.419
13	72014 (Conder @ Galgate)	3.736	42	17.222	0.192	0.058	1.188
14	45816 (Haddeo @ Upton)	3.751	16	3.539	0.331	0.427	1.467
15	25019 (Leven @ Easby)	3.779	31	6.088	0.355	0.396	0.918
16	33054 (Babingley @ Castle Risir	3.802	33	1.129	0.219	0.081	0.200
17							
18	Total		485				
19	Weighted means		485		0.265	0.162	

Original Pooling group

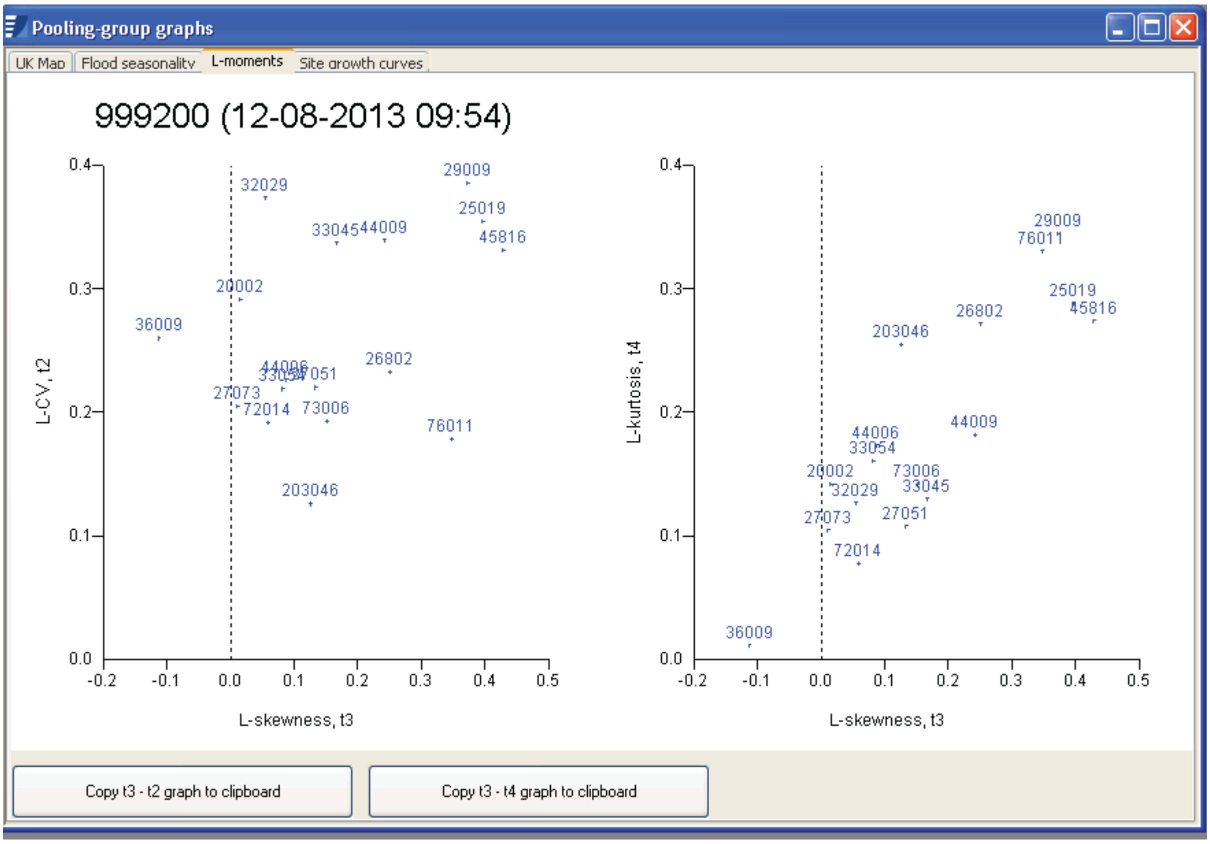


	Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordanc
1	27073 (Brompton Beck @ Snain	1.666	29	0.743	0.205	0.011	0.421
2	32029 (Flore @ Experimental Ca	2.906	5	2.538	0.374	0.054	1.471
3	29009 (Ancholme @ Toft Newto	2.907	35	1.851	0.386	0.371	1.965
4	33045 (Wittle @ Quidenham)	2.918	41	1.147	0.338	0.166	0.656
5	20002 (West Peffer Burn @ Luff	3.241	41	3.299	0.292	0.015	1.022
6	36009 (Brett @ Cockfield)	3.340	39	3.661	0.260	-0.113	1.347
7	76011 (Coal Burn @ Coalburn)	3.558	32	1.822	0.178	0.347	1.533
8	203046 (Rathmore Burn @ Rath	3.612	27	10.996	0.126	0.125	1.962
9	44009 (Wey @ Broadwey)	3.617	32	1.688	0.340	0.241	0.532
10	27051 (Crimple @ Burn Bridge)	3.633	37	4.514	0.220	0.133	0.921
11	44006 (Sydling Water @ Sydling	3.652	35	0.853	0.227	0.087	0.267
12	26802 (Gypsey Race @ Kirby Gı	3.689	10	0.127	0.233	0.250	0.456
13	72014 (Conder @ Galgate)	3.736	42	17.222	0.192	0.058	1.007
14	45816 (Haddeo @ Upton)	3.751	16	3.539	0.331	0.427	1.497
15	25019 (Leven @ Easby)	3.779	31	6.088	0.355	0.396	0.991
16	33054 (Babingley @ Castle Risir	3.802	33	1.129	0.219	0.081	0.209
17	73006 (Cunsey Beck @ Eel Hou	3.820	37	7.865	0.193	0.151	0.742
18							
19	Total		522				
20	Weighted means				0.261	0.161	

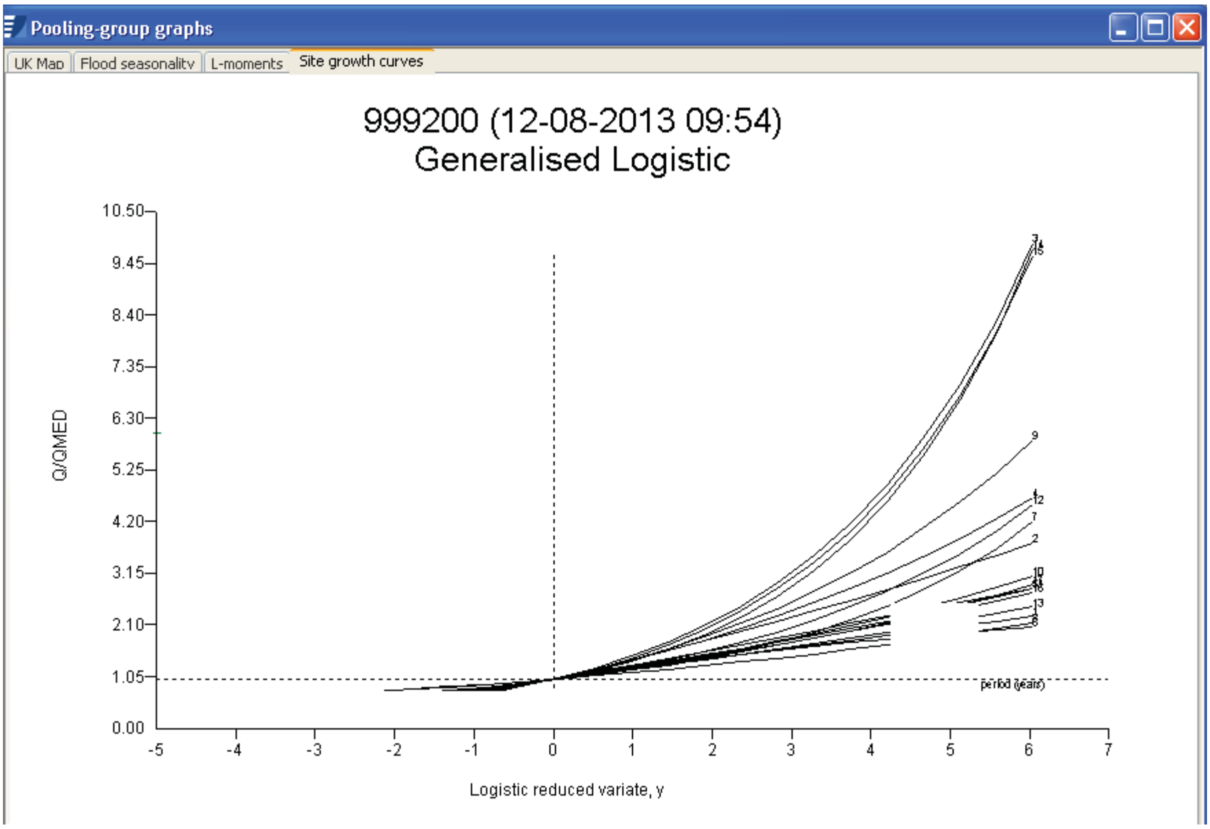
OK for pooling and QMED

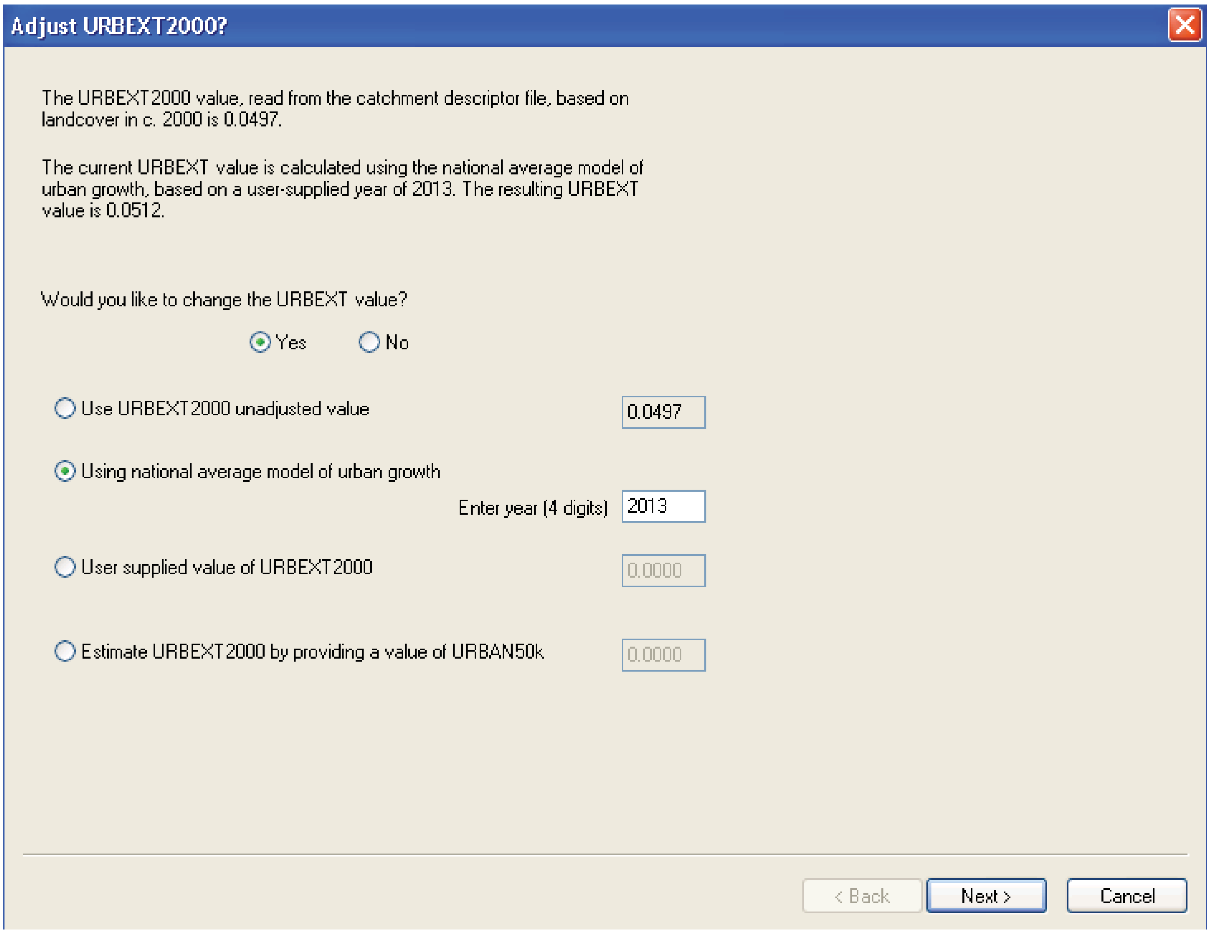


Goodness of fit and heterogeneity

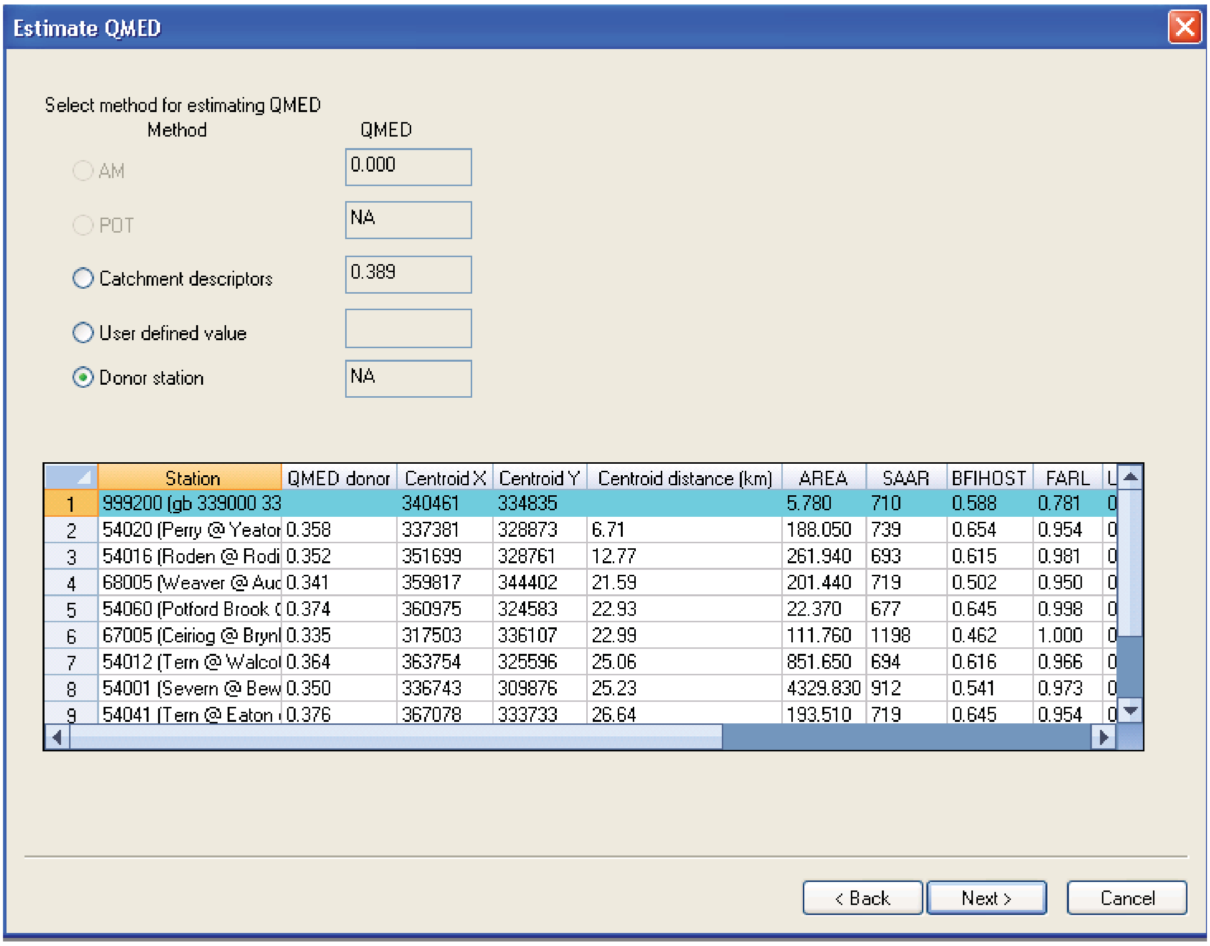


Pooling group analysis

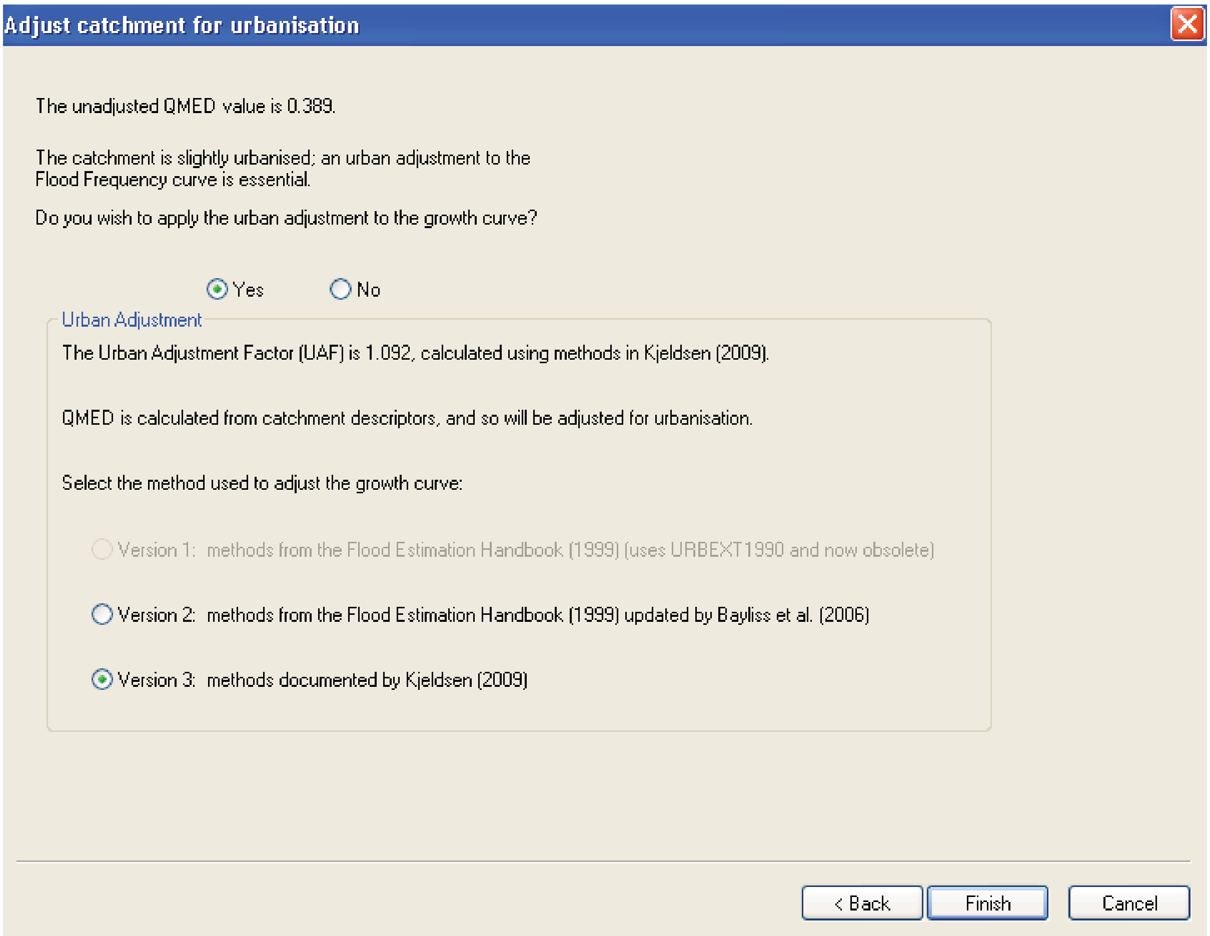




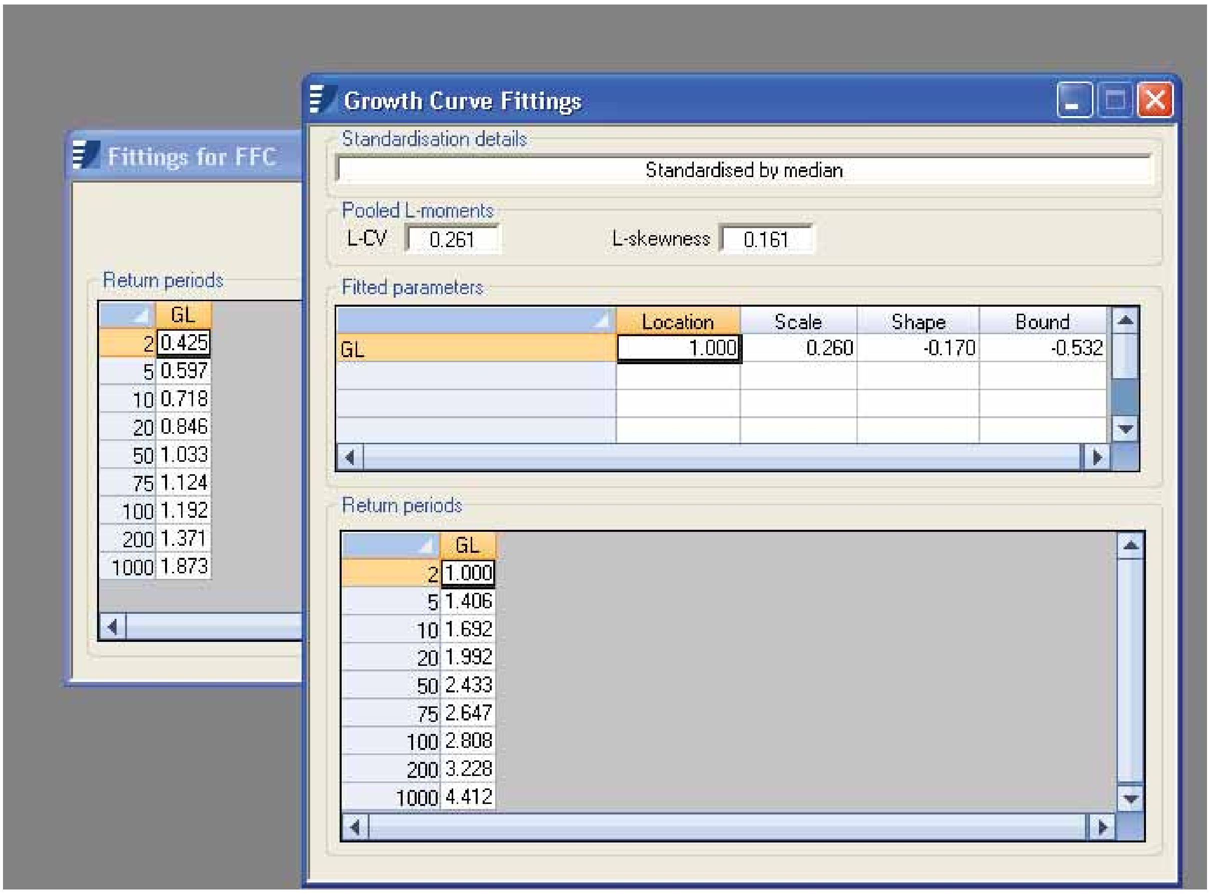
URBEXT updated to 2013 value using national average model of growth



Catchment descriptor QMED used as is most conservative



Version 3: methods documented by Kjeldson (2009) adjusting the growth curve was used



Growth curves and flood frequency fittings.

All analysis graphs

ANNEX B

Tetchill Brook Sub-Catchment Analysis

Descriptor	Tetchill Brook Sub-Catchments from the FEH CD-ROM			Tetchill Brook Sub-catchments for Modelling	
	(1) Confluence with the Newnes Brook*	(2) Upstream of the Site	(3) The Mere⁺	Between The Site & The Mere⁺ *(FEH Catchment 2 minus 3)*	Downstream Catchment⁺ *(FEH Catchment 1 minus 2)*
AREA	5.79	3.94	2.52	1.42	1.85
ALTBAR	101	102	104	102	101
ASPBAR	240	222	264	222	240
ASPVAR	0.25	0.29	0.35	0.29	0.25
BFIHOST	0.588	0.476	0.494	0.444	0.827
DPLBAR	3.17	2.48	1.88	1.21	1.40
DPSBAR	21.3	20.7	23.2	16.3	22.6
FARL	0.782	0.696	0.581	0.696	0.782
FPEXT	0.3094	0.2951	0.3262	0.240	0.340
FPDBAR	2.493	2.374	2.903	2.374	2.493
FPLOC	0.927	0.921	0.809	0.921	0.927
LDP	5.77	4.52	3.31	4.52	5.77
PROPWET	0.36	0.36	0.34	0.395	0.360
RMED-1H	9.4	9.5	9.5	9.5	9.4
RMED-1D	29.8	29.9	30	29.9	29.8
RMED-2D	38	38	38	38	38
SAAR	710	708	708	708	714
SAAR4170	738	739	740	739	738
SPRHOST	29.62	35.03	34.15	36.59	18.10
URBCONC1990	0.745	0.772	0.167	0.772	0.745
URBEXT1990	0.0493	0.0647	0.012	0.158	0.017
URBLOC1990	0.655	0.364	0.633	0.364	0.655
URBCONC2000	0.825	0.853	0.47	0.853	0.825
URBEXT2000	0.0495	0.0688	0.0067	0.179	0.008
URBLOC2000	0.658	0.352	0.258	0.352	0.658
C	-0.02492	-0.02495	-0.02499	-0.02495	-0.02492
D1	0.33792	0.33818	0.33927	0.33818	0.33792
D2	0.42295	0.41924	0.41521	0.41924	0.42295
D3	0.2727	0.27355	0.2758	0.27355	0.2727
E	0.28456	0.28436	0.28456	0.28436	0.28456
F	2.35864	2.36292	2.36416	2.36292	2.35864
C(1 km)	-0.024	-0.025	-0.025	-0.025	-0.024
D1(1 km)	0.326	0.343	0.338	0.343	0.326
D2(1 km)	0.443	0.43	0.426	0.43	0.443
D3(1 km)	0.267	0.267	0.269	0.267	0.267
E(1 km)	0.284	0.285	0.284	0.285	0.284
F(1 km)	2.338	2.35	2.361	2.35	2.338

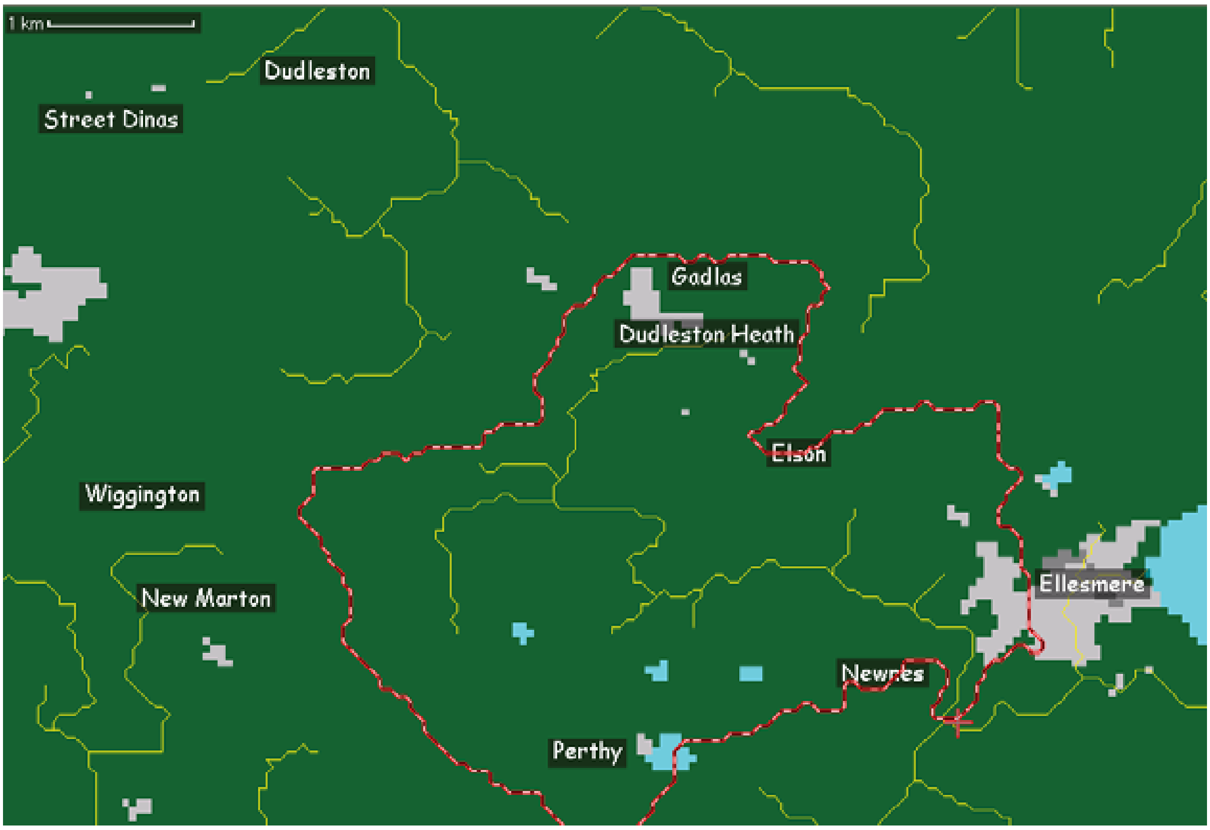
x	Adjusted using $DPLBAR = AREA^{0.548}$ [Equation 7.1 Vol 5 FEH]
x	Adjusted using FEH Area weighting [7.2 Vol. 5 FEH]
x	Unchanged - should not significantly vary from original catchment

* *used to set critical duration & seasonality of ReFH analysis*

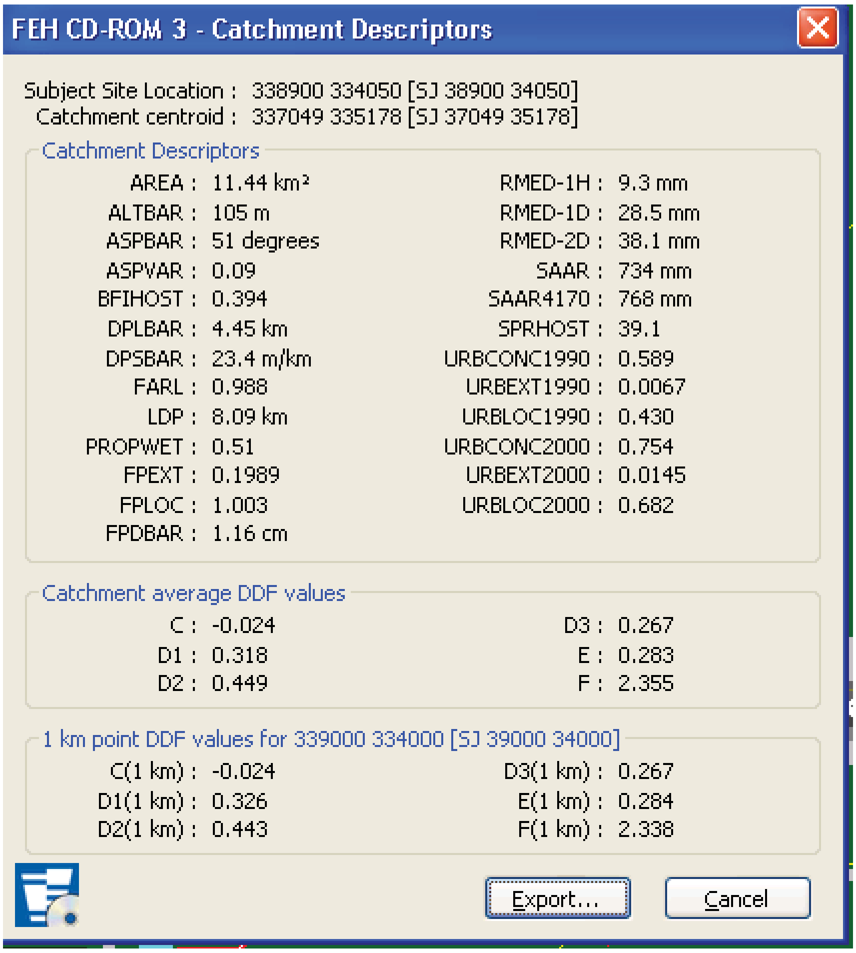
⁺*see Figure 2.2 for location*

ANNEX C

Newnes Brook FEH Statistical Analysis

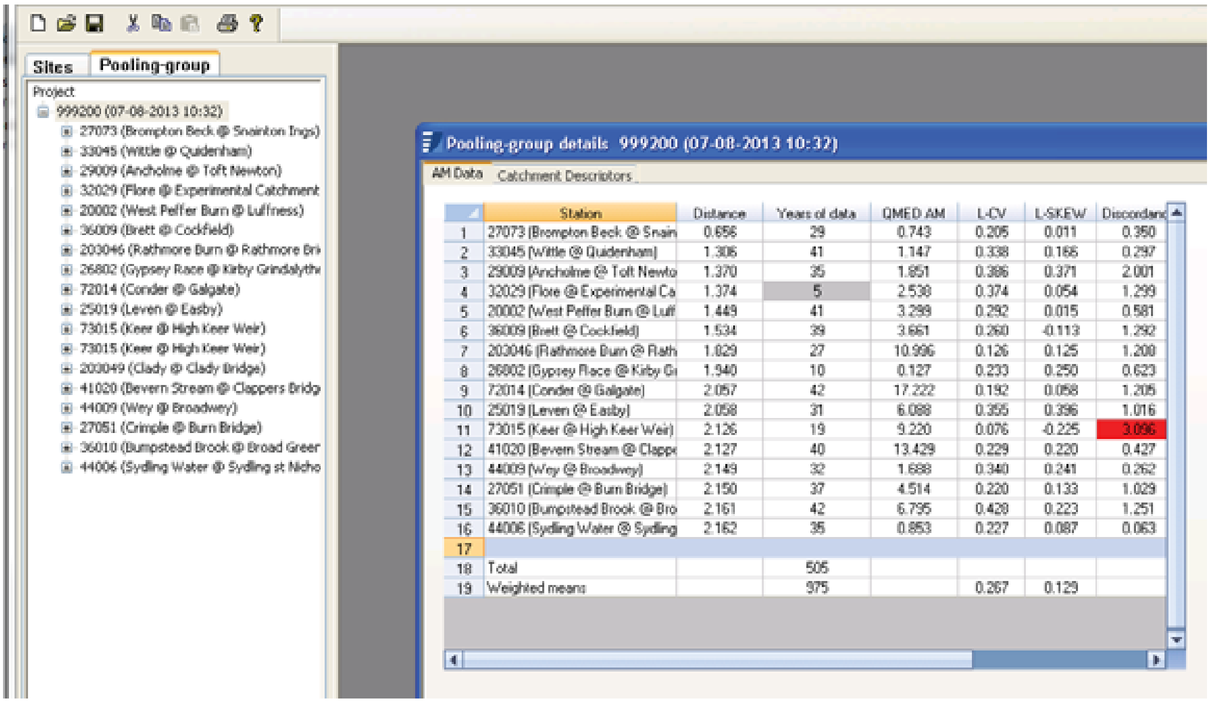


Newnes Catchment



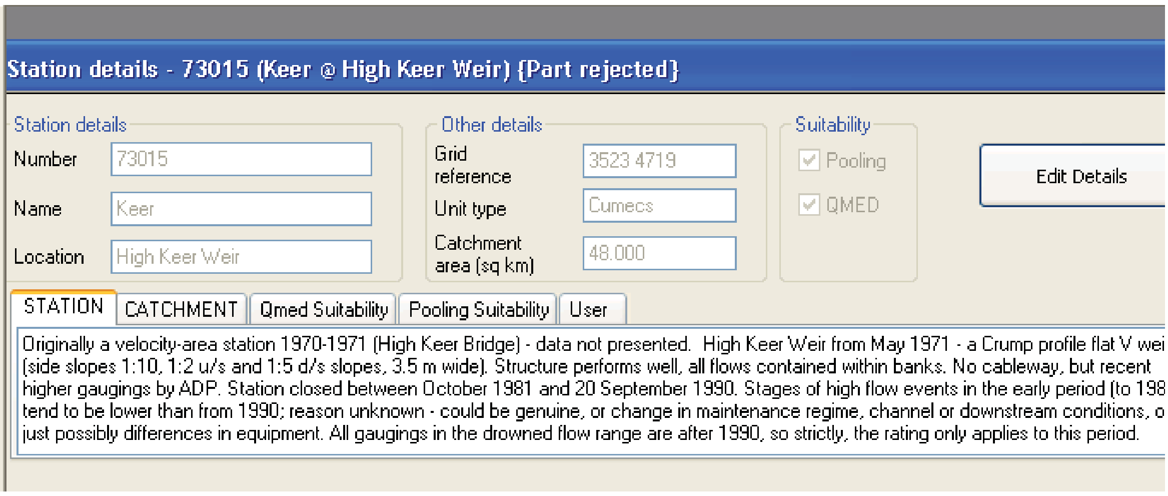
Newnes Catchment Descriptors

Original Pooling Group

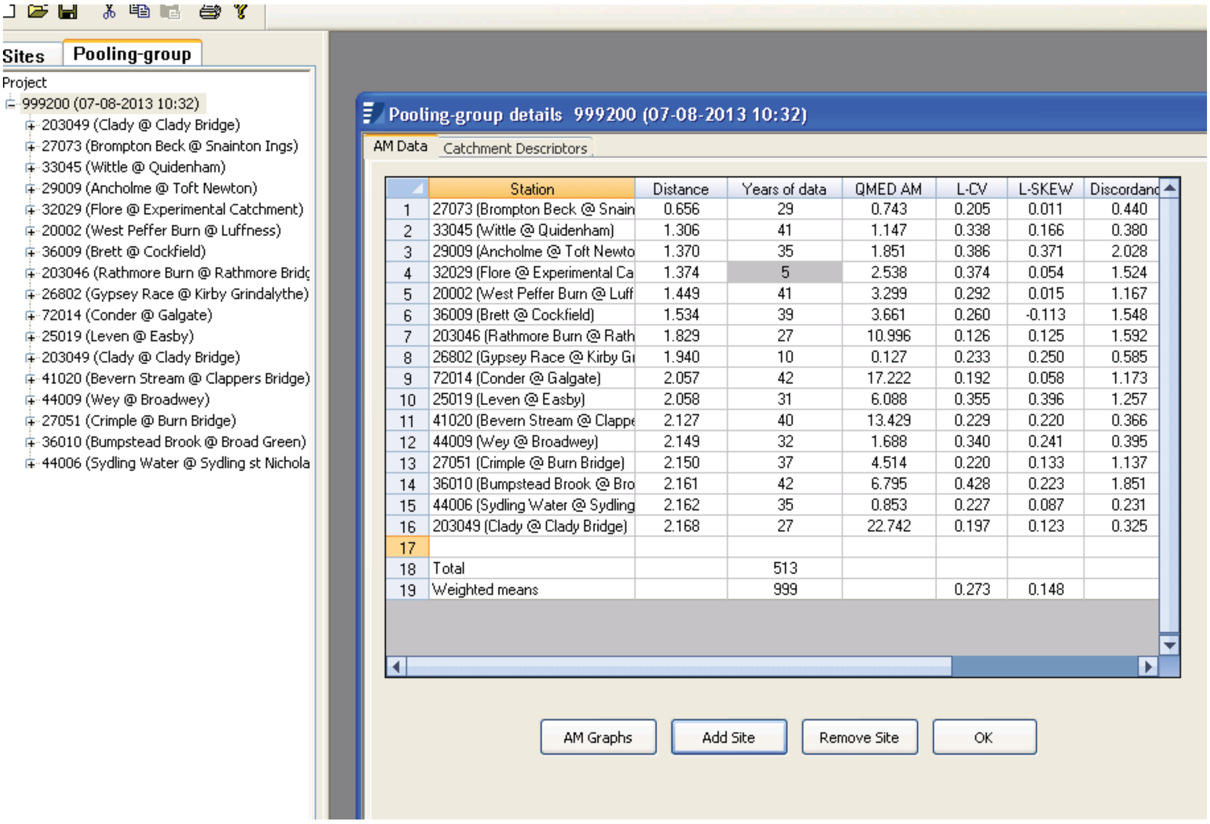


	Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordanc
1	27073 (Brompton Beck @ Snain	0.656	29	0.743	0.205	0.011	0.350
2	33045 (Wittle @ Quidenham)	1.306	41	1.147	0.338	0.166	0.297
3	29009 (Ancholme @ Toft Newto	1.370	35	1.851	0.386	0.371	2.001
4	32029 (Flore @ Experimental Ca	1.374	5	2.538	0.374	0.054	1.299
5	20002 (West Peffer Burn @ Luff	1.449	41	3.299	0.292	0.015	0.581
6	36009 (Brett @ Cockfield)	1.534	39	3.661	0.260	-0.113	1.292
7	203046 (Rathmore Burn @ Rath	1.829	27	10.996	0.126	0.125	1.200
8	26802 (Gypsey Race @ Kirby Gi	1.940	10	0.127	0.233	0.250	0.623
9	72014 (Conder @ Galgate)	2.057	42	17.222	0.192	0.058	1.205
10	25019 (Leven @ Easby)	2.058	31	6.088	0.355	0.396	1.016
11	73015 (Keer @ High Keer Weir)	2.126	19	9.220	0.076	-0.225	3.096
12	41020 (Bevern Stream @ Clappe	2.127	40	13.429	0.229	0.220	0.427
13	44009 (Wey @ Broadwey)	2.149	32	1.688	0.340	0.241	0.262
14	27051 (Crimple @ Burn Bridge)	2.150	37	4.514	0.220	0.133	1.029
15	36010 (Bumpstead Brook @ Bro	2.161	42	6.795	0.428	0.223	1.251
16	44006 (Sydling Water @ Sydling	2.162	35	0.853	0.227	0.087	0.063
17							
18	Total		505				
19	Weighted means		975		0.267	0.129	

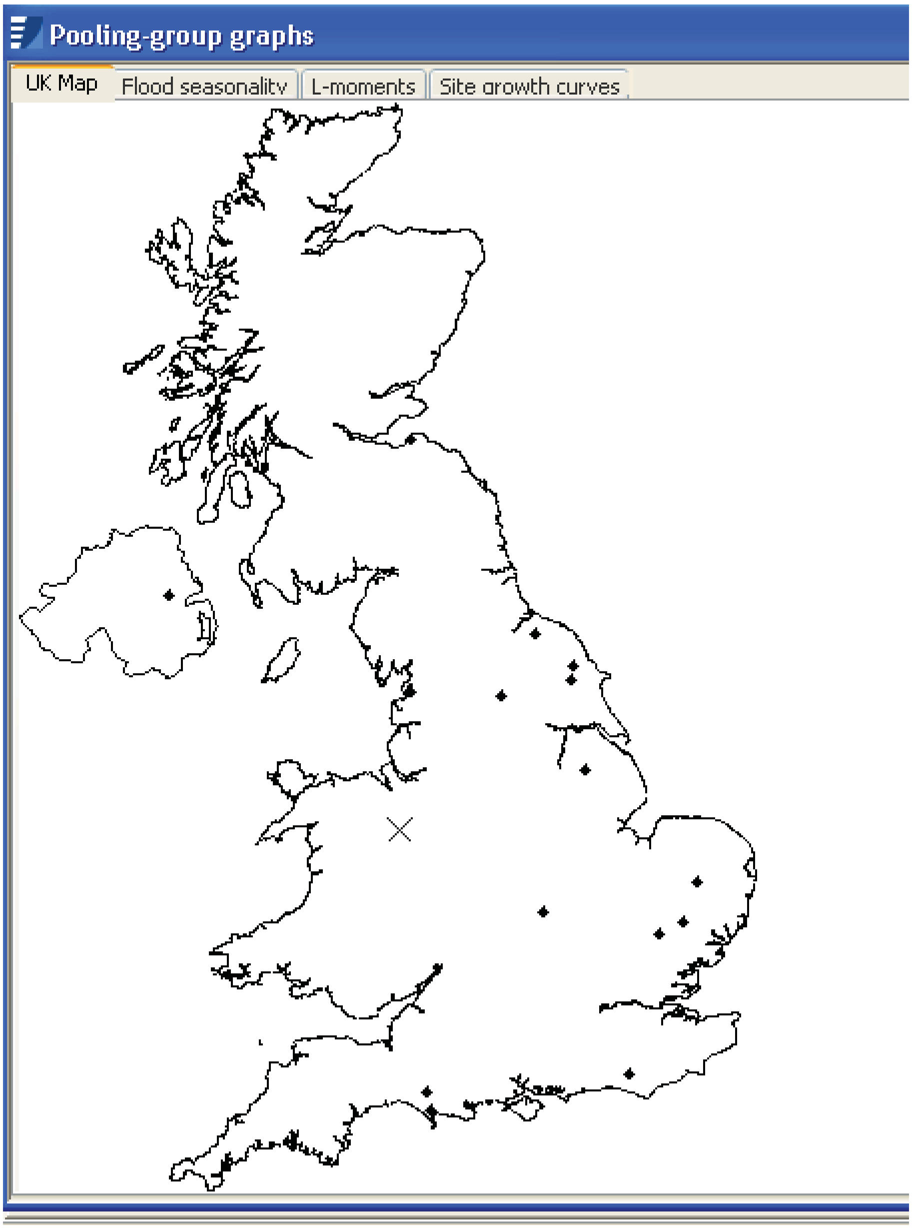
73015 – Keer, Removed as detailed below, due to the high discordancy as shown above. Part of the record has been rejected, and some is questionable.



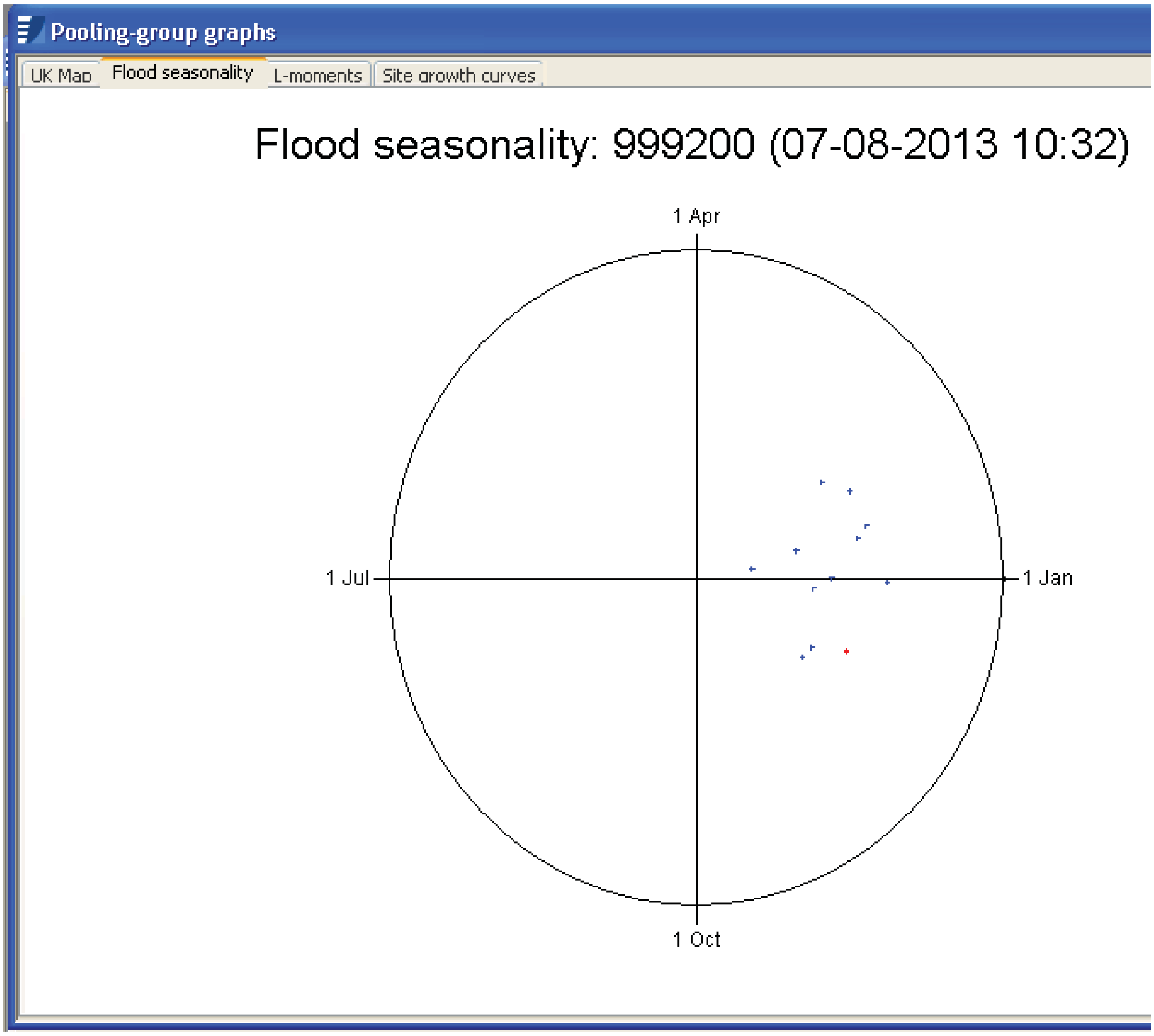
Added in Clady Bridge to increase number of available years.



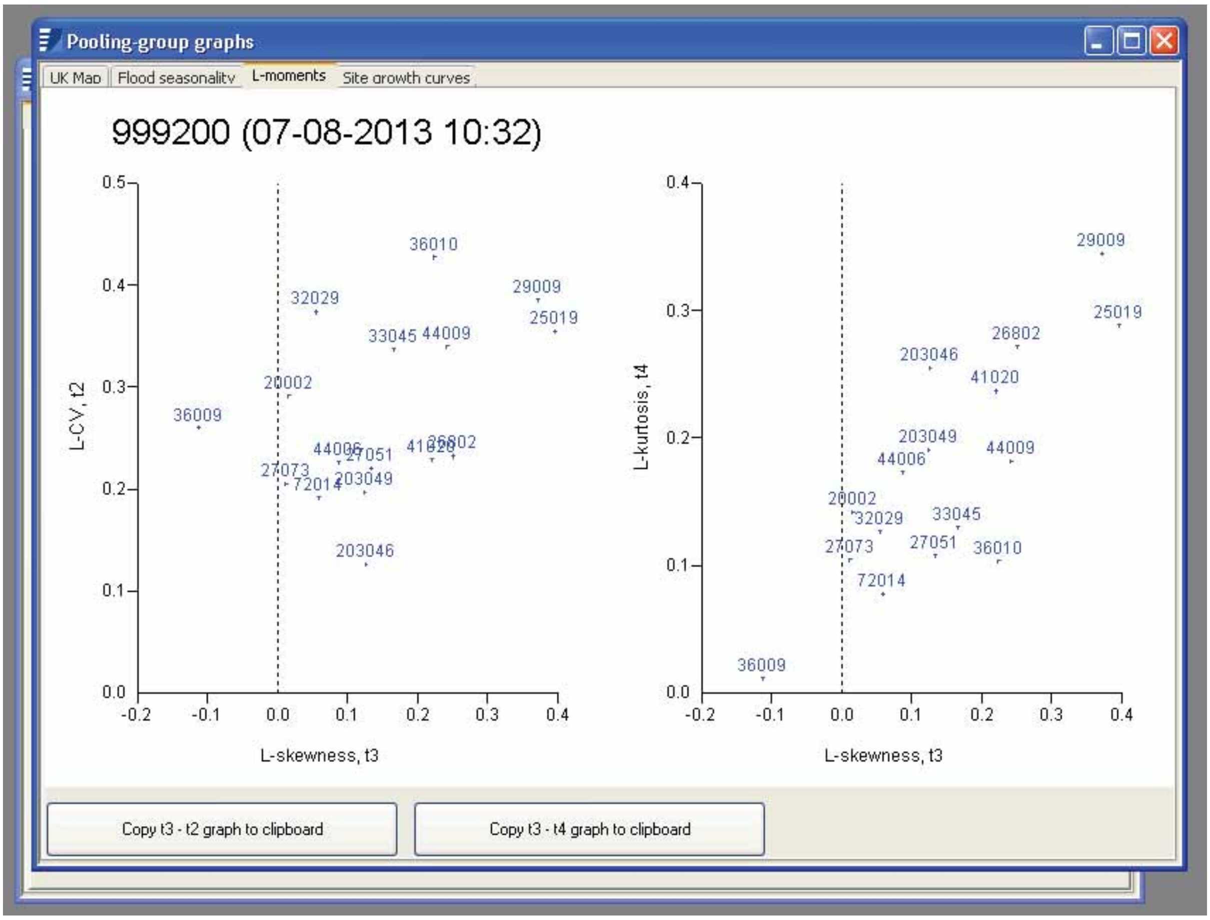
	Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordanc
1	27073 (Brompton Beck @ Snain	0.656	29	0.743	0.205	0.011	0.440
2	33045 (Wittle @ Quidenham)	1.306	41	1.147	0.338	0.166	0.380
3	29009 (Ancholme @ Toft Newto	1.370	35	1.851	0.386	0.371	2.028
4	32029 (Flore @ Experimental Ca	1.374	5	2.538	0.374	0.054	1.524
5	20002 (West Peffer Burn @ Luff	1.449	41	3.299	0.292	0.015	1.167
6	36009 (Brett @ Cockfield)	1.534	39	3.661	0.260	-0.113	1.548
7	203046 (Rathmore Burn @ Rath	1.829	27	10.996	0.126	0.125	1.592
8	26802 (Gypsey Race @ Kirby Gr	1.940	10	0.127	0.233	0.250	0.585
9	72014 (Conder @ Galgate)	2.057	42	17.222	0.192	0.058	1.173
10	25019 (Leven @ Easby)	2.058	31	6.088	0.355	0.396	1.257
11	41020 (Bevern Stream @ Clappe	2.127	40	13.429	0.229	0.220	0.366
12	44009 (Wey @ Broadwey)	2.149	32	1.688	0.340	0.241	0.395
13	27051 (Crimple @ Burn Bridge)	2.150	37	4.514	0.220	0.133	1.137
14	36010 (Bumpstead Brook @ Bro	2.161	42	6.795	0.428	0.223	1.851
15	44006 (Sydling Water @ Sydling	2.162	35	0.853	0.227	0.087	0.231
16	203049 (Clady @ Clady Bridge)	2.168	27	22.742	0.197	0.123	0.325
17							
18	Total		513				
19	Weighted means		999		0.273	0.148	



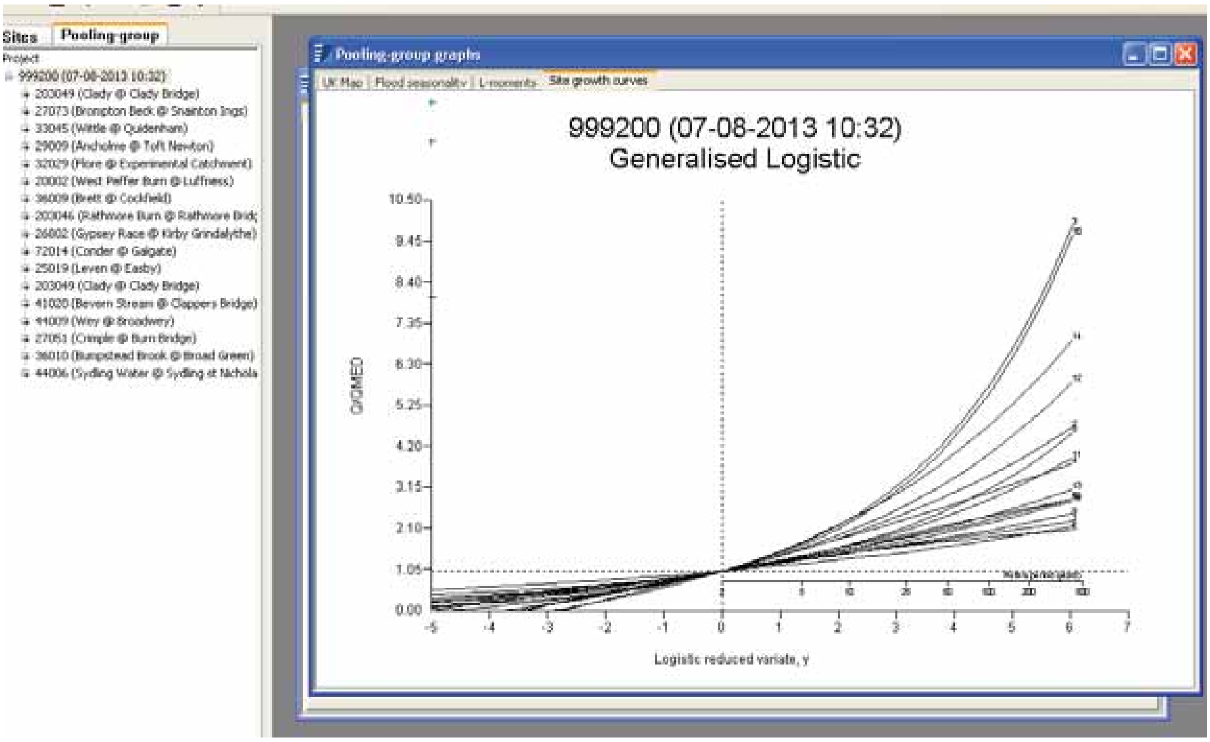
Geographical location of stations



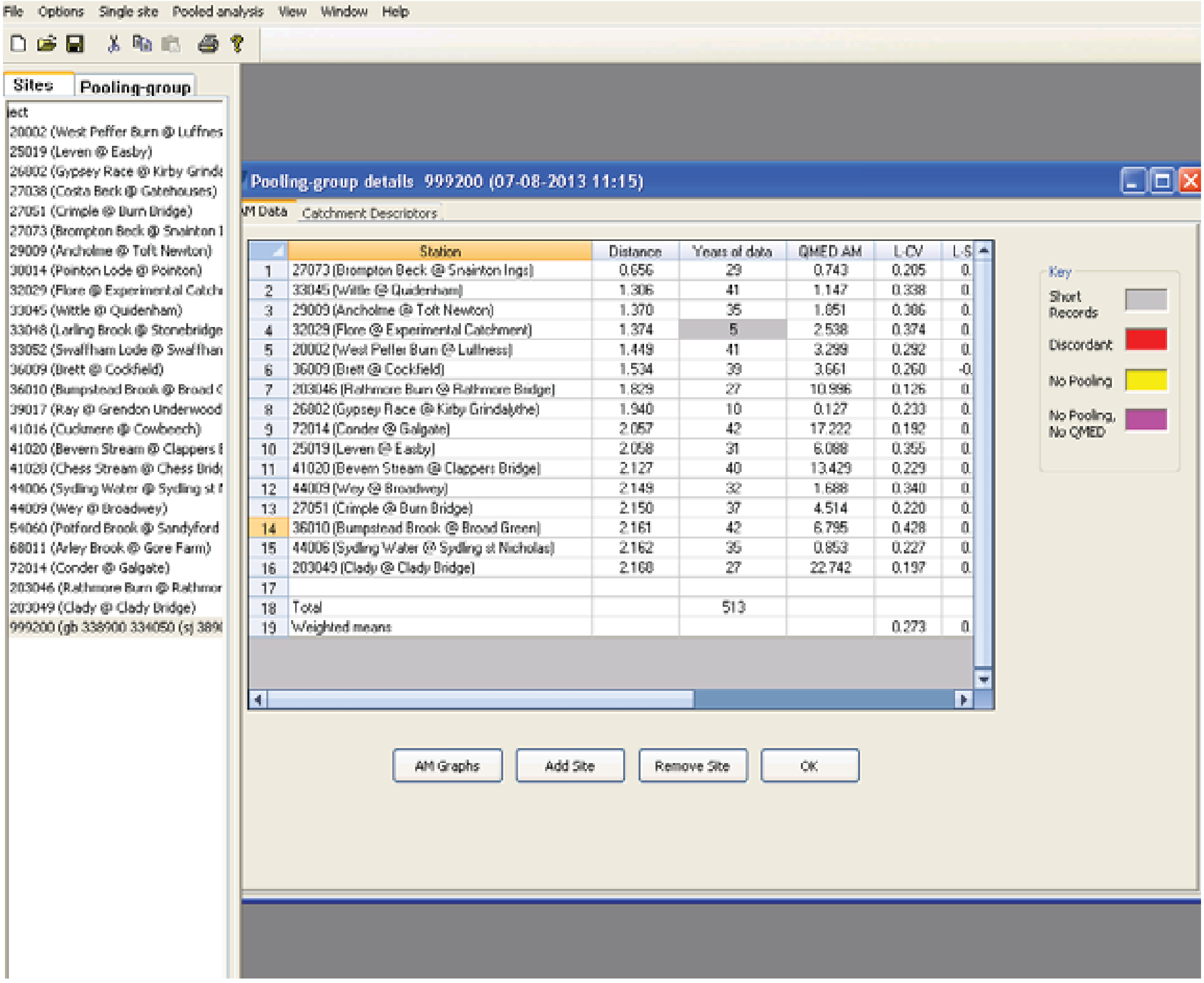
Flood seasonality



L-moments

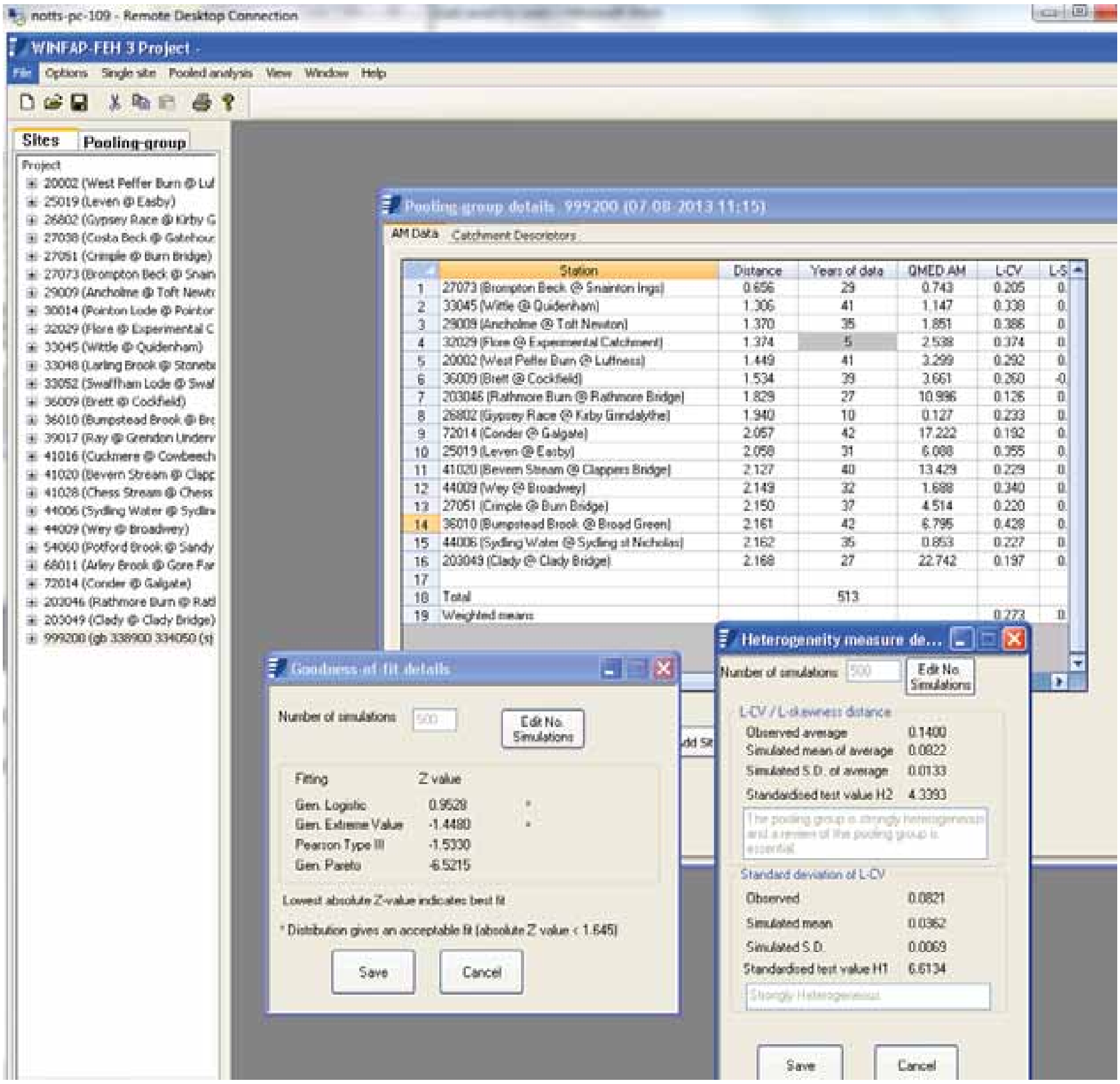


Growth Curves – Generalised logisitic

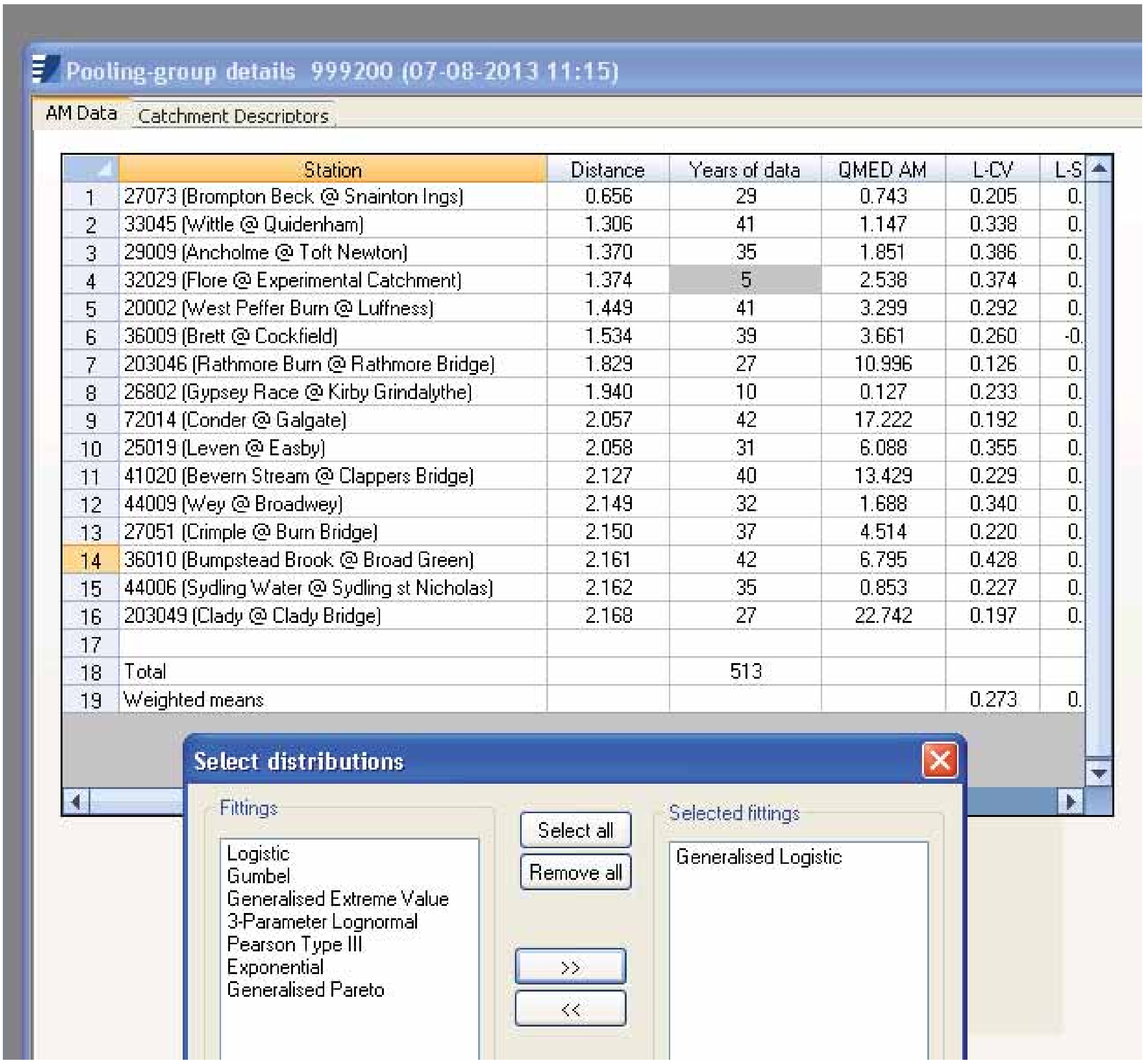


OK for QMED and Pooling

Removed yellow no pooling sites, and added in those from OK for pooling.

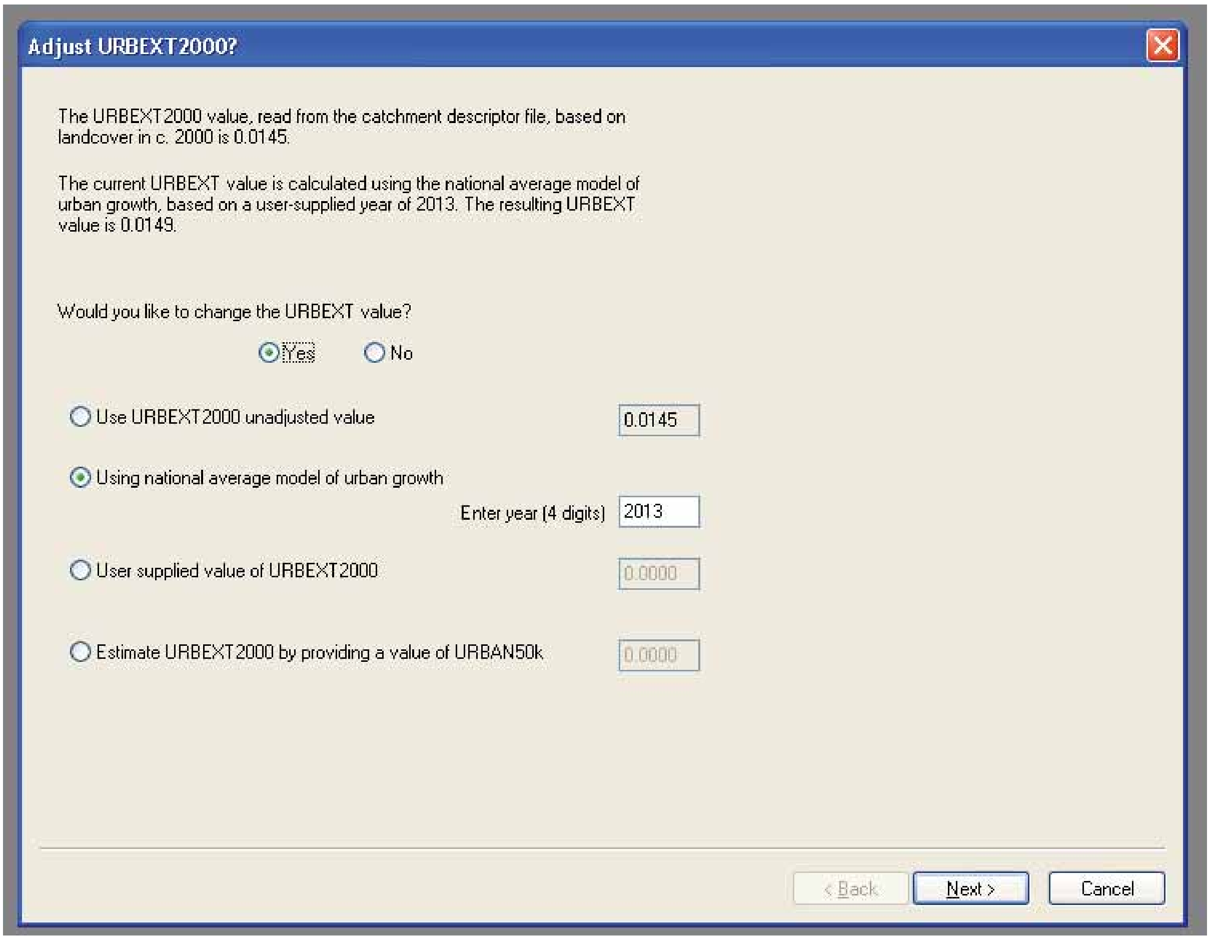


Goodness of fit and heterogeneity for pooled group.

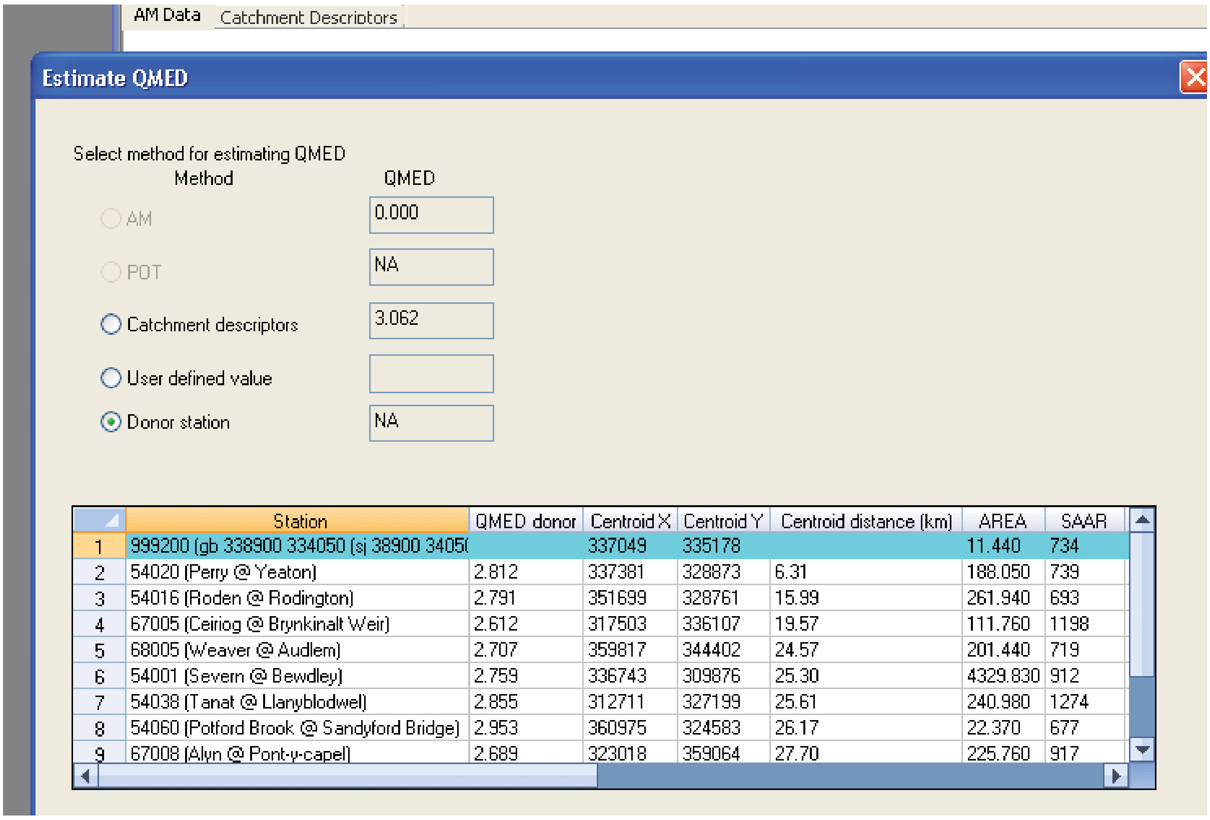


	Station	Distance	Years of data	QMED AM	L-CV	L-S
1	27073 (Brompton Beck @ Snainton Ings)	0.656	29	0.743	0.205	0.
2	33045 (Wittle @ Quidenham)	1.306	41	1.147	0.338	0.
3	29009 (Ancholme @ Toft Newton)	1.370	35	1.851	0.386	0.
4	32029 (Flore @ Experimental Catchment)	1.374	5	2.538	0.374	0.
5	20002 (West Peffer Burn @ Luffness)	1.449	41	3.299	0.292	0.
6	36009 (Brett @ Cockfield)	1.534	39	3.661	0.260	-0.
7	203046 (Rathmore Burn @ Rathmore Bridge)	1.829	27	10.996	0.126	0.
8	26802 (Gypsey Race @ Kirby Grindalythe)	1.940	10	0.127	0.233	0.
9	72014 (Conder @ Galgate)	2.057	42	17.222	0.192	0.
10	25019 (Leven @ Easby)	2.058	31	6.088	0.355	0.
11	41020 (Bevern Stream @ Clappers Bridge)	2.127	40	13.429	0.229	0.
12	44009 (Wey @ Broadwey)	2.149	32	1.688	0.340	0.
13	27051 (Crimple @ Burn Bridge)	2.150	37	4.514	0.220	0.
14	36010 (Bumpstead Brook @ Broad Green)	2.161	42	6.795	0.428	0.
15	44006 (Sydling Water @ Sydling st Nicholas)	2.162	35	0.853	0.227	0.
16	203049 (Clady @ Clady Bridge)	2.168	27	22.742	0.197	0.
17						
18	Total		513			
19	Weighted means				0.273	0.

Generalised logistic distribution was selected for growth curve analysis

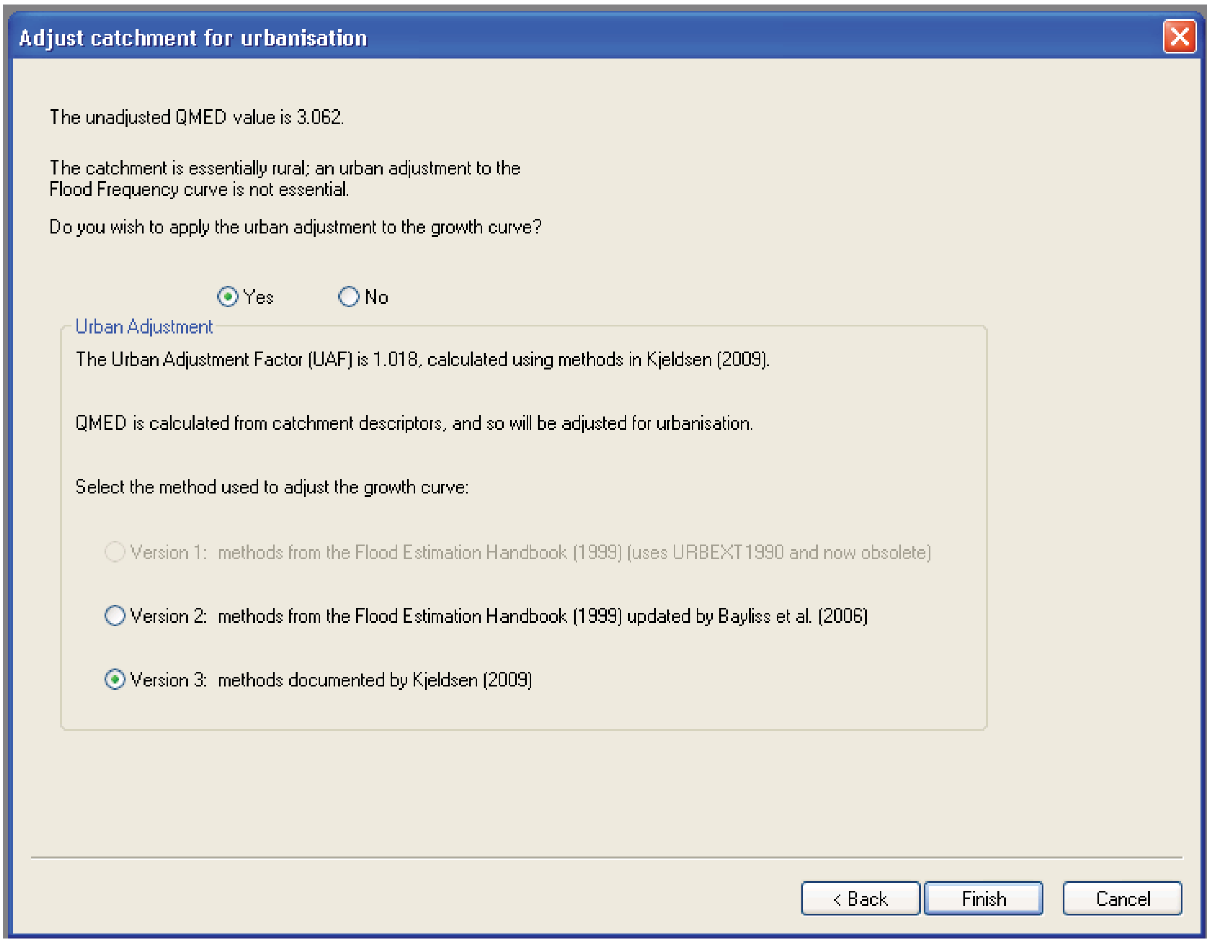


URBEXT was changed to 2013 values

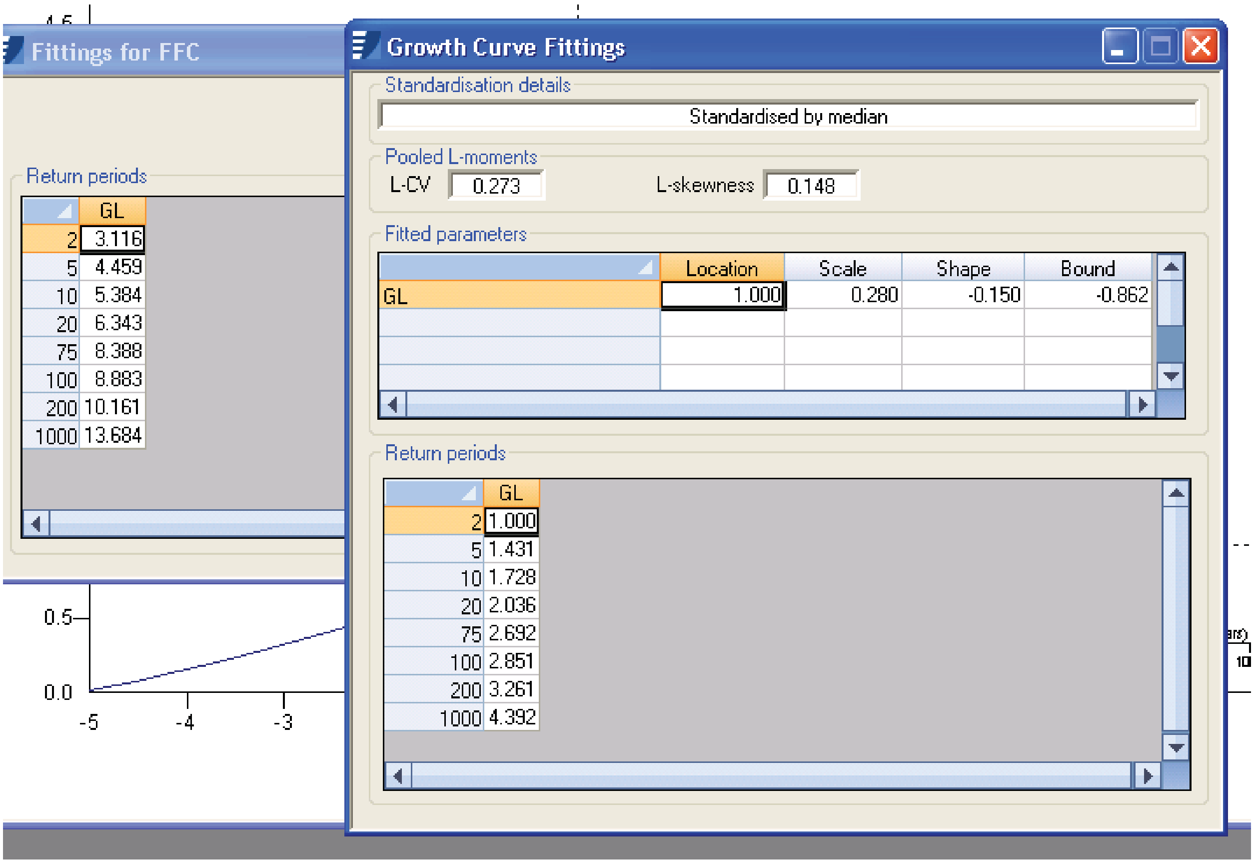


	Station	QMED donor	Centroid X	Centroid Y	Centroid distance (km)	AREA	SAAR
1	999200 (gb 338900 334050 (sj 38900 3405(		337049	335178		11.440	734
2	54020 (Perry @ Yeaton)	2.812	337381	328873	6.31	188.050	739
3	54016 (Roden @ Rodington)	2.791	351699	328761	15.99	261.940	693
4	67005 (Ceiriog @ Brynkinalt Weir)	2.612	317503	336107	19.57	111.760	1198
5	68005 (Weaver @ Audlem)	2.707	359817	344402	24.57	201.440	719
6	54001 (Severn @ Bewdley)	2.759	336743	309876	25.30	4329.830	912
7	54038 (Tanat @ Llanyblodwel)	2.855	312711	327199	25.61	240.980	1274
8	54060 (Potford Brook @ Sandyford Bridge)	2.953	360975	324583	26.17	22.370	677
9	67008 (Alyn @ Pont-y-capel)	2.689	323018	359064	27.70	225.760	917

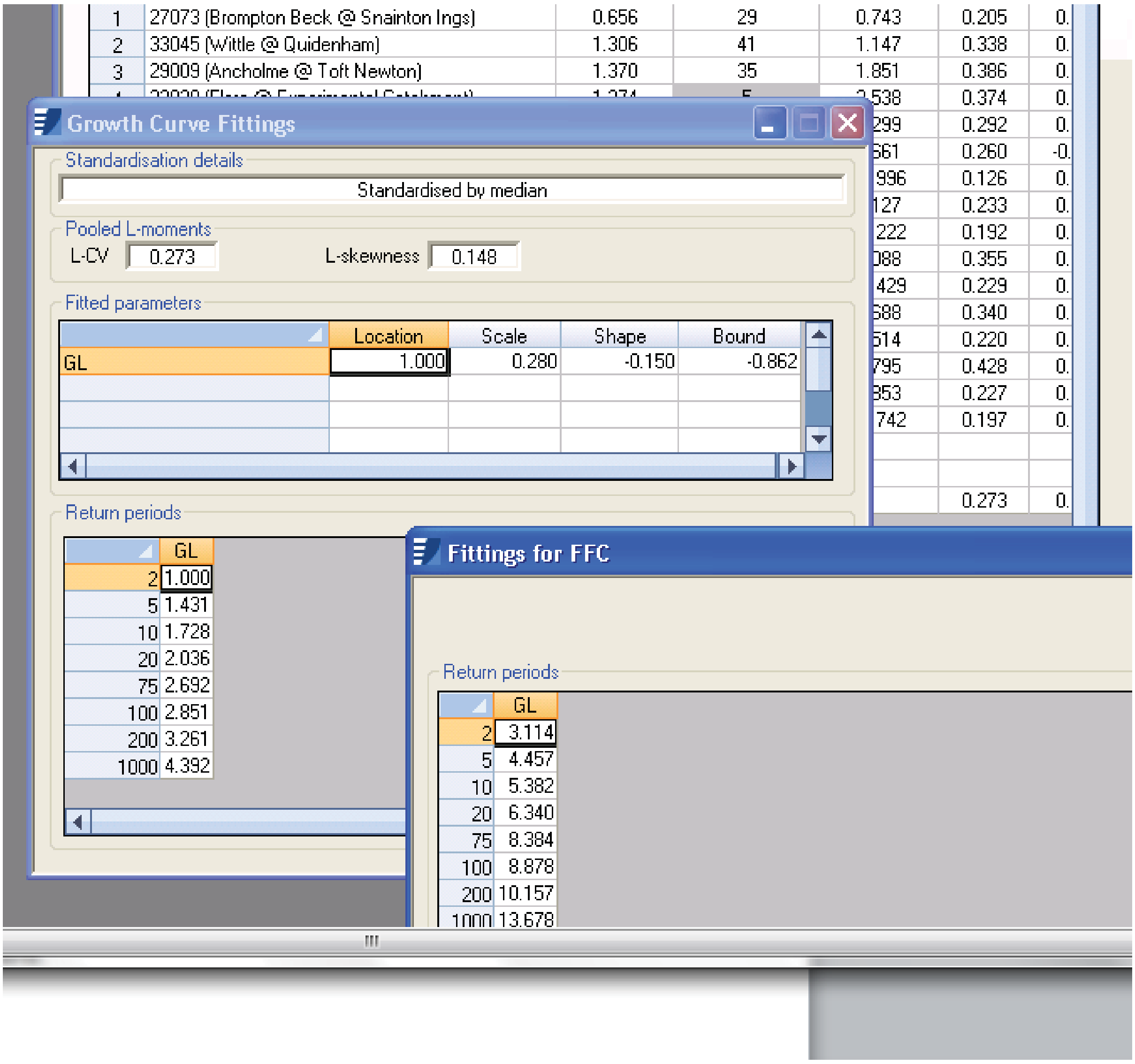
Catchment Descriptor QMED was taken – due to it being the most conservative value



Version 3 of the Urban Adjustment growth curve was applied



Fittings for FFC
Return periods
GL
2 3.116
5 4.459
10 5.384
20 6.343
75 8.388
100 8.883
200 10.161
1000 13.684
0.5
0.0
-5
-4
-3
Growth Curve Fittings
Standardisation details
Standardised by median
Pooled L-moments
L-CV 0.273
L-skewness 0.148
Fitted parameters
Location Scale Shape Bound
GL 1.000 0.280 -0.150 -0.862
Return periods
GL
2 1.000
5 1.431
10 1.728
20 2.036
75 2.692
100 2.851
200 3.261
1000 4.392



Growth curve fittings.

ANNEX D

Supplementary CCTV and Watercourse Survey

NOTES

1. DO NOT SCALE THIS DRAWING. ALL DIMENSIONS MUST BE CHECKED/ VERIFIED ON SITE. IF IN DOUBT ASK.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALISTS DRAWINGS AND SPECIFICATIONS.
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4. ANY DISCREPANCIES NOTED ON SITE ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
5. NO SCALE FACTOR HAS BEEN APPLIED TO THIS SURVEY. THEREFORE THE OS COORDINATES ARE TO BE TREATED AS ARBITRARY. PLEASE REFER TO SURVEY STATION INFORMATION BELOW FOR ON SITE CONTROL ESTABLISHMENT.
6. ALL COORDINATES AND HEIGHT DATA RELATE TO OSGB36 UNLESS OTHERWISE STATED. CONTROL STATIONS ARE COORDINATED BY MEANS OF GPS RECEIVING REALTIME CORRECTIONS VIA OS SMART NET.
7. ALL MANHOLE DATA IS COLLECTED FROM GROUND LEVEL THEREFORE DISCREPANCIES MAY OCCUR. MORE ACCURATE DATA IS ONLY ACHIEVABLE VIA CONFINED SPACE ENTRY.

LEGEND

	Buildings / Walls	Elec	Electric
	Kerb/Cannel line	CTV	Cable TV
	Edge of surface	BT	British Telecom
	Canopy / Overhang	FH	Fire Hydrant
	Line Marking	ST	Stop tap
	Fence/Barrier	SV	Stop valve
	Gate	WM	Water Meter
	Hedge	Mkr	Service Marker
	Overhead Powerline	RE	Rodding eye
1	Station and Name	AV	Air Valve
		CMP	Cable Marker Post
	Tree / Bush / Sapling	LP	Lamp Post
		SP	Sign Post
	Area of Undergrowth / Extent of Tree Canopy	EP	Electricity Post
		TP	Telegraph Post
	Body of Water	TL	Traffic light
		BS	Bus Stop
	OS Buildings	FL	Floodlight
		FP	Flagpole
	Surveyed Buildings	PB	Post box
		LB	Litter Bin
MH	Manhole	BO	Bollard
IC	Inspection chamber	TCB	Telephone call box
CL	Cover level	WL	Water level
IL	Invert level	ht	Height
P.Inv Ø0.25	Pipe invert (diameter)	FFL	Finished floor level
GY	Gully	THL	Threshold level
Bg	Back Gully	DK	Drop kerb
UTL	Unable to Lift	GV	Gas Valve
0.25	Flow direction and pipe diameter	ER	Earth rod

Rev	Date	Details of issue / revision	Drw	Rev
C1	07/08/13	Drawing Issue	SDS	TDP

ISSUES & REVISIONS

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Client
BURBURY INVESTMENTS LTD

Project Title
NEWNES BROOK ELLESMERE MARINA

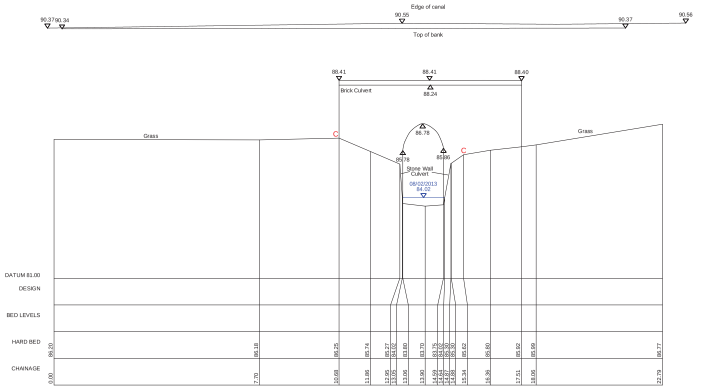
Drawing Title
SECTION LOCATION PLAN

Scale	1:1000 @ A1	Drawn	SDS
Size	A1	Reviewed	TDP

Drawing Status
CONSTRUCTION

Drawing No.
BMW/2025/SVY/101

Revision
C1



001
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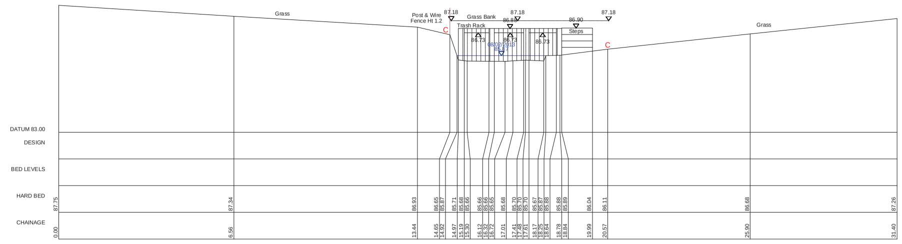
Chainage 29.5
Upstream Face of Canal Culvert



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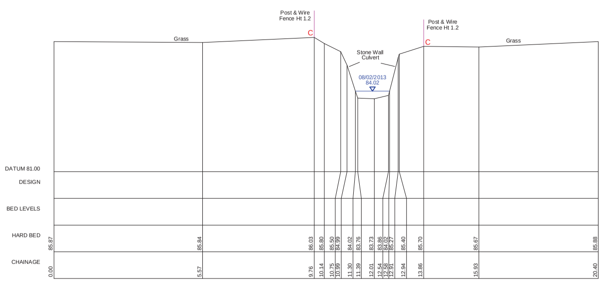
Chainage 463.4
Upstream Face Culvert



002
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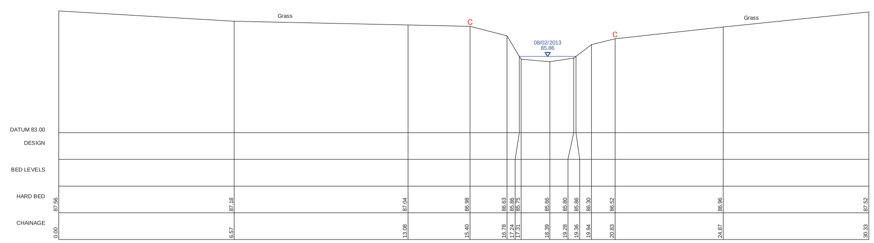
Chainage 74.0
Open Channel



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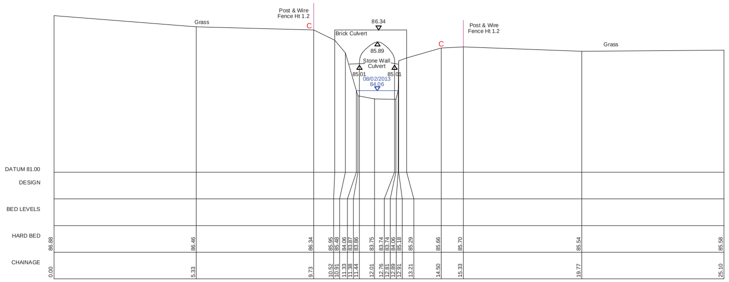
Chainage 474.2
Open Channel



003
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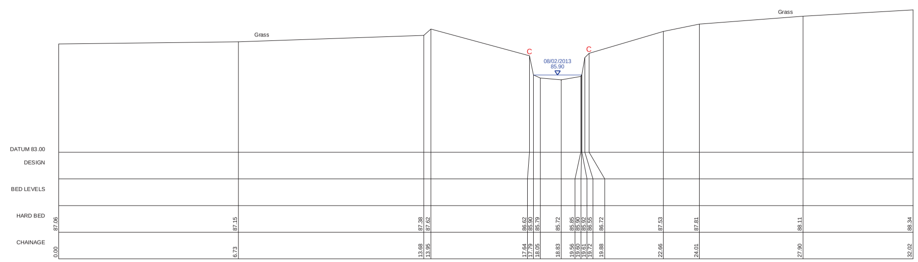
Chainage 124.0
Downstream Face Culvert



006
338885.26mE 333965.91mN Brg 316
Chainage 525.5
Open Channel

NOTES

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LEGEND

	Buildings / Walls	Elec	Electric
	Kerb/Cannel line	CTV	Cable TV
	Edge of surface	BT	British Telecom
	Canopy / Overhang	FH	Fire Hydrant
	Line Marking	ST	Stop tap
	Fence/Barrier	SV	Stop valve
	Gate	WM	Water Meter
	Hedge	Mkr	Service Marker
	Overhead Powerline	RE	Rodding eye
1	Station and Name	AV	Air Valve
	Tree / Bush / Sapling	CMP	Cable Marker Post
	Area of Undergrowth / Extent of Tree Canopy	LP	Lamp Post
	Body of Water	SP	Sign Post
	OS Buildings	EP	Electricity Post
	Surveyed Buildings	TP	Telegraph Post
MH	Manhole	TL	Traffic light
IC	Inspection chamber	BS	Bus Stop
CL	Cover level	FL	Floodlight
IL	Invert level	FP	Flagpole
P.Inv Ø0.25	Pipe invert (diameter)	PB	Post box
GY	Gully	LB	Litter Bin
Bg	Back Gully	BO	Bollard
UTL	Unable to Lift	TCB	Telephone call box
0.25	Flow direction and pipe diameter	WL	Water level
		ht	Height
		FFL	Finished floor level
		THL	Threshold level
		DK	Drop kerb
		GV	Gas Valve
		ER	Earth rod

Rev	Date	Details of issue / revision	Drw	Rev
C1	07/08/13	Drawing Issue	SDS	TDP

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Client
BURBURY INVESTMENTS LTD

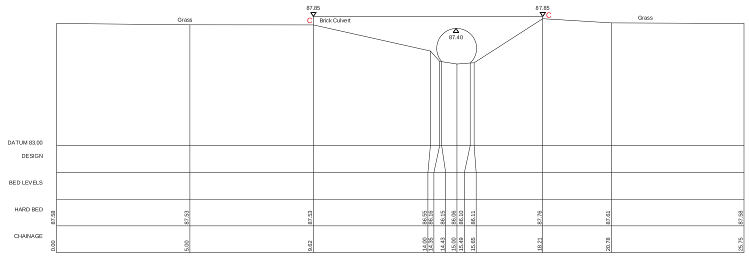
Project Title
NEWNES BROOK ELLESMERE MARINA

Drawing Title
CROSS SECTIONS 1-6

Scale	1:100 @ A1	Drawn	SDS
Size	A1	Reviewed	TDP

Drawing Status
CONSTRUCTION

Drawing No.	Revision
BMW/2025/SVY/102	C1



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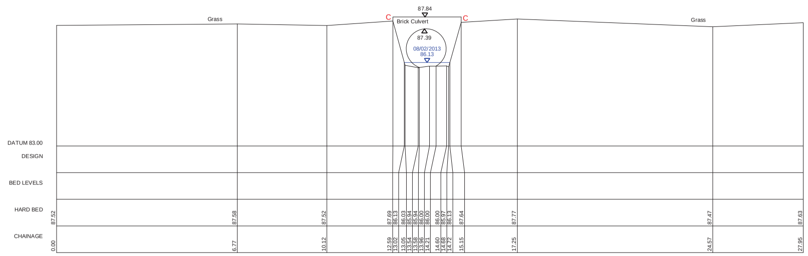
Chainage 581.0
Downstream Face Culvert



008
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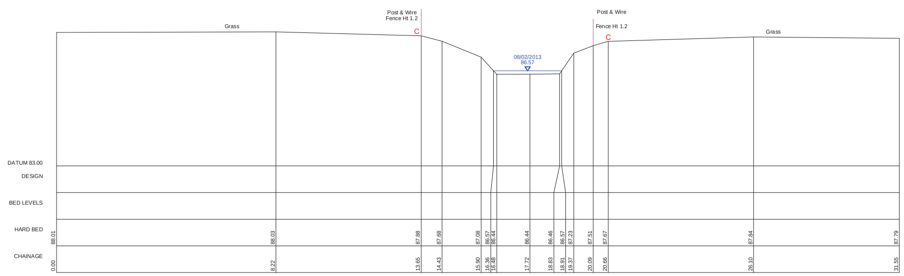
Chainage 591.1
Upstream Face Culvert



009
338962.06mE 334082.58mN Brg 304
Chainage 661.3
Open Channel

NOTES

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LEGEND

Buildings / Walls
Kerb/Channel line
Edge of surface
Canopy / Overhang
Line Marking
Fence/Barrier
Gate
Hedge
Overhead Powerline
Station and Name
Tree / Bush / Sapling
Area of Undergrowth / Extent of Tree Canopy
Body of Water
OS Buildings
Surveyed Buildings
MH Manhole
IC Inspection chamber
CL Cover level
IL Invert level
P.inv Ø0.25 Pipe invert (diameter)
GY Gully
Bg Back Gully
UTL Unable to Lift
Flow direction and pipe diameter

Elec Electric
CTV Cable TV
BT British Telecom
FH Fire Hydrant
ST Stop tap
SV Stop valve
WM Water Meter
SM Service Marker
RE Rodding eye
AV Air Valve
CMP Cable Marker Post
LP Lamp Post
SP Sign Post
EP Electricity Post
TP Telegraph Post
TL Traffic light
BS Bus Stop
FL Floodlight
FP Flagpole
PB Post box
LB Litter Bin
BO Bollard
TCB Telephone call box
WL Water level
H Height
FFL Finished floor level
THL Threshold level
DK Drop kerb
GV Gas Valve
ER Earth rod

Rev	Date	Details of issue / revision	Drw	Rev
C1	07/08/13	Drawing Issue	SDS	TDP

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Project Title
NEWNES BROOK ELLESMERE MARINA

Drawing Title
CROSS SECTIONS 7-9

Scale	1:100 @ A1	Drawn	SDS
Size	A1	Reviewed	TDP

Drawing Status
CONSTRUCTION

Drawing No.
BMW/2025/SVY/103

Revision
C1

NOTES

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3. ALL DIMENSIONS AND LEVELS IN METRES UNLESS NOTED OTHERWISE.
4. ANY DISCREPANCIES NOTED ON SITE ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
5. ELECTRODETECTION AND/OR GROUND PROBING RADAR (GPR) TECHNIQUES HAVE BEEN USED TO LOCATE UNDERGROUND SERVICES SHOWN ON THIS PLAN. THESE ARE INTERPRETIVE METHODS AND IT IS THEREFORE RECOMMENDED THAT TRIAL EXCAVATIONS OR SIMILAR ARE CARRIED OUT TO CONFIRM IDENTIFICATION, LOCATION AND DEPTH OF UTILITIES. ALL REASONABLE CARE HAS BEEN TAKEN AND EFFORT MADE IN SEARCHING AVAILABLE UTILITIES RECORD INFORMATION. HOWEVER, THE COMPLETENESS OF INFORMATION SUPPLIED TO AND BY BWB CANNOT BE GUARANTEED.
6. DEPTHS OBTAINED USING GEOPHYSICAL TECHNIQUES SUCH AS GPR ARE AFFECTED BY GROUND CONDITIONS THEREFORE MUST BE VIEWED AS INDICATIVE ONLY.
7. DEPTHS TO TRACED METALLIC PIPEWORK REFER TO PIPE CENTRE.
8. PIPE RUNS ARE ASSUMED STRAIGHT BETWEEN CHAMBERS UNLESS OTHERWISE INDICATED.
9. ALL UTILITIES ARE UNDERGROUND EXCEPT WHERE INDICATED.
10. INFORMATION SHOWN AS TFR (TAKEN FROM RECORDS) HAS NOT BEEN PROVEN ON SITE.
11. PLEASE NOTE THAT OUR CAD LAYERING CONVENTION CONTAINS FURTHER INFORMATION.
12. IT IS INTENDED THAT THIS DRAWING BE REPRODUCED IN COLOUR.

DRAINAGE/CCTV SURVEY LEGEND

FOUL SEWER
SURFACE WATER SEWER
COMBINED SEWER
RISING MAIN
SW AR — ASSUMED ROUTES
FW TFR — SERVICES TAKEN FROM RECORDS
SERVICES SURVEY AREA
MH CL 48.93 — UTILITIES COMMENT BOX
elec 0.60d — DEPTH TO SERVICE (m)

INFORMATION SHOWN AS TFR HAS NOT BEEN PROVEN ON SITE

1D 5C	1 DUCT 5 CABLES	DTS	DEPTH TO SOFFIT
AR	ASSUMED ROUTE	EBD	EXTERNAL BACKDROP
ACP	ASSUMED CONNECTION POINT	EOT	END OF TRACE
CB	CONCRETE BENCHING	FW	FOUL WATER SEWER
CBC	CIRCULAR BRICK CHAMBER	IBD	INTERNAL BACKDROP
CDP	CABLE DRAW PIT	IL	INVERT LEVEL
CL	COVER LEVEL	PCC	PRECAST CONCRETE CHAMBER
CPC	CIRCULAR PLASTIC CHAMBER	RBC	RECTANGULAR BRICK CHAMBER
CrL	CROWN LEVEL	SL	SOFFIT LEVEL
DCr	DEPTH TO CROWN	SW	SURFACE WATER SEWER
dia	DIAMETER	TFR	TAKEN FROM RECORDS
DTB	DEPTH TO BASE	UTL	UNABLE TO LIFT
DTI	DEPTH TO INVERT	UTS	UNABLE TO SURVEY
		UTT	UNABLE TO TRACE

AVAILABILITY OF STATUTORY UNDERTAKERS RECORDS DRAWINGS

TYPE	COMMENTS	TYPE	COMMENTS
COMBINED	YES	SITE RECORDS	NO
FOUL	YES	AS BUILT	NO
RISING MAIN	YES	SITE SPECIFIC	NO
SURFACE	YES	OTHER	NO

Rev	Date	Details of issue / revision	Drw	Rev
C1	04/07/13	Drawing Issue – To be read in Conjunction with report TDP/JMG/BMW2025/Culvert Survey report	JMG	DWH

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Client
BURBURY INVESTMENTS

Project Title
CULVERT SURVEY ELLESMERE, SHROPSHIRE

Drawing Title
ROUTE OF CULVERT SHEET 2 OF 4

Scale	1:500 @ A1	Drawn	JMG
Size	A1	Reviewed	DWH

Drawing Status
CONSTRUCTION

Drawing No.
BMW/2025/SVY/302

Revision
C1

NOTES

1. DO NOT SCALE FROM THIS DRAWING. ALL DIMENSIONS MUST BE CHECKED/VERIFIED ON SITE. IF IN DOUBT, ASK.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALISTS DRAWINGS AND SPECIFICATIONS.
3. ALL DIMENSIONS AND LEVELS IN METRES UNLESS NOTED OTHERWISE.
4. ANY DISCREPANCIES NOTED ON SITE ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
5. ELECTRODETECTION AND/OR GROUND PROBING RADAR (GPR) TECHNIQUES HAVE BEEN USED TO LOCATE UNDERGROUND SERVICES SHOWN ON THIS PLAN. THESE ARE INTERPRETIVE METHODS AND IT IS THEREFORE RECOMMENDED THAT TRIAL EXCAVATIONS OR SIMILAR ARE CARRIED OUT TO CONFIRM IDENTIFICATION, LOCATION AND DEPTH OF UTILITIES. ALL REASONABLE CARE HAS BEEN TAKEN AND EFFORT MADE IN SEARCHING AVAILABLE UTILITIES RECORD INFORMATION. HOWEVER, THE COMPLETENESS OF INFORMATION SUPPLIED TO AND BY BWB CANNOT BE GUARANTEED.
6. DEPTHS OBTAINED USING GEOPHYSICAL TECHNIQUES SUCH AS GPR ARE AFFECTED BY GROUND CONDITIONS THEREFORE MUST BE VIEWED AS INDICATIVE ONLY.
7. DEPTHS TO TRACED METALLIC PIPEWORK REFER TO PIPE CENTRE.
8. PIPE RUNS ARE ASSUMED STRAIGHT BETWEEN CHAMBERS UNLESS OTHERWISE INDICATED.
9. ALL UTILITIES ARE UNDERGROUND EXCEPT WHERE INDICATED.
10. INFORMATION SHOWN AS TFR (TAKEN FROM RECORDS) HAS NOT BEEN PROVEN ON SITE.
11. PLEASE NOTE THAT OUR CAD LAYERING CONVENTION CONTAINS FURTHER INFORMATION.
12. IT IS INTENDED THAT THIS DRAWING BE REPRODUCED IN COLOUR.

DRAINAGE/CCTV SURVEY LEGEND

FOUL SEWER
SURFACE WATER SEWER
COMBINED SEWER
RISING MAIN
ASSUMED ROUTES
SERVICES TAKEN FROM RECORDS
SERVICES SURVEY AREA
UTILITIES COMMENT BOX
DEPTH TO SERVICE (m)

INFORMATION SHOWN AS TFR HAS NOT BEEN PROVEN ON SITE

AVAILABILITY OF STATUTORY UNDERTAKERS RECORDS DRAWINGS

TYPE	COMMENTS	TYPE	COMMENTS
COMBINED	YES	SITE RECORDS	NO
FOUL	YES	AS BUILT	NO
RISING MAIN	YES	SITE SPECIFIC	NO
SURFACE	YES	OTHER	NO

Rev	Date	Details of issue / revision	Drw	Rev
C1	04/07/13	Drawing Issue – To be read in Conjunction with report TDP/JMG/BMW2025/Culvert Survey report	JMG	DWH

ISSUES & REVISIONS

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Client
BURBURY INVESTMENTS

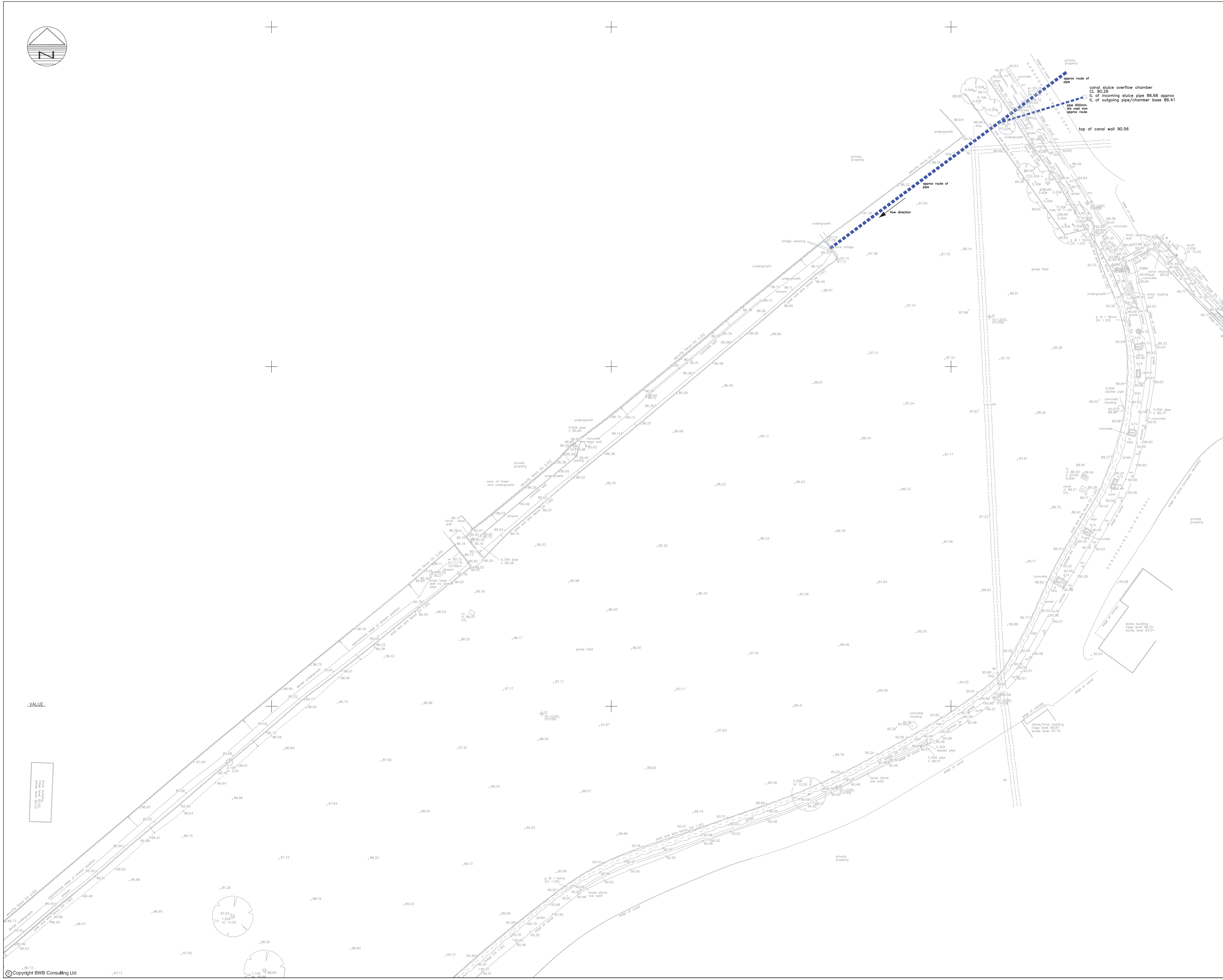
Project Title
CULVERT SURVEY ELLESMERE, SHROPSHIRE

Drawing Title
ROUTE OF CULVERT SHEET 3 OF 4

Scale	1:500 @ A1	Drawn	JMG
Size	A1	Reviewed	DWH

Drawing Status
CONSTRUCTION

Drawing No. **BMW/2025/SVY/303**
Revision **C1**



NOTES

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8. PIPE RUNS ARE ASSUMED STRAIGHT BETWEEN CHAMBERS UNLESS OTHERWISE INDICATED.
9. ALL UTILITIES ARE UNDERGROUND EXCEPT WHERE INDICATED.
10. INFORMATION SHOWN AS TFR (TAKEN FROM RECORDS) HAS NOT BEEN PROVEN ON SITE.
11. PLEASE NOTE THAT OUR CAD LAYERING CONVENTION CONTAINS FURTHER INFORMATION.
12. IT IS INTENDED THAT THIS DRAWING BE REPRODUCED IN COLOUR.

DRAINAGE/CCTV SURVEY LEGEND

FOUL SEWER
SURFACE WATER SEWER
COMBINED SEWER
RISING MAIN
SW AR — ASSUMED ROUTES
FW TFR — SERVICES TAKEN FROM RECORDS
SERVICES SURVEY AREA
MH CL 48.93 — UTILITIES COMMENT BOX
elec 0.60d — DEPTH TO SERVICE (m)

INFORMATION SHOWN AS TFR HAS NOT BEEN PROVEN ON SITE

1D 5C	1 DUCT 5 CABLES	DTS	DEPTH TO SOFFIT
AR	ASSUMED ROUTE	EBD	EXTERNAL BACKDROP
ACP	ASSUMED CONNECTION POINT	EOT	END OF TRACE
CB	CONCRETE BENCHING	FW	FOUL WATER SEWER
CBC	CIRCULAR BRICK CHAMBER	IBD	INTERNAL BACKDROP
CDP	CABLE DRAW PIT	IL	INVERT LEVEL
CL	COVER LEVEL	PCC	PRECAST CONCRETE CHAMBER
CPC	CIRCULAR PLASTIC CHAMBER	RBC	RECTANGULAR BRICK CHAMBER
CrL	CROWN LEVEL	SL	SOFFIT LEVEL
DCr	DEPTH TO CROWN	SW	SURFACE WATER SEWER
dia	DIAMETER	TFR	TAKEN FROM RECORDS
DTB	DEPTH TO BASE	UTL	UNABLE TO LIFT
DTI	DEPTH TO INVERT	UTS	UNABLE TO SURVEY
		UTT	UNABLE TO TRACE

AVAILABILITY OF STATUTORY UNDERTAKERS RECORDS DRAWINGS

TYPE	COMMENTS	TYPE	COMMENTS
COMBINED	YES	SITE RECORDS	NO
FOUL	YES	AS BUILT	NO
RISING MAIN	YES	SITE SPECIFIC	NO
SURFACE	YES	OTHER	NO

Rev	Date	Details of issue / revision	Drw	Rev
C1	04/07/13	Drawing Issue – To be read in Conjunction with report TDP/JMG/BMW2025/Culvert Survey report	JMG	DWH

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Client
BURBURY INVESTMENTS

Project Title
CULVERT SURVEY ELLESMERE, SHROPSHIRE

Drawing Title
ROUTE OF CULVERT SHEET 4 OF 4 (EAST SHEET)

Scale	1:500 @ A1	Drawn	JMG
Size	A1	Reviewed	DWH

Drawing Status
CONSTRUCTION

Drawing No.
BMW/2025/SVY/304

Revision
C1

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INFRASTRUCTURE MANAGEMENT

Scotland Street, off
Ellesmere

CCTV DRAINAGE SURVEY REPORT

CCTV SURVEY – Site Summary

Client:	BWB Consulting Ltd	NFCDD Ref:	13/083
Site Address:	Scotland Street, off, Ellesmere	Contact:	Jes Galtress
Date of Report:	1st July 2013	Job No:	13/083

On the day of the survey we dye tested from the Outlet pipe of The Mere Reservoir which proved to connect into MH05 and MH06 which are located off Wharf Road, from here it continues to flow in a Southerly direction. The direction changes to a South Westerly direction at the cricket pitch, the flow continues until it reaches the Outlet 2.

MH04 which is located off cricket pitch which then links in as a node point where there is no MH available to survey to and from.

Scotland Street, off
Ellesmere

Report Index Page

Sewer Surveys UK

Project-information / Inspection: 1

Project name :	Contract Number :	Contact :	Date :
13-083-BWB, Ellesmere		**Jes Galtress**	**25/06/2013**

Client:	**BWB Consulting Ltd**
Contact Name:	**Jes Galtress**
Department:	**Survey Team Leader**
Road:	**5th Floor, Waterfront House, Station Street**
Town:	**Nottingham**
County:	**Nottinghamshire, NG2 3DQ**
Telephone:	**0115 9241100**
Fax:	
Mobile:	**07500 015447**
E-mail:	**jes.galtress@bwbconsulting.com**

Site:	**BWB Consulting Ltd**
Contact Name:	**Jes Galtress**
Department:	**Survey Team Leader**
Road:	**Scotland Street, off**
Town:	**Ellesmere**
County:	**Cheshire**
Telephone:	**0115 9241100**
Fax:	
Mobile:	**07500 015447**
E-mail:	**jes.galtress@bwbconsulting.com**

Contractor	**Sewer Surveys UK Ltd**
Contact Name:	**Andrew Froggatt/Simon Bennett**
Department:	**Directors**
Road:	**Unit 6, Venture One, Longacre Close**
Town:	**Sheffield**
County:	**South Yorkshire, S20 3FR**
Telephone:	**0114 2513481**
Fax:	
Mobile:	**07837 768649**
E-mail:	**info@sewersurveysuk.co.uk**

Inspection report / Inspection: 1

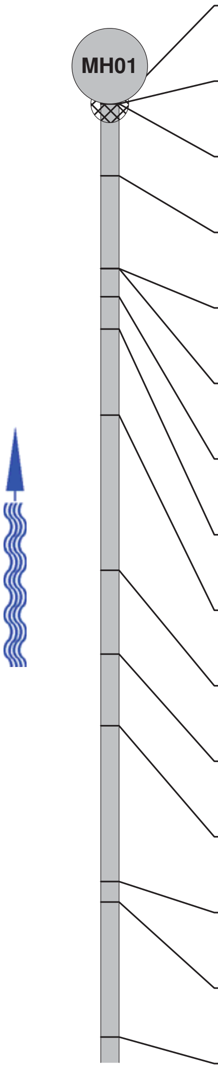
Date :	Job number :	Weather :	Sewer category:	Section number :	PLR suffix :
25/06/2013	**13-083**	**Dry**		**1**	**X**
Present :	Vehicle : **SG07 EHZ**	Camera : **Pan And Tilt**	Preset :	Cleaned : **no**	Operator : **MG**

Place :	**Ellesmere**	Location details:		U/S MH :	**MH02**
Road :	**Scotland Street, Off**	Catchment:		U/S Depth :	**2.60**
Location	**Fields**	Tape number :		D/S MH :	**MH01**
Inspection	**MH01 (U/S) MH02**	Pipe length :		D/S Depth :	**3.6**

Use:	**WaterCourse (culverted)**	Pipe shape :	**Arched (with flat bottom)**
Year laid :	**Z**	Pipe size :	**1270 mm**
Purpose :	**Sample survey to determin asset condition**	Pipe material :	**Masonry - randomly coursed**
Total length :	**140.00 m**	Lining :	

Comment :

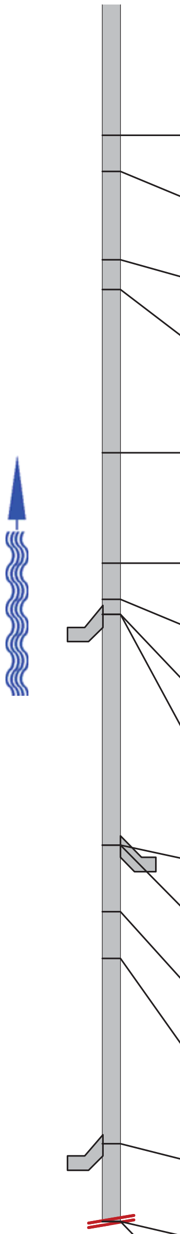
1:486 **Depth: 3.6**



Position		Code	Observation	Photo	Grade
0.00		ST	Start of survey		(Misc) 0
0.01		MH	Manhole Remarks: MH01		(Constr) 0
0.02		WL	Water level, 20% of sewer height		(Serv) 0
4.60		EL	Encrustation, light, from 4 to 5 o'clock		(Serv) 2
10.60		EL	Encrustation, light, from 4 to 5 o'clock		(Serv) 2
10.60		ID	Infiltration, dripper, at 1 o'clock		(Serv) 0
12.40	**S1**	ID	Infiltration, dripper, from 11 to 1 o'clock, Start Remarks: Clocks Vary		(Serv) 0
14.50		GP	General condition photograph	1_8A	(Misc) 0
20.00		GP	General condition photograph	1_9A	(Misc) 0
30.00		GP	General condition photograph	1_10A	(Misc) 0
35.40		H	Hole in sewer, at 11 o'clock	1_11A	(Struct)
40.00		GP	General condition photograph	1_12A	(Misc) 0
50.00		GP	General condition photograph	1_13A	(Misc) 0
51.30	**F1**	ID	Infiltration, dripper, from 11 to 1 o'clock, End Remarks: Clocks Vary		(Serv) 0
60.00		GP	General condition photograph	1_15A	(Misc) 0

Inspection report / Inspection: 1

Date :	Job number :	Weather :	Sewer category:	Section number :	PLR suffix:
25/06/2013	13-083	Dry		1	X
Present :	Vehicle : SG07 EHZ	Camera : Pan And Tilt	Preset :	Cleaned : no	Operator: MG



1:486	Position		Code	Observation	Photo	Grade
	70.20		GP	General condition photograph	1_16A	(Misc) 0
	72.50		ID	Infiltration, dripper, from 11 to 1 o'clock		(Serv) 0
	78.20	S2	LR	Line of sewer deviates right, Start Remarks: Slight		(Serv) 0
	80.10		GP	General condition photograph	1_19A	(Misc) 0
	90.60		GP	General condition photograph	1_20A	(Misc) 0
	97.70	F2	LR	Line of sewer deviates right, End Remarks: Slight		(Serv) 0
	100.00		GP	General condition photograph	1_22A	(Misc) 0
	101.00		CX	Connection defective, at 2 o'clock, 100mm diameter Remarks: Live		(Constr) 0
	101.00		EM	Encrustation, medium, from 2 to 5 o'clock, 10% cross-sectional area loss	1_24A	(Serv) 3
	115.80		CX	Connection defective, at 10 o'clock, 100mm diameter Remarks: Connection Broken	1_25A	(Constr) 0
	115.80		GP	General condition photograph	1_26A	(Misc) 0
	120.10		GP	General condition photograph	1_27A	(Misc) 0
	123.10		DE	Debris, 20% cross-sectional area loss Remarks: Rubble		(Serv) 4
	135.00		CN	Connection, at 2 o'clock, 150mm diameter		(Constr) 0
	140.00		GP	General condition photograph		(Misc) 0
	140.00		SA	Survey abandoned Remarks: Due To Extent Of Survey		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	4	5	0.06	9	4

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**1**	**X**

Photo: 1_8A
14.5m, General condition photograph

Photo: 1_9A
20m, General condition photograph

Sewer Surveys UK

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**1**	**X**

Photo: 1_10A
30m, General condition photograph

Photo: 1_11A
35.4m, Hole in sewer, at 11 o'clock

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**1**	**X**

Photo: 1_12A
40m, General condition photograph

Photo: 1_13A
50m, General condition photograph

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**1**	**X**

Photo: 1_15A
60m, General condition photograph

Photo: 1_16A
70.2m, General condition photograph

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**1**	**X**

Photo: 1_19A
80.1m, General condition photograph

Photo: 1_20A
90.6m, General condition photograph

Sewer Surveys UK

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**1**	**X**

Photo: 1_22A
100m, General condition photograph

Photo: 1_24A
101m, Encrustation, medium, from 2 to 5 o'clock, 10% cross-sectional area loss

Sewer Surveys UK

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**1**	**X**

Photo: 1_25A
115.8m, Connection defective, at 10 o'clock, 100mm diameter
Remarks: Connection Broken

Photo: 1_26A
115.8m, General condition photograph

Sewer Surveys UK

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**1**	**X**

Photo: 1_27A
120.1m, General condition photograph

Sewer Surveys UK

Inspection report / Inspection: 1

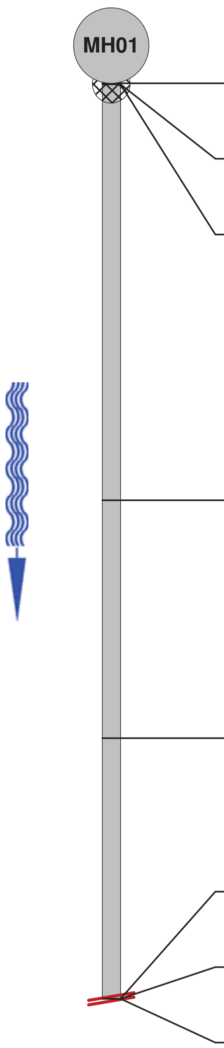
Date :	Job number :	Weather :	Sewer category:	Section number :	PLR suffix :
25/06/2013	13-083	Dry		2	X
Present :	Vehicle :	Camera :	Preset :	Cleaned :	Operator :
	SG07 EHZ	Pan And Tilt		no	MG

Place :	**Ellesmere**	Location details:		U/S MH :	**MH01**
Road :	**Scotland Street, Off**	Catchment:		U/S Depth :	**3.60**
Location	**Fields**	Tape number :		D/S MH :	**Outfall**
Inspection	**MH01 (D/S) Outfall**	Pipe length :		D/S Depth :	**0**

Use:	**WaterCourse (culverted)**	Pipe shape :	**Arched (with flat bottom)**
Year laid :	**Z**	Pipe size :	**1270 mm**
Purpose :	**Sample survey to determin asset condition**	Pipe material :	**Masonry - randomly coursed**
Total length :	**20.00 m**	Lining :	

Comment :

1:165 **Depth: 3.60**



Position	Code	Observation	Photo	Grade
0.00	ST	Start of survey		(Misc) 0
0.01	MH	Manhole Remarks: MH01		(Constr) 0
0.02	WL	Water level, 20% of sewer height		(Serv) 0
9.10	RF	Roots, fine		(Serv) 2
14.30	RF	Roots, fine		(Serv) 2
20.00	LR	Line of sewer deviates right Remarks: Slight		(Serv) 0
20.00	GP	General condition photograph	2_7A	(Misc) 0
20.00	SA	Survey abandoned Remarks: Due To Extent Of Survey		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	2	1	0.1	2	2

Sewer Surveys UK

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**2**	**X**

Photo: 2_7A
20m, General condition photograph

Sewer Surveys UK

Inspection report / Inspection: 1

Date :	Job number :	Weather :	Sewer category:	Section number :	PLR suffix :
25/06/2013	13-083	Dry		3	X
Present :	Vehicle :	Camera :	Preset :	Cleaned :	Operator :
	SG07 EHZ	Pan And Tilt		no	MG

Place :	**Ellesmere**	Location details:		U/S MH :	**MH02**
Road :	**Scotland Street, Off**	Catchment:		U/S Depth :	**2.60**
Location	**Fields**	Tape number :		D/S MH :	**MH01**
Inspection	**MH02 (D/S) MH01**	Pipe length :		D/S Depth :	**3.6**

Use:	**WaterCourse (culverted)**	Pipe shape :	**Arched (with flat bottom)**
Year laid :	**Z**	Pipe size :	**1320 mm**
Purpose :	**Sample survey to determin asset condition**	Pipe material :	**Masonry - randomly coursed**
Total length :	**103.90 m**	Lining :	

Comment : **MHST wrong on second page of vt until 30.4m**

1:558	Position		Code	Observation	Photo	Grade
Depth: 2.60						
MH02	0.00		ST	Start of survey		(Misc) 0
	0.01		MH	Manhole Remarks: MH02		(Constr) 0
	0.02		WL	Water level, 20% of sewer height		(Serv) 0
	1.60		DE	Debris, 20% cross-sectional area loss Remarks: Rubble		(Serv) 4
	9.40		CN	Connection, at 10 o'clock, 150mm diameter Remarks: Abandoned		(Constr) 0
	20.40		GP	General condition photograph	3_6A	(Misc) 0
	40.30		GP	General condition photograph	3_7A	(Misc) 0
	60.00		GP	General condition photograph	3_8A	(Misc) 0
	62.70		EL	Encrustation, light, from 8 to 9 o'clock		(Serv) 2
	62.70		ID	Infiltration, dripper, at 8 o'clock		(Serv) 0
	66.60	S1	LR	Line of sewer deviates right, Start Remarks: Slight		(Serv) 0

Inspection report / Inspection: 1

Date :	Job number :	Weather :	Sewer category:	Section number :	PLR suffix:
25/06/2013	**13-083**	**Dry**		**3**	**X**
Present :	Vehicle : **SG07 EHZ**	Camera : **Pan And Tilt**	Preset :	Cleaned : **no**	Operator: **MG**

1:558	Position		Code	Observation	Photo	Grade
	80.10		GP	General condition photograph	3_12A	(Misc) 0
	91.10		GP	General condition photograph	3_13A	(Misc) 0
	100.20		GP	General condition photograph	3_14A	(Misc) 0
	103.90	F1	LR	Line of sewer deviates right, End Remarks: Slight		(Serv) 0
	103.90		SA	Survey abandoned Remarks: Due To Extent Of Survey		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	2	5	0.06	6	4

Sewer Surveys UK

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**3**	**X**

Photo: 3_6A
20.4m, General condition photograph

Photo: 3_7A
40.3m, General condition photograph

Sewer Surveys UK

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**3**	**X**

Photo: 3_8A
60m, General condition photograph

Photo: 3_12A
80.1m, General condition photograph

Sewer Surveys UK

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**3**	**X**

Photo: 3_13A
91.1m, General condition photograph

Photo: 3_14A
100.2m, General condition photograph

Sewer Surveys UK

Inspection report / Inspection: 1

Date :	Job number :	Weather :	Sewer category:	Section number :	PLR suffix :
25/06/2013	13-083	Dry		4	X
Present :	Vehicle : SG07 EHZ	Camera : Pan And Tilt	Preset :	Cleaned : no	Operator : MG

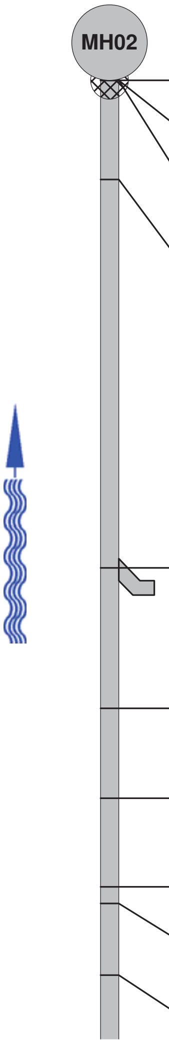
Place :	Ellesmere	Location details:		U/S MH :	MH03
Road :	Scotland Street, Off	Catchment:		U/S Depth :	1.83
Location	Fields	Tape number :		D/S MH :	MH02
Inspection	MH02 (U/S) MH03	Pipe length :		D/S Depth :	2.6

Use:	WaterCourse (culverted)	Pipe shape :	Arched (with flat bottom)
Year laid :	Z	Pipe size :	1300 mm
Purpose :	Sample survey to determin asset condition	Pipe material :	Masonry - randomly coursed
Total length :	163.70 m	Lining :	

Comment :

1:846

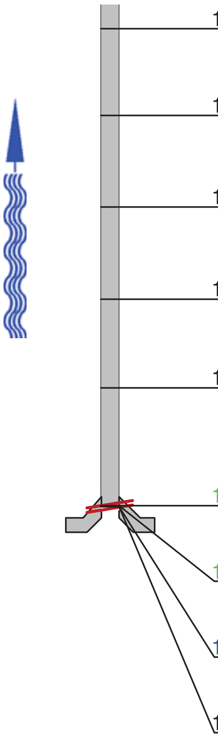
Depth: 2.6



Position		Code	Observation	Photo	Grade
0.00		ST	Start of survey		(Misc) 0
0.01		MH	Manhole Remarks: MH02		(Constr) 0
0.02		WL	Water level, 20% of sewer height		(Serv) 0
11.10		GP	General condition photograph	4_4A	(Misc) 0
54.60		CN	Connection, at 10 o'clock, 150mm diameter		(Constr) 0
70.30		LR	Line of sewer deviates right Remarks: Slight		(Serv) 0
80.40		GP	General condition photograph	4_7A	(Misc) 0
90.30		GP	General condition photograph		(Misc) 0
92.10	S1	LR	Line of sewer deviates right, Start Remarks: Slight		(Serv) 0
100.20		GP	General condition photograph	4_10A	(Misc) 0

Inspection report / Inspection: 1

Date :	Job number :	Weather :	Sewer category:	Section number :	PLR suffix:
25/06/2013	**13-083**	**Dry**		**4**	**X**
Present :	Vehicle :	Camera :	Preset :	Cleaned :	Operator:
	SG07 EHZ	**Pan And Tilt**		**no**	**MG**



1:846 Position		Code	Observation	Photo	Grade
110.20		GP	General condition photograph	4_11A	(Misc) 0
120.00		GP	General condition photograph	4_12A	(Misc) 0
130.20		GP	General condition photograph	4_13A	(Misc) 0
140.50		GP	General condition photograph	4_14A	(Misc) 0
150.40		GP	General condition photograph	4_15A	(Misc) 0
163.60		CN	Connection, at 8 o'clock, 150mm diameter		(Constr) 0
163.60		CN	Connection, at 4 o'clock, 150mm diameter		(Constr) 0
163.70	F1	LR	Line of sewer deviates right, End Remarks: Slight		(Serv) 0
163.70		SA	Survey abandoned Remarks: Due To Loss Of Traction		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**4**	**X**

Photo: 4_4A
11.1m, General condition photograph

Photo: 4_7A
80.4m, General condition photograph

Sewer Surveys UK

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**4**	**X**

Photo: 4_10A
100.2m, General condition photograph

Photo: 4_11A
110.2m, General condition photograph

Sewer Surveys UK

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**4**	**X**

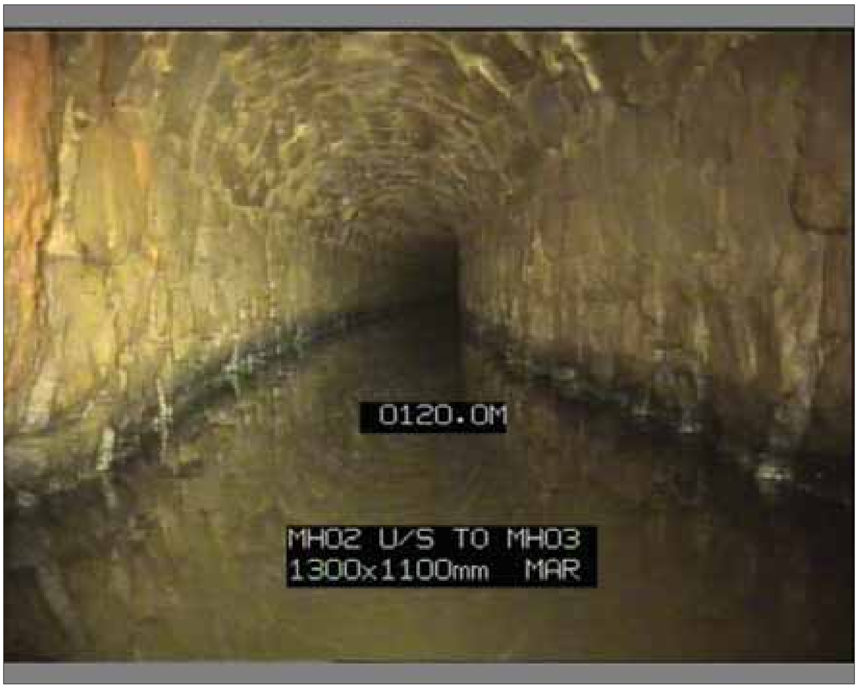


Photo: 4_12A
120m, General condition photograph

Photo: 4_13A
130.2m, General condition photograph

Sewer Surveys UK

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**4**	**X**

Photo: 4_14A
140.5m, General condition photograph

Photo: 4_15A
150.4m, General condition photograph

Inspection report / Inspection: 1

Date :	Job number :	Weather :	Sewer category:	Section number :	PLR suffix :
25/06/2013	**13-083**	**Dry**		**5**	**X**
Present :	Vehicle :	Camera :	Preset :	Cleaned :	Operator :
	SG07 EHZ	**Pan And Tilt**		**no**	**MG**

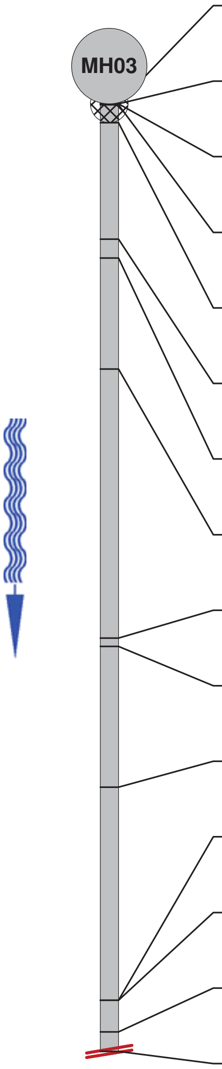
Place :	**Ellesmere**	Location details:	U/S MH :	**MH03**
Road :	**Scotland Street, Off**	Catchment:	U/S Depth :	**1.83**
Location	**Fields**	Tape number :	D/S MH :	**MH02**
Inspection	**MH03 (D/S) MH02**	Pipe length :	D/S Depth :	**2.6**

Use:	**WaterCourse (culverted)**	Pipe shape :	**Arched (with flat bottom)**
Year laid :	**Z**	Pipe size :	**1300 mm**
Purpose :	**Sample survey to determin asset condition**	Pipe material :	**Masonry - randomly coursed**
Total length :	**71.50 m**	Lining :	

Comment :

1:570

Depth: 1.83



Position	Code	Observation	Photo	Grade
0.00	ST	Start of survey		(Misc) 0
0.01	MH	Manhole Remarks: MH03		(Constr) 0
0.02	WL	Water level, 20% of sewer height		(Serv) 0
0.03	RF	Roots, fine		(Serv) 2
1.40	DE	Debris, 20% cross-sectional area loss Remarks: Rubble		(Serv) 4
10.20	GP	General condition photograph	5_6A	(Misc) 0
11.60	DE	Debris, 20% cross-sectional area loss Remarks: Rubble		(Serv) 4
20.00	GP	General condition photograph	5_8A	(Misc) 0
40.30	GP	General condition photograph	5_9A	(Misc) 0
40.90	DE	Debris, 20% cross-sectional area loss Remarks: Rubble		(Serv) 4
51.50	GP	General condition photograph	5_11A	(Misc) 0
67.60	DE	Debris, 20% cross-sectional area loss Remarks: Rubble		(Serv) 4
67.60	GP	General condition photograph	5_13A	(Misc) 0
70.00	GP	General condition photograph	5_14A	(Misc) 0
71.50	SA	Survey abandoned Remarks: Due To Loss Of Traction		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	5	5	0.3	21	4

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Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**5**	**X**

Photo: 5_6A
10.2m, General condition photograph

Photo: 5_8A
20m, General condition photograph

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**5**	**X**

Photo: 5_9A
40.3m, General condition photograph

Photo: 5_11A
51.5m, General condition photograph

Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**5**	**X**

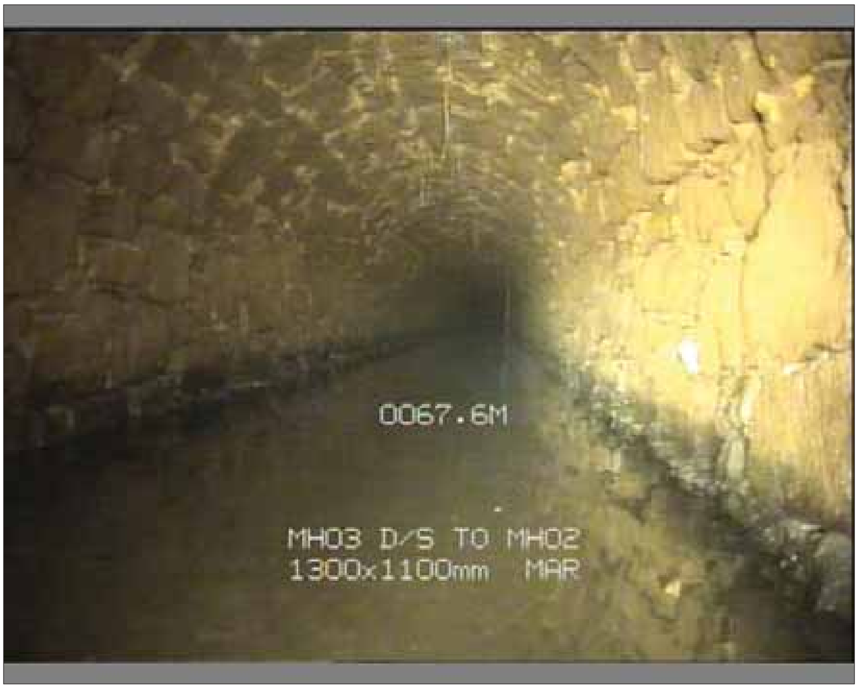


Photo: 5_13A
67.6m, General condition photograph

Photo: 5_14A
70m, General condition photograph

Sewer Surveys UK

Inspection report / Inspection: 1

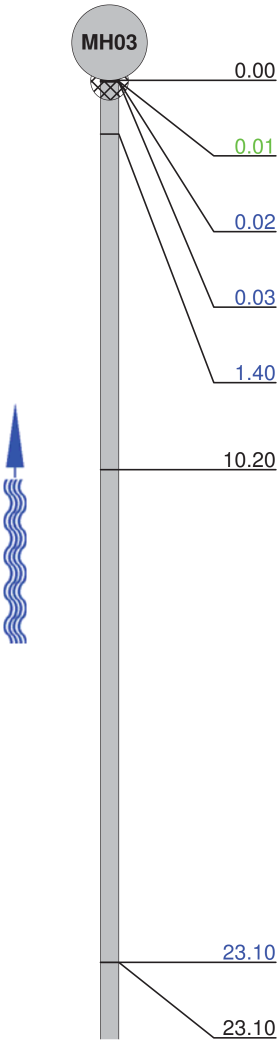
Date :	Job number :	Weather :	Sewer category:	Section number :	PLR suffix :
25/06/2013	13-083	Dry		6	X
Present :	Vehicle :	Camera :	Preset :	Cleaned :	Operator :
	SG07 EHZ	Pan And Tilt		no	MG

Place :	**Ellesmere**	Location details:		U/S MH :	**Inlet**
Road :	**Scotland Street, Off**	Catchment:		U/S Depth :	**0.00**
Location	**Fields**	Tape number :		D/S MH :	**MH03**
Inspection	**MH03 (U/S) Inlet**	Pipe length :		D/S Depth :	**1.83**

Use:	**WaterCourse (culverted)**	Pipe shape :	**Arched (with flat bottom)**
Year laid :	**Z**	Pipe size :	**1300 mm**
Purpose :	**Sample survey to determin asset condition**	Pipe material :	**Masonry - randomly coursed**
Total length :	**35.60 m**	Lining :	

Comment :

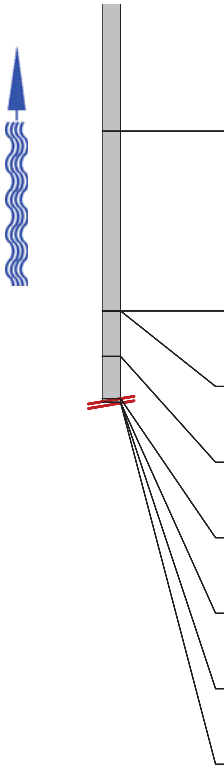
Depth: 1.83



1:198 Position	Code	Observation	Photo	Grade
0.00	ST	Start of survey		(Misc) 0
0.01	MH	Manhole Remarks: MH03		(Constr) 0
0.02	WL	Water level, 20% of sewer height		(Serv) 0
0.03	DE	Debris, 20% cross-sectional area loss		(Serv) 4
1.40	DE	Debris, 20% cross-sectional area loss Remarks: Bolder		(Serv) 4
10.20	GP	General condition photograph	6_6A	(Misc) 0
23.10	RF	Roots, fine		(Serv) 2
23.10	GP	General condition photograph	6_8A	(Misc) 0

Inspection report / Inspection: 1

Date :	Job number :	Weather :	Sewer category:	Section number :	PLR suffix:
25/06/2013	**13-083**	**Dry**		**6**	**X**
Present :	Vehicle :	Camera :	Preset :	Cleaned :	Operator:
	SG07 EHZ	**Pan And Tilt**		**no**	**MG**



1:198 Position	Code	Observation	Photo	Grade
28.50	WL	Water level, 25% of sewer height		(Serv) 0
33.20	GO	General observation Remarks: Dip In Line	6_10A	(Misc) 0
33.20	WL	Water level, 40% of sewer height		(Serv) 0
34.40	WL	Water level, 50% of sewer height		(Serv) 0
35.50	WL	Water level, 60% of sewer height		(Serv) 0
35.60	CU	Camera under water		(Misc) 0
35.60	GO	General observation Remarks: Large Dip In Line		(Misc) 0
35.60	SA	Survey abandoned Remarks: Due To Camera Under Water		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	3	5	0.31	11	4

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Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**6**	**X**

Photo: 6_6A
10.2m, General condition photograph

Photo: 6_8A
23.1m, General condition photograph

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Inspection pictures / Inspection: 1

Place :	Road :	Date :	Section number :	PLR suffix :
Ellesmere	**Scotland Street, Off**	**25/06/2013**	**6**	**X**

Photo: 6_10A
33.2m, General observation Remarks: Dip In Line

Inspection report / Inspection: 1

Date : 26/06/2013	Job number : 13-083	Weather : Dry	Sewer category:	Section number : 7	PLR suffix : X
Present :	Vehicle : SG07 EHZ	Camera : Pan And Tilt	Preset :	Cleaned : no	Operator : MG

Place :	**Ellesmere**	Location details:		U/S MH :	**MH04**
Road :	**Scotland Street, Off**	Catchment:		U/S Depth :	
Location	**Fields**	Tape number :		D/S MH :	**XXX1**
Inspection	**MH04 (D/S) XXX1**	Pipe length :	**1.00 m**	D/S Depth :	**0**

Use:	**WaterCourse (culverted)**	Pipe shape :	**Circular**
Year laid :	**Z**	Pipe size :	**600 mm**
Purpose :	**Sample survey to determin asset condition**	Pipe material :	**Cast iron**
Total length :	**26.00 m**	Lining :	

Comment : **Wrong Finish Manhole On M-Peg**

1:210	Position	Code	Observation	Photo	Grade
MH04	0.00	ST	Start of survey		(Misc) 0
	0.01	MH	Manhole Remarks: MH04		(Constr) 0
	0.02	WL	Water level, 5% of sewer height		(Serv) 0
	23.10	MC	Sewer material changes Remarks: Vitrified clay		(Misc) 0
	26.00	GO	General observation Remarks: Wrong Finish Manhole On M-Peg		(Misc) 0
	26.00	GO	General observation Remarks: Node Point		(Misc) 0
	26.00	MH	Manhole Remarks: XXX1-Node Point		(Constr) 0
XXX1	26.00	FH	Finish survey		(Misc) 0

Depth: 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

∑∅ / Main sections / Inspection: 1

Project name :	Contract number :	Contact :	Date :
13-083-BWB, Ellesmere		**Jes Galtress**	**25/06/2013**

No.	U/S MH	D/S MH	Date	Road	Tape No.	Material	m	(m)
1	MH02	MH01	25/06/2013	Scotland Street, Off		Masonry - randomly coursed	140.00	140.00
2	MH01	Outfall	25/06/2013	Scotland Street, Off		Masonry - randomly coursed	20.00	20.00

Pipe size: ARCHED (WITH FLAT BOTTOM) 1270/1400 = 160 m (160 m)

No.	U/S MH	D/S MH	Date	Road	Tape No.	Material	m	(m)
4	MH03	MH02	25/06/2013	Scotland Street, Off		Masonry - randomly coursed	163.70	163.70
5	MH03	MH02	25/06/2013	Scotland Street, Off		Masonry - randomly coursed	71.50	71.50
6	Inlet	MH03	25/06/2013	Scotland Street, Off		Masonry - randomly coursed	35.60	35.60

Pipe size: ARCHED (WITH FLAT BOTTOM) 1300/1100 = 270.8 m (270.8 m)

No.	U/S MH	D/S MH	Date	Road	Tape No.	Material	m	(m)
3	MH02	MH01	25/06/2013	Scotland Street, Off		Masonry - randomly coursed	103.90	103.90

Pipe size: ARCHED (WITH FLAT BOTTOM) 1320/1100 = 103.9 m (103.9 m)

No.	U/S MH	D/S MH	Date	Road	Tape No.	Material	m	(m)
7	MH04	XXX1	26/06/2013	Scotland Street, Off		Cast iron	26.00	26.00

Pipe size: CIRCULAR 600 = 26 m (26 m)

All sections = 560.7 m (560.7 m)

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Service / Operational Defects (SRM 4) / Inspection: 1

Project name : 13-083-BWB, Ellesmere	Contract Number :	Contact : Jes Galtress	Date : 25/06/2013

No.	PLR	Dir.	Use	Shape / Size	Date	Mat.	Total Length	Insp. Length	Year laid	Peak Score	Grade	Mean Score	Total Score
1	MH02X	U	W	A 1270/1400	25/06/2013	MAR	140.00	140.00	Z	5	4	0.06	9
2	MH01X	D	W	A 1270/1400	25/06/2013	MAR	20.00	20.00	Z	1	2	0.1	2
3	MH02X	D	W	A 1320/1100	25/06/2013	MAR	103.90	103.90	Z	5	4	0.06	6
4	MH03X	U	W	A 1300/1100	25/06/2013	MAR	163.70	163.70	Z	0	1	0	0
5	MH03X	D	W	A 1300/1100	25/06/2013	MAR	71.50	71.50	Z	5	4	0.3	21
6	InletX	U	W	A 1300/1100	25/06/2013	MAR	35.60	35.60	Z	5	4	0.31	11
7	MH04X	D	W	C 600	26/06/2013	CI	26.00	26.00	Z	0	1	0	0

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Structural Defects (SRM 4) / Inspection: 1

Project name :	Contract Number :	Contact :	Date :
13-083-BWB, Ellesmere		**Jes Galtress**	**25/06/2013**

No.	PLR	Dir.	Use	Shape / Size	Date	Mat.	Total Length	Insp. Length	Year laid	Peak Score	Grade	Mean Score	Total Score
1	MH02X	U	W	A 1270/1400	25/06/2013	MAR	140.00	140.00	Z	0	1	0	0
2	MH01X	D	W	A 1270/1400	25/06/2013	MAR	20.00	20.00	Z	0	1	0	0
3	MH02X	D	W	A 1320/1100	25/06/2013	MAR	103.90	103.90	Z	0	1	0	0
4	MH03X	U	W	A 1300/1100	25/06/2013	MAR	163.70	163.70	Z	0	1	0	0
5	MH03X	D	W	A 1300/1100	25/06/2013	MAR	71.50	71.50	Z	0	1	0	0
6	InletX	U	W	A 1300/1100	25/06/2013	MAR	35.60	35.60	Z	0	1	0	0
7	MH04X	D	W	C 600	26/06/2013	CI	26.00	26.00	Z	0	1	0	0

Scotland Street, off
Ellesmere

Photo 1, Location of MH05

Photo 2, Location of MH05

Scotland Street, off
Ellesmere

Photo 3, Location of MH05

Photo 4, Location of MH05

Scotland Street, off
Ellesmere

Photo 5, Defects in MH05

Photo 6, Defects in MH05

Scotland Street, off
Ellesmere

Photo 7, Downstream from MH05

Photo 8, Upstream from MH05

Scotland Street, off
Ellesmere

Photo 9, Overflow pipe from pumping station in MH05

Scotland Street, off
Ellesmere

Photo 10, Location of MH06

Photo 11, Location of MH06

Scotland Street, off
Ellesmere

Photo 12, Location of MH06

Scotland Street, off
Ellesmere

Photo 13, Hole in the top of the culvert

Photo 14, Hole in the top of the culvert

Scotland Street, off
Ellesmere

Photo 15, Evidence of foul in surface culvert in uncharted MH

Photo 16, Evidence of foul in surface culvert in uncharted MH

Scotland Street, off
Ellesmere

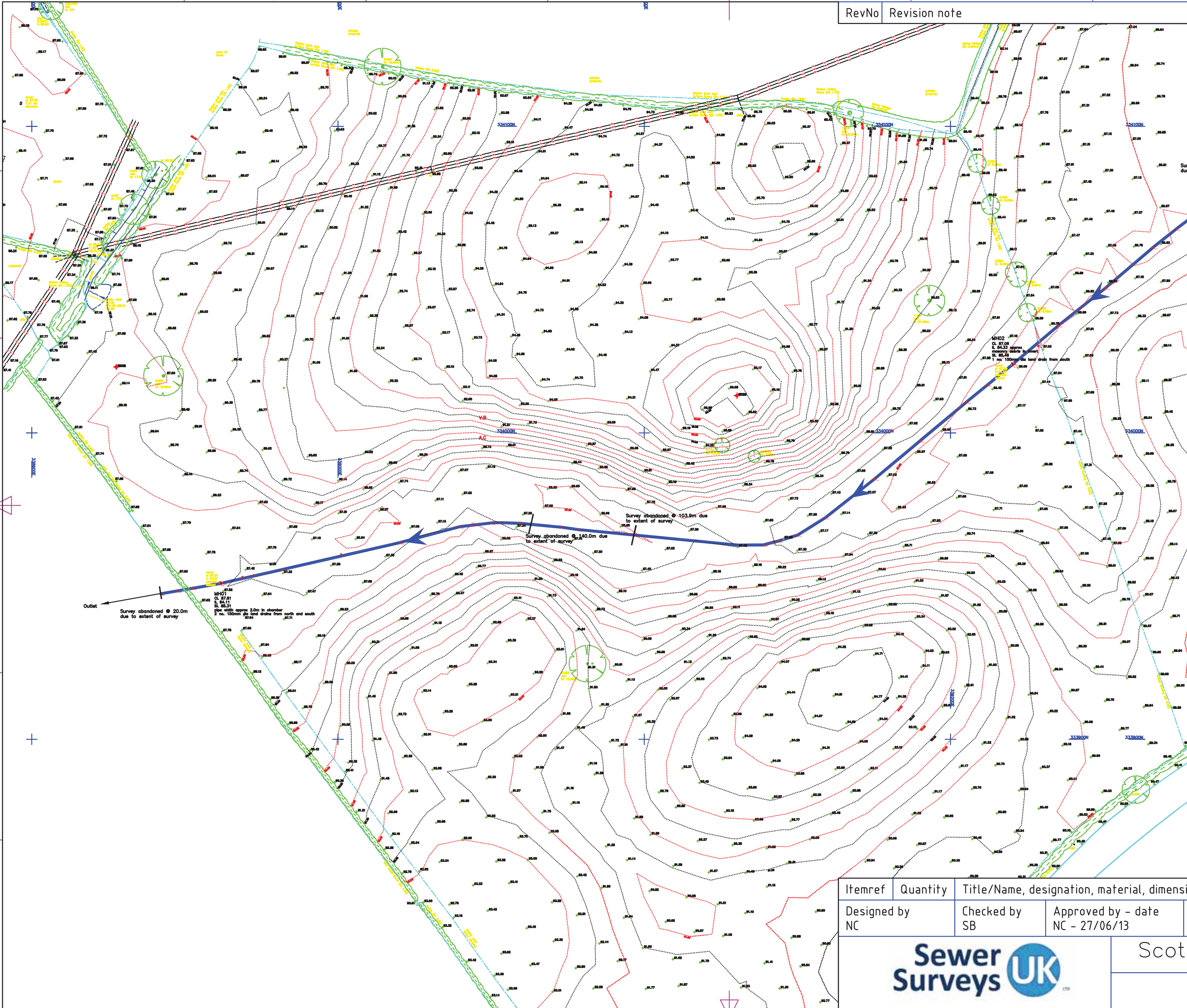
Photo 17, Tracing Dye located in manhole

Photo 18, Tracing Dye located in manhole

Scotland Street, off
Ellesmere

Photo 19, Tracing Dye in Outfall


MH 6
MH5
HOLE IN SOFIT
Birch Rd
St John's Close
A495
Laurels Close
Levi St
New Wharf Rd
Canal Way
Ber...yn View
MH4
Approx 600MM SILT
NODE
OUTLET 2
© 2013 Google
Image © 2013 Getmapping plc
1999
Imagery Date: 4/20/2009 52°54'15.46" N 2°53'38.51" W elev 91 m eye alt
Google



RevNo	Revision note	Date	Signature	Checked

Sewer Surveys UK Ltd

Surface Water Line

Itemref	Quantity	Title/Name, designation, material, dimension etc			Article No./Reference	
Designed by NC		Checked by SB	Approved by - date NC - 27/06/13	File name 13/083	Date 27/06/13	Scale N.T.S.

Scotland Street, off

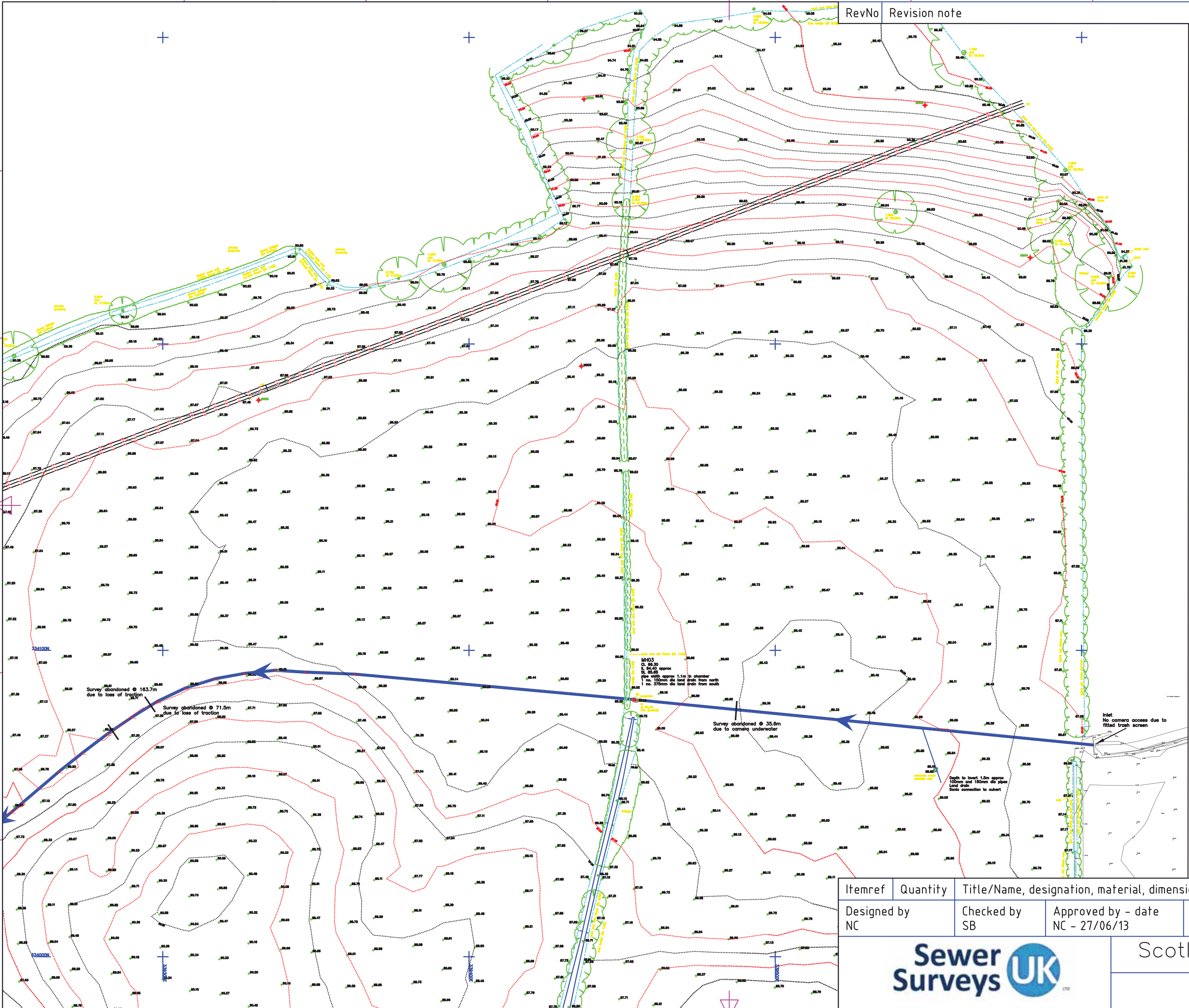
Ellesmere

Edition	Sheet
0	1/2

RevNo	Revision note	Date	Signature	Checked

Sewer Surveys UK Ltd

Surface Water Line



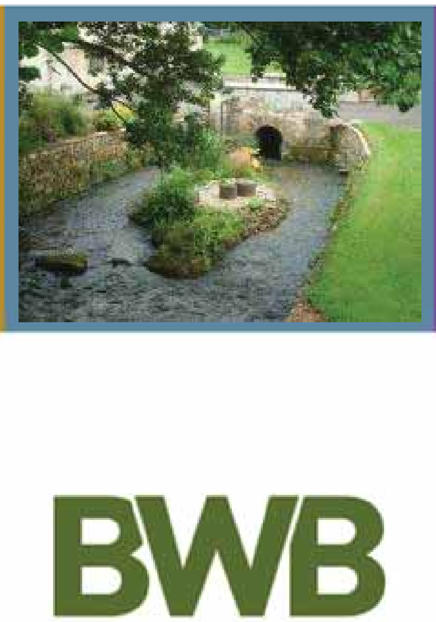
Itemref	Quantity	Title/Name, designation, material, dimension etc			Article No./Reference	
Designed by NC		Checked by SB	Approved by - date NC - 27/06/13	File name 13/083	Date 27/06/13	Scale N.T.S.

Sewer Surveys UK

Scotland Street, off

Ellesmere

Edition	Sheet
0	2/2



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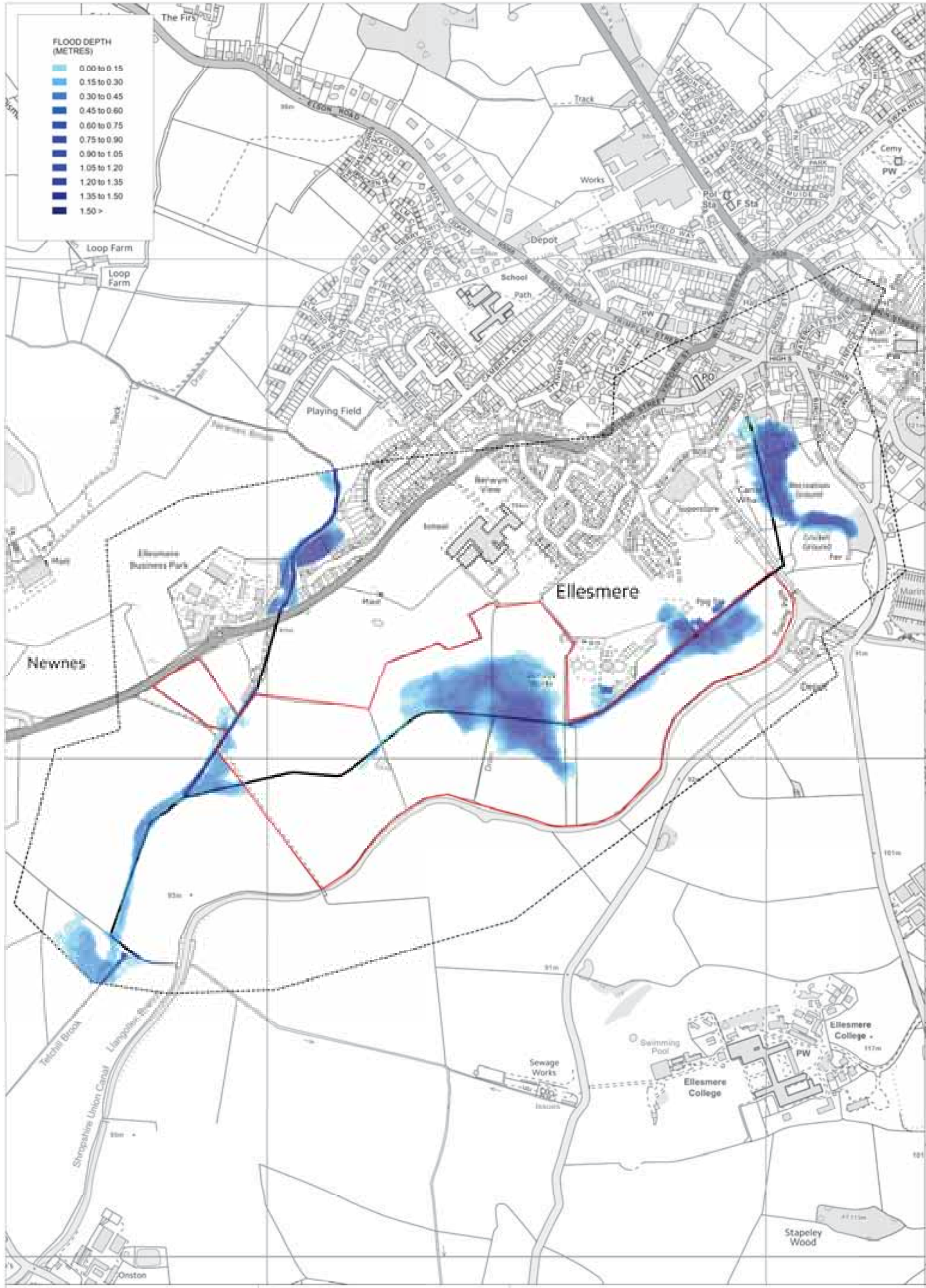
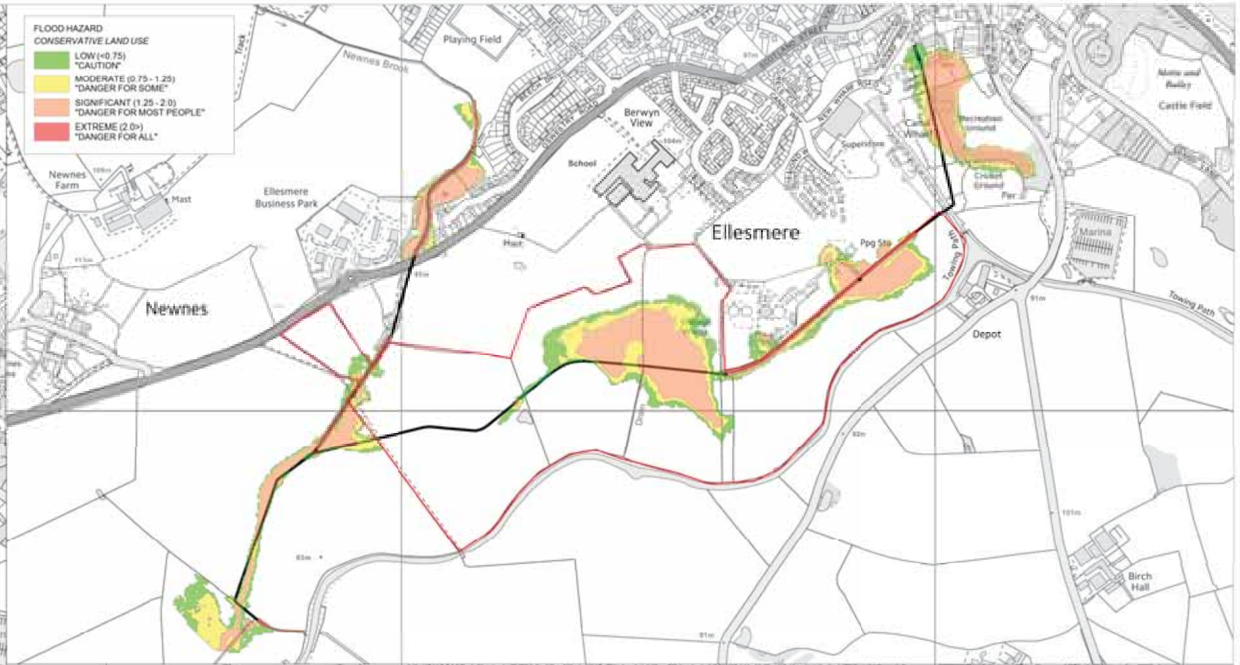
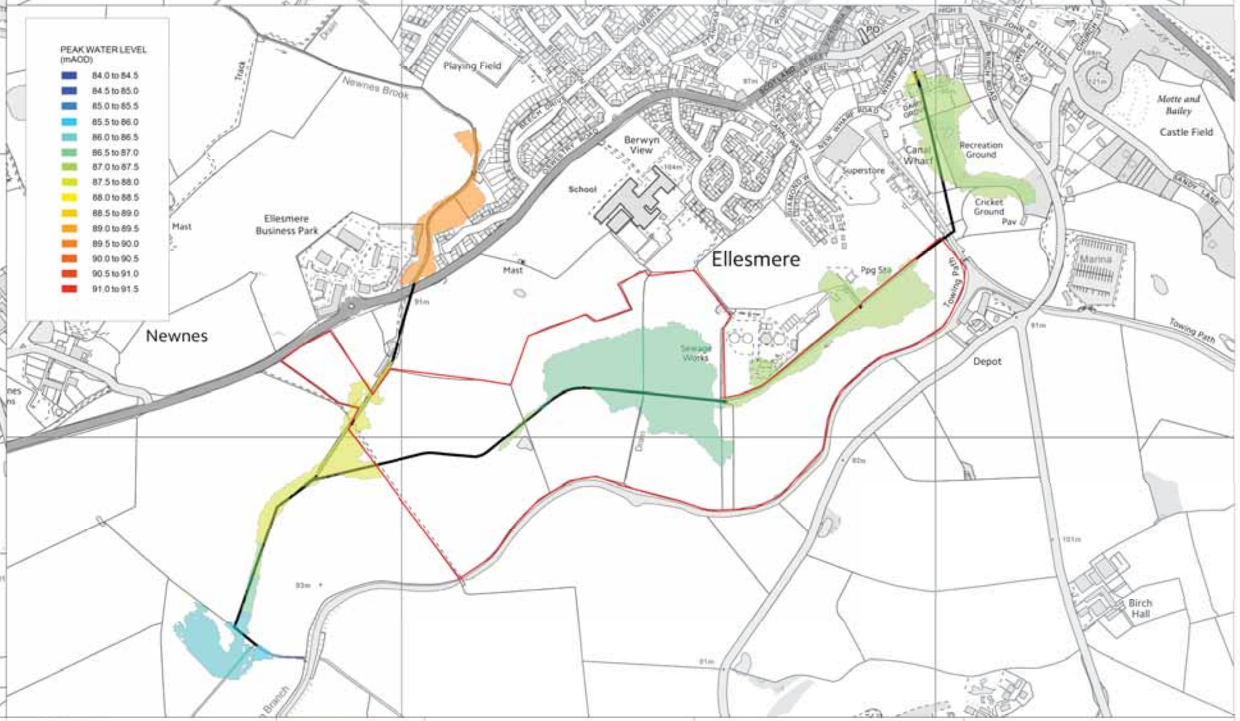
ANNEX E

Floodplain Mapping: Baseline Conditions







NOTES

1. DO NOT SCALE THIS DRAWING. ALL DIMENSIONS MUST BE CHECKED/ VERIFIED ON SITE. IF IN DOUBT ASK.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALISTS DRAWINGS AND SPECIFICATIONS.
3. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE. ALL LEVELS IN METRES UNLESS NOTED OTHERWISE.
4. ANY DISCREPANCIES NOTED ON SITE ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
5. THE RESULTS OF TEH FLOOD MODELLING ARE YET TO BE PEER REVIEWED AND ARE SUBJECT TO CHANGE.

KEY

- STUDY SITE
- CULVERTED WATERCOURSE
- MODEL EXTENT

ISSUES & REVISIONS

Rev	Date	Details of issue / revision	Drw	Rev
P1	16.04.14	PRELIMINARY ISSUE	RG	SN

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Client
BURBURY INVESTMENTS LTD

Project Title
ELLESMERE MARINA

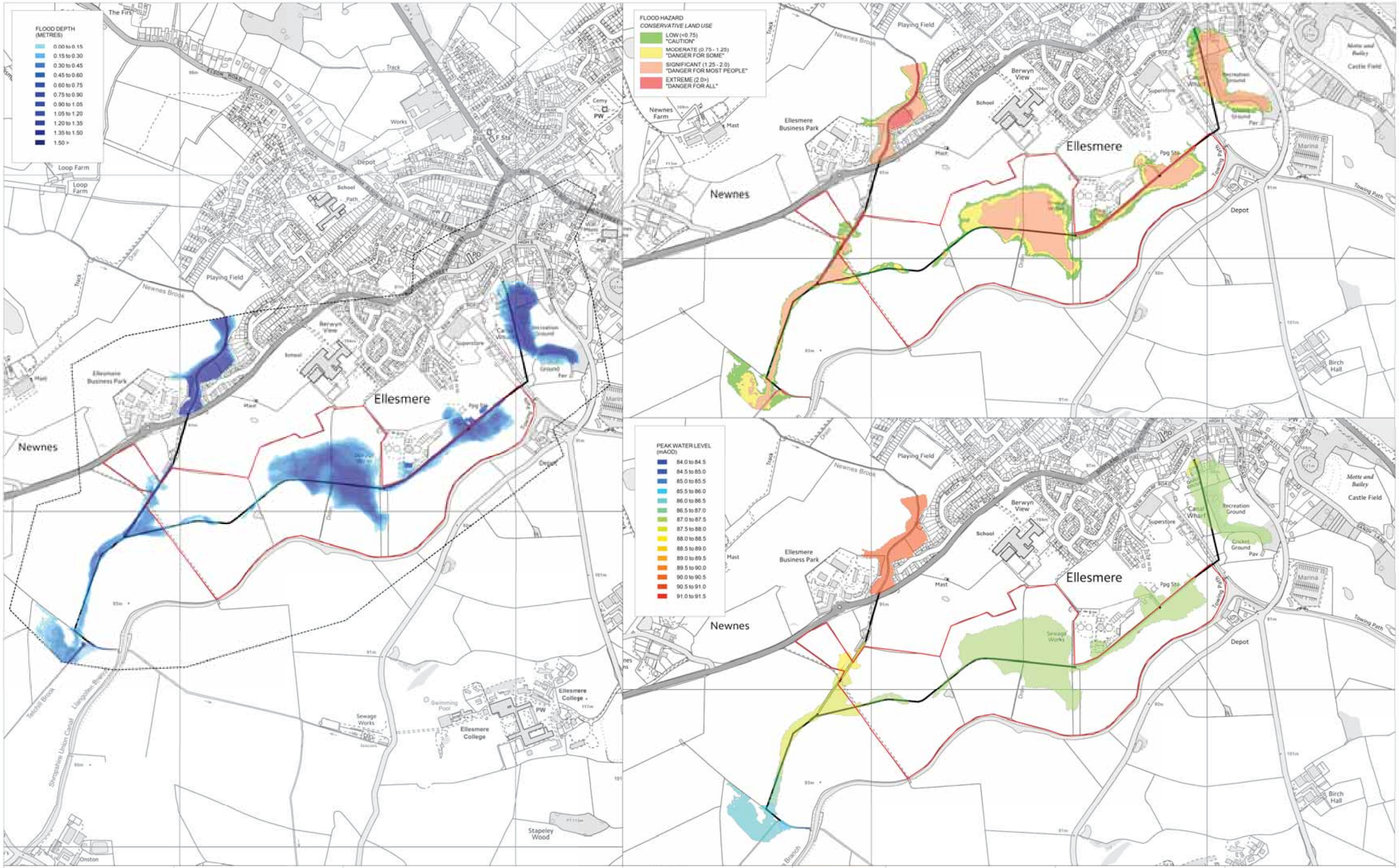
Drawing Title
FLOODPLAIN MAPPING EXISTING CONDITIONS: 1IN20YR

Scale	1:5000	Drawn	R.GREEN
Size	A1	Reviewed	S.NELMES

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK35

Revision
P1



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KEY

- STUDY SITE
- CULVERTED WATERCOURSE
- MODEL EXTENT

ISSUES & REVISIONS

Rev	Date	Details of issue / revision	Drw	Rev
P1	16.04.14	PRELIMINARY ISSUE	RG	SN

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Project Title
ELLESMERE MARINA

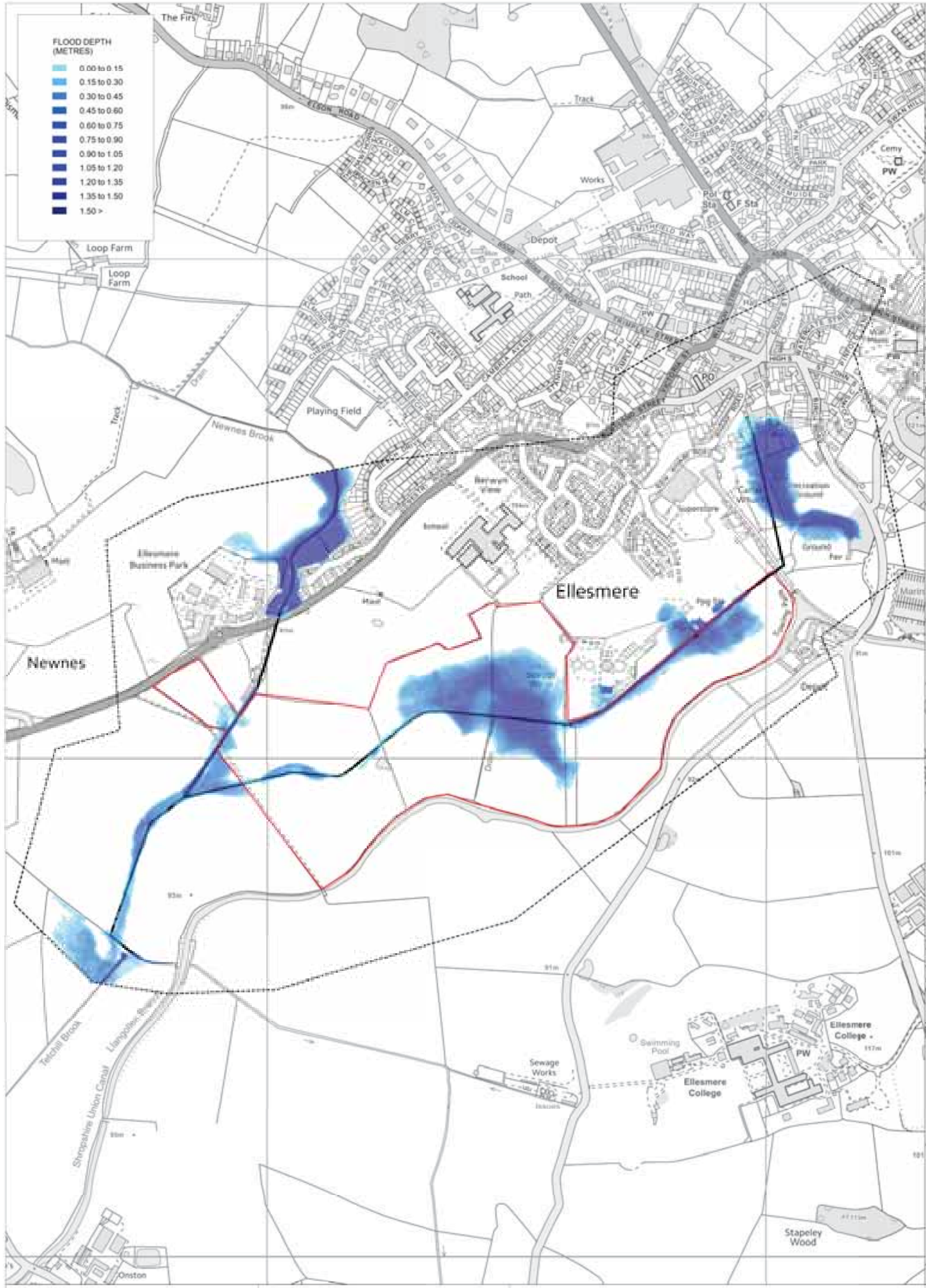
Drawing Title
FLOODPLAIN MAPPING EXISTING CONDITIONS: 1IN75YR

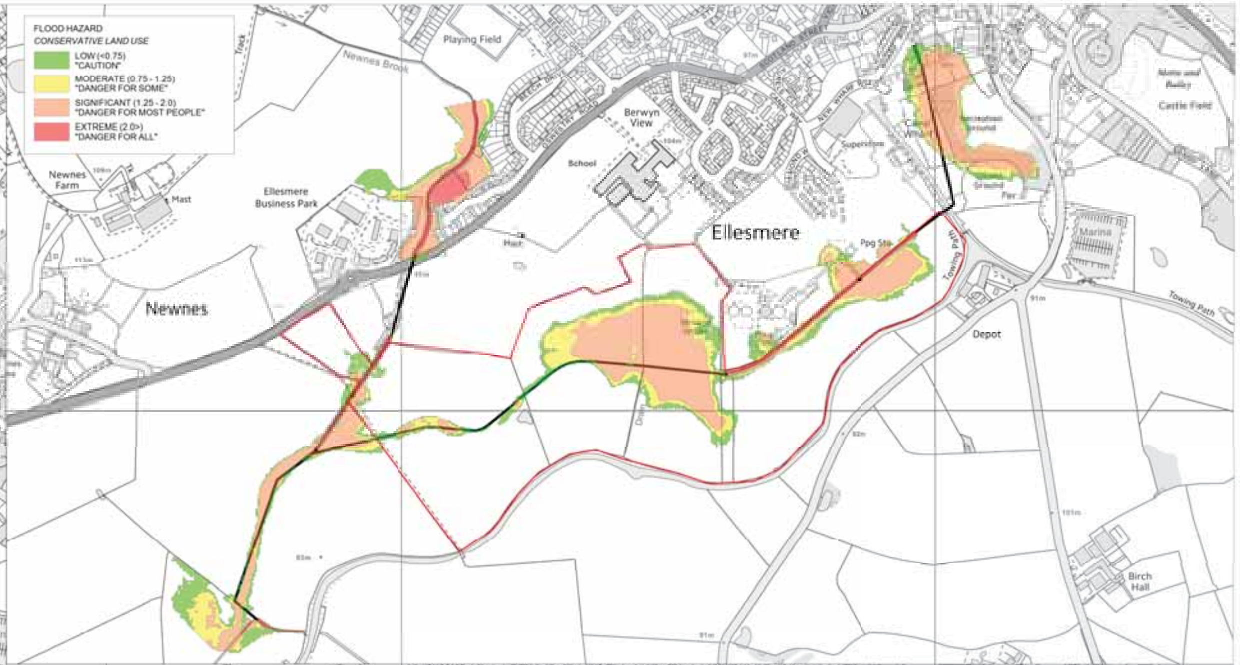
Scale	1:5000	Drawn	R.GREEN
Size	A1	Reviewed	S.NELMES

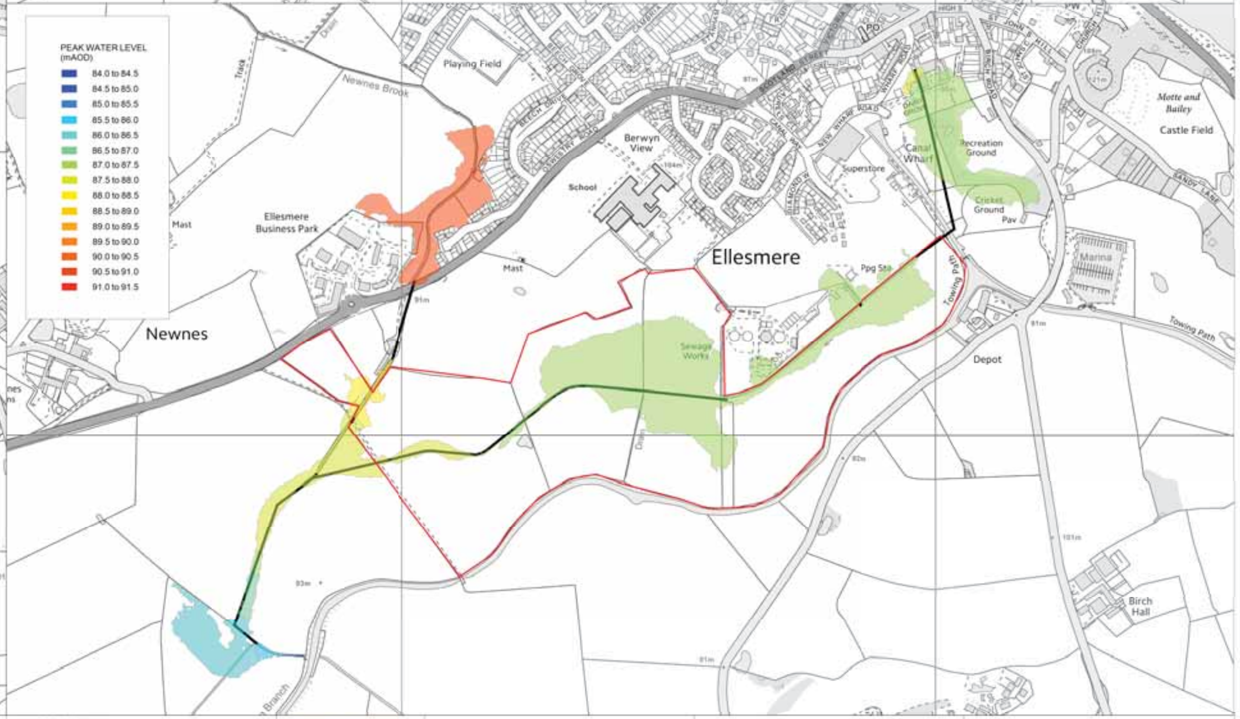
Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK34

Revision
P1







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KEY

- STUDY SITE
- CULVERTED WATERCOURSE
- MODEL EXTENT

ISSUES & REVISIONS

Rev	Date	Details of issue / revision	Drw	Rev
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Project Title
ELLESMERE MARINA

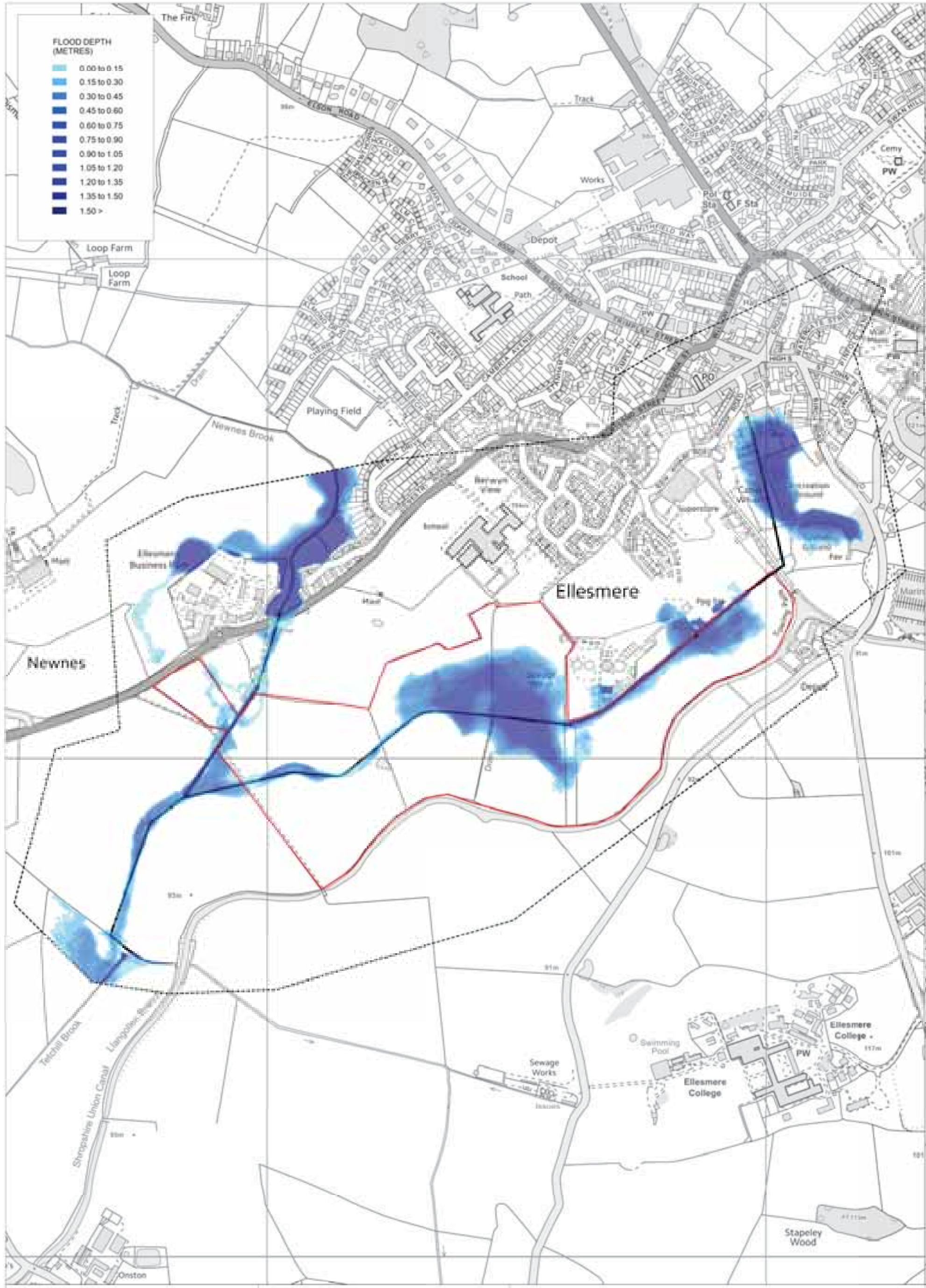
Drawing Title
FLOODPLAIN MAPPING EXISTING CONDITIONS: 1IN100YR

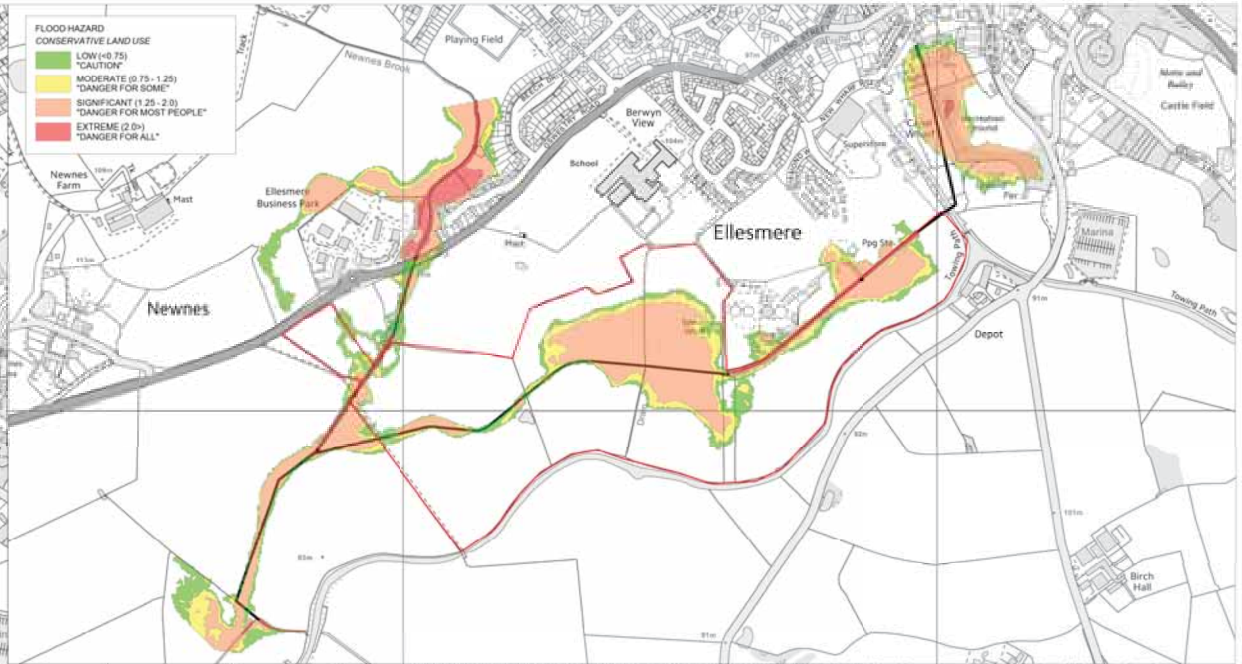
Scale	1:5000	Drawn	R.GREEN
Size	A1	Reviewed	S.NELMES

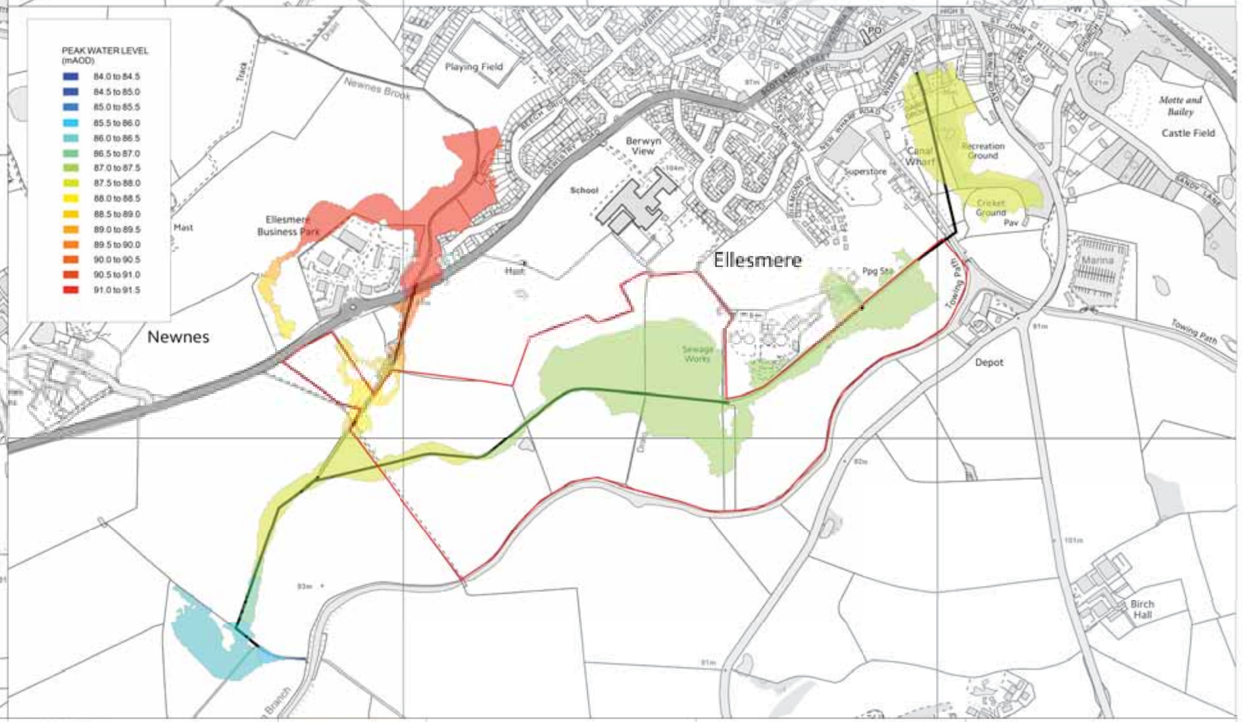
Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK33

Revision
P1







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KEY

STUDY SITE

CULVERTED WATERCOURSE

MODEL EXTENT

ISSUES & REVISIONS

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P1	16.04.14	PRELIMINARY ISSUE	RG	SN

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Project Title
ELLESMERE MARINA

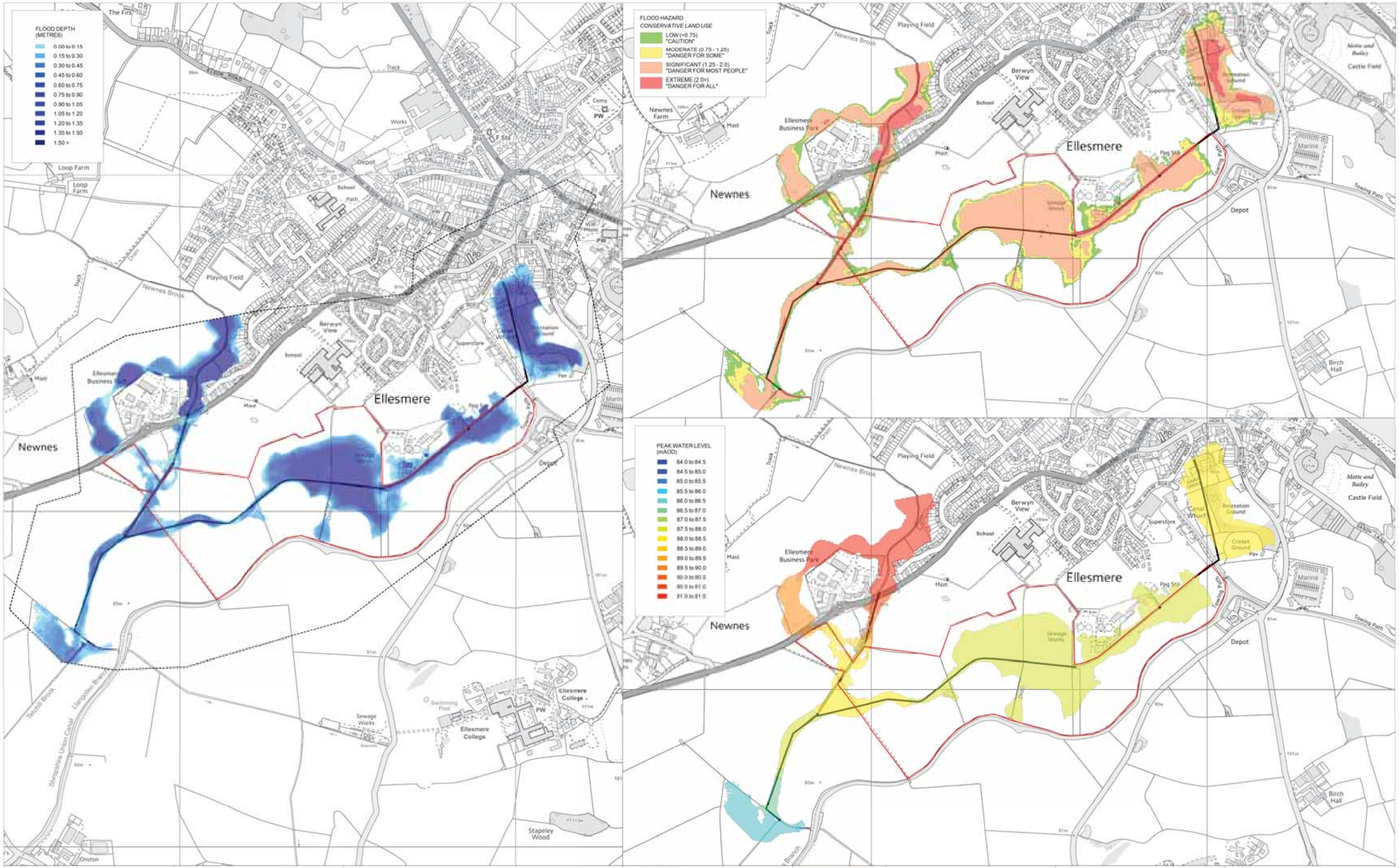
Drawing Title
FLOODPLAIN MAPPING EXISTING CONDITIONS: 1IN100YRCC

Scale	1:5000	Drawn	R.GREEN
Size	A1	Reviewed	S.NELMES

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK32

Revision
P1



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KEY

- STUDY SITE
- CULVERTED WATERCOURSE
- MODEL EXTENT

ISSUES & REVISIONS

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Client
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Project Title
ELLESMERE MARINA

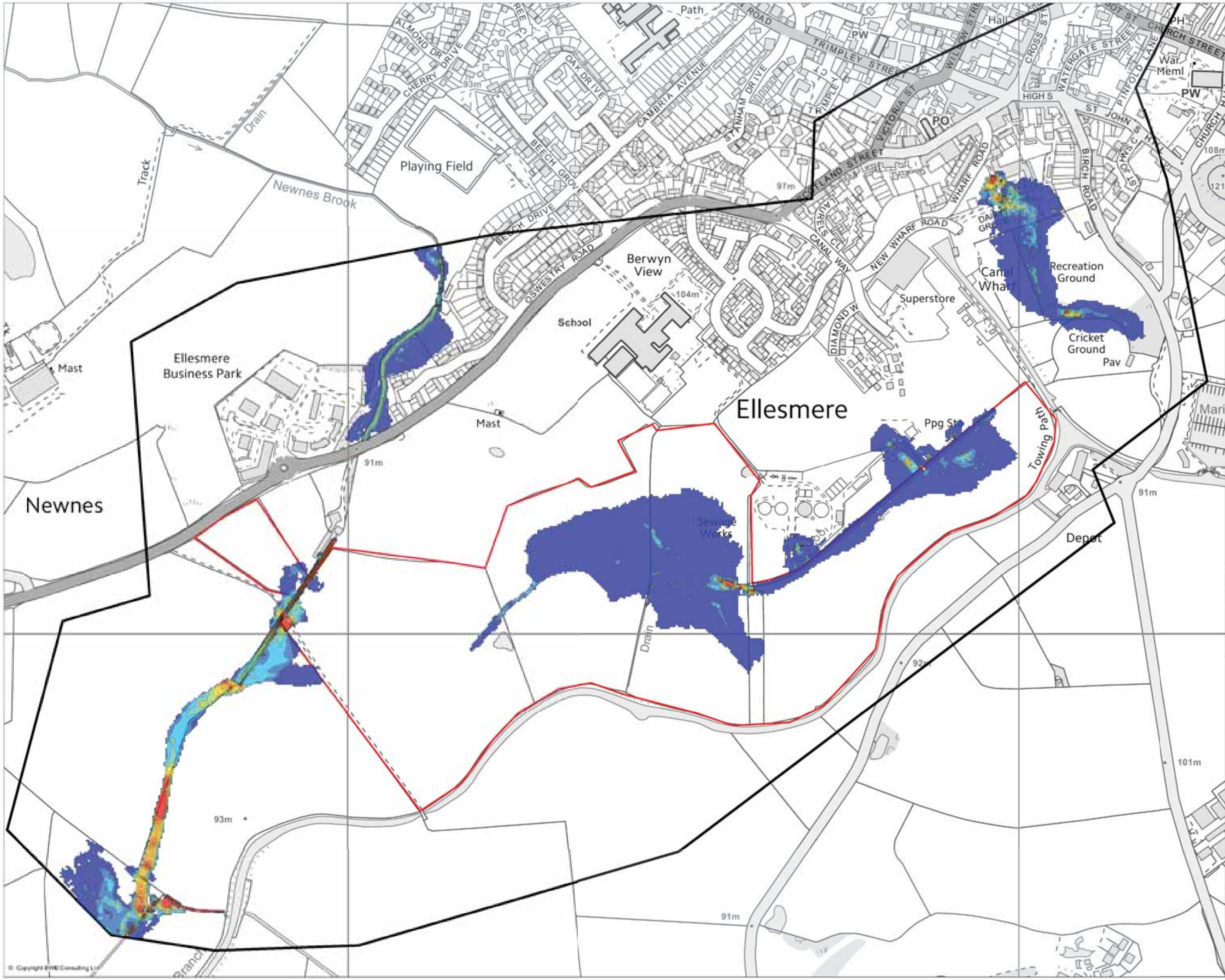
Drawing Title
FLOODPLAIN MAPPING EXISTING CONDITIONS: 1IN1000YR

Scale	1:5000	Drawn	R.GREEN
Size	A1	Reviewed	S.NELMES

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK31

Revision
P1



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4. ANY DISCREPANCIES NOTED ON SITE ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.

KEY

Model Extent

Study Site

PEAK VELOCITY (m/s)

0.000 to 0.100
0.100 to 0.200
0.200 to 0.300
0.300 to 0.400
0.400 to 0.500
0.500 to 0.600
0.600 to 0.700
0.700 to 0.800
0.800 to 0.900
0.900 to 1.000
1.000 >

P1	04.07.14	PRELIMINARY ISSUE	RG	SN
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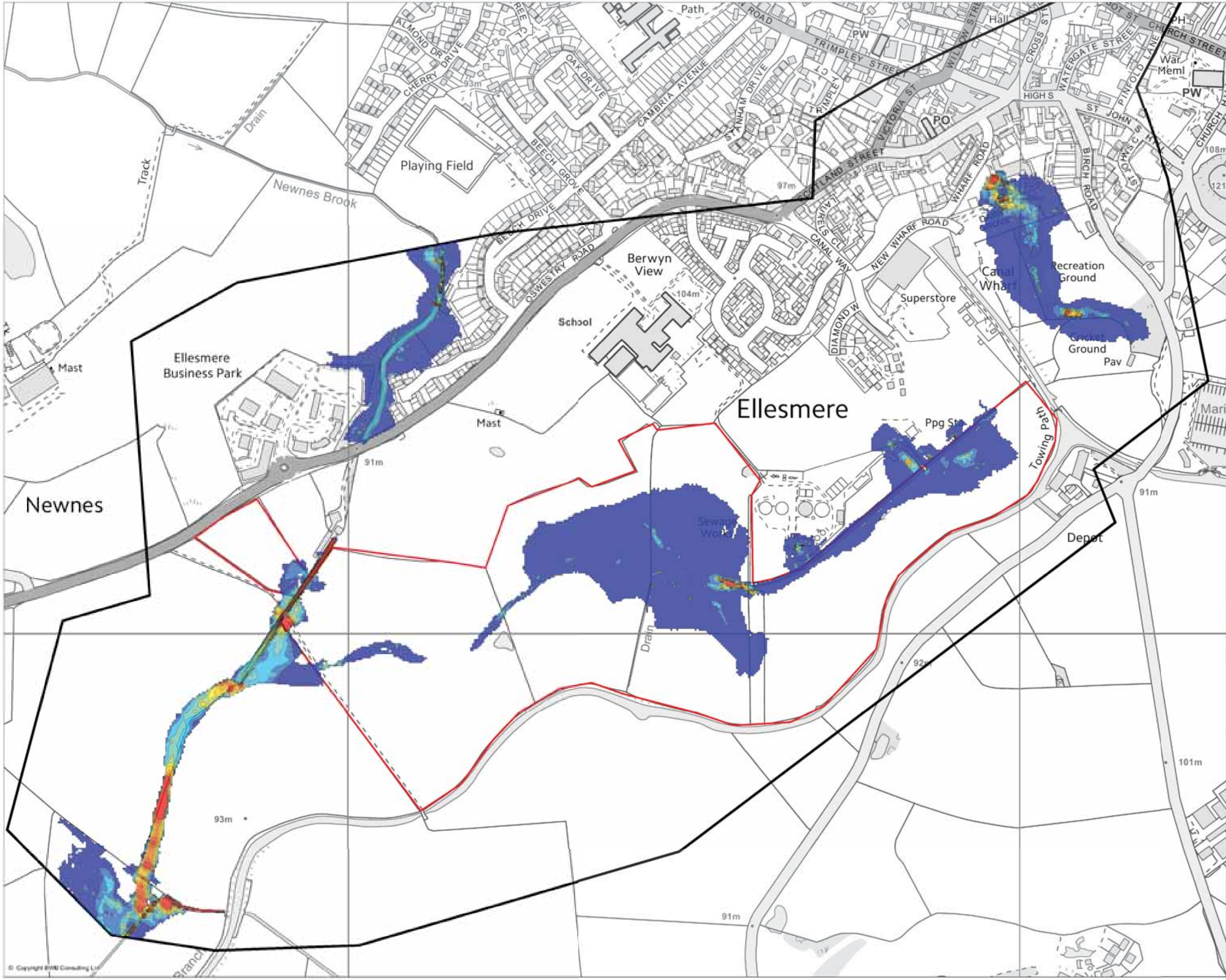
Project Title
ELLESMERE MARINA, SHORPSHIRE

Drawing Title
VELOCITY MAPS BASELINE CONDITIONS: 1 IN 20 YR

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No. BMW/2025/WSK61 Revision P1



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KEY

Model Extent

Study Site

PEAK VELOCITY (m/s)

- 0.000 to 0.100
- 0.100 to 0.200
- 0.200 to 0.300
- 0.300 to 0.400
- 0.400 to 0.500
- 0.500 to 0.600
- 0.600 to 0.700
- 0.700 to 0.800
- 0.800 to 0.900
- 0.900 to 1.000
- 1.000 >

Rev	Date	Details of issue / revision	Drw	Rev
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Project Title
ELLESMERE MARINA, SHORPSHIRE

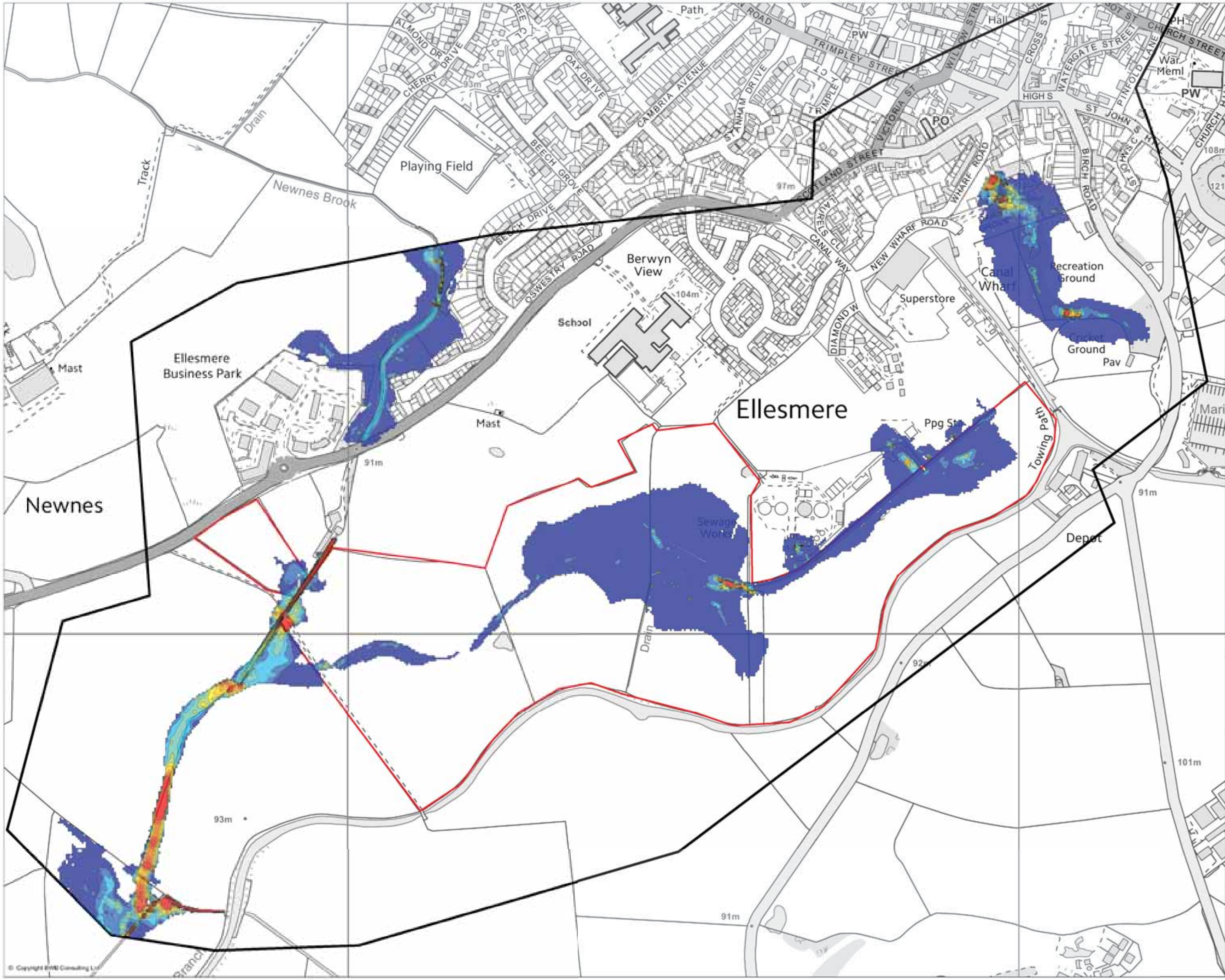
Drawing Title
VELOCITY MAPS BASELINE CONDITIONS: 1 IN 75 YR

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK62

Revision
P1



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KEY

Model Extent

Study Site

PEAK VELOCITY (m/s)

0.000 to 0.100
0.100 to 0.200
0.200 to 0.300
0.300 to 0.400
0.400 to 0.500
0.500 to 0.600
0.600 to 0.700
0.700 to 0.800
0.800 to 0.900
0.900 to 1.000
1.000 >

Rev	Date	Details of issue / revision	Drw	Rev
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Project Title
ELLESMERE MARINA, SHORPSHIRE

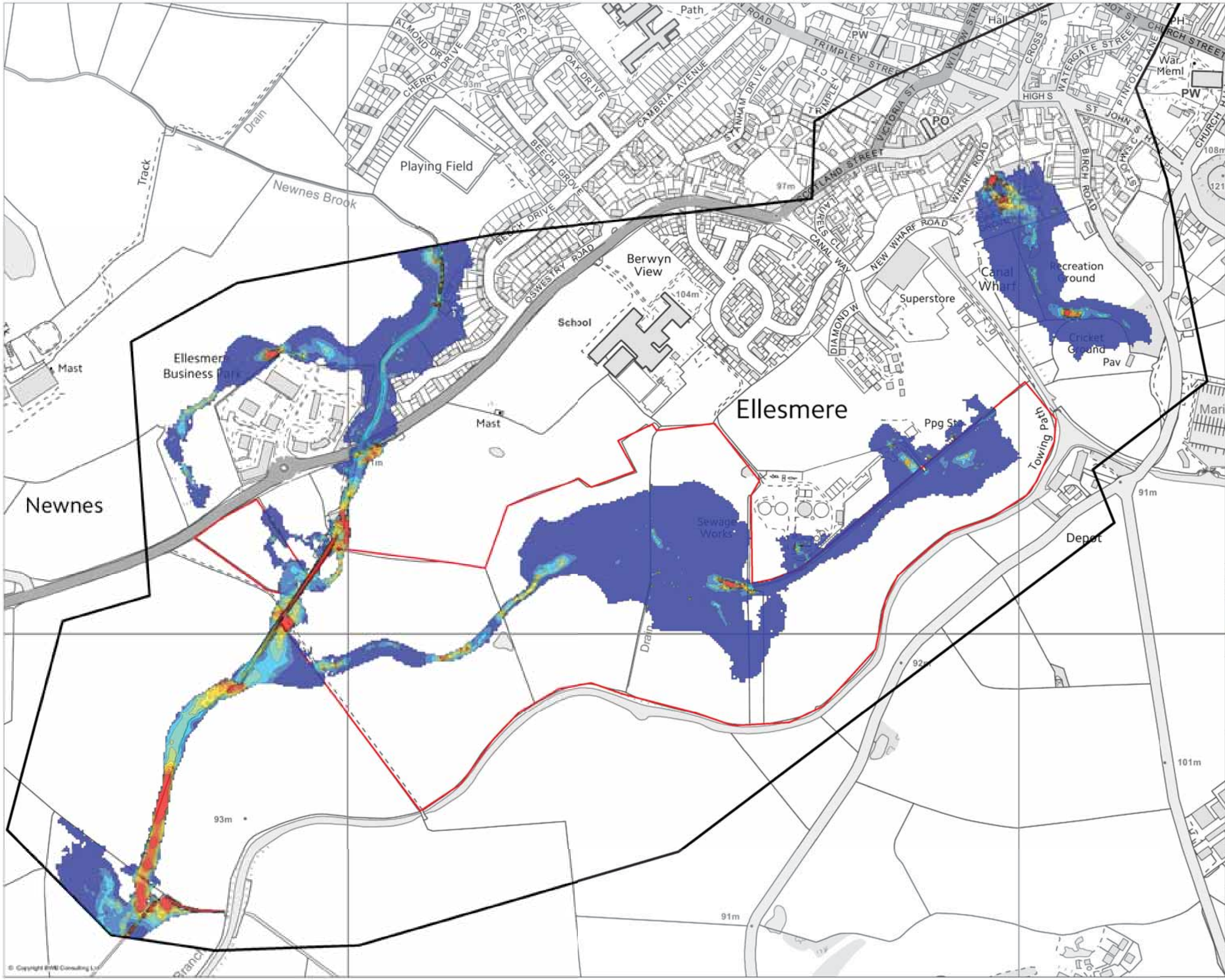
Drawing Title
VELOCITY MAPS BASELINE CONDITIONS: 1 IN 100 YR

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK63

Revision
P1



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KEY

Model Extent

Study Site

PEAK VELOCITY (m/s)

- 0.000 to 0.100
- 0.100 to 0.200
- 0.200 to 0.300
- 0.300 to 0.400
- 0.400 to 0.500
- 0.500 to 0.600
- 0.600 to 0.700
- 0.700 to 0.800
- 0.800 to 0.900
- 0.900 to 1.000
- 1.000 >

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Project Title
ELLESMERE MARINA, SHORPSHIRE

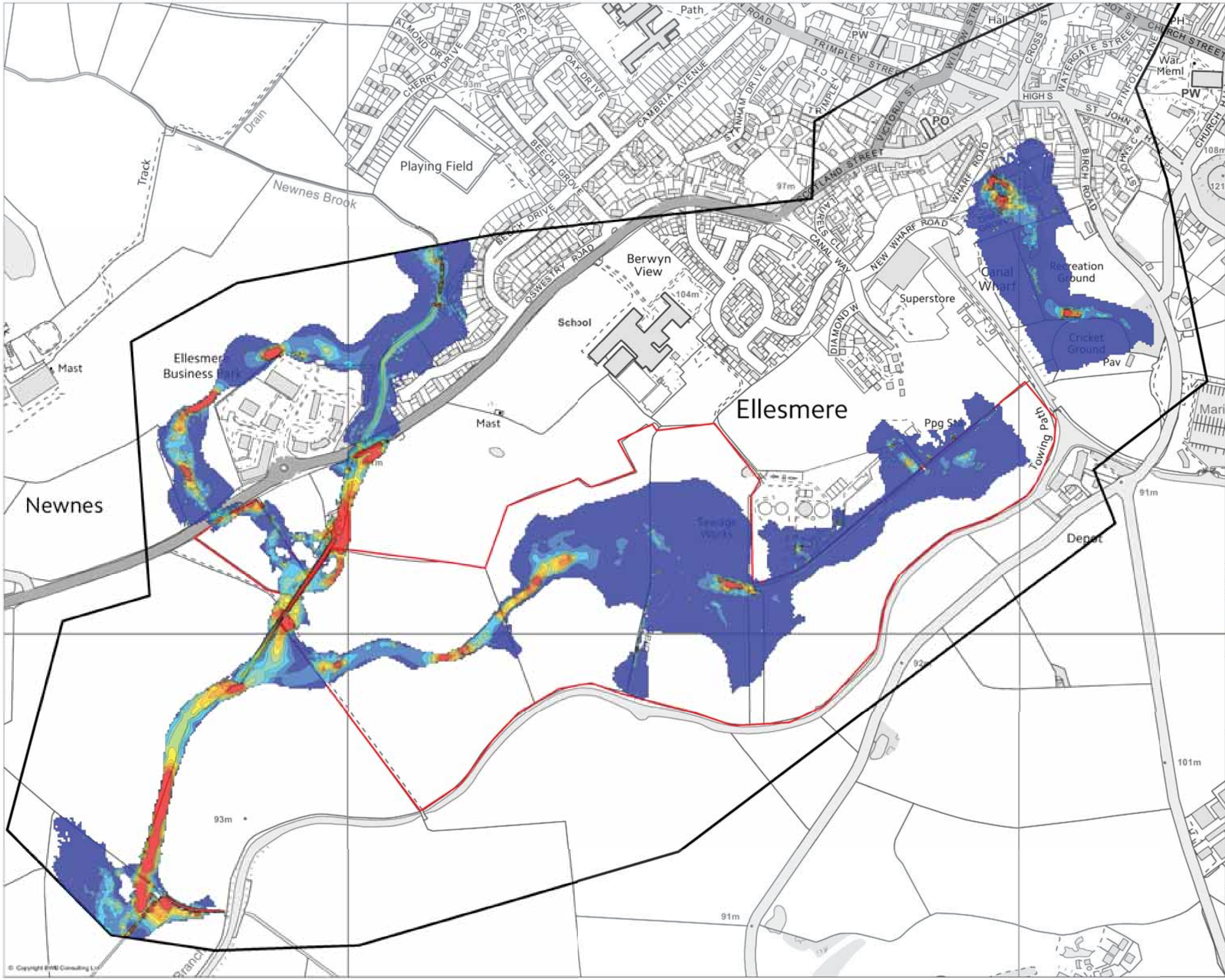
Drawing Title
VELOCITY MAPS BASELINE CONDITIONS: 1 IN 100 YR + CC

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK64

Revision
P1



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KEY

Model Extent

Study Site

PEAK VELOCITY (m/s)

- 0.000 to 0.100
- 0.100 to 0.200
- 0.200 to 0.300
- 0.300 to 0.400
- 0.400 to 0.500
- 0.500 to 0.600
- 0.600 to 0.700
- 0.700 to 0.800
- 0.800 to 0.900
- 0.900 to 1.000
- 1.000 >

Rev	Date	Details of issue / revision	Drw	Rev
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Client
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Project Title
ELLESMERE MARINA, SHORPSHIRE

Drawing Title
VELOCITY MAPS BASELINE CONDITIONS: 1 IN 1000 YR

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

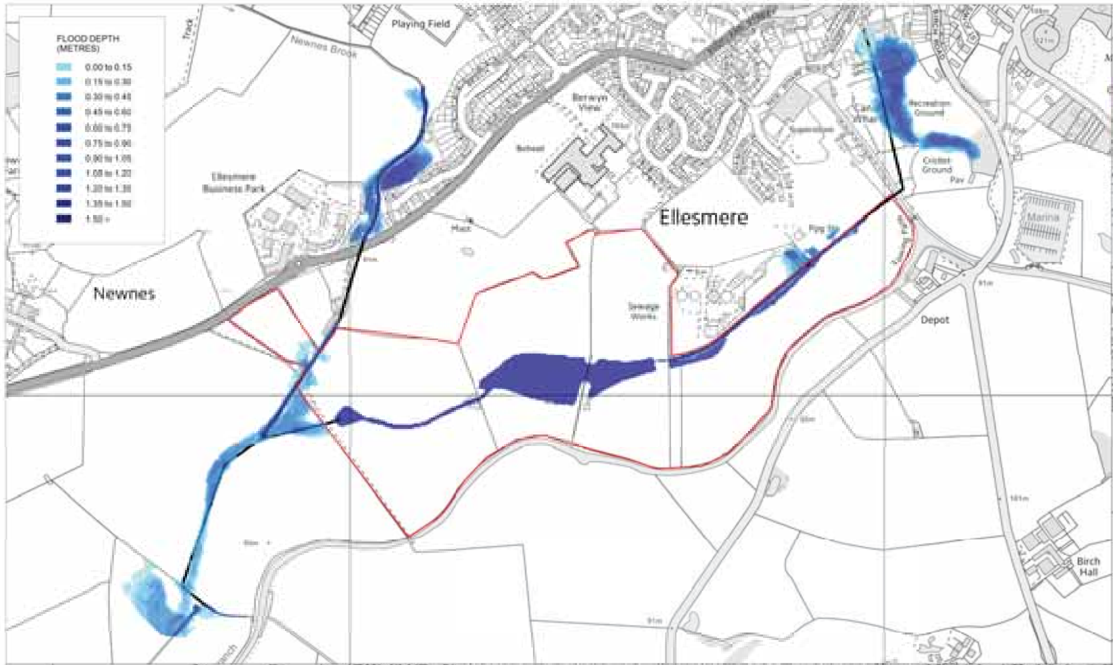
Drawing Status
PRELIMINARY

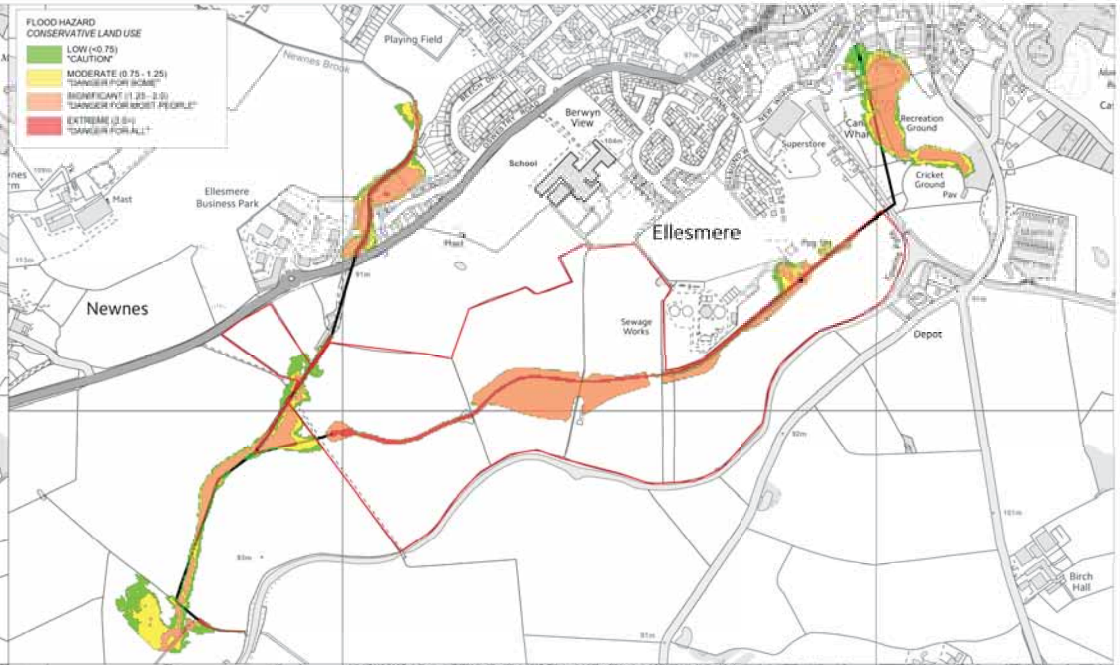
Drawing No.
BMW/2025/WSK65

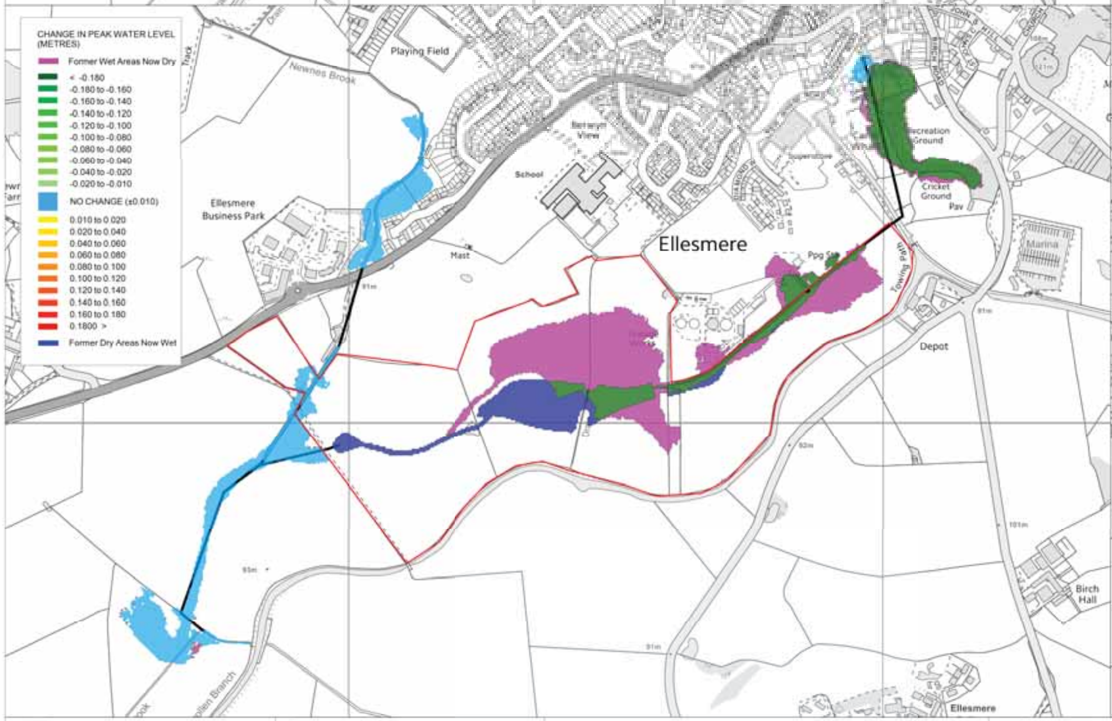
Revision
P1

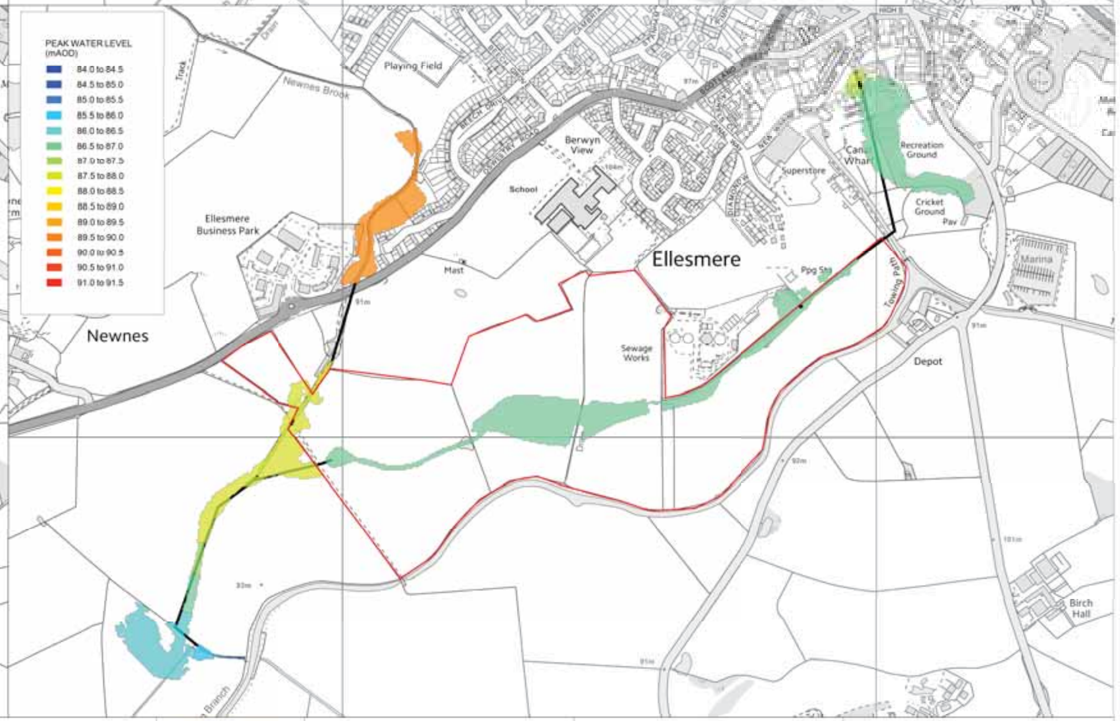
ANNEX F

Floodplain Mapping: Proposed Day-Lighting









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KEY

- STUDY SITE
- CULVERTED WATERCOURSE

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Client
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Project Title
ELLESMERE MARINA

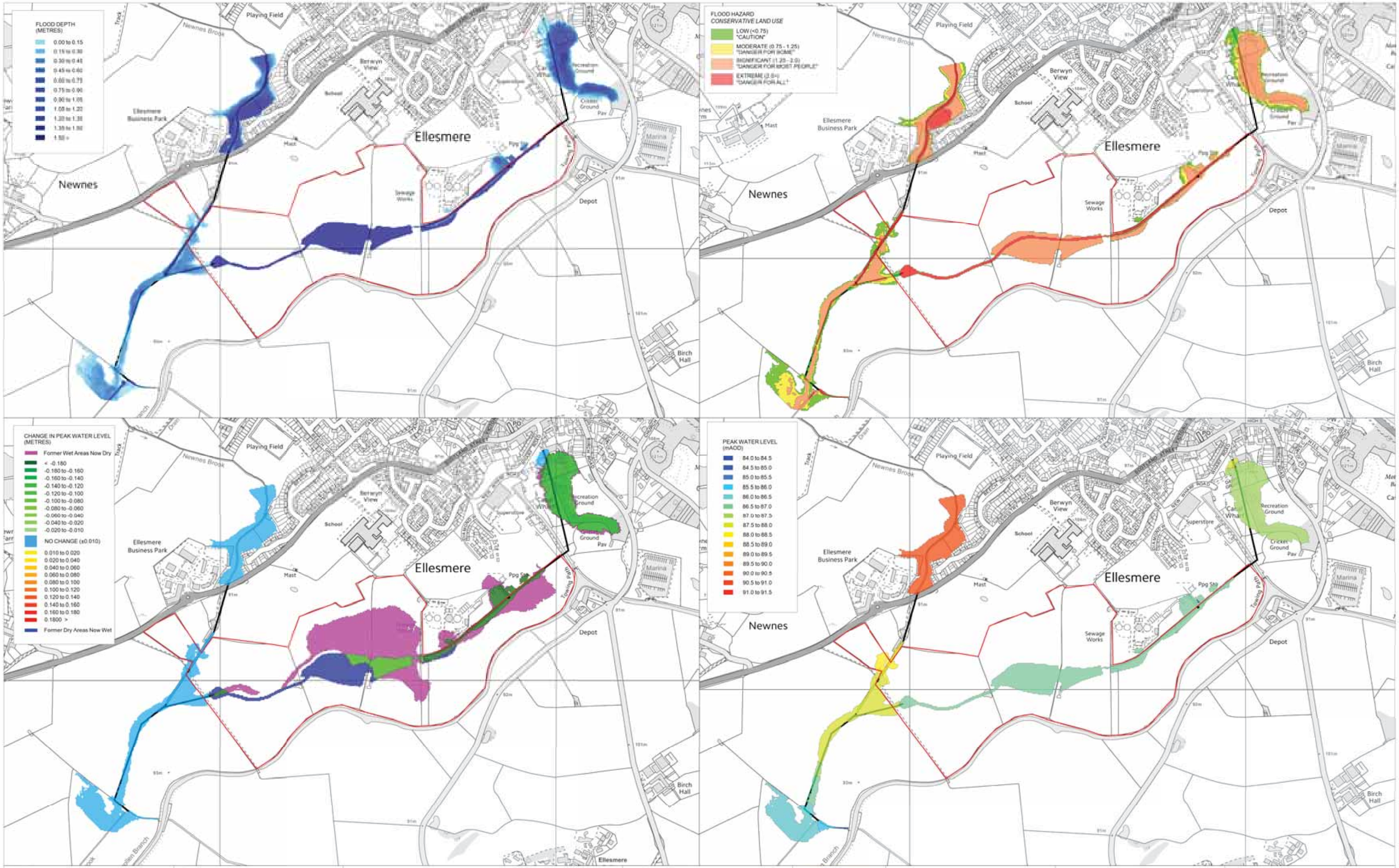
Drawing Title
DE-CULVERTED FLOODPLAIN MAPPING: 1IN20YR

Scale	1:5000	Drawn	R.GREEN
Size	A1	Reviewed	S.NELMES

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK44

Revision
P2



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KEY

STUDY SITE

CULVERTED WATERCOURSE

ISSUES & REVISIONS

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Client
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Project Title
ELLESMERE MARINA

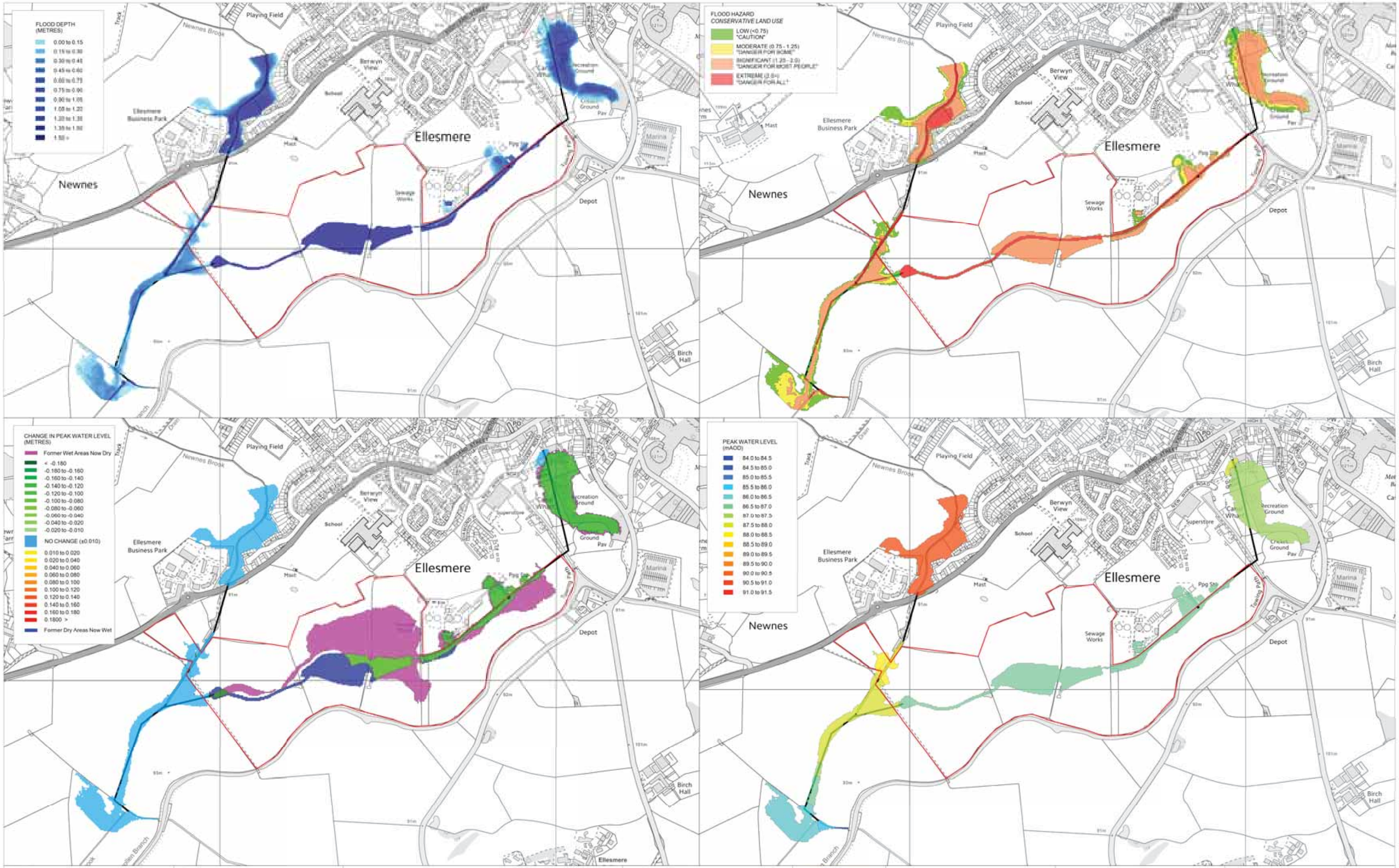
Drawing Title
DE-CULVERTED FLOODPLAIN MAPPING: 1IN75YR

Scale	1:5000	Drawn	R.GREEN
Size	A1	Reviewed	S.NELMES

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK43

Revision
P2



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Project Title
ELLESMERE MARINA

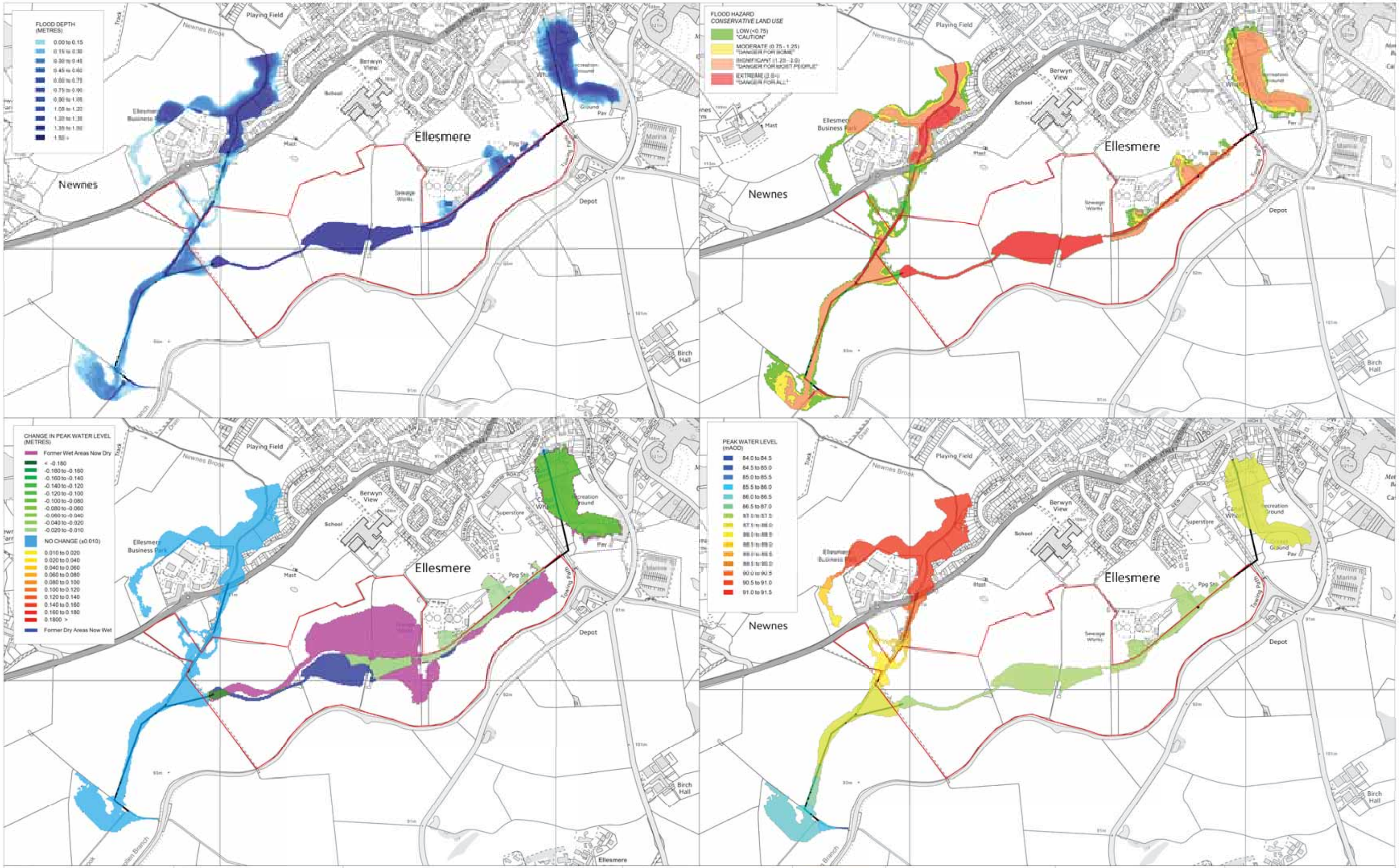
Drawing Title
DE-CULVERTED FLOODPLAIN MAPPING: 1IN100YR

Scale	1:5000	Drawn	R.GREEN
Size	A1	Reviewed	S.NELMES

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK42

Revision
P2



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5. THE RESULTS OF TEH FLOOD MODELLING ARE YET TO BE PEER REVIEWED AND ARE SUBJECT TO CHANGE.

KEY

STUDY SITE

CULVERTED WATERCOURSE

ISSUES & REVISIONS

Rev	Date	Details of issue / revision	Drw	Rev
P1	18.04.14	PRELIMINARY ISSUE	RG	SN
P2	01.05.14	P023 RESULTS	RG	SN

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Client
BURBURY INVESTMENTS LTD

Project Title
ELLESMERE MARINA

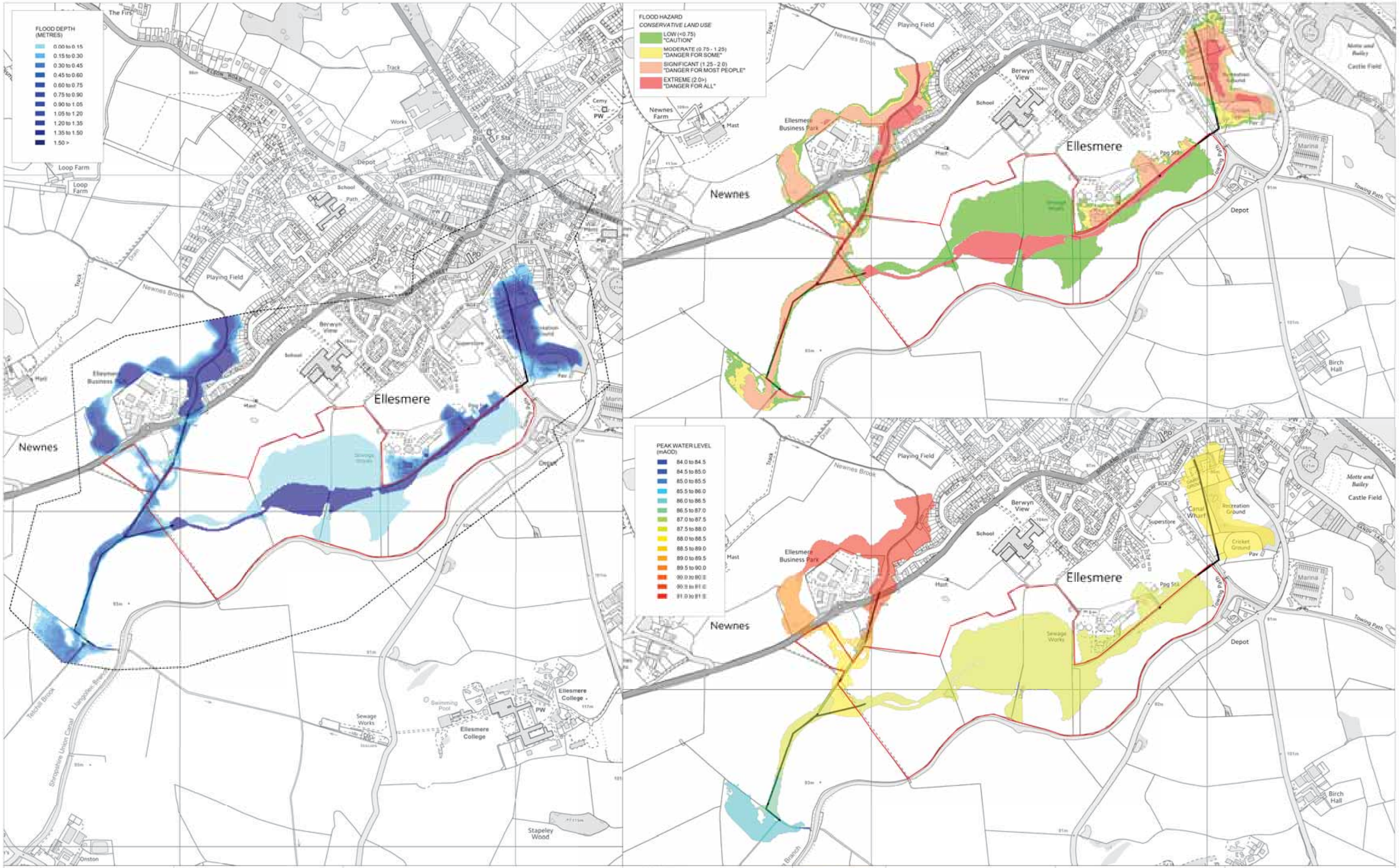
Drawing Title
DE-CULVERTED FLOODPLAIN MAPPING: 1IN100YRCC

Scale	1:5000	Drawn	R.GREEN
Size	A1	Reviewed	S.NELMES

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK41

Revision
P2



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KEY

- STUDY SITE
- CULVERTED WATERCOURSE
- MODEL EXTENT

ISSUES & REVISIONS

Rev	Date	Details of issue / revision	Drw	Rev
P1	01.05.14	PRELIMINARY ISSUE	RG	SN

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Client
BURBURY INVESTMENTS LTD

Project Title
ELLESMERE MARINA

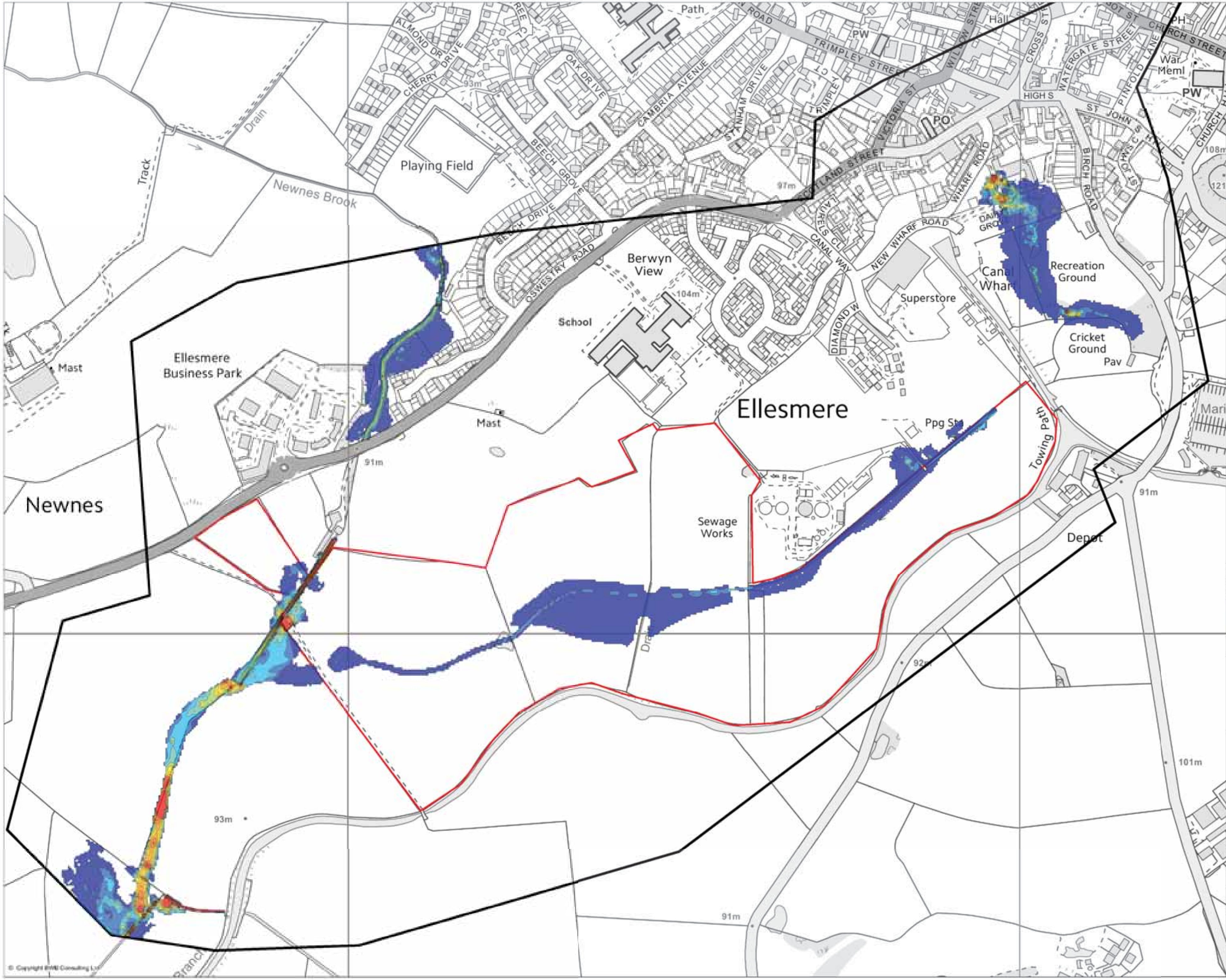
Drawing Title
DE-CULVETED FLOODPLAIN MAPPING: 1IN1000YR

Scale	1:5000	Drawn	R.GREEN
Size	A1	Reviewed	S.NELMES

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK40

Revision
P1



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KEY

Model Extent

Study Site

PEAK VELOCITY (m/s)

- 0.000 to 0.100
- 0.100 to 0.200
- 0.200 to 0.300
- 0.300 to 0.400
- 0.400 to 0.500
- 0.500 to 0.600
- 0.600 to 0.700
- 0.700 to 0.800
- 0.800 to 0.900
- 0.900 to 1.000
- 1.000 >

Rev	Date	Details of issue / revision	Drw	Rev
P1	04.07.14	PRELIMINARY ISSUE	RG	SN

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Client
BURBURY INVESTMENTS LTD

Project Title
ELLESMERE MARINA, SHORPSHIRE

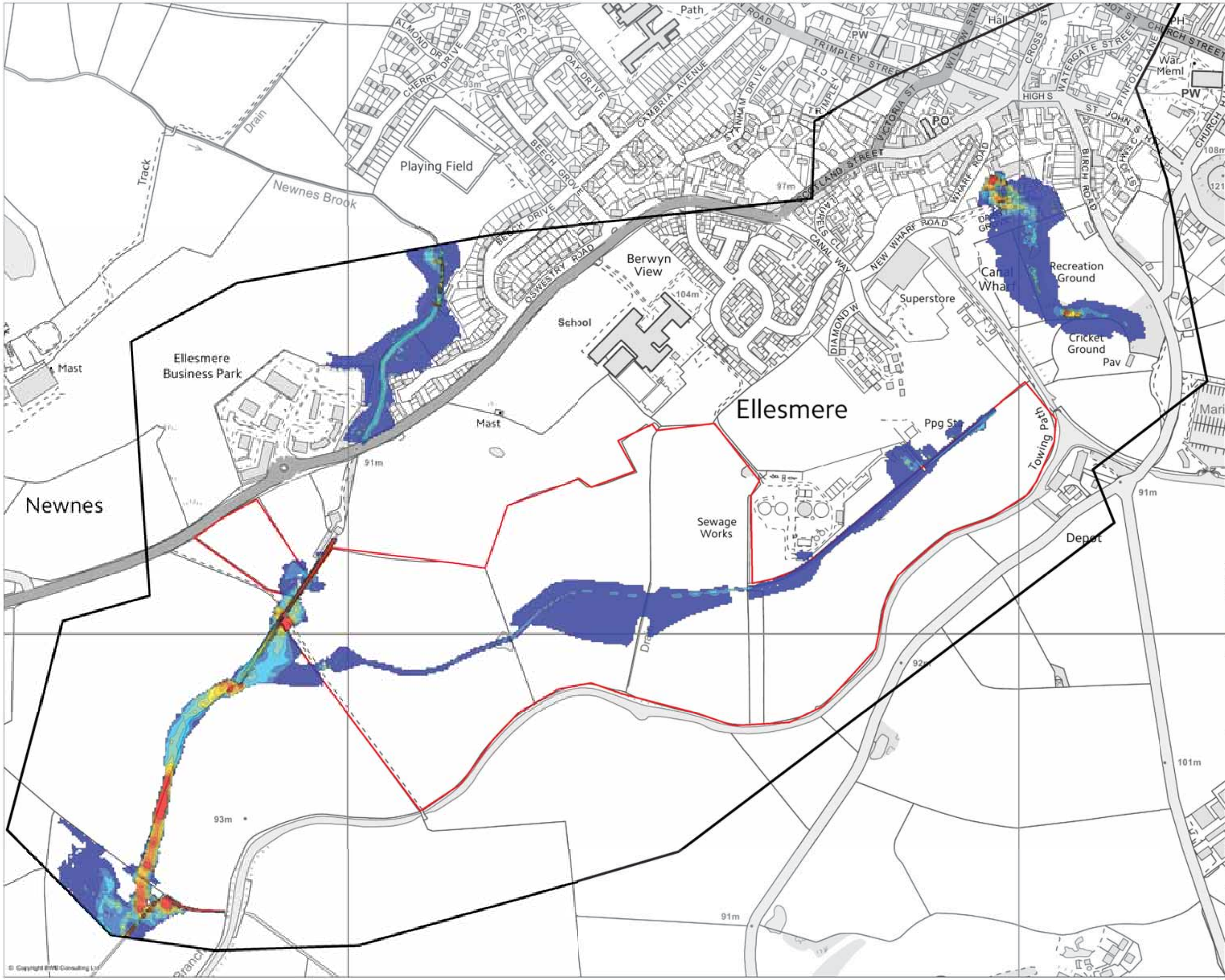
Drawing Title
VELOCITY MAPS PROPOSED CONDITIONS: 1 IN 20 YR

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK66

Revision
P1



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KEY

Model Extent
Study Site

PEAK VELOCITY (m/s)

0.000 to 0.100
0.100 to 0.200
0.200 to 0.300
0.300 to 0.400
0.400 to 0.500
0.500 to 0.600
0.600 to 0.700
0.700 to 0.800
0.800 to 0.900
0.900 to 1.000
1.000 >

Rev	Date	Details of issue / revision	Drw	Rev
P1	04.07.14	PRELIMINARY ISSUE	RG	SN

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Client
BURBURY INVESTMENTS LTD

Project Title
ELLESMERE MARINA, SHORPSHIRE

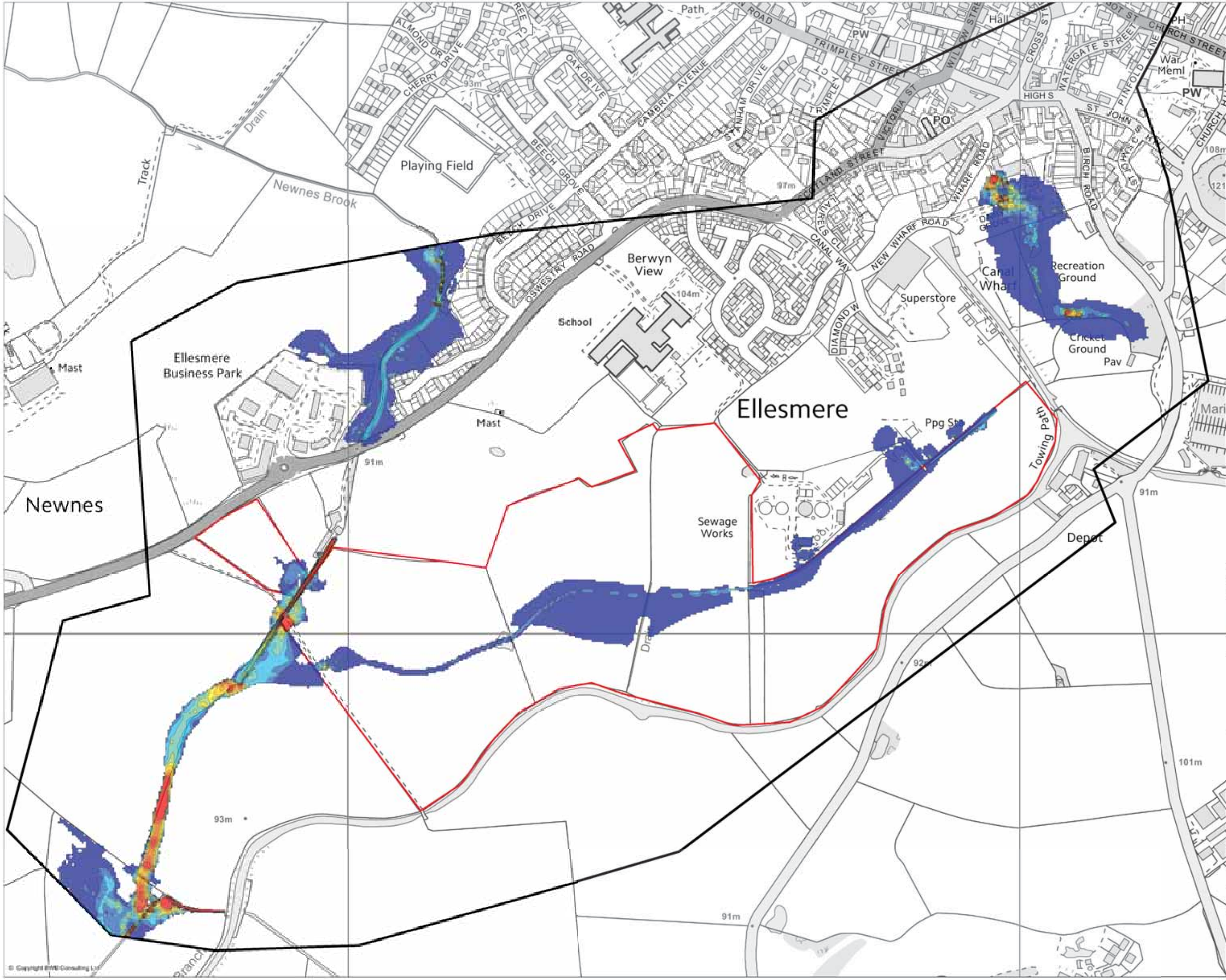
Drawing Title
VELOCITY MAPS PROPOSED CONDITIONS: 1 IN 75 YR

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK67

Revision
P1



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KEY

Model Extent

Study Site

PEAK VELOCITY (m/s)

- 0.000 to 0.100
- 0.100 to 0.200
- 0.200 to 0.300
- 0.300 to 0.400
- 0.400 to 0.500
- 0.500 to 0.600
- 0.600 to 0.700
- 0.700 to 0.800
- 0.800 to 0.900
- 0.900 to 1.000
- 1.000 >

Rev	Date	Details of issue / revision	Drw	Rev
P1	04.07.14	PRELIMINARY ISSUE	RG	SN

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Client
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Project Title
ELLESMERE MARINA, SHORPSHIRE

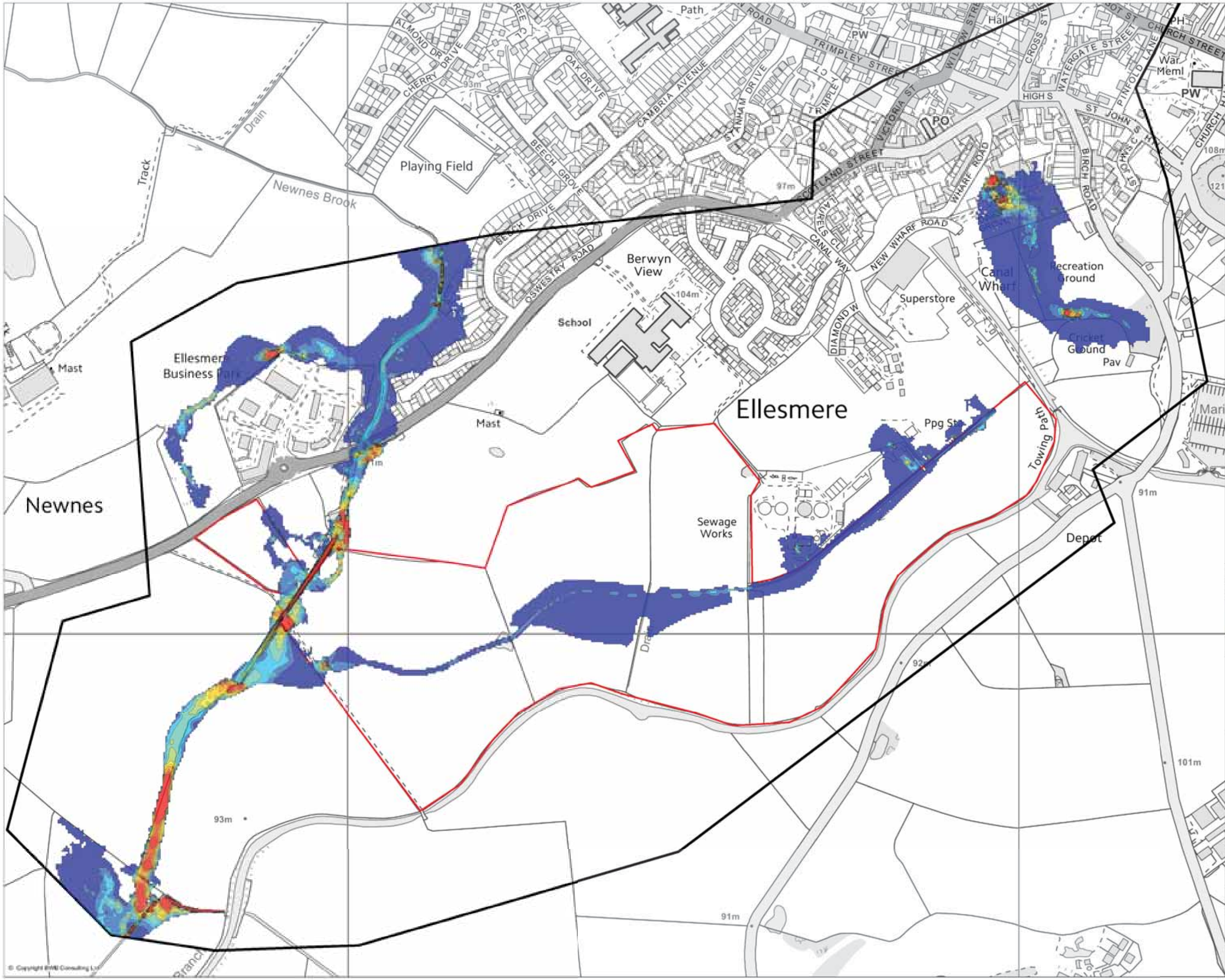
Drawing Title
VELOCITY MAPS PROPOSED CONDITIONS: 1 IN 100 YR

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK68

Revision
P1



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KEY

Model Extent

Study Site

PEAK VELOCITY (m/s)

0.000 to 0.100
0.100 to 0.200
0.200 to 0.300
0.300 to 0.400
0.400 to 0.500
0.500 to 0.600
0.600 to 0.700
0.700 to 0.800
0.800 to 0.900
0.900 to 1.000
1.000 >

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P1	04.07.14	PRELIMINARY ISSUE	RG	SN

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Client
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Project Title
ELLESMERE MARINA, SHORPSHIRE

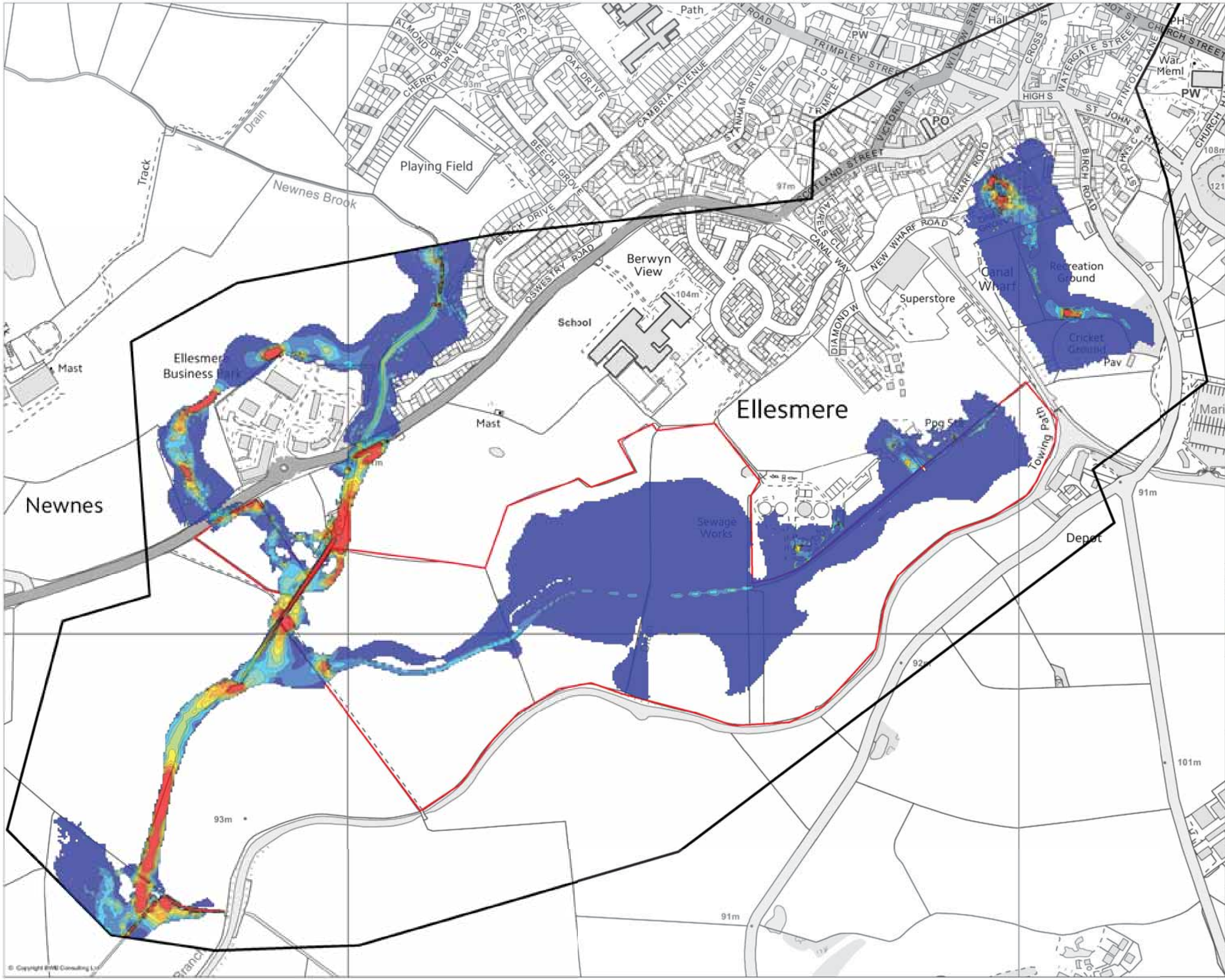
Drawing Title
VELOCITY MAPS PROPOSED CONDITIONS: 1 IN 100 YR + CC

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK69

Revision
P1



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KEY

Model Extent

Study Site

PEAK VELOCITY (m/s)

- 0.000 to 0.100
- 0.100 to 0.200
- 0.200 to 0.300
- 0.300 to 0.400
- 0.400 to 0.500
- 0.500 to 0.600
- 0.600 to 0.700
- 0.700 to 0.800
- 0.800 to 0.900
- 0.900 to 1.000
- 1.000 >

Rev	Date	Details of issue / revision	Drw	Rev
P1	04.07.14	PRELIMINARY ISSUE	RG	SN

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Project Title
ELLESMERE MARINA, SHORPSHIRE

Drawing Title
VELOCITY MAPS PROPOSED CONDITIONS: 1 IN 1000 YR

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

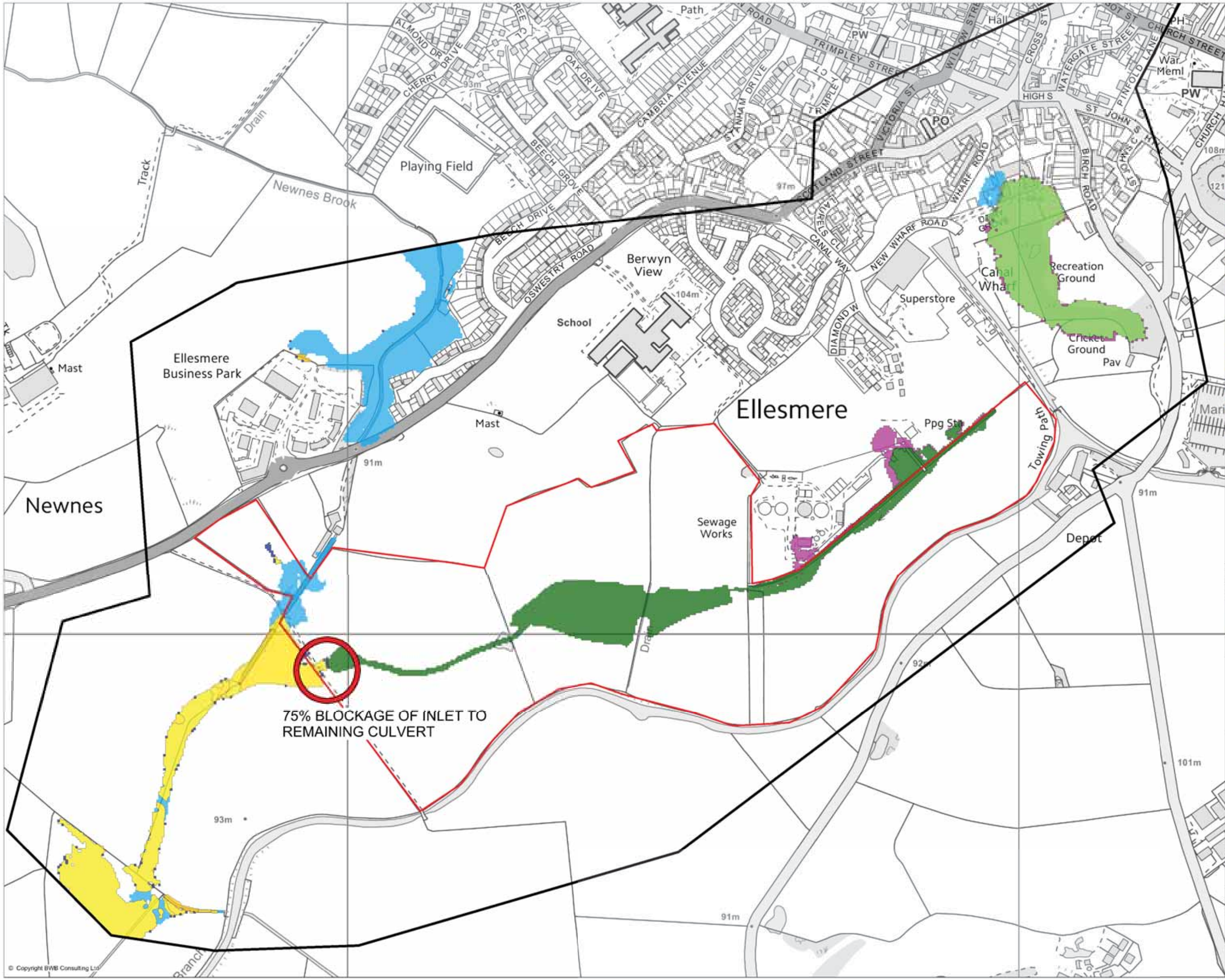
Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK70

Revision
P1

ANNEX G

Floodplain Mapping: Sensitivity Tests



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KEY

Model Extent

Study Site

CHANGE IN PEAK WATER LEVEL (METRES)

Former Wet Areas Now Dry
< -0.180
-0.180 to -0.160
-0.160 to -0.140
-0.140 to -0.120
-0.120 to -0.100
-0.100 to -0.080
-0.080 to -0.060
-0.060 to -0.040
-0.040 to -0.020
-0.020 to -0.010
NO CHANGE (±0.010)
0.010 to 0.020
0.020 to 0.040
0.040 to 0.060
0.060 to 0.080
0.080 to 0.100
0.100 to 0.120
0.120 to 0.140
0.140 to 0.160
0.160 to 0.180
0.1800 >
Former Dry Areas Now Wet

Rev	Date	Details of issue / revision	Drw	Rev
P1	01.05.14	PRELIMINARY ISSUE	RG	SN

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Client
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Project Title
ELLESMERE MARINA, SHORPSHIRE

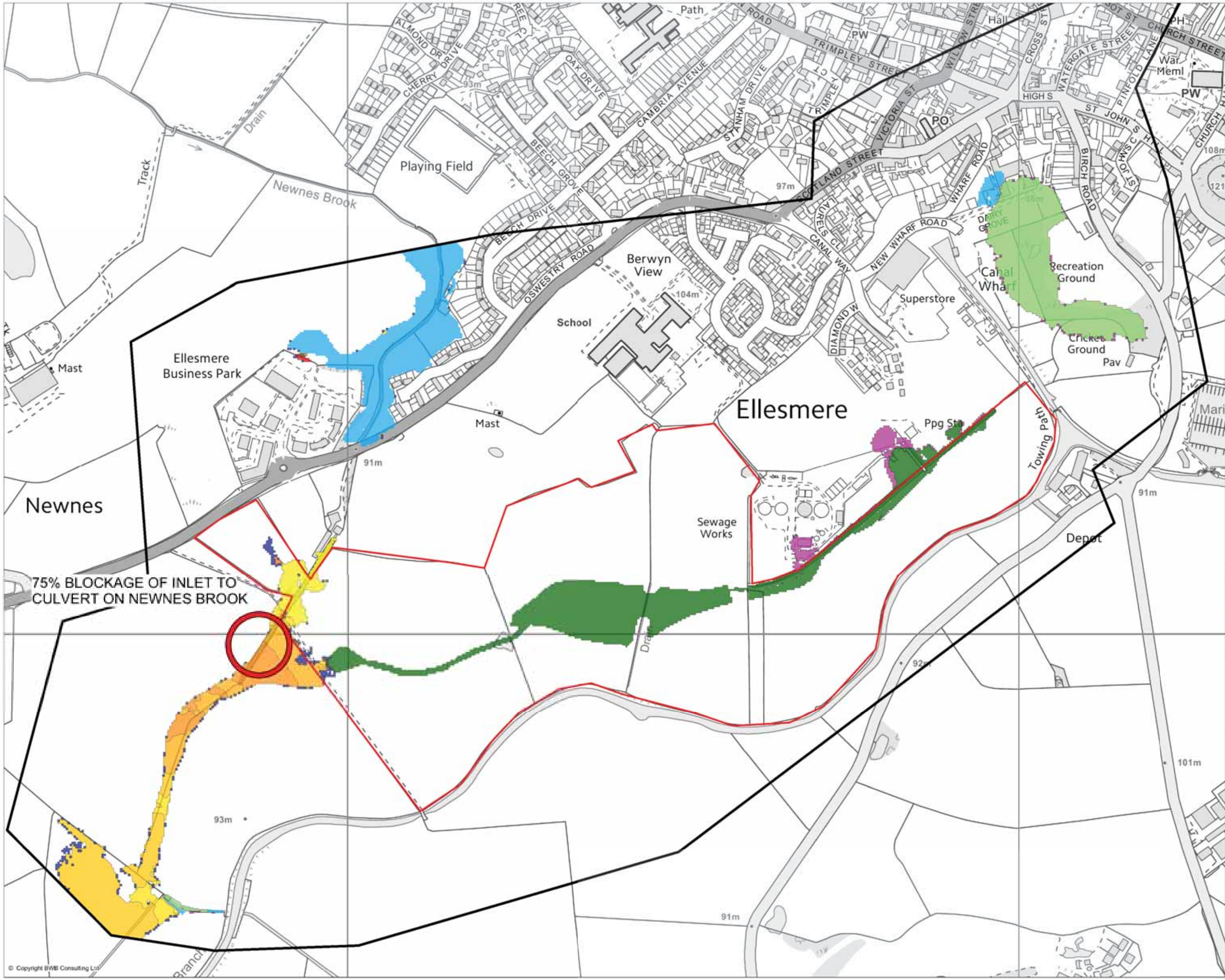
Drawing Title
DE-CULVERTED SENSITIVITY TESTS: BLOCKAGE BL1

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK54

Revision
P1



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KEY

Model Extent

Study Site

CHANGE IN PEAK WATER LEVEL (METRES)

Former Wet Areas Now Dry
< -0.180
-0.180 to -0.160
-0.160 to -0.140
-0.140 to -0.120
-0.120 to -0.100
-0.100 to -0.080
-0.080 to -0.060
-0.060 to -0.040
-0.040 to -0.020
-0.020 to -0.010
NO CHANGE (±0.010)
0.010 to 0.020
0.020 to 0.040
0.040 to 0.060
0.060 to 0.080
0.080 to 0.100
0.100 to 0.120
0.120 to 0.140
0.140 to 0.160
0.160 to 0.180
0.1800 >
Former Dry Areas Now Wet

Rev	Date	Details of issue / revision	Drw	Rev
P1	01.06.14	PRELIMINARY ISSUE	RG	SN

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Client
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Project Title
ELLESMERE MARINA, SHORPSHIRE

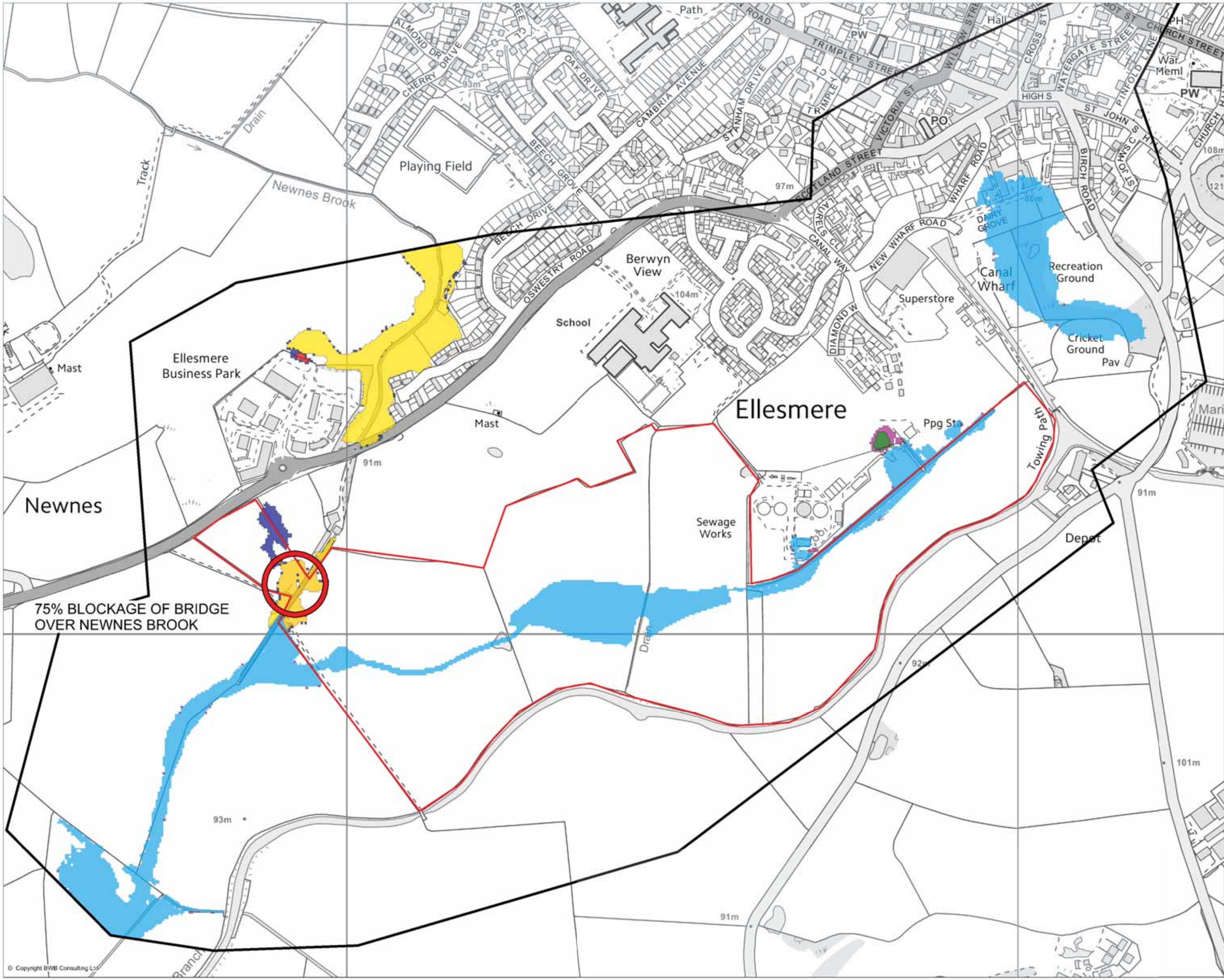
Drawing Title
DE-CULVERTED SENSITIVITY TESTS: BLOCKAGE BL2

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK55

Revision
P1



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KEY

Model Extent

Study Site

CHANGE IN PEAK WATER LEVEL (METRES)

- Former Wet Areas Now Dry
- < -0.180
- -0.180 to -0.160
- -0.160 to -0.140
- -0.140 to -0.120
- -0.120 to -0.100
- -0.100 to -0.080
- -0.080 to -0.060
- -0.060 to -0.040
- -0.040 to -0.020
- -0.020 to -0.010
- NO CHANGE (±0.010)
- 0.010 to 0.020
- 0.020 to 0.040
- 0.040 to 0.060
- 0.060 to 0.080
- 0.080 to 0.100
- 0.100 to 0.120
- 0.120 to 0.140
- 0.140 to 0.160
- 0.160 to 0.180
- 0.1800 >
- Former Dry Areas Now Wet

Rev	Date	Details of issue / revision	Drw	Rev
P1	01.06.14	PRELIMINARY ISSUE	RG	SN

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Client
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Project Title
ELLESMERE MARINA, SHORPSHIRE

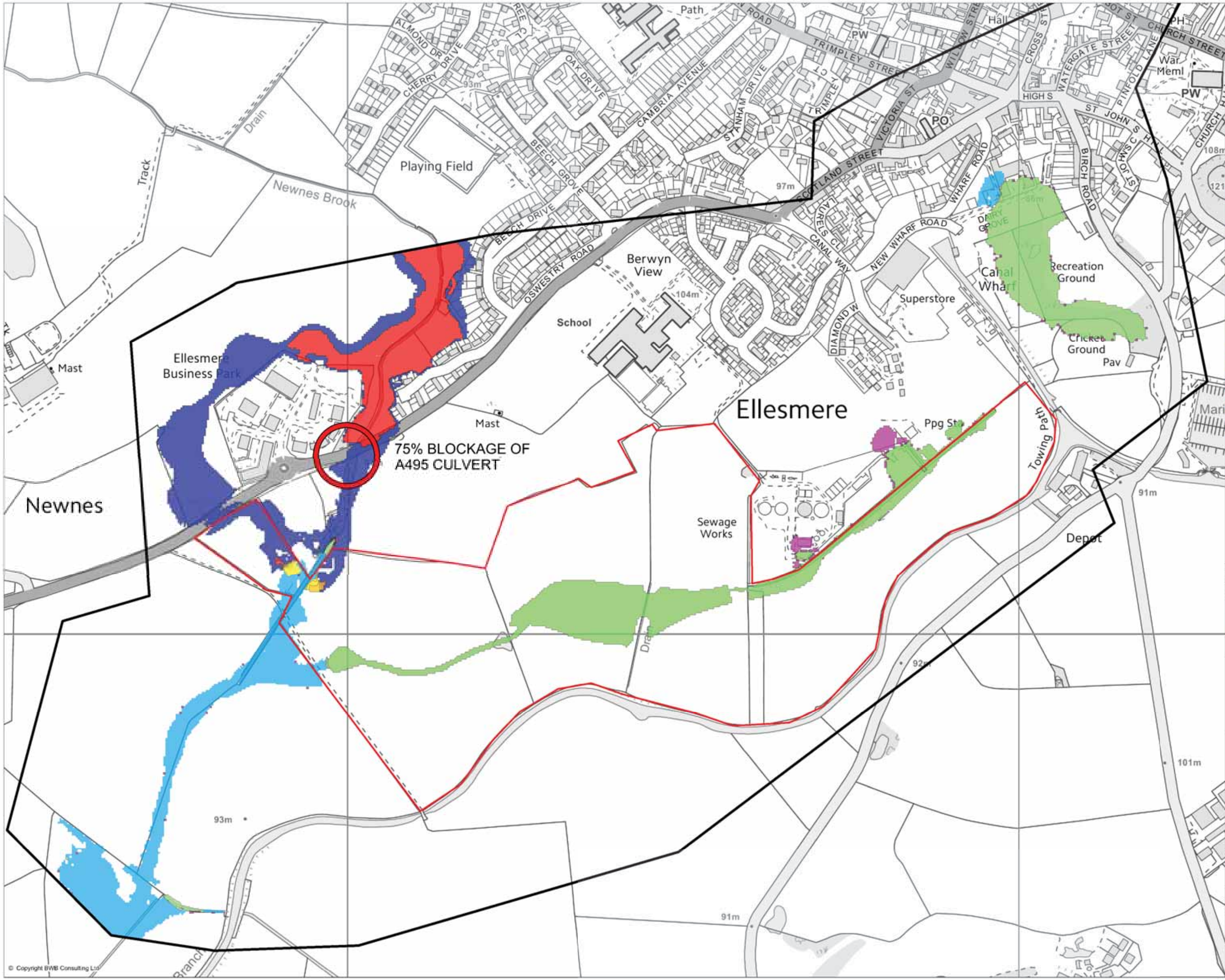
Drawing Title
DE-CULVERTED SENSITIVITY TESTS: BLOCKAGE BL3

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK56

Revision
P1



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KEY

Model Extent

Study Site

CHANGE IN PEAK WATER LEVEL (METRES)

- Former Wet Areas Now Dry
- < -0.180
- -0.180 to -0.160
- -0.160 to -0.140
- -0.140 to -0.120
- -0.120 to -0.100
- -0.100 to -0.080
- -0.080 to -0.060
- -0.060 to -0.040
- -0.040 to -0.020
- -0.020 to -0.010
- NO CHANGE (±0.010)
- 0.010 to 0.020
- 0.020 to 0.040
- 0.040 to 0.060
- 0.060 to 0.080
- 0.080 to 0.100
- 0.100 to 0.120
- 0.120 to 0.140
- 0.140 to 0.160
- 0.160 to 0.180
- 0.1800 >
- Former Dry Areas Now Wet

Rev	Date	Details of issue / revision	Drw	Rev
P1	01.06.14	PRELIMINARY ISSUE	RG	SN

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Client

BURBURY INVESTMENTS LTD

Project Title

ELLESMERE MARINA, SHORPSHIRE

Drawing Title

DE-CULVERTED SENSITIVITY TESTS: BLOCKAGE BL4

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status

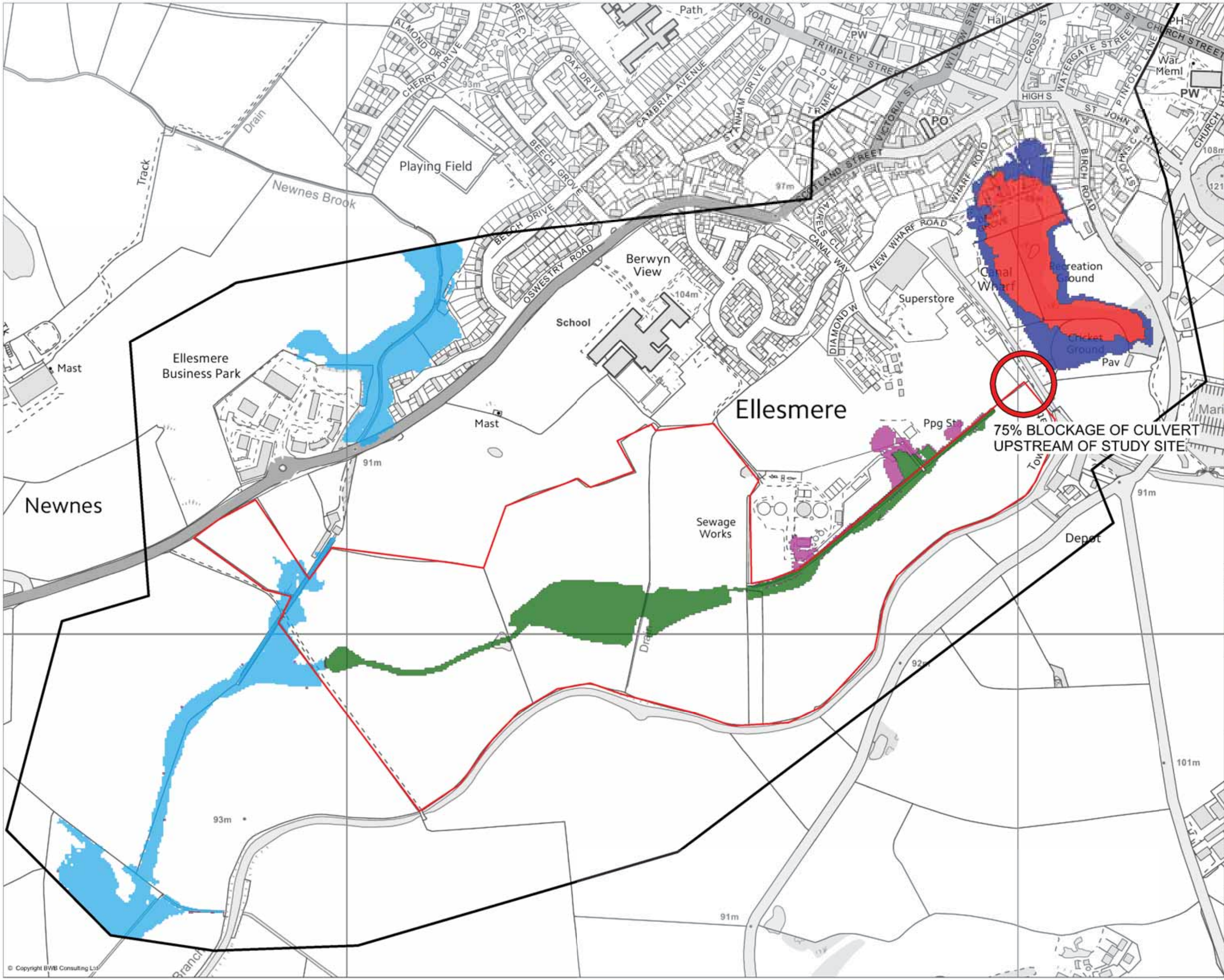
PRELIMINARY

Drawing No.

BMW/2025/WSK57

Revision

P1



NOTES

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KEY

Model Extent

Study Site

CHANGE IN PEAK WATER LEVEL (METRES)

- Former Wet Areas Now Dry
- < -0.180
- -0.180 to -0.160
- -0.160 to -0.140
- -0.140 to -0.120
- -0.120 to -0.100
- -0.100 to -0.080
- -0.080 to -0.060
- -0.060 to -0.040
- -0.040 to -0.020
- -0.020 to -0.010
- NO CHANGE (±0.010)
- 0.010 to 0.020
- 0.020 to 0.040
- 0.040 to 0.060
- 0.060 to 0.080
- 0.080 to 0.100
- 0.100 to 0.120
- 0.120 to 0.140
- 0.140 to 0.160
- 0.160 to 0.180
- 0.1800 >
- Former Dry Areas Now Wet

Rev	Date	Details of issue / revision	Drw	Rev
P1	01.06.14	PRELIMINARY ISSUE	RG	SN

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Client
BURBURY INVESTMENTS LTD

Project Title
ELLESMERE MARINA, SHORPSHIRE

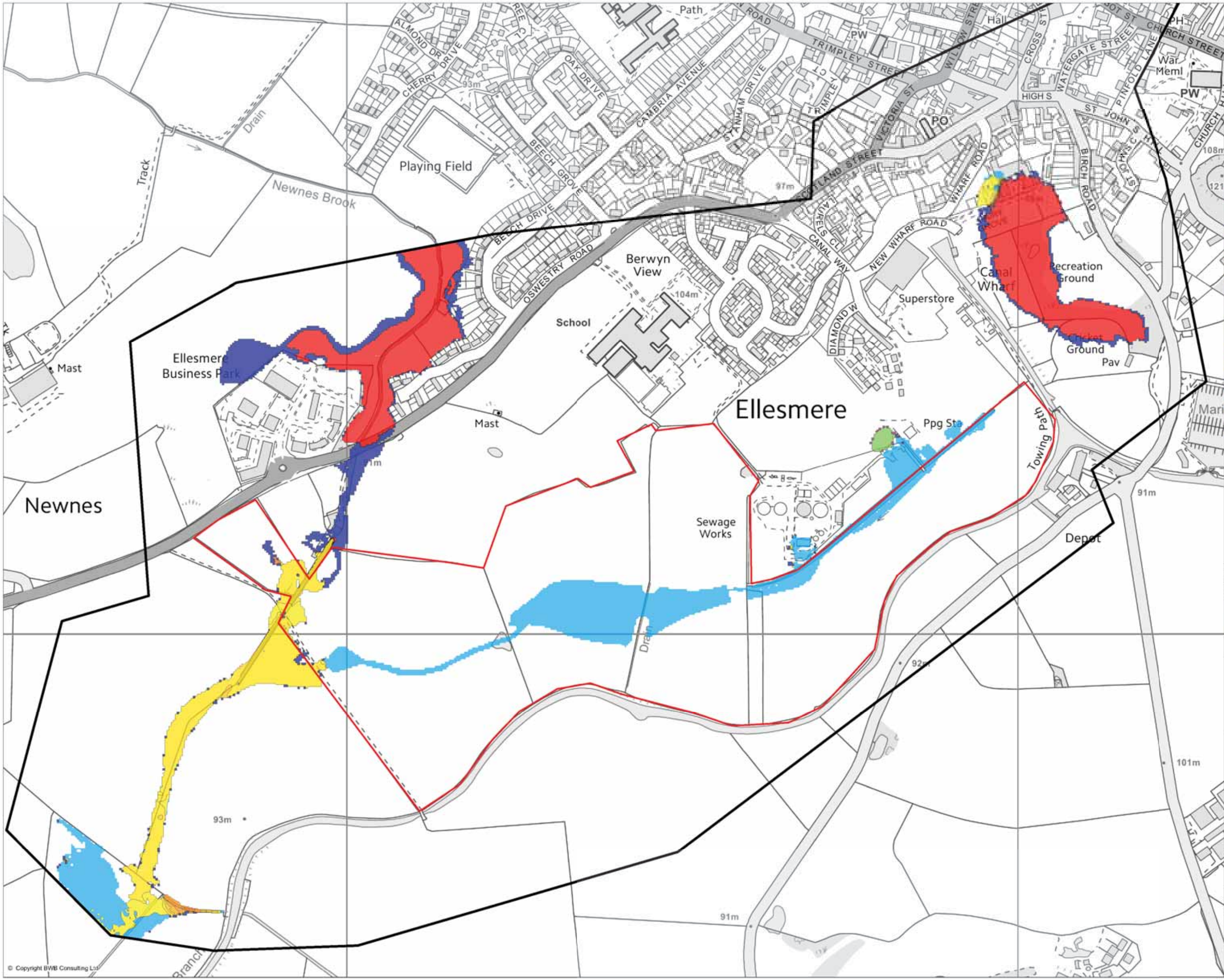
Drawing Title
DE-CULVERTED SENSITIVITY TESTS: BLOCKAGE BL5

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK58

Revision
P1



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KEY

Model Extent

Study Site

CHANGE IN PEAK WATER LEVEL (METRES)

- Former Wet Areas Now Dry
- < -0.180
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- -0.160 to -0.140
- -0.140 to -0.120
- -0.120 to -0.100
- -0.100 to -0.080
- -0.080 to -0.060
- -0.060 to -0.040
- -0.040 to -0.020
- -0.020 to -0.010
- NO CHANGE (±0.010)
- 0.010 to 0.020
- 0.020 to 0.040
- 0.040 to 0.060
- 0.060 to 0.080
- 0.080 to 0.100
- 0.100 to 0.120
- 0.120 to 0.140
- 0.140 to 0.160
- 0.160 to 0.180
- 0.1800 >
- Former Dry Areas Now Wet

Rev	Date	Details of issue / revision	Drw	Rev
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- □ Nottingham | 0115 924 1100

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Client
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Project Title
ELLESMERE MARINA, SHORPSHIRE

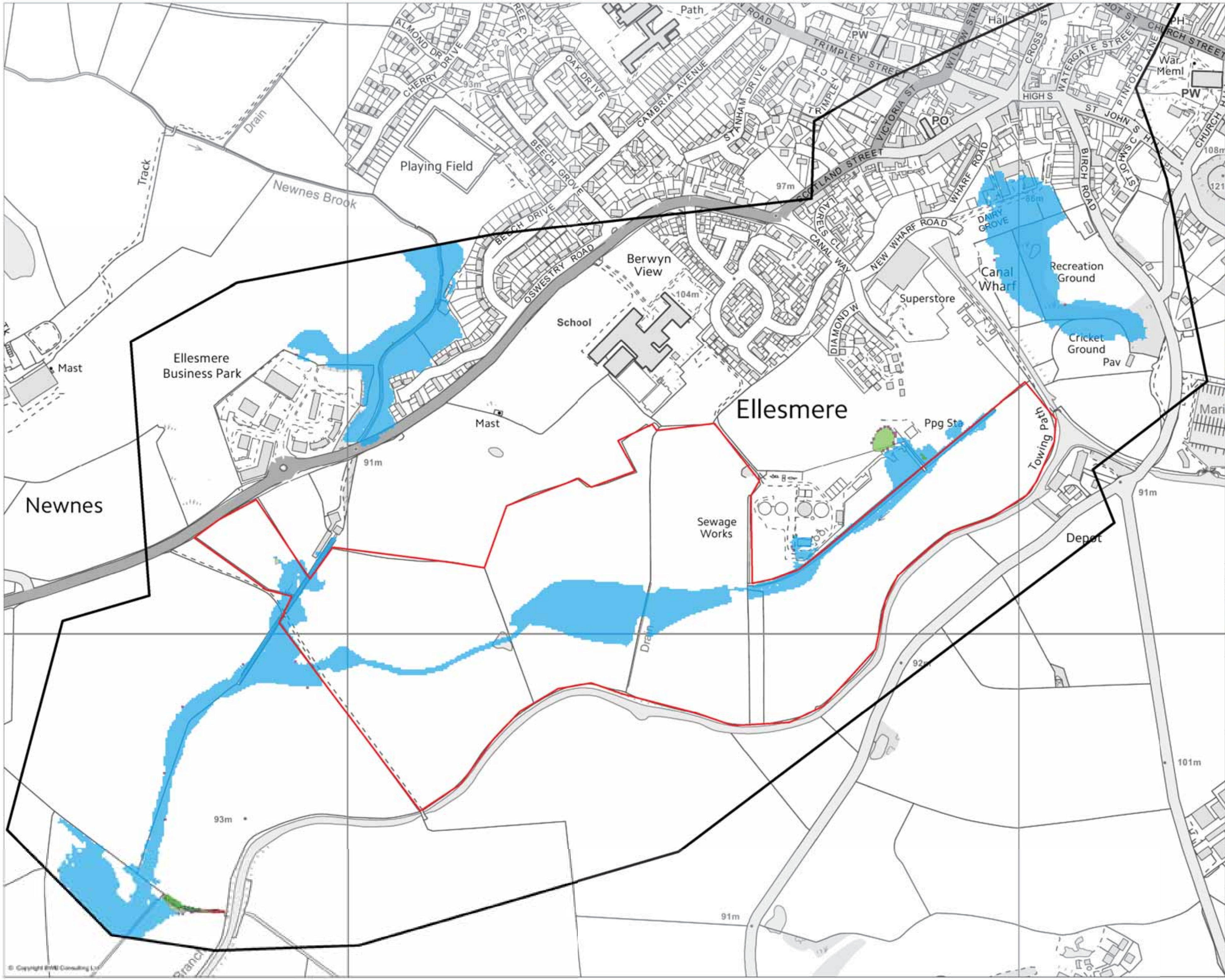
Drawing Title
DE-CULVERTED SENSITIVITY TESTS: ROUGHNESS+20%

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK52

Revision
P1



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KEY

- Model Extent
- Study Site

CHANGE IN PEAK WATER LEVEL (METRES)

- Former Wet Areas Now Dry
- < -0.180
- -0.180 to -0.160
- -0.160 to -0.140
- -0.140 to -0.120
- -0.120 to -0.100
- -0.100 to -0.080
- -0.080 to -0.060
- -0.060 to -0.040
- -0.040 to -0.020
- -0.020 to -0.010
- NO CHANGE (±0.010)
- 0.010 to 0.020
- 0.020 to 0.040
- 0.040 to 0.060
- 0.060 to 0.080
- 0.080 to 0.100
- 0.100 to 0.120
- 0.120 to 0.140
- 0.140 to 0.160
- 0.160 to 0.180
- 0.1800 >
- Former Dry Areas Now Wet

Rev	Date	Details of issue / revision	Drw	Rev
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Client
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Project Title
ELLESMERE MARINA, SHORPSHIRE

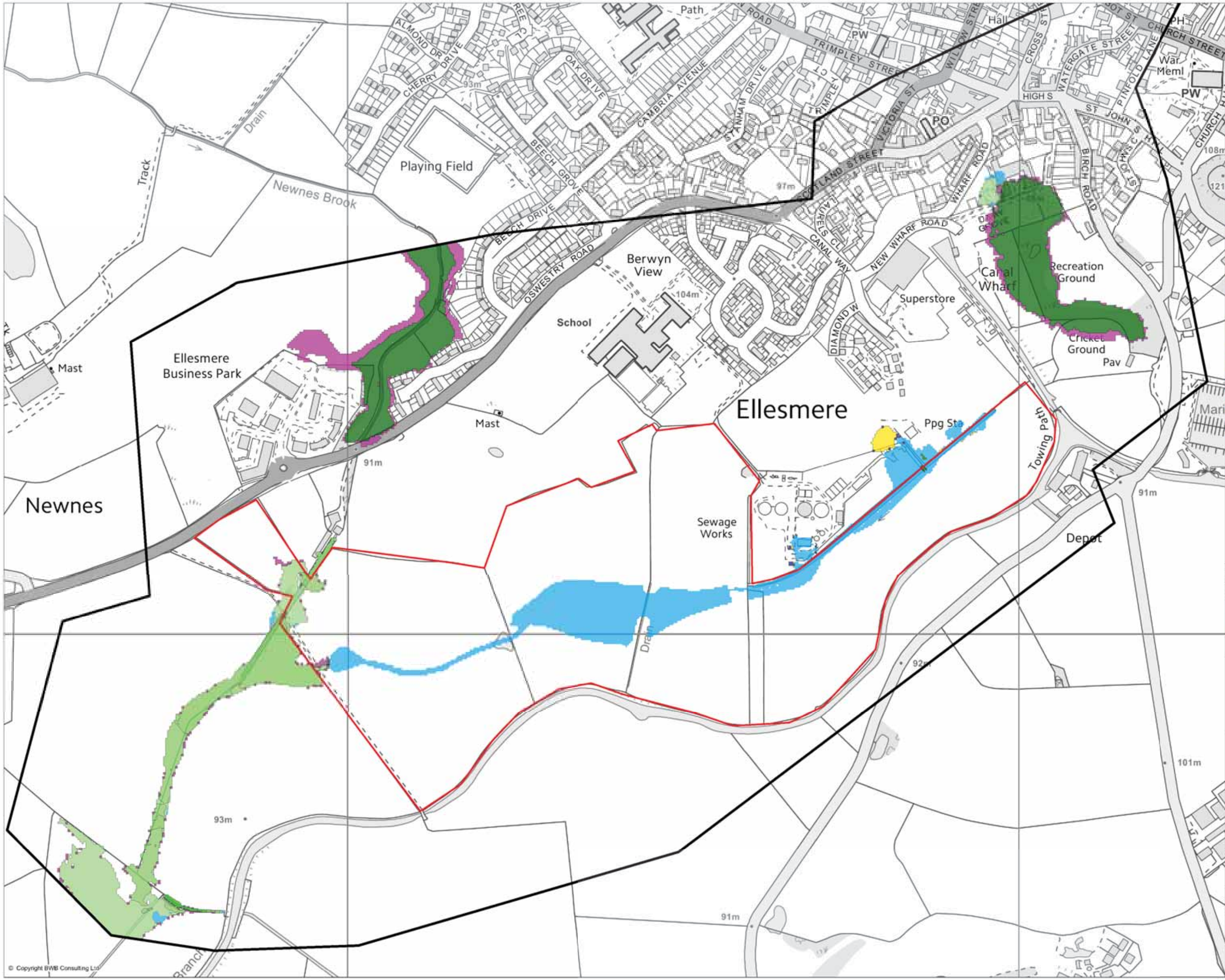
Drawing Title
DE-CULVERTED SENSITIVITY TESTS: D/S BOUNDARY + 0.5m

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK53

Revision
P1



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KEY

Model Extent

Study Site

CHANGE IN PEAK WATER LEVEL (METRES)

Former Wet Areas Now Dry
< -0.180
-0.180 to -0.160
-0.160 to -0.140
-0.140 to -0.120
-0.120 to -0.100
-0.100 to -0.080
-0.080 to -0.060
-0.060 to -0.040
-0.040 to -0.020
-0.020 to -0.010
NO CHANGE (±0.010)
0.010 to 0.020
0.020 to 0.040
0.040 to 0.060
0.060 to 0.080
0.080 to 0.100
0.100 to 0.120
0.120 to 0.140
0.140 to 0.160
0.160 to 0.180
0.1800 >
Former Dry Areas Now Wet

P1	01.06.14	PRELIMINARY ISSUE	RG	SN
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Project Title
ELLESMERE MARINA, SHORPSHIRE

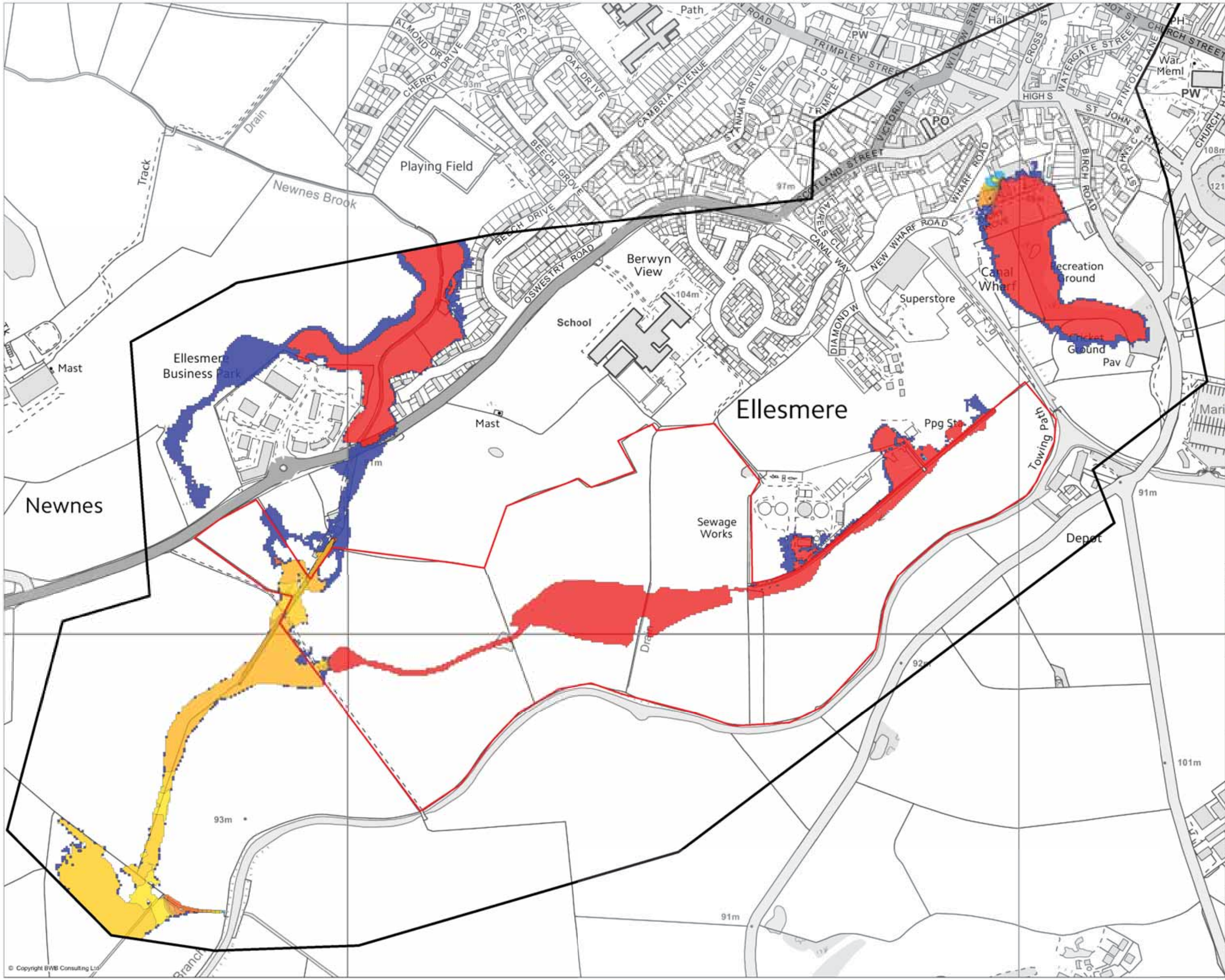
Drawing Title
DE-CULVERTED SENSITIVITY TESTS: ROUGHNESS-20%

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK51

Revision
P1



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KEY

Model Extent

Study Site

CHANGE IN PEAK WATER LEVEL (METRES)

- Former Wet Areas Now Dry
- < -0.180
- -0.180 to -0.160
- -0.160 to -0.140
- -0.140 to -0.120
- -0.120 to -0.100
- -0.100 to -0.080
- -0.080 to -0.060
- -0.060 to -0.040
- -0.040 to -0.020
- -0.020 to -0.010
- NO CHANGE (±0.010)
- 0.010 to 0.020
- 0.020 to 0.040
- 0.040 to 0.060
- 0.060 to 0.080
- 0.080 to 0.100
- 0.100 to 0.120
- 0.120 to 0.140
- 0.140 to 0.160
- 0.160 to 0.180
- 0.1800 >
- Former Dry Areas Now Wet

Rev	Date	Details of issue / revision	Drw	Rev
P1	01.05.14	PRELIMINARY ISSUE	RG	SN

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Project Title
ELLESMERE MARINA, SHORPSHIRE

Drawing Title
DE-CULVERTED SENSITIVITY TESTS: CLIMATE CHANGE

Scale	1:5000	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

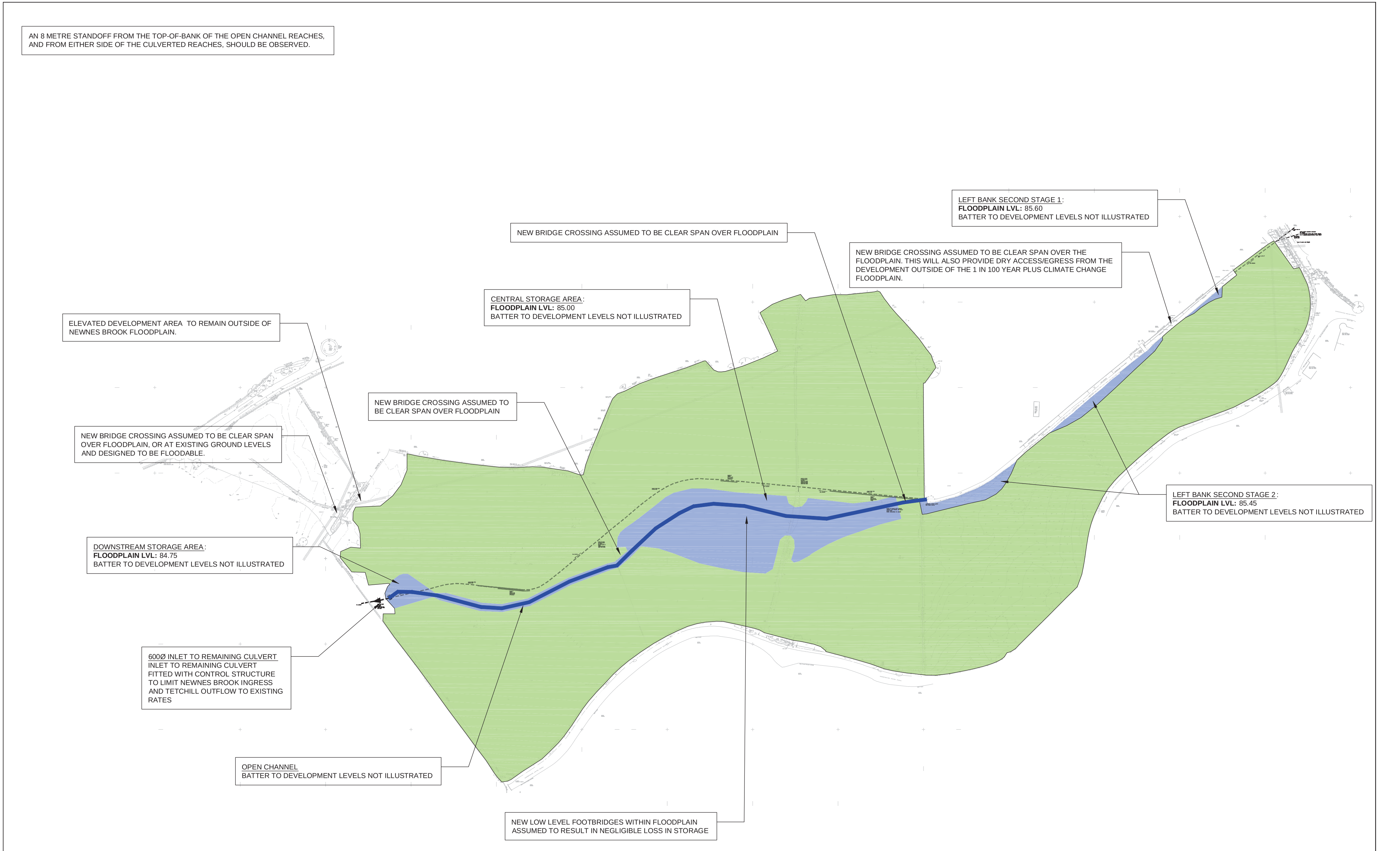
Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK59

Revision
P1

ANNEX H

Flood Corridor Parameters Plan



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KEY

- NEW 'DAY-LIGHTED' CHANNEL
- NEW FLOODPLAIN/STORAGE AREAS
- DEVELOPMENT AREA:
  MIN. GROUND LEVEL 300mm ABOVE ADJACENT 1 IN 100 YEAR + 20% FLOOD LEVEL
  MIN. FFL 600mm ABOVE ADJACENT 1 IN 100 YEAR + 20% FLOOD LEVEL

ISSUES & REVISIONS

Rev	Date	Details of issue / revision	Drw	Rev
P1	07,11,13	PRELIMINARY ISSUE	RG	IR
P2	11,11,13	STORAGE AREAS UPDATED	RG	IR
P3	13,11,13	FLOOD LEVEL UPDATED	RG	IR
P4	17,03,14	UPDATED WITH LATEST FLOOD MODELLING	RG	SN
P5	08,05,14	UPDATED WITH LATEST FLOOD MODELLING	RG	SN

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Client: BURBURY INVESTMENTS LTD

Project Title: ELLSEMERE MARINA, SHORPSHIRE

Drawing Title: ILLUSTRATIVE WATERCOURSE CORRIDOR PARAMETERS

Scale	1:4000	Drawn	R. Green
Size	A3	Reviewed	I. Rassool

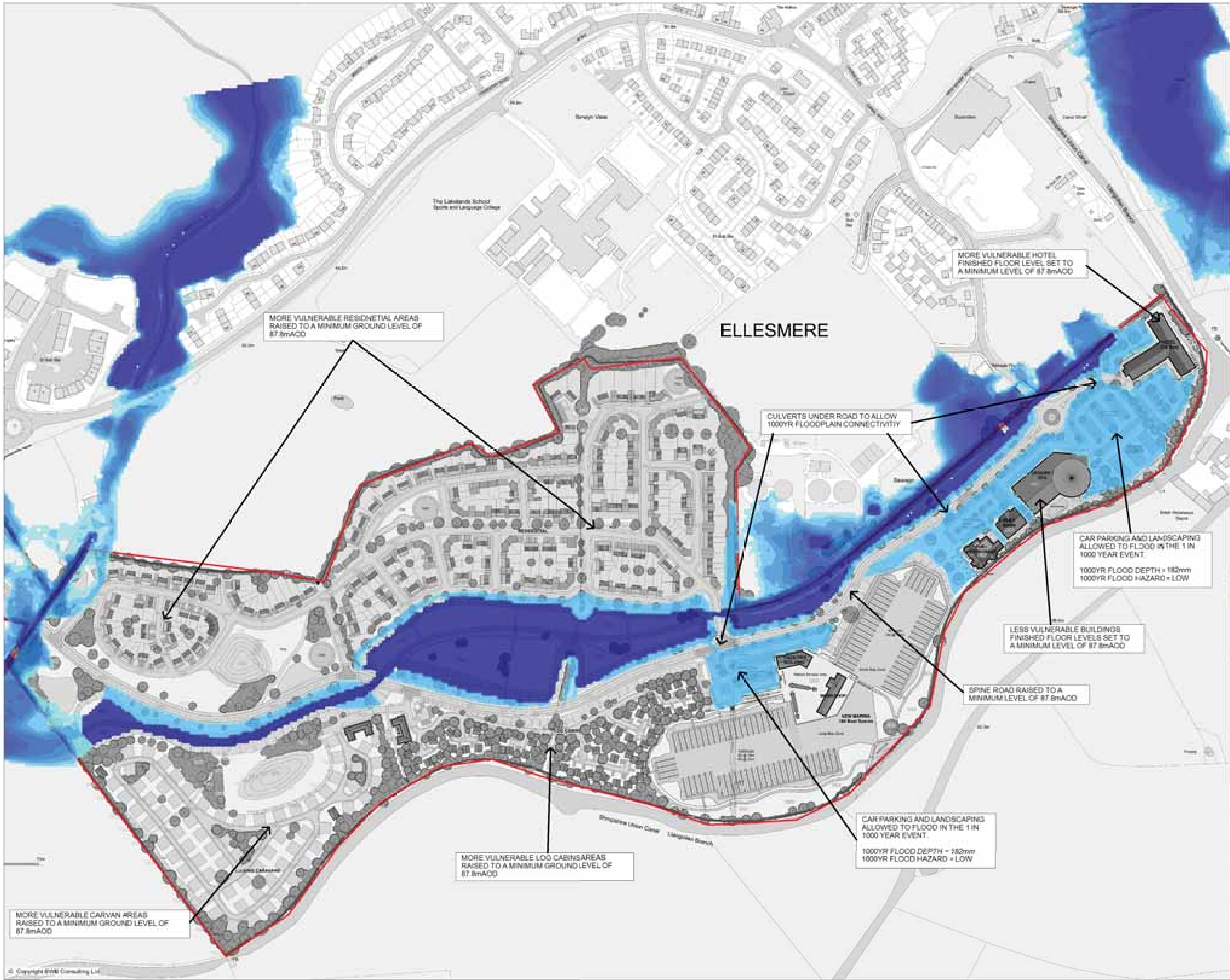
Drawing Status: PRELIMINARY

Drawing No.: BMW/2025/WSK15

Revision: P5

ANNEX I

Illustrative Sequential Arrangement of the 1 in 1000 Year Floodplain



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6. THIS EXAMPLE STRATEGY HAS BEEN PREPARED AND TESTED IN THE FLOOD MODEL TO DEMONSTRATE THAT THE 1 IN 1000 YEAR FLOODPLAIN COULD BE ARRANGED SEQUENTIALLY WITH THE SITE.

7. FINAL DEVELOPMENT LEVELS AND FLOODPLAIN EXTENTS/DEPTHS WILL BE DETERMINED AT THE DETAILED DESIGN STAGE.

KEY

FLOOD DEPTH (METRES)

- 0.00 to 0.15
- 0.15 to 0.30
- 0.30 to 0.45
- 0.45 to 0.60
- 0.60 to 0.75
- 0.75 to 0.90
- 0.90 to 1.05
- 1.05 to 1.20
- 1.20 to 1.35
- 1.35 to 1.50
- 1.50 >

Rev	Date	Details of issue / revision	Drn	Rev
P1	04.07.14	PRELIMINARY ISSUE	RG	SN

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Client
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Project Title
ELLESMERE MARINA, SHORPSHIRE

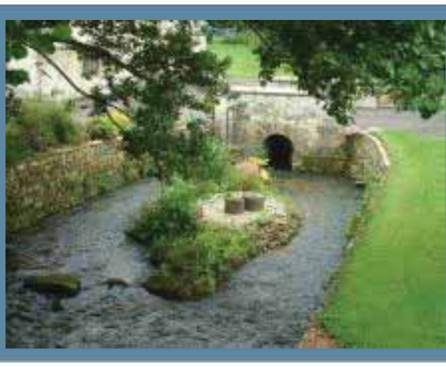
Drawing Title
ILLUSTRATIVE EXAMPLE OF THE SEQUENTIAL ARRANAGEMENT OF THE 1 IN 1000 YR FLOODPLAIN

Scale	NTS	Drawn	R. Green
Size	A3	Reviewed	S. Nelmes

Drawing Status
PRELIMINARY

Drawing No.
BMW/2025/WSK45

Revision
P1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APPENDIX F

Drainage Calculations

ICP SUDS Mean Annual Flood

Input

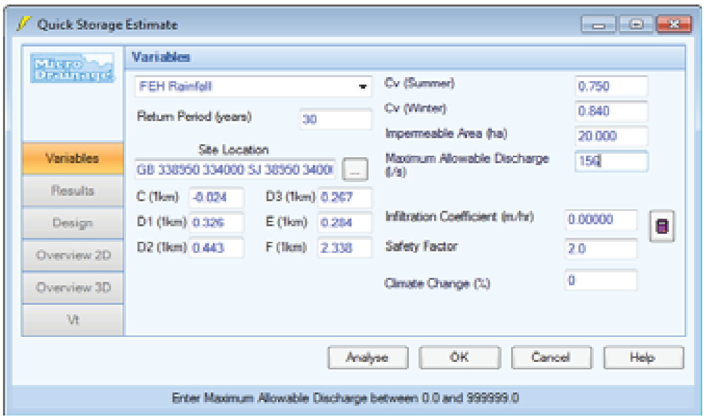
Return Period (years)	100	Soil	0.450
Area (ha)	31.000	Urban	0.000
SAAR (mm)	786	Region Number	Region 4

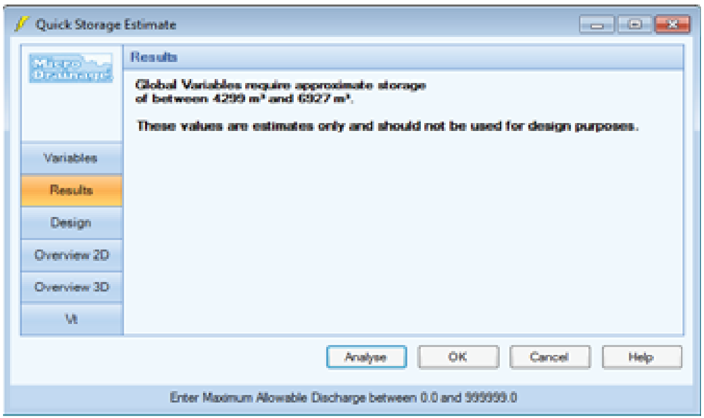
Results l/s

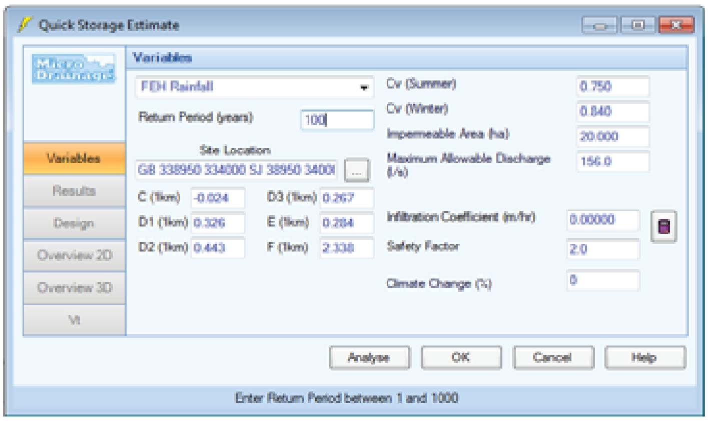
QBAR Rural 156.0
QBAR Urban 156.0

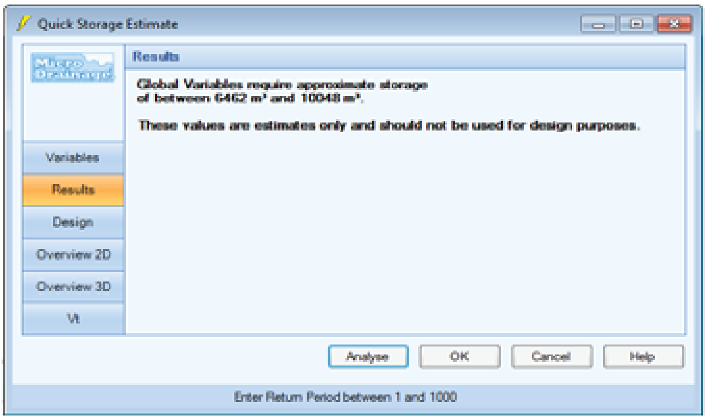
Q100 years 400.8

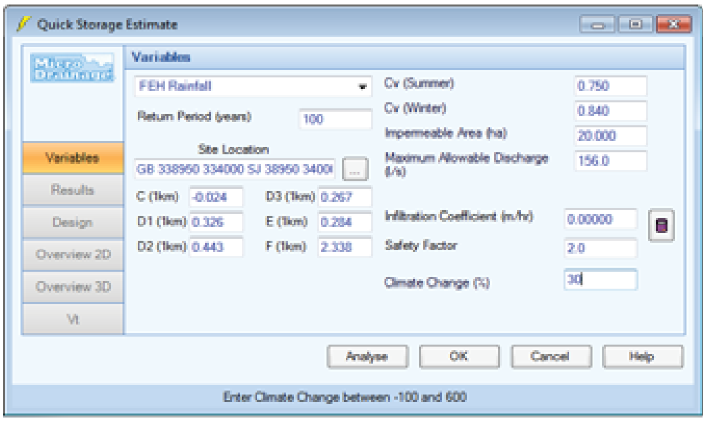
Q1 year 129.4
Q30 years 305.6
Q100 years 400.8

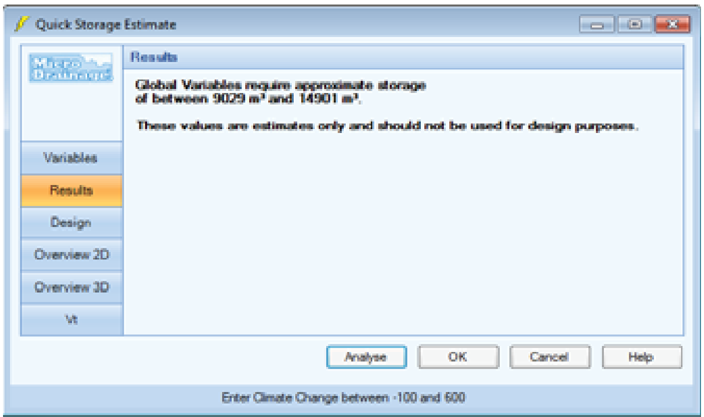

Quick Storage Estimate
Variables
FEH Rainfall
Return Period (years) 30
Site Location
GB 338950 334000 SJ 38950 3400
C (1km) -0.024
D1 (1km) 0.326
D2 (1km) 0.443
D3 (1km) 0.267
E (1km) 0.284
F (1km) 2.338
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 20.000
Maximum Allowable Discharge (l/s) 156
Infiltration Coefficient (m/hr) 0.00000
Safety Factor 2.0
Climate Change (%) 0
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Maximum Allowable Discharge between 0.0 and 999999.0

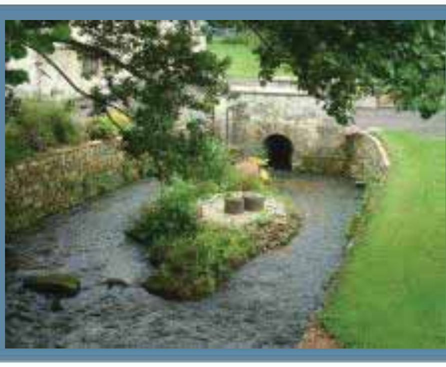

Quick Storage Estimate
Results
Global Variables require approximate storage of between 4299 m³ and 6927 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Maximum Allowable Discharge between 0.0 and 999999.0


Quick Storage Estimate
Variables
FEH Rainfall
Return Period (years) 100
Site Location
GB 338950 334000 SJ 38950 3400
C (1km) -0.024
D1 (1km) 0.326
D2 (1km) 0.443
D3 (1km) 0.267
E (1km) 0.284
F (1km) 2.338
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 20.000
Maximum Allowable Discharge (l/s) 156.0
Infiltration Coefficient (m/hr) 0.00000
Safety Factor 2.0
Climate Change (%) 0
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Return Period between 1 and 1000


Quick Storage Estimate
Results
Global Variables require approximate storage of between 6462 m³ and 10048 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Return Period between 1 and 1000


Quick Storage Estimate
Variables
FEH Rainfall
Return Period (years) 100
Site Location
GB 338950 334000 SJ 38950 3400
C (1km) -0.024
D1 (1km) 0.326
D2 (1km) 0.443
D3 (1km) 0.267
E (1km) 0.284
F (1km) 2.338
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 20.000
Maximum Allowable Discharge (l/s) 156.0
Infiltration Coefficient (m/hr) 0.00000
Safety Factor 2.0
Climate Change (%) 30
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600


Quick Storage Estimate
Results
Global Variables require approximate storage of between 9029 m³ and 14901 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600



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